CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous)

Kokapet (Village), Gandipet, Hyderabad, Telangana – 500075

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1.1.3 Average percentage of courses having focus on employability/ entrepreneurship/ skill development offered by the institution during the last five years

1.1.3.1 Number of courses having focus on employability/ entrepreneurship/ skill development year-wise during the last five years.

Year	2021-22	2020-21	2019-20	2018-19	2017-18
Number	1166	1106	985	922	984

List of courses courses having focus on employability/ entrepreneurship/ skill development offered by the institution during 2019-20 from S. No. 2279 - 2648

S.No	Course Name	Code
2279	Mathematics -I	18MTC01
2280	Introduction To Mechanics And Electromagnetic Theory	18PYC03
2281	Programming for Problem Solving	18CSC01
2282	English	18EGC01
2283	Mechanics And Electromagnetic Lab	18PYC06
2284	Programming for Problem Solving Lab	18CSC02
2285	Workshop/Manufacturing Practice	18MEC02
2286	English Lab	18EGC02
2287	Mathematics -II	18MTC03
2288	Chemistry	18CYC01
2289	Engineering Mechanics	18CEC01
2290	Engineering Graphics and Design Lab	18MEC01N
2291	Basic Electrical Engineering	18EEC01
2292	Basic Electrical Engineering Lab	18EEC02
2293	Chemistry Lab	18CYC02
2294	Mathematics -III	18MTC05
2295	Engineering Economics And Accountancy	18MB C01
2296	Material Science And Metallurgy	18ME C03
2297	Mechanics Of Materials	18ME C04
2298	Manufacturing Processes	18PE C01
2299	Indian Constitution And Fundamental Principles	18EG M01
2300	Indian Traditional Knowledge	18EE A01
2301	Material Science And Metallurgy Lab	18ME C05
2302	Mechanics Of Materials Lab	18ME C06
2303	Manufacturing Processes Lab	18PE C02
2304	Basics Of Data Structures	18CS C05
2305	Kinematics Of Machines	18ME C07
2306	Thermo Dynamics	18ME C08
2307	Principles Of Management	18ME C09
2308	Fluid Principles And Hydraulic Machines	18ME C10

2309	Environmental Science	18CE M01
2310	Basics Of Data Structures Lab	18CS C08
2311	Soft Skills Lab	18EG C03
2312	Fluid Principles And Hydraulic Machines Lab	18ME C11
2313	Dynamics of Machines	16ME C20
2314	Applied Thermodynamics & Heat Transfer	16ME C21
2315	Design of Machine Elements	16ME C22
2316	Refrigeration and Air Conditioning	16ME E01
2317	Mechanical Vibrations	16ME E02
2318	Product Design and Process Planning	16PE E02
2319	Principles of Industrial Engineering	16PE E05
2320	Fuels, Combustion and Environment	16ME E03
2321	Non Destructive Testing and Evaluation	16PE E03
2322	Plastics, Ceramics and Composite Materials	16PE E04
2323	Probability and Numerical Methods	16MT E04
2324	Dynamics & Vibrations Lab	16ME C23
2325	Applied Thermodynamics & Heat Transfer Lab	16ME C24
2326	Electrical Machines & Microcontroller Applications Lab	16EE C22
2327	Industrial Visit	16ME C25
2328	CAD and CAM	16ME C26
2329	Metal Cutting and Machine Tool Engineering	16ME C27
2330	Thermal Turbo Machines	16ME C28
2331	Machine Design	16ME C29
2332	Advanced IC Engines	16ME E05
2333	Computational Fluid Dynamics	16ME E06
2334	Automobile Engineering	16ME E07
2335	Digital Manufacturing	16PE E10
2336	Heat and Mass Transfer	16ME E08
2337	Object Oriented Programming With C++	16ME E09
2338	Modern Machining and Forming Methods	16PE E08
2339	Surface Engineering	16PE E09
2340	CAD and CAM Lab	16ME C30
2341	Metal Cutting and Machine Tool Engineering Lab	16ME C31
2342	Thermal Engineering Lab	16ME C32
2343	Metrology and Instrumentation	16ME C33
2344	Operations Research	16ME C34
2345	Production Drawing	16PE C10
2346	Production and Operations Management	16PE C11
2347	Finite Element Analysis	16ME C35
2348	Renewable Energy Sources	16ME E10
2349	Energy Conservation, Management and Audit	16ME E11
2350	Engineering Research Methodology	16ME E12
2351	Environmental Pollution	16ME E13
2352	Metrology and Instrumentation Lab	16ME C36
2353	Computer Aided Engineering Lab	16ME C37
2354	Project Seminar	16ME C38
2355	Power Plant Engineering	16ME E15

2356	Principles of Entrepreneurship	16ME E16
2357	Innovations, Protection and Legal Aspects	16ME E17
2358	Supply Chain Management	16PE E11
2359	Nano Science and Technology	16ME E18
2360	Disaster Mitigation and Management	16CE O02
2361	Principles of Internet of Things	16IT O02
2362	Energy Auditing	16EE O03
2363	System Automation and Control	16EC O07
2364	Basics of Artificial Intelligence	16CS O09
2365	Object Oriented Programming using JAVA	16IT O01
2366	History of Science and Technology	16PY O01
2367	Waste Management	16EE O05
2368	MEMS and its Applications	16EC O05
2369	Basics of Cyber Security	16CS O07
2370	Seminar	16ME C39
2371	Project	16ME C40
2372	Mathematics -I	18MTC01
2373	Introduction To Mechanics And Electromagnetic Theory	18PYC03
2374	Programming for Problem Solving	18CSC01
2375	English	18EGC01
2376	Mechanics And Electromagnetic Lab	18PYC06
2377	Programming for Problem Solving Lab	18CSC02
2378	Workshop/Manufacturing Practice	18MEC02
2379	English Lab	18EGC02
2380	Mathematics -II	18MTC03
2381	Chemistry	18CYC01
2382	Engineering Mechanics	18CEC01
2383	Engineering Graphics and Design Lab	18MEC01N
2384	Basic Electrical Engineering	18EEC01
2385	Basic Electrical Engineering Lab	18EEC02
2386	Chemistry Lab	18CYC02
2387	Mathematics -III	18MTC05
2388	Engineering Economics And Accountancy	18MB C01
2389	Material Science And Metallurgy	18ME C03
2390	Mechanics Of Materials	18ME C04
2391	Fluid Principles And Hydraulic Machines	18ME C10
2392	Indian Constitution And Fundamental Principles	18EG M01
2393	Indian Traditional Knowledge	18EE A01
2394	Material Science And Metallurgy Lab	18ME C05
2395	Mechanics Of Materials Lab	18ME C06
2396	Fluid Principles And Hydraulic Machines Lab	18ME C11
2397	Basics Of Data Structures	18CS C05
2398	Kinematics Of Machines	18ME C07
2399	Thermo Dynamics	18ME C08
2400	Principles Of Management	18ME C09
2401	Metal Casting And Welding	18PE C03
2402	Environmental Science	18CE M01
2403	Basics Of Data Structures Lab	18CS C08
2404	Soft Skills Lab	18EG C03

2405	Metal Casting And Welding Lab	18PE C04
2406	Dynamics of Machines	16ME C20
2407	Applied Thermodynamics & Heat Transfer	16ME C21
2408	Design of Machine Elements	16ME C22
2409	Refrigeration and Air Conditioning	16ME E01
2410	Mechanical Vibrations	16ME E02
2411	Product Design and Process Planning	16PE E02
2412	Powder Processing	16PE E01
2413	Hydraulic Machines	16ME E04
2414	Non Destructive Testing and Evaluation	16PE E03
2415	Plastics, Ceramics and Composite Materials	16PE E04
2416	Probability and Numerical Methods	16MT E04
2417	Dynamics & Vibrations Lab	16ME C23
2418	Applied Thermodynamics & Heat Transfer Lab	16ME C24
2419	Electrical Machines & Microcontroller Applications Lab	16EE C22
2420	Industrial Visit	16PE C05
2421	CAD and CAM	16ME C26
2422	Machine Tool Engineering	16PE C06
2423	Additive Manufacturing	16PE C07
2424	Machine Design	16ME C29
2425	Work System Design	16PE E06
2426	Computational Fluid Dynamics	16ME E06
2427	Automobile Engineering	16ME E07
2428	Quality and Reliability Engineering	16PE E07
2429	Turbo Machines	16ME E10
2430	Object Oriented Programming With C++	16ME E09
2431	Modern Machining and Forming Methods	16PE E08
2432	Surface Engineering	16PE E09
2433	CAD and CAM Lab	16ME C30
2434	Machine Tool Engineering Lab	16PE C08
2435	Additive Manufacturing Lab	16PE C09
2436	Metrology and Instrumentation	16ME C33
2437	Operations Research	16ME C34
2438	Production Drawing	16PE C10
2439	Production and Operations Management	16PE C11
2440	Tool Engineering	16PE C12
2441	Renewable Energy Sources	16ME E10
2442	Energy Conservation, Management and Audit	16ME E11
2443	Engineering Research Methodology	16ME E12
2444	Finite Element Methods	16ME E14
2445	Metrology and Instrumentation Lab	16ME C36
2446	Manufacturing Engineering Lab	16PE C13
2447	Project Seminar	16PE C14
2448	Power Plant Engineering	16ME E15
2449	Principles of Entrepreneurship	16ME E16
2450	Innovations, Protection and Legal Aspects	16ME E17
2451	Supply Chain Management	16PE E11
2452	Total Quality Management	16PE E12
2453	Disaster Mitigation and Management	16CE O02

2454	Principles of Internet of Things	16IT O02
2455	Energy Auditing	16EE O03
2456	System Automation and Control	16EC O07
2457	Basics of Artificial Intelligence	16CS O09
2458	Object Oriented Programming using JAVA	16IT O01
2459	History of Science and Technology	16PY O01
2460	Waste Management	16EE O05
2461	MEMS and its Applications	16EC O05
2462	Basics of Cyber Security	16CS O07
2463	Seminar	16PE C15
2464	Project	16PE C16
2465	Computer Aided Modeling and Design	19MEC 101
2466	Computer Integrated Manufacturing	19MEC 102
2467	Research Methodology and IPR	19MEC 103
2468	Advanced Machine Design	19MEE 101
2469	Advanced Vibrations and Acoustics	19MEE 102
2470	Optimization Techniques	19MEE 103
2471	Automation	19MEE 104
2472	Design for Manufacturing and Assembly	19MEE 105
2473	Industrial Robotics	19MEE 106
2474	Integrated Design and Manufacturing Lab	19MEC 104
2475	Vibrations and Acoustics Lab	19MEC 105
2476	Value Education	19ECA 101
2477	Pedagogy Studies	19ITA 101
2478	Disaster Mitigation and Management	19CEA 101
2479	Sanskrit for Technical Knowledge	19EEA 101
2480	Finite Element Techniques	19MEC 106
2481	Mechanical Design and Analysis	19MEC 107
2482	Computational Fluid Dynamics	19MEE 206
2483	Mechanics of Composite Materials	19MEE 107
2484	Fracture Mechanics	19MEE 108
2485	Multibody Dynamics	19MEE 109
2486	Tribology in Design	19MEE 110
2487	Failure Analysis and Design	19MEE 111
2488	Computer Aided Engineering Lab	19MEC 108
2489	Computational Fluid Dynamics Lab	19MEC 206
2490	Mini Project with Seminar	19MEC 109
2491	English for Research Paper Writing	19EGA 101
2492	Indian Constitution and Fundamental Rights	19EGA 102
2493	Stress Management by Yoga	19EGA 103
2494	Personality Development through Life's Enlightenment Skills	19EGA 104
2495	Project Seminar	16MEC111
2496	Project work	16MEC112
2497	Thermodynamics and Combustion	19MEC 201
2498	Advanced Fluid Dynamics	19MEC 202
2499	Research Methodology and IPR	19MEC 103
2500	Thermal and Nuclear Power Plants	19MEE 201
2501	Environmental Engineering and Pollution Control	19MEE 202
2502	Optimization Techniques	19MEE 103

2503	Air Conditioning System Design	19MEE 203
2504	Energy Conservation and Management	19MEE 204
2505	Design of Solar and Wind Systems	19MEE 205
2506	Disaster Mitigation and Management	19CEA 101
2507	Sanskrit for Technical Knowledge	19EEA 101
2508	Value Education	19ECA 101
2509	Pedagogy Studies	19ITA 101
2510	Thermal Systems Lab	19MEC 203
2511	Design of Solar and Wind Systems Lab	19MEC 204
2512	Finite Element Techniques	19MEC 106
2513	Advanced Heat and Mass Transfer	19MEC 205
2514	Computational Fluid Dynamics	19MEE 206
2515	Refrigeration and Cryogenics	19MEE 207
2516	Design of Heat Exchangers	19MEE 208
2517	Turbo Machines	19MEE 209
2518	Gas Turbines	19MEE 210
2519	Power Plant Control and Instrumentation	19MEE 211
2520	English for Research Paper Writing	19EGA 101
2521	Indian Constitution and Fundamental Rights	19EGA 102
2522	Stress Management by Yoga	19EGA 103
2523	Personality Development through Life's Enlightenment Skills	19EGA 104
2524	Computer Aided Engineering Lab	19MEC 108
2525	Computational Fluid Dynamics Lab	19MEC 206
2526	Mini Project with Seminar	19MEC 207
2527	Project Seminar	16MEC 211
2528	Project work	16MEC 212
2529	Engg. Mathematics -I	18MT C02
2530	Biology-I	18BTC01
2531	Programming for Problem Solving	18CS C01
2532	English	18EG C01
2533	Programming for Problem Solving Lab	18CS C02
2534	Workshop/ Manufacturing Practice	18ME C02
2535	English Lab	18EG C02
2536	Engg.Mathematics -II	18MT C04
2537	Basics of Biology-II	18BT C02
2538	Engineering Mathematics-III	18MTC06
2539	Cell and Molecular Biology	18BT C03
2540	Biochemistry	18BT C04
2541	Microbiology and Industrial Biotechnology	18BT C05
2542	Process Principles and Reaction Engineering	18BT C06
2543	Genetics	18BT C07
2544	Biochemistry Lab	18BT C08
2545	Microbiology Lab	18BT C09
2546	Basics of Data Structures	18CS C05
2547	Immunology	18BT C10
2548	Instrumental Methods in Biotechnology	18BT C11
2549	Chemical and Biochemical Thermodynamics	18BT C12
2550	Principles of Management	18ME C09
2551	Basics of Data Structures	18CS C06

2552	Immunology Lab	18BT C13
2553	Instrumentation Lab	18BT C14
2554	Soft Skills Lab	18EG C03
2555	Biostatistics	16MT C08
2556	Fluid Mechanics and Heat Transfer	16BT C19
2557	Protein Engineering and Enzyme Technology	16BT C20
2558	Genetic Engineering and rDNA Technology	16BT C21
2559	Environmental Biotechnology	16BT E22
2560	Food Biotechnology	16BT E23
2561	Computational Numerical Methods	16MT E02
2562	Python for Bioinformatics	18CS E02
2563	Virology	16BT E24
2564	Metabolic Engineering	16BT E25
2565	Fluid Mechanics and Heat Transfer Lab	16BT C26
2566	Enzyme Technology Lab	16BT C27
2567	Genetic Engineering Lab	16BT C28
2568	Fermentation Technology	16BT C29
2569	Mass Transfer Operations	16BT C30
2570	Bioinformatics	16BT C31
2571	JAVA Programming and Bio-Java	18CS E02
2572	Medical Biotechnology	16BT E32
2573	Phyto Chemicals and Herbal Products	16BT E33
2574	Developmental Biology	16BT E34
2575	Pharamceutical Biotechnology	16BT E35
2576	Bioprocess Economics & Plant Design	16BT E36
2577	Bioprocess Lab	16BT C37
2578	Mass Transfer Operations Lab	16BT C38
2579	Bioinformatics Lab	16BT C39
2580	Mini Project	16BT C40
2581	Down Stream Processing	16BT C41
2582	Plant Biotechnology	16BT C42
2583	Animal Biotechnology	16BT C43
2584	Bioprocess Dynamics & Control	16BT C44
2585	Computer Applications in Bioprocess Industries	16BT C45
2586	Genomics & Proteomics	16BT E46
2587	Cancer Biology	16BT E47
2588	Intellectual Property Rights Regulatory Affairs & Clinical Trials	16BT E48
2589	Down Stream Processing Lab	16BT C49
2590	Tissue Culture Lab	16BT C50
2591	Project Seminar	16BT C51
2592	Tissue Engineering	16BT E52
2593	Immunodiagnostics	16BT E53
2594	Molecular Modeling & Drug Design	16BT E54
2595	Research Methodologies	16ME O06
2596	Biomedical Instrumentation	16EC O02
2597	Technical Writing Skills	16EG O01
2598	IOT and Applications	16CS O03
2599	Basics of Data Science Using R	16CS O04
2600	Entrepreneurship	16ME O01

2601	Seminar	16BT C55
2602	Project	16BT C56
2603	Discrete Mathematics	16MCC101
2604	Computer Programming and Problem Solving	16MCC102
2605	Elements Of Information Technology	16MCC103
2606	Managerial Economics and Financial Analysis	16MBC128
2607	Professional Communication in English	16EGC101
2608	Computer Programming Lab Using C	16MCC104
2609	Elements of Information Technology Lab	16MCC105
2610	Professional Communication Lab	16EGC102
2611	Object Oriented Programming(OOP)	16MCC106
2612	Computer Organization	16MCC107
2613	Software Engineering	16MCC108
2614	Data Structures Using C++	16MCC109
2615	Operations Research	16MCC110
2616	Probability and Statistics	16MTC102
2617	Object Oriented Programming Lab Using Java	16MCC111
2618	Data Structures Lab Using C++	16MCC112
2619	Database Management Systems	16MCC113
2620	Web Technologies	16MCC114
2621	Design and Analysis of Algorithms	16MCC115
2622	Operating Systems	16MCC116
2623	Database Management Systems Lab	16MCC117
2624	Web Technologies Lab	16MCC118
2625	Operating Systems Lab	16MCC119
2626	Organizational Behavior	16MBC04
2627	Disaster Mitigation and Management	16CE E21
2628	Computer Networks	16MCC120
2629	Data warehousing and Data Mining	16MCC121
2630	Advanced Java Programming	16MCC122
2631	Computer Networks Lab	16MCC123
2632	Data warehousing and Data Mining Lab	16MCC124
2633	Mini Projects	16MCC125
2634	Software Testing	16MCE102
2635	Artificial Neural Networks	16MCE103
2636	Cloud Computing	16MCE106
2637	Software Project Management	16MCE107
2638	Object Oriented System Development(OOSD)	16MCC126
2639	Machine Learning	16MCC127
2640	Cryptography & Network Security	16MCC128
2641	Object Oriented System Development Lab	16MCC129
2642	Machine Learning Lab using Python	16MCC130
2643	Seminar	16MCC131
2644	Internet of Things	16MCE110
2645	Business Intelligence and Analytics	16MC E111
2646	Big Data Analytics	16MC E113
2647	E-Commerce	16MC E114
2648	MAJOR PROJECT WORK	16MC C132

19-20

18MT C01

MATHEMATICS– I

(Common to all branches and except for Bio-Tech)

Instruction	3 L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits	4

Course Objectives:

1. To solve linear system of equations using Matrix Methods.
2. To know the convergence of the Series.
3. To represent the function in series form.
4. To know the Partial Derivatives and use them to interpret the way a function of two variables behaves.
5. To learn Vector Differential Operator and its Physical interpretations on Scalars and vector functions.
6. To solve improper integrals.

Course Outcomes: On the successful completion of this course student shall be able to

1. Solve system of linear equations and identify the Eigen values and Eigen vectors in engineering problems.
2. Check the series convergence.
3. Find the evolutes of the given curves.
4. Expand and find extreme values of functions of two variables.
5. Understanding the significance of gradient, divergence and curl.
6. An ability to solve the problems and interpret in geometrical approach.

UNIT-I: Matrices:

Rank of the matrix, Echelon form, System of linear equations, Linearly dependence and independence of vectors, Eigenvalues, Eigenvectors, Properties of eigenvalues, Cayley-Hamilton theorem, Quadratic forms, Diagonalization of Matrices, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic forms.

UNIT-II: Sequences and Series:

Definition of Convergence of sequence and series. Tests for convergence of series: comparison test, limit comparison test, D'Alembert ratio test, Raabes test, Cauchy's n^{th} root test, logarithmic test, alternative series, absolute and conditional convergence.

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UNIT-III: Calculus:

Rolle's Theorem, Lagranges Mean value theorem, Cauchy's mean value theorem (without proofs). Curvature, radius of curvature, Evolutes and involutes , Fourier series, half range sine and cosine series.

UNIT-IV: Multivariable Calculus (Differentiation):

Functions of two variables, Partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions (Chain rule), Change of variables, Jacobian, Higher order partial derivatives, Taylor's series of functions of two variables, Maximum and minimum values of functions two variables, Lagrange's multipliers method.

UNIT-V: Vector Calculus (Differentiation):

Scalar and vector fields, Gradient of a scalar field, Directional derivative, Divergence and Curl of a vector field, vector identities. Improper integrals: Beta and Gamma functions and their properties.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Suggested Reading:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. R.K. Jain, S.R.K. Iyengar, Advanced engineering mathematics Narosa Publications, 5th edition, 2016. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

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18PY C03

INTRODUCTION TO MECHANICS AND ELECTROMAGNETIC THEORY
(for Civil, Mech & Prod)

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:
The objectives of the course is to make the student
1. Understands the fundamentals of oscillations and ultrasonics.
2. Gains knowledge of rigid body dynamics.
3. Learns the basics of electrostatics.
4. Understands the fundamentals of magnetostatics.
5. Familiar with electromagnetic waves.

Course Outcomes:
At the end of the course, the student will be able to
1. Describe the types of oscillations and analyze them.
2. Develop the concepts of dynamics and apply them to solve the related problems.
3. Analyze the role of different laws in electrostatics.
4. Discuss the significance of magnetostatics.
5. Develop the concepts related to electromagnetic behavior.

UNIT- I :Oscillations:
Simple harmonic motion, Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly- damped oscillators; Forced oscillations and resonance.
Ultrasonics: Production of ultrasonics by piezoelectric and magnetostriction methods – Detection of ultrasonics — Determination of ultrasonic velocity in liquids – Applications.

UNIT-II: Rigid body Dynamics:
Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples. two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor.

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UNIT- III :Electrostatics in Vaccum:

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction, Boundary conditions of electric field and electrostatic potential.

UNIT - IV : Magnetostatics:

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities: ferromagnetic, paramagnetic and diamagnetic materials, B-H curve.

UNIT- V : Electromagnetic Waves:

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves, Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples.

TEXT BOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text BookEngineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGahill Education Publications, 2013.
3. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

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18CS C01

Programming for Problem Solving
(Common to All Programs)

Instruction	3 Periods per week
Duration of Semester-End Examination	3 Hours
Semester-End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives

1. Identification of computer components, Operating environments, IDEs
2. Understanding the steps in problem solving and formulation of algorithms to problems.
3. Develop programming skills as an means of implementing an algorithmic solution with appropriate control anddata structures.
4. Develop intuition to enable students to come up with creative approaches to problems.
5. Manipulation of text data using files.

Course Outcomes: At the end of the course, students will be able to:

1. Identify the computing environments.
2. Formulate solutions to problems and represent them using algorithms/ Flowcharts.
3. Choose proper control statements and data structures to implement the algorithms.
4. Trace the programs with test the program solution.
5. Decompose a problem into modules and use functions to implement the modules.
6. Develop applications using file I/O.

UNIT -I

Introduction to computers and Problem Solving: Components of a computer, Operating system, compilers, Program Development Environments, steps to solve problems, Algorithm, Flowchart / Pseudocode with examples.

Introduction to programming: Programming languages and generations, categorization of high level languages.

Introduction to C: Introduction, structure of C program, keywords, identifiers, Variables, constants, I/O statements, operators, precedence and associativity.

UNIT – II

Introduction to decision control statements: Selective, looping and nested statements.

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Functions: Introduction, uses of functions, Function definition, declaration, passing parameters to functions, recursion, scope of variables and storage classes.

Case study:

UNIT – III

Arrays: Introduction, declaration of arrays, accessing and storage of array elements, 1-dimensional array, Searching (linear and binary search algorithms) and sorting(selection and Buble) algorithms, 2-D arrays, matrix operations.
Strings: Introduction, stringsrepresentation, string operations with examples.

Case study:

UNIT – IV

Pointers: Understanding computer's memory, introduction to pointers, declaration pointer variables, pointer arithmetic, pointers and strings, array of pointers, function pointers, array of function pointers, dynamic memory allocation, advantages and drawbacks of pointers.

Structures: Structure definition, initialization and accessing the members of a structure, nested structures, structures and functions, self- referential structures, unions and enumerated data types.

UNIT-V

Files: Introduction to files, file operations, reading data from files, writing data to files, error handing during file operations.
Preprocessor Directives: Types of preprocessor directives, examples.

Suggested Reading:

1. A K Sharma "**Computer Fundamentals and Programming**", 2nd Edition, University Press, 2018.
2. PradeepDey and Manas Ghosh, "**Programming in C"**, Oxford Press, 2nd Edition, 2017.

References:

1. Byron Gottfried, Schaum's"**Outline of Programming with C**", McGraw-Hill.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
4. ReemaTharaja "**Introduction to C Programming**", Second Edition, OXFORD Press,2015.
5. https://www.tutorialspoint.com/cprogramming/index.htm
6. https://onlinecourses.nptel.ac.in/noc18-cs10/preview.

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18EG C01

ENGLISH

(Common to all branches)

Instruction	2Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation:	20 Marks
Credits	2

Course Objectives:

1. To enable the students to understand the role and importance of communication and to develop their basic communication skills in English.
2. To equip the students with basics of writing correct sentences to coherent paragraphs.
3. To equip the students with techniques of writing a précis and an essay by using accurate grammar and appropriate vocabulary.
4. To train the students to describe, define and classify processes and to draft formal reports by adhering to the proper structure.
5. To develop the reading skills and reading comprehension techniques of the students.
6. To develop the students reading, writing, grammatical, lexical and communicative competence.

Course Outcomes:

1. The students will understand the nature, process and types of communication and will communicate effectively without barriers.
2. The students will write correct sentences and coherent paragraphs.
3. The students will know how to condense passages by writing précis and write essays by using accurate grammar and appropriate vocabulary.
4. The students will demonstrate advanced writing skills by drafting formal reports.
5. The students will apply their reading techniques and analyze reading comprehension passages.
6. The students will become effective communicators and will display their advanced skills of reading and writing and use correct grammar and appropriate vocabulary in all contexts.

UNIT-IUnderstanding Communication in English:

Introduction, nature and importance of communication.Process of communication.Basic types of communication - verbal and non-verbal.Barriers to communication.Intrapersonal and interpersonal communication.Johari Window

Vocabulary &Grammar: The concept of Word Formation. Importance of proper punctuation.Articles.

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UNIT- II Developing Writing Skills I:
Types of sentences.Use of phrases and clauses in sentences.Cohesion and coherence.Paragraph writing.Organizing principles of paragraphs in documents.Vocabulary & Grammar: Cohesive devices. Root words from foreign languages and their use in English. Prepositions.

UNIT- III Developing Writing Skills II:
Techniques for writing precisely. Précis Writing. Essay Writing.
Vocabulary and Grammar: Subject-verb agreement, Noun-pronoun agreement Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Redundancies, Clichés.

UNIT- IV Developing Writing Skills III:
Describing, Defining, Classifying, Providing examples or evidence.Writing introduction and conclusion.
Report writing – Importance, structure and elements of style of formal reports.
Vocabulary and Grammar: Misplaced modifiers. Synonyms, antonyms.

UNIT-VDeveloping Reading Skills:
The reading process, purpose, different kinds of texts. Reading comprehension.Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.
Vocabulary and Grammar : Words often Confused. Standard abbreviations.

Text Books:

1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan, 2017.
2. Swan Michael,Practical English Usage,OUP, 1995.

Suggested Readings:

1. Wood F.T,Remedial English Grammar, Macmillan,2007
2. Zinsser William,On Writing Well, Harper Resource Book, 2001
3. Sanjay Kumar and PushpLata,Communication Skills,Oxford University Press, 2011.

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18PY C06

MECHANICS AND ELECTROMAGNETIC LABORATORY
(for Civil, Mech & Prod)

Instruction:	3 Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits:	1.5

Course Objectives:

The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments.
2. Understand the various kinds of oscillators.
3. Analyze the behavior of magnetic and dielectric materials.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the concept of errors and find the ways to minimize the errors
2. Demonstrate the various kinds of oscillations.
3. Determine the loss of energy of a ferromagnetic material and its uses in electrical engineering .
4. Understand the suitability of dielectric materials in engineering applications.
5. Use LCR circuits in different applications.

Experiments

1. *e/m* of Electron by Thomson's Method.
2. B-H curve – Determination of Hall coefficient, carrier concentration & mobility of charge carriers of given semiconductor specimen.
3. Stewart & Gee's.
4. Mutual induction.
5. Dielectric constant – Determination of dielectric constant of given PZT sample.
6. Error analysis – Estimation of errors in the determination of time period of a torsional pendulum.
7. Helmholtz's resonator.
8. Compound pendulum.
9. Flywheel.
10. Coupled oscillator.
11. LCR circuit.
12. Melde's experiment.
13. Young's modulus.
14. Viscosity by oscillating disc (Lamp scale method).

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15. Ultrasonic interferometer – Determination of velocity of ultrasonics in a given liquid.

SUGGESTED READING:

1. *Engineering Physics Manual* by Department of Physics, CBIT, 2016.
2. S.K. Gupta, *Engineering Physics Practical*, Krishna's Educational Publishers, 2014.
3. O.P. Singh, V. Kumar and R.P. Singh, *Engineering Physics Practical Manual*, Ram Prasad & Sons Publications, 2009.
4. Indu Prakash, Ram Krishna and A.K. Jha, *A Text Book of Practical Physics*, Kitab Mahal Publications, 2012.

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18CS C02

Programming for Problem Solving
(Programming Lab – I)
(Common to All Programs)

Instruction	4 Periods per week
Duration of Semester-End Examination	3 Hours
Semester-End Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate C programming constructs to implement algorithms.
4. Identification and rectification of coding errors in program.
5. Develop applications in a modular fashion.
6. Manage data using files.

Course Outcomes:

At the end of the course students will be able to:

1. Identify and setup program development environment.
2. Implement the algorithms using C programming language constructs.
3. Identify and rectify the syntax errors and debug program for semantic errors.
4. Analyze the results to evaluate the solutionsof the problems.
5. Solve problems in amodular approach using functions.
6. Implement file operations with simple text data.

Lab experiments

1. Familiarization with programming environment.
2. Simple computational problems using arithmetic expressions.
3. Problems involving if-then-else structures.
4. Iterative problems e.g., sum of series.
5. 1D Array manipulation.
6. 2D arrays and strings.
7. Matrix problems, String operations.
8. Simple functions.
9. Recursive functions.
10. Pointers and structures.
11. Dynamic memory allocation and error handling.
12. File handling.

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Design the experiments in such a way that the students will be able to end up the solution for a real world problem that uses most of the concepts of C programming language. For example: A banking application where it uses the concepts of operators, control structures, switch case for menu, structures, functions, error handling, files etc.

Suggested Reading:

1. Pradeep Dey and Manas Ghosh, "**Programming in C**", Oxford Press, 2nd Edition, 2017.
2. ReemaTharaja "**Introduction to C Programming**", Second Edition, OXFORD Press,2015.

References:

1. https://www.tutorialspoint.com/cprogramming/index.htm
2. https://www.w3resource.com/c-programming/programming-in-c.php
3. https://www.w3schools.in/c-tutorial/

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18ME C02

WORKSHOP/ MANUFACTURING PRACTICE

Instruction	1T+4P Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits	3

Course Objectives:

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive & team work attitude to get things right the first time.
3. To provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. To advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.
6. Engineering Skill development with regard to making components, system integration and assembly to form a useful device.

Course Outcomes – (Laboratory): Student will be able to

1. Fabricate components with their own hands.
2. Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. Assembling different components, student will be able to produce small mechanisms/devices of their interest.
4. Gain practical skills of carpentry, tinsmithy, fitting, house wiring.
5. Gain knowledge of different Engineering Materials and Manufacturing Methods.
6. Understand trades and techniques used in Workshop and chooses the best material/ manufacturing process for the application.

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18EG C02

ENGLISH LAB

(Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
Continuous Internal Evaluation:	15 Marks
Credits	1

Course Objectives:

1. To introduce students to phonetics and the different sounds in English.
2. To familiarize the students with the software and give them sufficient practice in correct pronunciation.
3. To enable students to speak English correctly with focus on stress and intonation.
4. The students will enhance their listening skills by practicing IELTS and TOEFL material.
5. To help students overcome their inhibitions while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
6. To help students to understand team work, role behavior and to develop their ability to discuss in groups and make oral presentations.

Course Outcomes:

1. The students will differentiate the speech sounds in English.
2. The students will interact with the software and understand the nuances of pronunciation in English.
3. The students will speak with the proper tone, intonation and rhythm and apply stress correctly.
4. The students will demonstrate their listening skills by analyzing the IELTS and TOEFL listening comprehension texts.
5. The students will speak with clarity and confidence.
6. The students will work in teams and discuss various topics and demonstrate their presentation skills through posters.

Exercises

1. **Introduction to English Phonetics:** Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs . The syllable: types of syllables, consonant clusters.
3. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.

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4. **Rhythm &Intonation** : Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – practice with IELTS and TOEFL material.
6. **Situational dialogues and role play** – Dialogue writing, – Role behavior and role enactment.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
9. **Poster presentation** – Theme, poster preparation, team work and presentation.

Suggested Reading

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 201.
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016.

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18MT C03

MATHEMATICS- II

(Common to all branches and except for Bio-Tech)

Instruction	3 L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits	4

Course Objectives

1. To evaluate double and triple integrals of various functions and their significance.
2. To evaluate vector line, surface and volume integrals.
3. To know the relevant method to solve higher order differential equations.
4. To evaluate complex integration.
5. To evaluate real and definite integrals.
6. To know the methods to solve real life problems.

Course Outcomes: On the successful completion of this course student shall be able to

1. Find the areas, volumes and surface of solids revolution.
2. Use Greens, Gauss and Stoke's theorems to find the surface and volume integrals.
3. Able to solve solutions of differential equations with initial and boundary value problems.
4. Solve the problems on analytic functions, Cauchy's theorem and Cauchy's integral formula.
5. Real and complex integrals by using Cauchy's theorems.
6. Solve physical and engineering problems.

UNIT-I: Multivariable Calculus (Integration):

Applications of definite integrals to evaluate surface areas and volumes of revolutions. Double integrals, Change of order of integration, Triple integrals, Change of variables in integrals, Applications: areas and volumes, Centre of mass and Gravity (constant and variable densities).

UNIT-II: Vector Integral Calculus:

Line, Surface and Volume integrals, Green's theorem in a plane, Gauss's divergence theorem and Stroke's theorem (without proof).

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First Order Ordinary Differential Equations: Exact first order differential equations , Integrating factors, Linear first order equations , Bernoulli's, Riccati's and Clairaut's differential equations ,Orthogonal trajectories of a given family of curves.

UNIT-III: Ordinarydifferential equations of higher orders:
Solutions of higher order linear equations with constants coefficients, Method of variation of parameters, solution of Euler-Cauchy equation. Ordinary point, singular point and regular singular point, Power Series solution. Legendre Polynomial of first kind (without proof), Rodrigues formula, Generating function, recurrence relations, orthogonality of Legendre polynomials, Bessel's function of first kind (without proof), recurrence relations and problems.

UNIT- IV: Complex Variables –I :
Differentiation, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof).

UNIT- V: Complex Variables – II:
Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, Laurent's series, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine. Improper real integrals with singular points on the upper half plane.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Suggested Reading:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. R.K. Jain, S.R.K. Iyengar, Advanced engineering mathematics Narosa Publications,5th edition,2016.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

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18CY C01

CHEMISTRY

(Common to all branches)

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives

1. The aim of framing the syllabus is to impart intensive and extensive knowledge of the subject so that students can understand the role of chemistry in the field of engineering.
2. This syllabus helps at providing the necessary introduction of the inorganic chemistry principles and concepts of chemical bonding involved in a comprehensive manner understandable to the students aspiring to become practicing engineers.
3. Thermodynamic and Electrochemistry units give conceptual knowledge about spontaneous processes and how can they be harnessed for producing electrical energy and efficiency of systems.
4. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
5. New materials lead to discovering of technologies in strategic areas like defense and space research for which an insight into nano and composite materials of modern chemistry is essential.

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations & Ionic Equilibria.
3. List major chemical reactions that are used in the synthesis of molecules.
4. Apply the various methods used in treatment of water for domestic and industrial use.

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5. Discuss the various Engineering materials & Drug synthesis & their applications.

UNIT-I Atomic and molecular structure:

Molecular Orbital theory - atomic and molecular orbitals.Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Energy level diagrams of diatomics (H_2, He_2^+, N_2, O_2, O_2^-, CO, NO). Pi- molecular orbitals of butadiene , benzene and their aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

UNIT-II Use of free energy in chemical equilibria and Ionic Equilibria:

Use of free energy in chemical equilibria : Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy(criteria of spontaneity).Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials –electrochemical series.Nernst equation and its applications.Potentiometric Acid base & Redox Titrations.Numericals.

Ionic Equilibria: Solubility product, Determination of solubility product, Applications of solubility product- Determination of solubilities of sparingly soluble salts; Predicting precipitation reactions; Precipitation of an insoluble salt; Precipitation of soluble salts ; Inorganic analysis .Numericals.

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures , Symmetry and chirality, Stereoisomers - Configurational isomers (Geometrical&Optical isomers), Conformational isomers - Newman and sawhorse representations of n-butane ,enantiomers (lactic acid), diastereomers (Tartaric acid) , optical activity, absolute configurations , Sequence rules for R&S notation.

Organic reactions

Types of Organic reactions:

Substitution Reactions- Electrophilic substitution (Nitration of Benzene) ;Nucleophilic Substitution(S_N1& S_N2) ; Free Radical Substitution(Halogenation of Alkanes)

Additions Reactions:

Electrophilic Addition – Markonikoff's rule

Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Free radical Addition - Anti Markonikoff's rule (Peroxide effect)

Eliminations-E_1 and E_2 (dehydrohalogenation of alkyl halides)

Oxidation with $KMno_4$, $K_2Cr_2O_7$; **Reduction** with $LiAlH_4$,$NaBH_4$

Cyclization (Diels - Alder reaction)

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UNIT–IV Water Chemistry:

Hardness of water – Types, units of hardness, Disadvantages of hard water , Boiler troubles - scales & sludge formation , causes and effects , Softening of water by ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination , Ozonisation & UV radiation.

UNIT-V Engineering Materials and Drugs:

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol gel method. Carbon nanotubes and their applications.

Composite materials- Definition, types of composites, fibre reinforced, glass fibre reinforced and carbon fibre reinforced composites and applications.

Conducting polymers- Definition, classification and applications.

Drugs-Introduction,Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Mali, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition(2011).
4. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C. Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & CompanyLtd.,46th edition(2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8thedition (2006).

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18CE C01

ENGINEERING MECHANICS

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. The objective of this course is to understand the resolution of forces and to obtain resultant of all force systems, to understand moment of a force and equilibrium conditions of static loads for smooth and frictional surface
2. To obtain centroid, centre of gravity and moment of inertia for various regular and composite areas and bodies.
3. To understand the basic structural analysis, principles of virtual work and energy methods.
4. To know the basic concepts of dynamics and analysis as a particle and rigid bodies.
5. To understand the work energy principles, impulse momentum and their applications and to know the concept of simple harmonic motion and free vibration.

Course Outcomes: The students will be able to

1. Solve problems dealing with forces in plane and space force systems, draw free body diagrams to analyze various problems in equilibrium, for smooth and frictional surface.
2. Determine centroid and moment of inertia for elementary, composite areas and bodies.
3. Analyze simple trusses for forces in various members of a truss.
4. Solve problem in kinematics and kinetics of particles and rigid bodies.
5. Analyze body motion using work energy principles, impulse and momentum approach and able to apply the concepts of simple harmonic motion and free vibrations in dynamics.

Unit–I: Resolution, Resultant and Equilibrium of force system and Friction: Concepts of force, System of forces, components of forces in a plane and in space systems.Resultant of force systems.Moment of forces and its applications.Couples and its applications.Equilibrium of Force systems. Free body diagrams, equation of equilibrium of coplanar and spatial force systems. Static indeterminacy. Types of friction, Laws of friction, application of friction to a single body & connecting systems, wedge friction.

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Unit–II: Centroid, centre of gravity and moment of Inertia:

Centroid of simple figures from first principle, centroid of composite sections. Centre of gravity and its implications, Definition of Area moment of Inertia, Moment of inertia of plane section from first principles, Theorems of moment of inertia, moment of inertia of standard sections and composite sections, Mass moment of inertia of rectangular and circular plates, cylinder, cone & sphere.

Unit–III: Analysis of simple trusses, Virtual work and Energy methods:

Analysis of simple trusses using method of joints, methods of sections. Determine if a member is in tension or compression, zero force members. Virtual displacements, Principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom.Conservative forces and potential energy, energy equation for equilibrium.

Unit–IV: Particle Dynamics:

Rectilinear and curvilinear translation using rectangular, normal and tangential components.Relative and constrained motion. Newton's 2nd Law, rectangular and path coordinates. Basic terms, general principles in dynamics, D' Alembert's principle and its application in plane motion and connected bodies.Instantaneous centre of rotation in plane motion and simple problems.

Unit–V: Work- Energy, Impulse-momentum and Mechanical Vibrations:

Equation of work energy for translation and fixed axis rotation, work energy principles applied to particle motion, connected systems. Introduction to linear impulse momentum, principle of conservation of linear momentum, Impact, direct and oblique. Introduction to vibration, free and forced vibrations, simple harmonic motion, simple pendulum and compound pendulum.

Text Books:

1. Reddy Vijaykumar K. and J. Suresh Kumar," Singer's Engineering Mechanics Statics and Dynamics", B. S. Publications 2011.
2. A. Nelson, "Engineering Mechanics", Tata McGraw Hill, New Delhi, 2010.

Suggested Reading:

1. Irving H. Shames, "Engineering Mechanics", 4th Edition, Prentice Hall, 2006.
2. F. P. Beer and E. R Johnson, "Vector Mechanics for engineers, Vol. I - Statics, Vol. II - Dynamics", 9th edition, Tata McGraw Hill, 2011.
3. R. C. Hibbeler, "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press, 2006.

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18ME C01

ENGINEERING GRAPHICS AND DESIGN

Instruction	1T+4D Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits	3

Course Objectives:

1. to prepare to design a system, component, or process to meet desired needs within realistic constraints.
2. to prepare the student to communicate effectively.
3. to prepare the student to use the techniques, skills, and modern engineering tools necessary for engineering practice.
4. to get exposure to a CAD package.

Course Outcomes:

1. Introduction to engineering design and its place in society.
2. Exposure to the visual aspects of engineering design.
3. To become familiar with engineering graphics standards.
4. Exposure to solid modelling.
5. Exposure to computer-aided geometric design.
6. Exposure to creating working drawings.
7. Exposure to engineering communication.

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views;

Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Coordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory).

UNIT-1 Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute;

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UNIT-2 Orthographic Projections:
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes (without traces) ; Projections of planes inclined Planes;
Introduction to CAD package:
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

UNIT-3 Projections of Regular Solids:
Projection of Prism, Cylinder, Pyramid and Cone : Simple position, axis inclined to one of the reference plane only. Customization & CAD Drawing: consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT-4 Sections and Sectional Views of Right Angular Solids:
Sections of solids in simple position Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.
Annotations, layering & other functions:
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); rinting documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and twodimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

UNIT-5 Isometric Projections:
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Viceversa, Conventions;

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Demonstration of a simple team design project:

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; geometric dimensioning and tolerancing;

Use of solid-modeling software for creating associative models at the component and assembly levels; (Examples of specific components to the branch of study may be included).

Text Books:

1. N.D.Bhatt, Elementary Engineering Drawing, Charotar Publishers,2012.
2. K.L.Narayana and P.K.Kannaiah, –Text Book of Engineering Drawing Scitech Publications, 2011.
3. Basanth Agrawal and C M Agrawal –Engineering Drawing 2e –, McGraw-Hill Education(India) Pvt.Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., –Engineering drawing Pearson, 2ndedition, 2009.
2. K.Veenugopal, –Engineering Drawing and Graphics + Autocad New Age International Pvt.Ltd,2011.
3. Bhattacharya. B, –Engineering Graphics I. K. International Pvt.Ltd, 2009.

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18EE C01

BASIC ELECTRICAL ENGINEERING

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. To understand the behavior of different circuit elements R,L & C, and the basic concepts of electrical circuit analysis.
2. To know the concepts of AC circuits, RMS value, Average value, Phasor analysis etc., 3. To understand the basic principle of operation of Transformer and DC machines.
4. To understand the basic principle of operation of DC machines and AC machines.
5. To know about different types of electrical wires and cables, domestic and industrial wiring.
6. To understand safety rules and methods of earthing.

Course Outcomes: At the end of the course, the student will be able to

1. Acquire the concepts of Kirchhoff's laws and network theorems and able to get the solution of simple dc circuits.
2. Obtain the steady state response of RLC circuits and also determine the different powers in AC circuits.
3. Acquire the concepts of principle of operation of Transformers and DC machines.
4. Acquire the concepts of principle of operation of DC machines and AC machines.
5. Acquire the knowledge of electrical wiring and cables and electrical safety precautions.
6. Recognize importance of earthing and methods of earthing and electrical installations.

UNIT-I: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Time-domain analysis of first order RL and RC circuits.

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UNIT-II: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III: Transformers

Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation, Auto transformer

UNIT-IV: DC and AC Machines

DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt, series and compound generators. DC Motors: Classification, Torque equation, Characteristics, Efficiency, Speed Control of Series and Shunt Motors. Three - Phase Induction Motors: Construction, Principle of operation, Torque equation, torque-slip characteristics, Power stages, speed control of induction motors.

UNIT-V: Electrical Installations

Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Earthing, Elementary calculations for energy consumption.

Text books:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, –Basic Electrical Engineering .Tata McGraw Hill, 2010.
2. V. D. Toro, –Electrical Engineering Fundamentals Prentice Hall India, 1989.
3. D.C. Kulshreshtha, –Basic Electrical Engineering McGraw Hill,2009
4. P.V.Prasad, S.sivanagaraju, R.Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013.

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18EE C02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
Continuous Internal Evaluation:	15 Marks
Credits	1

Course Objectives:

1. To acquire the knowledge of different types of electrical elements.
2. To verify the basic electrical circuit laws and theorems.
3. To determine the parameters and power factor of a coil.
4. To calculate the time and frequency responses of RLC circuits
5. To determine the characteristics of Transformers.
6. To determine the characteristics of dc and ac machines.

Course Outcomes: At the end of the course, the students are expected to

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the circuit analysis techniques.
4. Determine the parameters of the given coil.
5. Understand the basic characteristics of transformer.
6. Understand the basic characteristics of dc and ac machines.

List of Laboratory Experiments/Demonstrations:

1. Demonstration of Measuring Instruments and Electrical Lab components
2. Verification of KCL and KVL.
3. Time response of RL and RC circuits.
4. Calculation of permittivity of a choke or coil by Wattmeter Method.
5. Verification of Thevenin's and Norton's theorems.
6. Turns ratio /voltage ratio verification of 1-Ph Transformers.
7. OC and SC tests on a given 1-Ph Transformer.
8. Observation of Excitation Phenomenon in Transformer.
9. Measurement of 3-Ph power in a balanced system (By 2- Wattmeter method).
10. Measurement of 3-Ph Energy by an Energy Meter (Demonstration of Principle).
11. Load test of DC Shunt motor.
12. Speed control of DC Shunt motor.
13. Load test of 3-Ph Induction motor.
14. Demonstration of LT Switchgear Equipment/Components.
15. Demonstration of cut - out section of Machines like DC Machine, Induction Machine, etc.

Note: at least **TEN** experiments should be conducted in the semester.

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18CY C02

CHEMISTRY LAB

(Common to all branches)

Instruction:	3 Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits:	1.5

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory
2. The student should be conversant with the principles of volumetric analysis and identification of organic functional groups.
3. To apply various instrumental methods to analyze the chemical compounds and to improve understanding of theoretical concepts.

Course Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

1. Estimate rate constants of reactions from concentration of reactants/ products as a function of time.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
3. Synthesize a small drug molecule and Identify the organic compounds.
4. understand importance of analytical instrumentation for different chemical analysis.
5. Perform interdisciplinary research such that the findings benefit the common man.

Chemistry Lab

1. Estimation of temporary and permanent hardness of water using EDTA solution.
2. Estimation of amount of chloride in water.
3. Determination of rate constant for the reaction of hydrolysis of methyl acetate (first order).
4. Estimation of amount of HCl Conductometerically using NaOH solution.

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5. Estimation of (a) amount of CH_3 COOH Conductometerically using NaOH solution. (b) amount of HCl and CH_3 COOH present in the given mixture of acids Conductometerically using NaOH solution.
6. Estimation of amount of HCl Potentiometrically using NaOH solution.
7. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution.
8. Distribution of acetic acid between n-butanol and water.
9. Synthesis of drug - Aspirin.
10. Organic Chemistry- Identification of Functional groups - neutral group (carbonyl groups-acetaldehyde and acetone); acidic group(benzoic acid) ; basic group (aniline).
11. Determination of surface tension of organic solvents (ethanol, ethyl acetate).
12. Determination of Viscosity.

TEXT BOOKS

1. J. Mendham and Thomas ,"Vogel' s text book of quantitative chemical analysis", Pearson education Pvt.Ltd., New Delhi , 6th ed. 2002.

SUGGESTED READINGS

1. Dr. Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

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SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	18MT C05	Mathematics-III	3	1	--	3	30	70	4
2	[illegible]	Engineering Economics and Accountancy	3	--	--	3	30	70	3
3	[illegible]	Material Science and Metallurgy	3	--	--	3	30	70	3
4	[illegible]	Mechanics of Materials	3	1	--	3	30	70	4
5	[illegible]	Manufacturing Processes	3	--	--	3	30	70	3
6	[illegible]	Indian Constitution and Fundamental Principles	2	--	--	2	--	50*	Non-Credit
7	[illegible]	Indian Traditional Knowledge	2	--	--	2	--	50*	Non-Credit
PRACTICALS									
8	[illegible]	Material Science and Metallurgy Lab	--	--	2	3	[illegible]	[illegible]	1
9	[illegible]	Mechanics of Materials Lab	--	--	2	3	[illegible]	[illegible]	1
10	[illegible]	Manufacturing Processes Lab	--	--	2	3	[illegible]	[illegible]	1
		TOTAL	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

18MT C05

MATHEMATICS – III

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:

1. To form PDE and to find its solution.
2. To solve wave and heat equations.
3. To learn the Laplace and Inverse Laplace transforms for solving engineering problems.
4. To learn Fourier transform and Z-transforms for solving engineering problems.
5. Learning the basic concepts of probability and Statistical Analysis.

Outcomes: On successful completion of this course, the students shall be able to

1. Solve Linear and Non-Linear PDE's.
2. Solve One-Dimension Wave and Heat equations and Two Dimension Laplace equation.
3. Find Laplace transform and inverse Laplace transform and can solve Linear Differential equations.
4. Find the solutions of various Transforms.
5. Find moments of discrete and continuous random variables as well as familiar with distribution.

UNIT - I

Partial Differential Equations: Formation of Partial Differential Equations, Solution of First Order Linear Partial Differential Equations by Lagrange's Method, Solution of First Order Non-linear Partial Differential Equation by Standard types and Charpits Method.

UNIT - II

Applications of Partial Differential Equation: Solution by Method of Separation of Variables, Solution of One dimensional Wave equation, One dimensional Heat equation, Two dimensional Laplace equation and its related problems.

UNIT - III

Laplace Transform: Laplace Transform of standard functions, Linearity property, change of scale property, Shifting theorems, Laplace Transform of Periodic

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Function, Unit step function and Unit impulse function. Transforms of derivatives, Transforms of integrals. Multiplication by t^n and division by t. Inverse Laplace Transform properties, Inverse Laplace Transform by partial fractions and Convolution theorem, Applications of Laplace Transform (Solution of Linear Differential Equations).

UNIT - IV

Fourier Transforms and Z-Transforms:

Fourier Transforms: Fourier integral theorem (statement), Complex form of Fourier integrals, Fourier transforms, Inverse Fourier Transforms, Fourier Sine and Cosine transforms, Inverse Fourier Sine and Cosine Transforms. Properties of Fourier transforms: Linear property, change of scale property, shifting property and Modulation theorem.

Z-Transforms: Z-transforms of standard functions, linearity property, damping rule, shifting theorems, multiplication by 'n', initial and final value theorems. Inverse Z-Transform: Inverse Z-transform by Convolution theorem, partial fractions. Z-transform application to difference equations.

UNIT - V

Basic Statistics: Random variable, discrete probability distribution and continuous probability distribution. Expectation, Addition theorem and Multiplication theorem of expectation, properties of variance, Poisson distribution (Mean, variance, MGF& CGF), Normal distribution (Mean, variance, MGF& CGF), Properties of Normal distribution, Areas of under normal curve. Correlation and regression.

Textbooks:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9/e, John Wiley & Sons, 2006.
2. B.S. Grewal, "Higher Engineering Mathematics", 35/e, Khanna Publishers, 2000.
3. Sheldon Ross, "A First Course in Probability", 9/e, Pearson publications, 2014.

Suggested Reading:

1. S. J. Farlow, "Partial Differential Equations for Scientists and Engineers", Dover Publications, 1993.
2. Ian Snedon, "Elements of Partial Differential equations", McGraw Hill, 1964.
3. S.C.Gupta, V.K.Kappoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.

18MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The objectives of the course are

1. To demonstrate the importance of Managerial Economics in decision making.
2. To understand the importance of project evaluation in achieving a firm's objective.
3. To explain the concept of Accountancy and provided knowledge on preparation and analysis of Final accounts.

Outcomes: At the end of the course a student will be able to

1. Apply fundamental knowledge of Managerial economics concepts and tools.
2. Understand various aspects of demand analysis and forecasting.
3. Analyze production and cost relationships to make best use of resources available.
4. Analyze different opportunities and come out with best feasible capital investment decisions
5. Apply accountancy concepts and conventions and preparation of final accounts.

UNIT-I

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its scope, importance, relationship with other subjects, its usefulness to engineers - Basic concepts of Managerial economics.

UNIT-II

Demand and Supply Analysis: Demand Analysis - Concept of demand, determinants, Law of demand, its assumptions, Elasticity of demand, price, income and cross elasticity, Concept of supply, determinants of supply, law of supply, Demand Forecasting – simple numerical problems.

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UNIT-III

Production and Cost Analysis: Theory of Production. Production function - input-output relations - laws of returns - internal and external economics of scale.

Cost Analysis: Cost concepts - fixed and variable costs - explicit and implicit costs - out of pocket costs and imputed costs - Opportunity cost - Cost output relationship - Firm and industry, types of market structures, Break-even analysis, numerical problems.

UNIT-IV

Accountancy: Book-keeping, principles and significance of double entry book keeping, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

UNIT-V

Capital Budgeting: Introduction to capital budgeting, Methods: traditional and discounted cash flow methods, Introduction to working capital management, Numerical problems.

Text Books:

1. Mehta P.L., "Managerial Economics – Analysis, Problems and Cases", Sultan Chand and Son's Educational publishers, 2016.
2. Maheswari S.N., "Introduction to Accountancy", 11/e, Vikas Publishing House, 2013.
3. Panday I.M., "Financial Management", 11/e, Vikas Publishing House, 2015.

Suggested Reading:

1. Varshney and KL Maheswari, "Managerial Economics", Sultan Chand, 2014.
2. M.Kasi Reddy and S.Saraswathi, "Managerial Economics and Financial Accounting", PHI Pvt Ltd, 2007.
3. A.R.Aryasri, "Managerial Economics and Financial Analysis", McGraw-Hill, 2013.

18ME C03

MATERIAL SCIENCE AND METALLURGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Structure property relations, analyze the failures of metals and their prevention.
2. Fatigue, creep and diffusion mechanisms.
3. Classification of steels and their application.
4. Working principle of various heat treatment operations
5. Principles of extractive metallurgy.

Outcomes: At the end of the course a student will be able to

1. Understand the imperfections of crystals.
2. Understand crack propagation by fatigue, creep deformation and diffusion theory.
3. Understand the importance of steel in engineering applications.
4. Understand to the methods of improvement of mechanical properties by various heat treatment operations
5. Understand the methods of production of various metals by extractive metallurgy.

UNIT-I

Plastic deformation: Imperfections in crystals, dislocation in crystals, types of dislocations, effect of slip and twinning on the plastic deformation, cold and hot working, strain hardening and Bauchinger effect, recovery, recrystallization, grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, modes of fracture, Griffith theory of brittle fracture, crack propagation, ductile fracture, fracture under combined stress.

UNIT-II

Fatigue: S–N curve, Structure of fatigue fracture specimen. Fatigue crack propagation, effect of metallurgical variables on fatigue of metal, low cycle fatigue, experimental determination of fatigue strength (RR–Moore Test).

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Creep: Creep strength, creep curve, creep deformation mechanisms, creep test.
Diffusion: Fick's law of diffusion, application of diffusion theory in mechanical engineering.

UNIT-III
Structure of Alloys: study of eutectic, eutectoid, peritectic and peritectoid reactions, Iron–Iron Carbide equilibrium diagram, construction and interpretation. Types of plain carbon steels, cast irons and their properties and characteristics.

UNIT-IV
Heat Treatment: Annealing, normalising, hardening, tempering. Construction and interpretation of T-T-T diagram, austempering and martempering, case hardening, carburizing, nitriding, carbo nitriding, flame hardening, induction hardening.

UNIT-V
Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, cast iron by cupola furnace, Method of production of steel by Bessemer convertor, L.D process and electric arc process.
Alloy Steels: Effects of alloying elements like nickel, chromium, manganese, silicon tungsten, and titanium, Study about stainless steels, HSS, brass, bronze; their composition and properties.
Polymers and Ceramics: Polymerization, thermoplastics and thermosetting plastics, elastomers, resins. Types and applications of ceramics

Text Books:

1. V. Raghavan, "Materials Science and Engineering", 4/e, Prentice Hall of India Ltd., 2005.
2. S.H. Avner, "Introduction to Physical Metallurgy", 2/e, Tata McGraw Hill Publishers, 2005.

Suggested Reading:

1. S.P. Nayak, "Engineering Metallurgy and Material Science", 6/e, Charoter Publishing House, 2005.
2. E. Dieter, "Mechanical Metallurgy", 3/e,Metric Edition, Tata McGraw Hill, 2005.
3. K.L. Kakani, "Material Science", New Age Publications (P) Ltd., 2008.

18ME C04

MECHANICS OF MATERIALS

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:

1. Student is exposed to the concept of different types of loads, stresses, strains and analysis of members for axial loads.
2. Student will acquire knowledge in drawing bending and shear force diagrams of beams of various loads and configurations.
3. Student becomes familiar with methods of evaluation of deflection of beams of various configurations and stresses that arise due to simple bending.
4. Student is exposed to the concept of shear stresses in beams, principal stresses, strains and phenomenon of torsion.
5. Student will acquire knowledge in estimating stresses for thin, thick cylindrical shells and buckling of columns.

Outcomes: At the end of the course a student will be able to

1. Determine stresses and strains in members subjected to axial loads and temperature changes.
2. Draw shear force, bending moment diagrams for different types of beams and calculate stresses and strains due to simple bending.
3. Determine slope and deflection for various configurations of beams using different methods, analyze stress, strain and deflection due to torsion in circular members.
4. Analyze shear stress distribution in different sections of beams and find out principal stresses and strains.
5. Find out stresses and strains in thin, thick cylindrical shells and also able to calculate critical buckling loads in columns and struts.

UNIT-I
Stresses and Strains: Definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity, Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars.

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UNIT-II

Beams: Definition of bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams; simple theory of bending, moment of resistance, modulus of section.

UNIT-III

Slopes and Deflections: Slope and deflection calculations of cantilever, simply supported beams subjected to point loads and uniformly distributed loads with Macaulay's and double integration methods.

Torsion: Derivation of torsion formula for circular sections, power transmission, effect of combined bending and torsion.

UNIT-IV

Shear Stresses in beams: Distribution of shear stresses in rectangular, I-section, T-section, solid and hollow circular sections.

Compound stresses: principal stresses and strains. Mohr's circle of stress.

UNIT-V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures. Stresses in compound cylinders. **Columns and struts:** Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

Text Books:

1. S.S.Rattan, "Strength of Materials", 3/e, Tata Mc-Graw Hill, 2016.
2. S. Ramamrutham, "Strength of Materials", Dhanpatrai and Sons, 1993.
3. G.H.Ryder, "Strength of Materials", 3/e, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, "Strength of Materials", Vikas Publication, 2003.
2. James M Gere, "Mechanics of materials", 8/e, cengage learning, 2013.
3. R.C. Hibbeler, "Mechanics of Materials", 9/e, Pearson, 2018.

18PE C01

MANUFACTURING PROCESSES

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To enable the students to

1. Understand various terms related to manufacturing processes
2. Understand various manufacturing processes
3. Provide the ability to solve simple problems such as riser design and sheet metal calculations
4. Compare various Manufacturing processes
5. Select suitable manufacturing process for a given component

Outcomes: At the end of the course, a student will be able to

1. Students should able to define various terms related to manufacturing processes (Level-1)
2. Demonstrate the understanding of various manufacturing processes (Level 2)
3. Solve simple problems such as riser design and sheet metal calculations (Level 3)
4. Compare various Manufacturing processes (Level 4)
5. Choose suitable manufacturing process for a given component (level 5)

UNIT-I

Pattern Design and Methoding: Introduction to casting, classification of casting processes, pattern design: Types of patterns, pattern materials, pattern allowances; Gating system: purpose, elements, requirements, types of gates, Risering: purpose, requirements, chvorinov's rule, optimum shape and dimensions of riser, riser design by Caine's method, and Modulus method.

UNIT-II

Moulding, Melting and Special Casting Processes: Moulding sand: ingredients, required properties of moulding sand; Core : purpose, core prints, Melting by ,Cupola furnace, induction and arc furnace; casting defects and remedies; Special casting processes: Pressure die casting, Centrifugal casting, shell moulding, investment casting, CO2 moulding.

UNIT-III

Welding: Introduction, Classification of welding processes, Physics of arc, DCSP, DCRP, AC. shielded Metal Arc Welding, Submerged arc welding, Gas Tungsten arc welding, Plasma arc welding, Resistance welding: spot, projection, seam, butt and percussion welding. Oxy-Acetylene welding, Thermit welding, laser beam welding, Electron beam welding. solid state welding: friction welding, ultrasonic welding and explosive welding Soldering and brazing.

UNIT - IV

Metal Forming Processes: forging: open die ,closed die and isothermal forging processes, Rolling: process, nomenclature, geometric relationships, rolling mills; Extrusion: Direct, indirect, hydrostatic and impact extrusion processes ; Wire Drawing Process, shearing: shearing load, energy required, types of shearing processes; Cup Drawing : process, calculation of blank diameter for a given cup, drawing load; sheet bending: process, bend allowance.

UNIT – V

Additive Manufacturing: Introduction, Liquid based, powder based and deposition based layer wise manufacturing, Apllications of additive manufacturing.

Powder Processing: Introduction, Production of powders, mixing, blending, compacting and sintering. Secondary processes such as repressing, coining, sizing, P/M Forging, Impregnation and infiltration. Merits, demerits and application of powder metallurgy products.

Processing of Plastics, Ceramics and Composites: Injection moulding, Blow moulding, Thermoforming, Extrusion, Compression and transfer moulding processes. Ceramic processing techniques such as injection moulding and slip casting. Processing methods of composites such as roll bending, diffusion bonding, Pultrusion and filament winding processes.

Text Books:

1. P.N.Rao, "Manufacturing Technology", Vol.1, 3/e, Tata McGraw Hill Publ., 2011.
2. Amitabh Ghosh and Mullick, "Manufacturing Science", 4/e, Assoc. East West Press Pvt. Ltd., 2011.

Suggested Reading:

1. G.K.Lal and S.K.Choudhury," Fundamentals of Manufacturing Processes" Alpha science international ltd.,2005.
2. Schey, "Introduction To Manufacturing Processes", 2/e, Mcgraw - hill Education.
3. Mikell P.Grover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", 3/e, Willey A.

18EG M01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: The course will introduce the students to

1. The history of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Outcomes: After successful completion of the course the students will be able to

1. Understand the making of the Indian Constitution and its features.
2. Have an insight into various Organs of Governance - composition and functions.
3. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
4. Be aware of the Emergency Provisions in India.
5. Understand the Right To equality, the Right To freedom and the Right To Liberty.

UNIT-I

Constitution of India: Introduction and salient features, Constitutional History, Directive principles of state policy - Its importance and implementation.

UNIT-II

Union Government and its Administration: Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States; Parliamentary form of government in India. **President:** role, power and position.

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UNIT-III

Emergency Provisions in India: National emergency, President rule, Financial emergency

UNIT – IV

Local Self Government: District's Administration Head: Role and Importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Panchayati Raj: Introduction, Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and officials.

UNIT – V

Scheme of the Fundamental Rights & Duties: Fundamental Duties - the legal status.

Scheme of the Fundamental Rights: To Equality, to certain Freedom under Article 19, to Life and Personal Liberty under Article 21.

Text Books:

1. "The Constitution of India", 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1/e, 2015.

Suggested Reading:

1. M. P. Jain, "Indian Constitution Law", 7/e, Lexis Nexis, 2014.
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

18EEA01

INDIAN TRADITIONAL KNOWLEDGE

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: The course will introduce the students to

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India.

Outcomes: After successful completion of the course the students will be able to

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

UNIT-I

Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT-II

Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India

Indian Languages and Literature-II: Northern Indian languages & literature

UNIT-III

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT–IV

Fine Arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT – V

Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Text Books:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450-494-X, 2006
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014

Suggested Reading:

1. Kapil Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN-10: 8171880649, 1994
2. Karan Singh, "A Treasury of Indian Wisdom: An Anthology of Spiritual Learn", ISBN: 978-0143426158, 2016.

18ME C05

MATERIAL SCIENCE AND METALLURGY LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: Students will

1. Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heat treatment operations.
4. Understand differences between different heat treatment methods.
5. Understand the relation between micro structure and properties.

Outcomes: At the end of the course, a student will be able to

1. Identify crystal structure of various metals.
2. Measure hardness and can correlate with microstructure.
3. Perform a suitable heat treatment operation based on desired properties.
4. Underlines the importance of grain size in evaluating the desired mechanical properties.
5. Correlate the heat treatment methods and the mechanical properties obtained.

List of the Experiments

1. Study of: Metallurgical Microscope, Allotropes of Iron, Iron-Iron carbide diagram, Procedure for specimen preparation.
2. Observations for the following specimens - i) Low carbon steels,
   ii) Medium carbon steels,
   iii) Eutectoid steels, iv) High Carbon steels, v) Stainless steels, vi) Case carburized, vii)HSS, viii) White cast iron, ix) Gray cast iron, x) alleable iron, xi) Spheroidal iron,
   xii) Al–Si alloy and determination of grain size using Image Analyzer.
3. Preparations of the following specimens : i) ά "ὰ Brass, ii) Normalised steel iii) Medium carbon steel iv) Nodular cast iron v) Grey cast iron.

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4. Heat Treatment Processes
   i) Annealing
   ii) Normalizing
   iii) Hardening.

Text Books:

1. V. Raghavan, "Materials Science and Engineering", 4/e, Prentice Hall of India Ltd., 2005.
2. S.H. Avner, "Introduction to Physical Metallurgy", 2/e, Tata McGraw Hill Publishers, 2005.

Suggested Reading:

1. S.P. Nayak, "Engineering Metallurgy and Material Science", 6/e, Charutar Publishing House, 2005.
2. E. Dieter, "Mechanical Metallurgy", 3/e, Metric Edition, Tata McGraw Hill, 2005.
3. K.L. Kakani, "Material Science", New Age Publications (P) Ltd., 2008.

18ME C06

MECHANICS OF MATERIALS LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: Students will

1. Demonstrate an understanding of tension, and the relationship between stress, strain and application of Hooke's law.
2. Demonstrate an understanding of types of beams, deflections and measurement of material property through deflections.
3. Demonstrate an understanding of torsion and deformations resulting from torsion.
4. Demonstrate the understanding of hardness and its measurement using different scales like Brinnel and Rockwell.
5. Demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

Outcomes: At the end of the course, a student will be able to

1. Draw stress-strain curve for an isotropic material and understand the salient features of it.
2. Determine the Young's modulus of various beam materials by conducting load-deflection test and, rigidity modulus of a given shaft specimen by torsion test.
3. Able to find out Young's modulus and shear modulus for mechanical components like leaf spring and closely coiled helical spring through load-deflection test respectively.
4. Evaluate hardness of different materials using different scales
5. Find the compressive and crushing strengths of concrete cubes and bricks.

List of the Experiments

1. Uni-axial tension test using UTM.
2. Brinell's and Rockwell's hardness tests.
3. Load-deflection test on a leaf spring to find out the young's modulus of leaf material.

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4. Deflection test on a helical spring to determine the rigidity modulus.
5. Torsion of shaft to determine the rigidity modulus of shaft material.
6. Defection test on a cantilever beam to determine the Young's modulus.
7. Deflection test on a simply supported beam to determine the Young's modulus.
8. Deflection test on propped cantilever to determine the Young's modulus.
9. Deflection test on continuous beam to determine the Young's modulus.
10. Crushing and compression test on bricks and concrete cubes.
11. Measuring mechanical strain in a cantilever beam using strain gages and to compare the results with theoretical strain values calculated from an equation derived from solid mechanics.
12. To measure load (tensile/compressive) using load cell on tutor.

Text Books:

1. S.S.Rattan, "Strength of Materials", 3/e, Tata Mc Graw Hill, 2016.
2. S. Ramamrutham, "Strength of Materials", Dhanpatrai and Sons, 1993.
3. G.H.Ryder, "Strength of Materials", 3/e, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavikatti, "Strength of Materials", Vikas Publication, 2003.
2. James M Gere, "Mechanics of materials", 8/e, cengage learning, 2013.
3. R.C. Hibbeler, "Mechanics of Materials", 9/e, Pearson, 2018

18PE C02

MANUFACTURING PROCESSES LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: To enable the students to

1. Test the moulding sand and analyze the same.
2. Test the bead geometry and correlate the results to the input parameters.
3. Use TIG, MIG and Spot welding machines and experiment with them.
4. Test the formability characteristics of a given sheet metal and study different types of dies.
5. Understand the various type of sheet metal forming dies.

Outcomes: Students will be able to

1. Test the moulding sand and analyze the same.
2. Test the bead geometry and correlate the results to the input parameters.
3. Use TIG, MIG and Spot welding machines and experiment with them.
4. Test the formability characteristics of a given sheet metal and
5. Demonstrate the understanding of various types of dies

List of the Experiments:

Casting:

1. Design of a simple pattern with various allowances.
2. Moulding sand testing: GCS, GSS, DCS and DSS
3. Moulding sand testing: Permeability and shatter index.
4. Finding out the GFN and Moisture content for a given sand sample.
5. Melting and Pouring of Aluminum.

Welding:

6. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
7. Study of resistance welding process and spot of welding of MS Sheets.
8. Study of TIG welding process and plotting cooling curve in TIG welding process.

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9. Study of SAW Welding process and finding out deposition efficiency of the process.
10. Study of MIG welding process and testing of weld bead formed by MIG welding.

Metal Forming:

11. Evaluation of Formability of a given sheet material using Erichsen cupping test.
12. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity 6 Tons) and estimation of forces.
13. Study of Compound die design and manufacturing of washer components using the same on double body fly press (capacity 8 Tons) and estimation of forces.
14. Study of Combination die design and manufacturing of cylindrical cups using the same on a hydraulic power press (capacity 50 Tons) and estimation of drawing force.
15. Study of extrusion dies and demonstration of extruding lead material

Note: Minimum 12 Experiments need to be conducted by choosing any 4 from each section.

Text Books:

1. P.N.Rao, "Manufacturing Technology", Vol.1, 3/e, Tata McGraw Hill Publ., 2011.
2. Amitabh Ghosh and Mallick, "Manufacturing Science", 4/e, Assoc. East West Press Pvt. Ltd., 2011.

Suggested Reading:

1. Schey, "Introduction To Manufacturing Processes", 2/e, Mcgraw - hill Education
2. Roy A.Lindberg, "Materials and Process of Manufacturing", 5/e, Prentice Hall of India, 1992.
3. Mikell P.Grover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", 3/e, Willey A.

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SEMESTER – IV

S.No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	[illegible]	[illegible]	3	--	--	3	30	70	[illegible]
2	[illegible]	[illegible]	[illegible]	1	--	3	[illegible]	70	[illegible]
3	[illegible]	Thermodynamics	3	1	--	3	30	70	[illegible]
4	[illegible]	Principles of Management	3	--	--	3	30	70	[illegible]
5	[illegible]	[illegible]	3	1	--	[illegible]	[illegible]	70	[illegible]
6	[illegible]	[illegible]	2	--	--	2	--	[illegible]	Non-Credit
PRACTICALS									
7	[illegible]	[illegible]	--	--	2	[illegible]	15	[illegible]	[illegible]
8	[illegible]	[illegible]	--	--	2	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]		--	2	[illegible]	[illegible]	[illegible]	[illegible]
		TOTAL	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE – Semester End Examination
* Pass / Fail

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18CS C05

BASICS OF DATA STRUCTURES

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	20 Marks
Credits	2

Objectives: To introduce

1. Basic linear and non-linear data structures.
2. Analyzing the performance of operations on data structures.
3. Different sorting and searching techniques and their complexities.

Outcomes: The Student will be able to

1. Understand the basic concepts of data structures.
2. Understand the notations used to analyze the performance of algorithms.
3. Choose and apply an appropriate data structure for a specified application.
4. Understand the concepts of recursion and its applications in problem solving.
5. Demonstrate a thorough understanding of searching and sorting algorithms.

UNIT - I

Introduction: Data Types, Data structures, Types of Data Structures, Operations, ADTs, Algorithms, Comparison of Algorithms, Complexity, Time- space tradeoff. **Recursion:** Introduction, format of recursive functions, recursion Vs. Iteration, examples.

UNIT - II

Linked Lists: Introduction, Linked lists and types, Representation of linked list, operations on linked list, Comparison of Linked Lists with Arrays and Dynamic Arrays.

UNIT - III

Stacks and Queues: Introduction to stacks, applications of stacks, implementation and comparison of stack implementations. Introduction to queues, applications of queues and implementations, Priority Queues and applications.

UNIT - IV

Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree, Conversion of General Trees to Binary Trees, Representations of Trees, Tree Traversals, Binary search Tree.

UNIT - V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees.
Searching and Sorting: Linear searching, binary Searching, sorting algorithms- bubble sort, selection sort, quick sort, heap sort.

Text Books:

1. Narasimhakarumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, 2017
2. S. Sahni and Susan Anderson-Freed, Fundamentals of Data structures in C, E.Horowitz, Universities Press, 2nd Edition.
3. ReemaThareja, Data Structures using C, Oxford University Press.

Suggested Reading:

1. D.S.Kushwaha and A.K.Misra, Data structures A Programming Approach with C, PHI.
2. Seymour Lipschutz, Data Structures with C, Schaums Outlines, Kindle Edition

Online Resources:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-1#DS

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18ME C07

KINEMATICS OF MACHINES

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives: Students will acquire knowledge in

1. Fundamental definitions of kinematics of mechanism.
2. Drawing velocity and acceleration diagrams for various mechanisms
3. Working principles of brakes and dynamometers
4. Drawing displacement diagrams for various types of followers with various types of motions.
5. Estimation of transmission of power by belts and application of various gears and gear trains.

Outcomes: At the end of the course, student will be able to understand

1. Basic elements of mechanisms and their motion characteristics.
2. Designing a suitable mechanism depending on application.
3. Principles involved in functioning of brakes and dynamometer
4. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Selecting gear and gear train depending on application.

UNIT-I

Introduction: Definition of link, element, pair, kinematic chain, mechanism and machine, Grubler's criterion, single and double slider chains, inversions of quadratic chain, inversions of single and double slider crank chains. Mechanism with lower pairs and straight line motion mechanism, Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT-II

Analysis of mechanisms: Graphical methods to find velocities of mechanisms, instantaneous centre, body centre and space centre, Kennedy's theorem, graphical determination of acceleration of different mechanisms including Coriolis component of acceleration, analytical method to find the velocity and

acceleration, analysis of four bar mechanism with turning pairs, Freudenstein's method for synthesis of four bar linkage.

UNIT-III

Laws of Friction: Friction in screw threads, pivots, collars, Clutches - Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link.

Brakes and Dynamometers: Block or shoe, band and block, internal expanding shoe brake, Prony, rope brake, belt transmission, torsion dynamometers.

UNIT-IV

Cams: Types of cams and followers, displacement diagrams for followers, uniform motion, parabolic motion, simple harmonic motion, cycloidal motion, drawing cam profile with knife edge follower, translating roller follower and translating flat follower. Cams of specified contours, tangent cam with roller follower, circular arc (convex) cam with roller follower.

UNIT-V

Gears: Classification of gears, spur gears, nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profile. **Helical Gears:** Helical gear tooth relations, contact of helical gear teeth,

Gear trains: Gear trains-simple and compound, reverted and epicyclic gear trains. Differential of an Automobile.

Text Books:

1. Thomas Bevan, "Theory of Machines", CBS Publishers, 2009.
2. S.S. Rattan, "Theory of Machines", 4/e, Tata McGraw Hill Publishers, 2013.
3. J.E.Shigley, "Theory of Machines", 3/e, Tata Mc.Graw Hill Publishers, New Delhi, 2005.

Suggested Reading:

1. C.S. Sharma and Kamlesh Purohit, "Theory of Mechanisms and Machines", PHI Learning Pvt. Limited, 2006.
2. Amitabh Ghosh and A.K.Mallik, "Theory of Machines", 3/e, East West Publications, 2009.

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18ME C08

THERMO DYNAMICS

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives: Students will understand

1. Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
2. The importance and application of first law of thermodynamics.
3. The principles associated with second law of thermodynamics.
4. Properties of pure substances and use of Mollier diagram.
5. Various air standard cycles, vapour power cycles and their importance.

Outcomes: At the end of the course a student will be able to

1. Estimate the temperature of different scales of thermometers.
2. Apply the first law of thermodynamics to various thermodynamic processes.
3. Understand the meaning of perpetual motion of machine of second kind and its significance.
4. Read data from steam tables, Mollier diagram and its applications.
5. Distinguish working principles of various air standard cycles, vapour power cycles and determine air–fuel ratios required for combustion of fuels

UNIT-I

Introduction: Thermodynamics, Macroscopic and Microscopic approaches, thermodynamic systems, properties, processes and cycles, thermodynamic equilibrium, quasi – static process, measurement of pressure, Zeroth law of thermodynamics and its significance, measurement of temperature, reference points, ideal gas equation.

UNIT-II

First Law of Thermodynamics: Concept of heat and work, first law of thermodynamics for closed system, energy- a property of the system, application of first law to various thermodynamic processes like isobaric, isochoric, isothermal, adiabatic and polytropic, definition of enthalpy, PMM1, first law

applied to flow processes, application of SFEE to nozzle and diffuser, throttling device, turbine and compressor.

UNIT-III

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin–Planck and Clausius statements of second law of thermodynamics, PMM2, equivalence of Kelvin-Planck and Clausius statement, reversible and irreversible processes, Carnot theorem, Clausius inequality, calculation of entropy change during various thermodynamic processes, principle of entropy increase, T-S diagrams, application of entropy principle for mixing of two fluids, Helmholtz and Gibb's functions.

UNIT-IV

Thermodynamic Properties of Fluids: Properties of pure substances, p – v diagram, p–T diagram, p–v–T surface, T–s diagram, h–s diagram, dryness fraction, use of steam tables, Maxwell relations.

UNIT-V

Air Standard Cycles: Air standard cycles - Otto, Diesel, Dual Combustion Cycles, working principle, derivation of expression for air standard efficiency, comparison of otto, diesel and dual cycles-for the same compression ratio, for the same maximum pressure and temperature.

Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle.

Fuels and Combustion: Characteristics of an ideal fuel, classification of fuels, Stoichiometric air-fuel ratio, equivalence ratio, relation between volumetric and gravimetric analysis.

Text Books:

1. P.K. Nag, "Engineering Thermodynamics", 5/e, Tata McGraw Hill Publishers, 2013.
2. D.S. Kumar, "Thermal science and Engineering", 4/e, S. K.Kataria and Sons, 2013.
3. Y.A. Cengel and M.A. Boles, "Thermodynamics: An Engineering Approach", 7/e, Tata McGraw Hill Publishers, 2014.

Suggested Reading:

1. R.K. Rajput, "Thermal Engineering", 8/e, Laxmi Publications (P) Ltd. 2011.
2. Mahesh M. Rathore, "Thermal Engineering", Tata McGraw Hill Publishers, 2013.

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18ME C09

PRINCIPLES OF MANAGEMENT

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to

1. Understand basic fundamentals and insights of management
2. Understand the nature and purpose of planning
3. Gain the knowledge about the frame work of organizing
4. Understand the essence and significance of directing
5. Recognize the importance of controlling and its outcomes

Outcomes: At the end of the course, student will be able to understand

1. Identify and evaluate the principles of management
2. Demonstrate the ability to have an effective and realistic planning
3. Identify the nature and the type of organization
4. Apply the tools and techniques of directing
5. Explain and evaluate the necessity for controlling and further refinement of an organization.

UNIT-I

Management: Definition of management, science or art, manager vs entrepreneur; managerial roles and skills;. Evolution of management, Basic management theories by FW Taylor, Henry Fayol, Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management

UNIT-II

Planning: Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Planning plant location and layout, Decision making steps & processes.

UNIT-III

Organizing: Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human

resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management

UNIT-IV

Directing: Individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT-V

Controlling: system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:

1. S.P. Robins and M. Coulter, "Management", 10/e., Prentice Hall India, 2009.
2. JAF Stoner, RE Freeman and DR Gilbert, "Management", 6/e., Pearson Education, 2004.

Suggested Reading:

1. P.C. Tripathy & P.N. Reddy, "Principles of Management", Tata McGraw Hill, 1999.
2. Harold Koontz and Cyril O'Donnell "Principles of Management", Tata McGraw Hill, 2017.

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18ME C10

FLUID PRINCIPLES AND HYDRAULIC MACHINES

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives: Students will

1. Learn properties of fluids, laws related to fluid flow and their applications.
2. Understand the principles and problems associated with impact force of jet on the vanes
3. Understand various principles and performance characteristics related to Reciprocating pumps.
4. Come to know the working principles and performance characteristics of Centrifugal pumps.
5. Learn the working principle and efficiencies of hydraulic turbines.

Outcomes: At the end of the course, a student will be able to

1. Determine the various properties of fluid and their applications
2. Understand the methodology in calculation of impact force exerted by the jet on the vanes
3. Acquire the knowledge of the functionality and performance of Reciprocating pumps.
4. Understand the working, estimate the performance and testing of Centrifugal pumps.
5. Acquire knowledge in the functionality, performance and testing of hydraulic turbines.

UNIT-I

Properties and Laws of Fluid Flow: Fluids- Fluid properties- Pressure, Density, Specific weight, Specific volume, Dynamic and Kinematic viscosity -Laws of fluid flow-Continuity theorem-Bernoulli's theorem- Venturimeter-Notches-Pitot tube - Darcy's equation - Impulse-momentum equation and applications

UNIT-II

Hydraulic Machines: Classification- Lay-out of hydraulic power plant- working principle- Impact force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) at the centre of a fixed symmetrical curved vane (iii) at

one end of fixed symmetrical and unsymmetrical curved vanes (iv) flat vertical vane moving in the direction of jet (v) a series of flat vertical moving vanes (vi) at the centre of symmetrical moving curved vanes (vii) symmetrical curved vanes moving in the same direction as that of jet at inlet (viii) at one end of a series of un-symmetrical moving curved vanes. (Numerical problems for above cases only)

UNIT-III

Reciprocating Pumps: Classification- working principle- single and double acting pumps- discharge, work done and power required to drive the pumps- slip, % slip and negative slip- Variation of pressure head in the suction and delivery pipes due to acceleration of piston- Variation of pressure head due to friction in the suction and delivery pipes- Indicator diagrams- Ideal and actual diagrams- Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes- Air vessels-Function of air vessels- Work saved by fitting air vessels to single and double acting pumps- Discharge of liquid into and out of air vessels-Performance characteristic curves.

UNIT-IV

Centrifugal Pumps: Classification- Working principle- Comparison over reciprocating pumps-Velocity triangles- Manometric head- work done per second- Head equivalent of work done- Manometric, mechanical and overall efficiencies- Pressure rise in the impeller- Minimum starting speed- Specific speed- Physical significance of specific speed- Model testing- Conditions of similarity of CF pumps- Priming- Performance characteristic curves.

UNIT-V

Hydraulic Turbines: Classification- Impulse and reaction turbines-Construction and working of Pelton wheel, Francis turbine and Kaplan turbine- Velocity triangles- Work done (power developed)- Hydraulic, Mechanical and Overall efficiencies- Maximum efficiency- Specific speed- Physical significance of specific speed-Unit testing -Unit quantities- Model testing of turbines- Conditions for similarity of turbines- Performance characteristic curves.

Text Books:

1. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publication (P) Ltd., New Delhi, 2004.
2. R.S. Khurmi and N. Khurmi, "Hydraulics, Fluid Mechanics and Hydraulic Machines", 20/e, S. Chand publishing, 2014.

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Suggested Reading:

1. P.N. Modi, and. S.M.Seth, "Hydraulics and Fluid Machines", Standard Book House, New Delhi, 2004.
2. S.Ramamrutham, "Hydraulics, Fluid Mechanics and Fluid Machines", Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., "Fluid Mechanics and Turbomachines", PHI Learning Private Limited, New Delhi, 2009.

18CE M01

ENVIRONMENTAL SCIENCE

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	—
Credits	0

Objectives: To enable the student

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Become aware about the importance of eco system and biodiversity for maintaining ecological balance
3. To identify the importance of interlinking of food chain
4. Learn about various attributes of pollution management and waste management practices.
5. To make the students contribute for capacity building of nation for arresting and/or managing environmental

Outcomes: At the end of the course, the student should have learnt

1. To define environment, identify the natural resources and ecosystems and contribute for the conservation of bio-diversity.
2. To suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
3. To relate the social issues and the environment and contribute for the sustainable development.
4. To follow the environmental ethics.
5. To contribute for the mitigation and management of environmental disasters.

UNIT-I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural Resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem,

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food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems

UNIT - III

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V

Social Issues and the Environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues

Text Books:

1. Y. Anjaneyulu,"Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006.

18CS C08

BASICS OF DATA STRUCTURES LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives:

1. Design and construct simple programs by using the concepts of data structures as abstract data type.
2. To have a broad idea about how efficiently pointers can be used in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To strengthen the practical ability to apply suitable data structure for real time applications.

Outcomes: The Student will be able to

1. Implement the abstract data type.
2. Implement linear data structures such as stacks, queues using array and linked list.
3. Understand and implement non-linear data structures such as trees, graphs.
4. Implement various kinds of searching, sorting and traversal techniques.
5. Identify the suitable data structure for real world problem.

List of Experiments for Non-CSE/IT:

1. Implementation of operations on arrays
2. Implementation of Stack.
3. Implementation of Queue.
4. Implementation of basic operations on Single Linked List.
5. Implementation of Searching techniques.
6. Implementation of Sorting Techniques
7. Case study like Banking System, Students Marks Management, Canteen Management etc

Text Books

1. Brian W Kernighan, Dennis Ritchie, "C Programming Language", 2/e, PHPTR.
2. Richard M Reese, "Understanding and Using C Pointers O'Reily", 2013.

Web Links

https://nptel.ac.in/courses/106102064/

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18EG C03

SOFT SKILLS LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: The course will introduce the students to

1. Imbibe an impressive personality, etiquette, professional ethics & values, effective time management & goal setting.
2. Understand the elements of professional update & upgrade through industry exposure in a mini-live project. Understand confidence building strategies and thereby to make effective presentations through PPTs.
3. Learn what constitutes proper grooming and etiquette in a professional environment. Acquire the necessary skills to make a smooth the practical ability to apply suitable data structure for real time applications.

Outcomes: After successful completion of the course the students will be able to

1. Be assertive and set short term and long term goals. Also learn to manage time effectively and deal with stress.
2. Win in professional communication situations and participate in group discussions with confidence. Write abstracts.
3. Write effective resumes. Plan, prepare and face interviews confidently.
4. Adapt to corporate culture by being sensitive - personally and sensible - professionally. Draft an SOP.
5. Apply the soft skills learnt in the mini-live project, by collecting and analyzing data and making oral and written presentations on the same.

Exercise 1:
Main Topics: Thinking Skills, Personality Development – Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.
Flipped Sessions: Personal Sensitivity & Professional Sensibility (Reading & Discussion)

Writing Input: Writing to Express - Drafting & Delivering a Speech (Free Writing Exercise)
Exercise 2:
Main Topics: Advanced Group Discussion with Case studies : Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
Flipped Sessions: Importance of Professional Updating & Upgrading (Reading & Discussions)
Writing Input: Writing with Precision - Writing Abstracts

Exercise 3:
Main Topics: Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews. Resume' writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skills.
Flipped Sessions: Mock Interviews (Video Sessions & Practice)
Writing Input: Writing to Reflect - Resume Writing

Exercise 4:
Main Topic: Corporate Culture – Grooming and etiquette, communication media, academic ethics and integrity
Flipped Sessions: Corporate Culture, Etiquette & Grooming (Video Sessions & Practice through Role-play)
Writing Input: Writing to Define - Writing an effective SOP.

Exercise 5:
Main Topic: Mini Project – General/Technical. Research, developing a questionnaire, data collection, analysis, written report and project seminar. Elements & Structure of effective presentation. Presentation tools – Body language, Eye-contact, Props & PPT.
Flipped Sessions: Effective Presentations (Video & Writing Sessions, Practice through Emulation)
Writing Input: Writing to Record - Writing minutes of meeting.

Suggested Reading:

1. Madhavi Apte , "A Course in English communication", Prentice-Hall of India, 2007
2. Dr. Shalini Verma, "Body Language- Your Success Mantra", S Chand, 2006

3. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004

* Flipped Class-room: Students explore the concept first and then trainer explains it, students work on their own.

Web Resources:

1. https://www.goskills.com/Soft-Skills
2. https://www.trainerbubble.com
3. https://www.skillsconverged.com

18ME C11

FLUID PRINCIPLES AND HYDRAULIC MACHINES LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: Students will

1. Determine discharge of fluid flow.
2. Verify fluid laws like Bernoulli's equation and determine losses through pipes.
3. Determine impact force of jet on the vanes
4. Demonstrate knowledge in evaluating performance characteristics of pumps.
5. Evaluate the performance characteristics of turbines.

Outcomes: On completion of the course, the students will be able to

1. Carry out discharge measurements
2. Determine the energy loss in conduits.
3. Calculate forces and work done by a jet on fixed or moving, flat and curved blades.
4. Evaluate the performance characteristics of pumps.
5. Demonstrate the characteristics curves of turbines.

List of the Experiments:

1. Verification of Bernoulli's equation.
2. Determination of Darcy's friction factor and nature of water flow through pipes.
3. Determination of Cd for V- notch.
4. Determination of Cd for rectangular notch.
5. Determination of Cd for Venturimeter.
6. Determination of Cd for Orifice meter.
7. Determination of impact force of jet on fixed flat and fixed curved vanes.
8. Performance and characteristic curves of Reciprocating pump.
9. Performance and characteristic curves of Centrifugal pump.
10. Performance and characteristic curves of Self-priming pump.
11. Performance and characteristic curves of Gear pump.

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12. Performance and characteristic curves of Pelton wheel.
13. Performance and characteristic curves of Francis Turbine under constant speed and variable speed conditions.
14. Performance and characteristic curves of Kaplan turbine under constant speed and variable speed conditions.

Note: A minimum of 12 Experiments need to be conducted.

Text Books:

1. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publication (P) Ltd., New Delhi, 2004.
2. R.S. Khurmi and N. Khurmi, "Hydraulics, Fluid Mechanics and Hydraulic Machines", 20/e, S. Chand publishing, 2014

Suggested Reading:

1. P.N. Modi, and. S.M.Seth, "Hydraulics and Fluid Machines", Standard Book House, New Delhi, 2004.
2. S.Ramamrutham, "Hydraulics. Fluid Mechanics and Fluid Machines", Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., "Fluid Mechanics and Turbomachines", PHI Learning Private Limited. New Delhi, 2009.

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16ME C20

DYNAMICS OF MACHINES

Instruction	3 Hours + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. To find static and dynamic forces on planar mechanisms.
2. To know the causes and effects of unbalanced forces in machine members.
3. To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

Course Outcomes:

1. Graduates are expected to demonstrate the ability of the analysis of forces in mechanism which provide them the required inputs to design the systems which withstand operating conditions..
2. Graduates are expected to understand the turning moment diagram, cyclic fluctuation in speed, fluctuation in energy and get the ability of designing flywheel.
3. Graduates are expected to understand gyroscopic and centrifugal actions of vehicles and will be able to reckon additional bearings reactions due to gyroscopic and centrifugal effects.
4. Graduates will have ability to control speed using governors.
5. Graduates will have ability to identify the unbalance in rotor and engines and will get the knowledge of balancing.
6. Graduates will understand the concepts of vibration thereby they are able to design the systems free from ill effects of vibration.

UNIT-I: Static and Dynamic Force Analysis:
Force analysis of Four bar and slider crank mechanisms: Study of dynamically equivalent system, Inertia forces on connecting rod.
Flywheels: Functions, Turning moment diagrams, flywheels analysis for I.C. Engines and Presses.

UNIT-II: Gyroscope: Gyroscopic couple, gyroscopic effects on vehicles.
Governors: Classification of governors, Watt, Porter, Hartnell and Hartung governors, Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

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UNIT-III: Balancing of Rotating masses:
Forces on bearings due to rotating shaft carrying several masses in several planes. Determination of balance masses from the forces on the bearings.
Balancing of Reciprocating masses: Shaking forces in single cylinder engine, Partial balancing of reciprocating engine. Balancing of two cylinder locomotive engine. Balancing of multi cylinder in-line engines. Balancing of radial engines by direct and reverse cranks method.

UNIT-IV: Vibrations:
Vibrations of Single degree freedom system, (axial, transverse and torsional). Equivalent system of combination of springs, stepped shaft, whirling speed of shafts.

Damped vibrations:
Types of damping, Vibrations with viscous damping.

Forced vibrations:
Vibrations with harmonically applied force with viscous damping. Dynamic magnifier, Resonance, Vibration isolation and Transmissibility.

UNIT-V: Two degree freedom systems: Natural frequencies and modes of vibration
Approximate Methods: Dunkerley and Rayleigh's methods.
Multi rotor system: Holzers method.

Text Books:

1. S.S. Rattan, *Theory of Machines*, Tata-Mc Graw Hill, 1995.
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines & Mechanisms*, Oxford University Press, 2003.
3. Theory of Vibration with Application, J.J. Thompson, Dec-2002.

Suggested Reading:

1. A. Ghosh and Mallick, *Theory of mechanisms and machines*, Affiliated to E-W Press, 1988.
2. Ashok G Ambedkar, Mechanism and Machine Theory, PHI, 2013.
3. Robert L. Norton, *Design of Machinery*, Tata Mc Graw Hill, 2005.
4. J.S. Rao and Gupta, 'Theory and Practice of Mechanical Vibrations, PHI, 1984.
5. Benson H. Tangue, Principles of Vibration, 2nd Edn., Oxford University Press, 2007.

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16ME C21

APPLIED THERMODYNAMICS AND HEAT TRANSFER

Instruction	3 Hours + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. To demonstrate basic knowledge by understanding the basic working principles of reciprocating air compressor and its applications in engineering.
2. Students will come to know the working principle and various performance parameters of diesel and petrol engines.
3. Student will understand the configurational features of IC engine like ignition system, injection system, lubricating system and cooling systems.
4. To demonstrate basic knowledge by understanding different modes of heat transfer.
5. Students will understand the basic principles of radiation.
6. Student will understand the working principles of parallel and counter-flow heat exchangers.

Course Outcomes: Students will be able to

1. Estimate power required for reciprocating air compressor, used for many engineering applications.
2. Evaluate the performance of diesel and petrol engines and various heat losses from engines.
3. Understand the importance of combustion phenomenon and various functional systems of IC engines.
4. Apply appropriate equations depending on mode of heat transfer.
5. Distinguish the various modes of heat transfer.
6. Design heat exchangers with the basic knowledge acquired in heat exchangers.

UNIT-I: Reciprocating Air Compressors:
Single stage and multi stage compressors with and without clearance volume, work done, various Efficiencies of multi stage compression.

UNIT-II: Internal Combustion Engines:
Classification, Working principles of 2 stroke, 4 stroke SI and CI engines. Performance of IC Engines. Heat balance sheet.

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UNIT-III: Combustion Phenomena:
Normal and abnormal combustion phenomenon in SI and CI engines. Cooling, lubrication systems, Battery and magneto ignition systems of IC engines. Working principle of Simple Carburetor and Fuel Injector.

UNIT-IV: Modes of Heat Transfer:
General 3-D conduction equation in Cartesian and cylindrical coordinates, one dimensional steady state conduction through slabs, hollow cylinders without heat generation. Steady state heat transfer through composite slabs and cylinders, critical radius of insulation for cylinders.

UNIT-V: Convection:
Dimensional analysis and its use in free and forced convection, Buckingham "π" theorem, Physical significance of different dimensionless numbers.
Simple problems on free and forced convection.

Radiation:
Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's black body spectral distribution, Wien's and Steffan Boltzmann law. Concept of surface, space resistances and radiation shields.

Heat Exchangers:
Classification, LMTD and NTU Concepts.

Text Books

1. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2010.
2. V. Ganeshan, Internal Combustion Engines, Tata Mcgraw Hill Publishing, New Delhi,2015.
3. J.P. Holman, Heat Transfer, McGraw Hill Publication, New Delhi, 2004.

Suggested Reading

1. Rajput, R. K., Thermal Engineering, Laxmi Publishers, New Delhi, 2014
2. D.S. Kumar; Heat Transfer S k Kataria Publishers, 2015.

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16ME C22

DESIGN OF MACHINE ELEMENTS (USAGE OF DATA BOOK IS COMPULSORY)

Instruction	3 Hours + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives:

1. To understand the basics of mechanics of materials and design of machine elements for static and fatigue strength, rigidity and wear criterions, use of codes and standards.
2. To know the principles of ergonomic design.
3. To learn the principles to design shafts, keys, belt drives, joints and couplings.
4. To Develop and solve mechanical component design problems based upon given data and requirements.

Course Outcomes: Students will able to

1. Select material based on type of load and manufacturing considerations.
2. Design the components subjected to static loads.
3. Design the components subjected to fluctuating loads.
4. Become familiar with mechanical elements like shafts, keys, couplings and pulleys.
5. Become familiar with permanent types of joints and their design concepts.
6. Become familiar with detachable joints and power screws.

UNIT-I: Introduction:

Materials used in machine design and their specifications to Indian standards. Codes and standards used in design. Reliability. Principles of good Ergonomic Design. Manufacturing considerations. Preferred numbers. Value analysis.

Analysis of Stress and Strain: Definition of stress and strain, Types of loading, direct normal stress, bending stress, Torsional stress, crushing and bearing stresses, biaxial stress and triaxial stress. Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads.

UNIT-II: Design for Fatigue and Impact loads:

Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

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UNIT-III : Design of keys and Shafts:
Solid, hollow, stepped shafts and splined shafts under torsion and bending loads.
Design of couplings:
Muff and Split muff Couplings, Flange, Flexible and Marine type of couplings.
Design of belt drive systems: selection of belts and design of pulleys.

UNIT-IV: Design of riveted joints:
Types of joints, efficiency of the joints, structural joints, and joints subjected to direct and eccentric loads.
Design of welded joints - types of joints, joints subjected to direct and eccentric loading.

UNIT-V: Design of Cotter and Knuckle Joints:
Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints.
Design of power screws and screw jack.

Text Books:

1. V.B. Bhandari, Machine Design, Tata Mc Graw Hill Publication, 2010.
2. J.E. Shigley, C.R. Mischne, Mechanical Engineering Design, Tata Mc Graw Hill Publications, 2011.
3. Siraj Ahmed, Mechanical Engineering Design, PHI, 2014.

Suggested Reading

1. L. Robert Norton, Machine Design: An Integrated Approach, 2/e Pearson Education, 2013
2. P. Kannaiah, Machine Design, Science-Tech Publications, 2010
3. M.F. Spotts, Design of Machine Elements, Prentice Hall of India, 2013.

Machine Design Data Books:

1. Design Data Hand book for Mechanical Engineers, K. Mahadevan, K. Balaveera Reddy, CBS Publisher 3rd Edition, 2016.
2. Design Data book by PSG College – 2012.
3. Machine Design Data Book, by V.B. Bhandari McGraw hill education, 2015.

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16ME E01

REFRIGERATION AND AIR CONDITIONING (Professional Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives: Students will

1. Acquire the basic knowledge about the importance of refrigeration, its applications in aircraft refrigeration.
2. Demonstrate basic knowledge of vapor compression refrigeration system, cascade and compound refrigeration.
3. Understand various types of absorption refrigeration systems like ammonia, Electrolux and lithium bromide refrigeration systems.
4. Acquire the basic knowledge on various psychrometric processes.
5. Understand the importance of comfort air conditioning.
6. Acquire knowledge in estimating air conditioning loads.

Course Outcomes: Students will be able to

1. Differentiate refrigeration from air conditioning.
2. Understand merits and demerits of vapor compression refrigeration system over air refrigeration system.
3. Know the importance of absorption refrigeration system over vapor refrigeration system.
4. Apply a suitable psychrometric process depending on requirement or application.
5. Know the condition necessary for comfort condition.
6. Estimate the load required for AC system depending on application.

UNIT-I: Introduction to Refrigeration:
Application of Refrigeration, Definition of COP, Tonne of Refrigeration, Designation, Carnot cycle, Eco-friendly Refrigerants, Properties of Refrigerants.

Air Refrigeration Systems:
Analysis of Bell-Coleman Cycle, Application to aircraft refrigeration, Simple cooling system, Bootstrap simple evaporating system, Regenerative cooling system and Reduced ambient cooling system.

UNIT-II: Vapour Compression System:
Working principle and analysis of Simple vapor compression Refrigeration cycle. Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system. Low temperature

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refrigeration system (with single load system), Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages.

UNIT-III: Vapour Absorption Refrigeration System:
Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system
Steam Jet Refrigeration: Principle of working, Analysis of the system, Advantages, limitations and applications.

UNIT-IV: Psychrometry:
Psychrometric properties, Psychrometric chart, construction, Representation of various Psychrometric processes on the chart.
Introduction to Air Conditioning:
Requirements of comfort air conditioning, Thermodynamics of human body, ASHRE comfort chart, Effective temperature.

UNIT-V: Cooling Load Calculations in Air Conditioning:
Concept of bypass factor, Sensible heat factor, Apparatus Dew Point, Various Heat Loads.
Design of air conditioning systems: Simple Problems on Summer, Winter and Year Round Air conditioning systems Energy conservation in air conditioned building.
Air Conditioning Systems:
Components of air conditioner equipments, Humidifier, Dehumidifier, Filter.

Text Books

1. C.P. Arora, Refrigeration and Air conditioning, Tata McGraw Hill, New Delhi, 2004.
2. W.S. Stocker, Refrigeration and Air conditioning, McGraw Hill, New Delhi, 2004.
3. R.K. Rajput, Refrigeration and Air Conditioning Laxmi Publications, New Delhi, 2007.

Suggested Reading

1. V.K. Jain, Refrigeration and Air Conditioning, S Chand & Company, New Delhi, 2004.
2. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, Allahabad, 2007.
3. Edward G Pita, Air conditioning Principles and Sytems: An Energy Approach, 4^{th} edn, PHI, 2012.

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16ME E02

MECHANICAL VIBRATIONS (Professional Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. To gain the knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2. To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.
3. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.

Course Outcomes: Students aquire the

1. Ability to construct a Free Body Diagram, formulates the equations of motion, analytically solves the equations of motion for arbitrary linear single-degree-of-freedom systems in undamped, damped cases.
2. Ability to analyze the basic principles of vibration isolation and absorption and ability to apply them to the design of mechanical systems such as automotive suspensions.
3. Ability to formulate the equations of motion analytically solves the equations of motion for arbitrary linear two -degree-of-freedom systems in undamped, damped, free and forced cases.
4. Ability to analyze normal mode vibration, coordinate coupling and orthogonal property of modeshape.
5. Ability to differentiate discrete and continuous systems, formulate equation of motion and solve for string, bar and beams in continuous systems.
6. Ability to understand vibration measuring instruments, display and recording to elements, frequency analysis.

UNIT-I: Free Vibration Analysis-Single Degree of Freedom Systems Undamped and Damped Translation and Torsional Systems:

Different methods for equation of motion- Energy method, Rayleigh method, principal of virtual work, principal of conservation energy, Rayleigh's method. Viscously damped free vibration, logarithmic decrement, coulomb damping.

UNIT-II: Harmonically Excited Vibration:

Forced harmonic vibration, Rotating unbalance, whirling of rotating shafts, support motion, vibration isolation, energy dissipated by damping. Equivalent viscous damping, structural damping.

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UNIT-III: Damped and Undamped Vibrations of two Degree of Freedom System:

Free and forced vibration analysis of two degree of freedom system-different methods for the formulation of equation equations of motion, natural frequencies,
Normal mode vibration, Coordinate coupling and principal coordinates, semi definite systems, influence coefficients-flexibility, stiffness. Eigen values and Eigen vectors, orthogonal properties of Eigen vectors, repeated roots, modal matrix.

UNIT-IV: Vibrations of Continuous Systems:

Vibrations of strings, bars and beams, formulation of equation of motion, characteristic equation, identification of node and mode shape.

UNIT-V: Vibration Measurements and Applications:

Vibration pickup, Vibrometer, accelerometer. Transducers, piezoelectric transducers, Electrodynamic transducers. Vibration exciters, mechanical and electro dynamic shakers. Frequency measuring instruments.

Text Books:

1. Theory of Vibration with Application, J.J. Thomson, Dec-2002
2. S.S. Rao ,Mechanical vibration, 4th edn, Pearson, 2009
3. G.S. Grover & Nigam ,Mechanical Vibrations,Nem Chand & Bros, 6th edn,1998.

Suggested Reading:

1. V.P. Singh , Mechanical vibration, Dhanpath Rai &Co.,3rd edn,2006.
2. Graham Kelley,S., Mechanical vibration – Schaums Outline Series, TMH, 2011.
3. F.S. Tse, Morse & Hinkle, Mechanical Vibration, Allyn and Bacon, 1978.

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16PE E02

PRODUCT DESIGN AND PROCESSES PLANNING
(Professional Elective-I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. The Product Design and Process Functions.
2. The essence of innovation in product development.
3. The Human Machine Interactions (ergonomics).
4. The various Intellectual Property Rights.
5. The interaction between Design, Manufacturing, Quality and Marketing.
6. The awareness about overall view of Process Planning.

Course Outcomes:

1. Have overall view of Product Design and Process Planning.
2. Apply creativity techniques in Product Development.
3. Applying ergonomically enabled concepts in developing a new product.
4. Have awareness and apply Intellectual Property Rights.
5. Integrate various stages of developing a new product.
6. Develop and execute an effective Process Plan.

UNIT-I: Product Design and Process Design:
Functions, Essential factors of product design, Selection of right product, Systematic procedure of product innovation, function of design, value of appearance, colors and laws of appearance.

UNIT-II: Product Selection and Evaluation:
Need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques, collection of ideas. Selection criteria - screening ideas for new products using evaluation techniques. Principles of ergonomics, Anthropometry, Design with Human Machine Interaction (HMI).

UNIT-III: New Product Planning and Development:
Interaction between the functions of design, manufacture, and marketing, design and material selection, Steps for introducing new products after evaluation, Product life cycle, Research and new product development.

UNIT-IV: Intellectual Property Rights (IPR):
Patents, definitions, Types of Patent, Patent search, Patent laws, International code for patents, Trademark, Trade Secret, Copy Rights and Industrial Design.

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UNIT-V: Process Selection and Planning:

Process selection, process planning, process sheets, Selection of manufacturing process, estimation of machining time in various cutting operations, Estimation of costs for manufacture, value engineering in product design, Group technology, concepts of concurrent engineering.

Text Books:

1. Niebel BW & Draper AB, Production Design & Process Engg, McGraw Hill, Kogakusha, 1974.
2. K. G. Swift & J. D. Booker, Process Selection: From Design to Manufacture, Butterworth-Heinemann Ltd; 2nd Revised edition, 2003.
3. Bhaskaran Gopalakrishnan, Product Design and Process Planning in CE (Design & Manufacturing, Chapman and Hall publishers, 1994.

Suggested Reading:

1. Harry Nystrom, Creativity and Innovation, John Wiley & Sons, 1979.
2. Brain Twiss, Managing Technological Innovation, Pittman Publications, 1992.
3. Harry, B.Waton, New Product Planning, Prentice Hall Inc., 1992
4. Chitale, A. K. & Gupta RC., Product Design & Manufacturing, PHI, 1997.

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16PE E01

PRINCIPLES OF INDUSTRIAL ENGINEERING (Professional Elective-1)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: Student will learn the

1. Basic principles of industrial engineering along with work study techniques.
2. Concepts of plant location and layouts.
3. Significance of production planning & control.
4. Necessity of inventory control techniques.
5. Essence of quality engineering.
6. Productivity improvement tools and techniques.

Course Outcomes: At the end of the course, the students are able to

1. Conceptualize the essence of industrial engineering techniques.
2. Select and design plant location and layouts.
3. Plan, execute and control production related issues.
4. Analyze and choose right inventory control techniques.
5. Plot control charts and apply quality control tools.
6. Apply productivity improvement techniques.

UNIT – I: Concepts of Industrial Engineering:
Productivity-concepts, Principles and Techniques, Production Vs Productivity, Productivity Improvement Methods. Work Study: Method Study and Work Measurement steps involved in method study and work measurement, Recording Techniques-Flow Process Charts, multiple activity chart, two handed process chart, SIMO Chart. Various techniques of work measurement-Time Study, Work Sampling, PMTS etc, Standard time computation.

UNIT – II: Plant Location and Layout:
Factors for Plant Locations, Types of production - Mass, batch, job. Types of plant layout - product, process and fixed position layouts, cellular layouts.

UNIT – III: Production Planning and Control:
Elements of PPC-Planning, Routing, Scheduling, Dispatching. Production planning by line of Controls, Materials Requirement Planning (MRP), Manufacturing Resource Planning (MRP II).

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UNIT – IV: Inventory Control:
ABC analysis, FSN analysis, VED Analysis, P System, Q System. Economic order quantity, Lead time, Buffer Stock, ASRS, Stores management.

UNIT – V: Quality Engineering:
Control Charts-X, R, P, C charts. OC Curve, Acceptance Sampling, Kaizen, JIT, ISO-9000, Quality Concepts by Deming, Juran, Philip Crosby, Taguchi ' loss function.

Text Books:

1. SK Hajra Choudhury, Nirjhar Roy, AK Hajra Choudhury 'Industrial Engineering & Management' Media Promoters & Pub. Pvt. Ltd.,
2. Banga and Sharma 'Industrial Engineering and Management' Khanna Publishers, 2008.
3. O.P. Khanna, Industrial Engineering and Management, Dhanpat Rai Pub.,
4. M.S. Mahajan Industrial Organization & Management, Nirali Prakashan Pub.

Suggested Readings:

1. K.K.Ahuja, Industrial Management, Khanna Publishers, 5th Ed. 1993.
2. Production Systems - Planning Analysis And Control Riggs., Wiley Publishers, 1992.
3. Elwood S Buff Rakesh K Sarin Modern Production Operations Management, John Wiley & Sons (Asia) Pte Ltd. 1983.

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16ME E03

FUELS, COMBUSTION AND ENVIRONMENT (Professional Elective-II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: Student will understand

1. Different types of solid fuels with their properties.
2. Natural and Manufactured gaseous fuels with different tests on the gaseous fuels.
3. The principles of refining liquid fuels, properties & their tests.
4. The thermodynamics of combustion and stoichiometric relations.
5. Features of different types of burners.
6. The importance of control of air pollutants and its effect on human being and environment.

Course Outcomes: A student will be able to

1. Know different types of solid fuels along with the properties.
2. Understand different manufacturing methods of gaseous fuels.
3. Understand the refining methods of various liquid fuels.
4. Estimates the theoretical air fuel ratio for various fuels.
5. Select the different types of burners according to the application.
6. Know various techniques to control pollutants and emission standards.

UNIT-I: Solid and Gaseous Fuels:
Solid fuels—origin of coal, analysis of coal, tests on coal, coal petrology, classification of coal other solid fuels. Gaseous fuels—natural gas, methane from coal mines, coal gas, blast furnace gas, liquified petroleum gas(LPG), properties and testing of fuel gases. Alcohols and biogas.

UNIT-II: Liquid Fuels:
Origin of petroleum, chemistry of petroleum, refining of petroleum, other conversion process, properties and tests for petroleum products, various petroleum products

UNIT-III: Combustion of Fuels:
Combustion Stoichiometry— flue gas analysis, dew point of flue gases, Thermodynamics of Combustion—enthalpy of combustion, enthalpy of formation, Adiabatic flame temperature.

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UNIT-IV: Combustion Appliances:

Classification, Coal burning equipment over feed stokers, chain - grate stokers, under feed stokers, pulverized coal burners, cyclone furnaces. Oil burners—vaporized burners, rotary-cup oil burners, mechanical atomizing burners, high pressure and low pressure atomizing burners Gas burners—non-aerated burners, aerated burners, surface combustion burners.

UNIT-V: Environmental Considerations:

Air Pollution-types, combustion generated air pollution and its control, Effects on Environment, Human Health. Emission Standards.

Text Books:

1. Samir Sarkar, Fuels & Combustion Orient Longman, 1996
2. Sharma and Chander Mohan, Fuels and Combustion by Tata McGraw Hill, 1984.
3. Combustion Fundamentals by Roger A Strehlow, Tata McGraw Hill, 1984.

Suggested Reading:

1. Shaha AK, Combustion Engineering and Fuel Technology by Oxford and IBH, 1974.
2. R. Turns, An introduction to combustion-Stephen McGraw Hill International Edition, 2012.
3. S.P. Sharma and Chander Mohan, Fuels and Combustion, Tata McGrawhill, 2004.

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16PE 03

NON-DESTRUCTIVE TESTING AND EVALUATION
(Professional Elective - II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives: Student has to understand the

1. Need, basic concepts and technologies of Non Destructive Testing (NDT).
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications.
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography.
5. Merits and demerits of the different NDT Technologies.
6. Latest research and developments in NDT.

Course Outcomes: At the end of the course, the students will be able to demonstrate

1. The knowledge of different NDT techniques.
2. Clear understanding of liquid penetrant inspection and magnetic particle inspection.
3. View and interpret radiographs, utilize the various principles of radiography for different components of different shapes.
4. The knowledge of acoustic emission for NDT and the instrumentation used for NDT.
5. The ability to analyze and prepare a technical report.
6. The knowledge of latest research, developments and trends in NDT.

UNIT-I: Liquid Penetrate Inspection:
Principles of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system, solvent removable system, surface preparation and cleaning, penetrate application, development, advantages limitations, and applications.

Magnetic Particle Instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages and limitations.

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UNIT-II: Eddy Current Testing:
Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

UNIT-III: Ultrasonic Testing:
Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, Immersion testing , sensitivity and calibration. Reference standards. Surface condition, Applications.

UNIT-IV: Radiography:
Principle and uses of radiography, limitation principle, radiation sources, production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadow formation enlargement and distortion, radio graphic film and paper, Xeroradiography, fluoroscopy, exposure factors, radiographic screens, identification markers and image quality indicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

UNIT-V: Acoustic Emission:
Physical Principles, Sources of emission, instrumentation and applications, Other NDT Techniques: Neuron radiography, Laser induced ultrasonic, surface analysis, and thermography.

Text Books:

1. Barry Hull & Vernon John, Non Destructive Testing, 1988.
2. H J Frissell (Editorial Coordinator), Non-Destructive Evaluation and quality control, ASM handbook-International Publication USA, 1989.
3. Dove and Adams, Experimental Stress analysis and Motion Measurement, Prentice Hall of India, Delhi, 1964.

Suggested Reading:

1. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition, 1989.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
4. T.Rangachari, J. Prasad and B.N.S. Murthy, Treatise on non-destructive testing and evaluation, Navbharath Enterprises, Vol. 3, 1983.

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16PE E04

PLASTICS, CERAMICS AND COMPOSITE MATERIALS
(Professional Elective-II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives: To make the students to

1. Understand various types of plastics, their properties and uses.
2. Understand various methods of manufacturing plastic components.
3. Understand types of ceramics, refractoriness, their uses.
4. Familiarize with white wares ceramic coatings and glass.
5. Understand the manufacturing processes of ceramics.
6. Understand composites and their uses.

Course Outcomes: Students should able to

1. Describe about types of plastics, their properties and uses.
2. Suggest the suitable method of manufacturing a plastic component.
3. Describe about types of ceramics, refractoriness, their uses.
4. Express the details about white wares ceramic coatings and glass.
5. Suggest the suitable method of manufacturing processes of ceramics.
6. Describe about types composites and their uses.

UNIT I: Introduction to polymers:
Plastics and elastomeres, polymerization, degree of polymerization thermoplastics and thermosetting plastics, properties and applications of various thermo and thermosetting plastics, mechanical properties of plastics and their influencing parameters.

UNIT II: Manufacturing Methods of Plastics:
Injection moulding, Extrusion, calendering, thermoforming, Blow moulding, compaction moulding, transfer moulding

UNIT III: Introduction to Ceramics, Classification of Ceramic Materials , Conventional and Advanced; Refractories:
Classification of Refractories, Modern trends and developments, Basic raw materials, Elementary idea of manufacturing process technology, Flow diagram of steps necessary for manufacture, basic properties and areas of application.

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UNIT IV: White wares:
Classification and type of White wares, Elementary idea of manufacturing process technology including body preparation, basic properties and application area;.

Ceramic Coatings : Types of glazes and enamels, Elementary ideas on compositions, Process of enameling & glazing and their properties. Glass: Definition of glass, Basic concepts of glass structure, glass manufacturing processes, Different types of glasses. Application of glasses.

UNIT V: Fundamentals of composites:
Need for composites – enhancement of properties – classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement–particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers. Manufacturing methods of composites.

Text Books:

1. Mikell P. Groover_"Fundamentals of Modern Manufacturing: Materials, Processes, and Systems" Wiley publications, 6th edition'2015.
2. Kalpak Jain "Manufacturing Engineering and Technology" Pearson publications, 7th edition 2013.
3. P.N. Rao, Manufacturing Technology, Vol.-1, McGraw Hills Publication, 4th Edn., 2016.

Suggested Reading:

1. R.K.Rajput 'a text book of Manufacturing Technology", laxmi Pub., Vol-I, 2007.
2. P.C. Sharma, 'A Text book of Production Technology', S. Chand & Co., Pvt.Ltd., 8th Edn 2014.

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16MT EO4
PROBABILITY AND NUMERICAL METHODS (Professional Elective-II)

Instruction	3 Hours per week
Duration	3 Hours
End Exam	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:
1. To compute the statistical averages& different properties.
2. To study the probability distributions for stochastic data.
3. To understand for finding solution of non-linear equations.
4. To study the process of calculating the value of the numerical derivative of a functions & numerical integration of a given data.
5. To identify the solution for initial value problem numerical differential equations.

Course Outcomes: On the successful completion of this course, the student shall be able to
1. Analyse the statistical averages and different properties for probability function.
2. Fit the probability distribution for the random data.
3. Solve the non-linear equations for finding the roots.
4. Solving the Differentiation & Integration for numerical data.
5. Solving the ordinary differential equations using single & multi-step methods.

UNIT I: Random Variables: Mathematical Expectation, Variance, Co-Variance, and its properties, Probability function, Moments, mgf, cgf and its properties.

UNIT II:
Probability Distributions: Discrete distribution: Binomial, Poison distributions, finding Mean and Variance through mgf. Continuous distribution: Normal distribution, Exponential & Uniform distributions.

UNIT III:
Solution For Non-Linear Equations: Algebraic & transcendental equations, Bisection method, Regular False Method and Newton Raphson method, interpolation, Newton's forward and backward formulas.

UNIT IV: Numerical Differentiation & Integration: Numerical differentiation using numerical forward & backward interpolation formula, Numerical integration: Simpson's 3/8th rule, Weddle's rule.

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UNIT V: Numerical Solution Of Oridinary Differential Equations: Picard's method, Euler's method, R.K method (fourth order) and Milne Thompson's method (predictor & corrector)

Text Books:

1. S.C Gupta and V.K.Kapoor, Fundamentals of Mathematical statistics, S.Chand& Co.2006.
2. M.K.Jain, S.R.K Iyengar and R.K.Jain: Numerical methods for Scientific and Engineering Computation. New Age International publications, 2008.

Suggested Reading:

1. Miller and Freund, Probability and Statistics for Engineers, Pearson, 2005.
2. S.S.Shastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt. Ltd., 2012.

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16ME C23

DYNAMICS AND VIBRATIONS LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. To demonstrate basic principle and exposure to evaluate CAM Follower Motion and Gyroscopic effects.
2. Students will understand the importance of static and dynamic balancing.
3. Students will acquire the knowledge in evaluating the stability of dynamic systems.

Course Outcomes: Students will be able to

1. Evaluate the effect of gyroscopic couple.
2. Evaluate the effect of CAM Follower Motions in machines.
3. Estimate the performance of governors.
4. Evaluate the static and dynamic balancing of rotating masses.
5. Estimate the natural frequency of different un-damped vibrating systems.
6. Estimate the natural frequency of different damped vibrating systems.

List of experiments:

(1) To study the motion of follower with the given profile of the cam. (To plot the n-q (Follower displacement Vs Angle of rotation) curves for different cam follower pairs.
(2) To study the gyroscopic effect on a rotating disc.
(3) Determination of the frequency of torsional vibration.
(4) Static and Dynamic balancing in a Rotating mass system.
(5) Study the effect of varying mass on the centre of sleeve in porter governor.
(6) Study the effect of varying the initial spring compression in Hartnell governor.
(7) Undamped torsional vibrations of double rotor system.
(8) To study the longitudinal vibrations of helical coiled spring.
(9) To study the undamped forced vibration of spring mass system.
(10) To study the force damped vibration of spring mass system.
(11) Determination of critical speed of the given shaft with the given end conditions (Whirling of Shafts).
(12) Frequency response of spring mass system with damping.

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Text Books:

1. S. Rattan, Theory of Machines, Tata-Mc Graw Hill, 1995.
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, Theory of Machines & Mechanisms, Oxford University Press, 2003.

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16ME C24

APPLIED THERMODYNAMICS AND HEAT TRANSFER LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives:

1. To demonstrate basic knowledge and exposure to determine valve and port diagram and also to evaluate the performance of the petrol engine and diesel engine.
2. Student will determine the importance of heat balance sheet of IC engine.
3. Students will acquire knowledge in evaluating the performance of multi-stage reciprocating compressor.
4. To demonstrate knowledge in evaluating thermal conductivity and heat transfer coefficient under natural convection phenomena and forced convection phenomena.
5. Students will understand the basic concepts of radiation heat transfer
6. Student will understand the effectiveness of parallel and counter flow heat exchangers.

Course Outcomes: Students will be able to

1. Evaluate the performance of petrol and diesel engines.
2. Estimate the heat losses in heat balance sheet of IC engine.
3. Evaluate the performance of multi stage reciprocating air compressor and its importance over single stage air compressor.
4. Estimate the effect of insulation on conduction heat transfer and also estimate the value of convection heat transfer coefficients under different scenario.
5. Determine Steffan and Boltzman constant and emissivity in radiation heat transfer.
6. Estimate the properties of radiating body and effectiveness of heat exchangers.

Applied Thermodynamics

1. Determination of Valve timing diagram and Port diagram of IC engine.
2. Determination of Performance characteristics of a multi-cylinder petrol engine.
3. To conduct Morse test on multi cylinder petrol engine.
4. To conduct performance test on a variable compression ratio petrol engine.
5. To conduct performance test on single cylinder diesel engine.

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6. To conduct heat balance test on single cylinder diesel engine.
7. To determine volumetric efficiency, isothermal efficiency of multi -stage reciprocating air compressor.

Heat Transfer

1. Determination of Thermal conductivity of insulating powder.
2. Determination of thermal conductivity of composite wall.
3. Determination of convective heat transfer coefficient under Natural and Forced convection phenomena using pin-fin apparatus.
4. Determination of Emissivity of a given plate.
5. Determination of the value of Stefan-Boltzman constant.
6. Determination of Heat transfer coefficient in parallel and counter flow heat exchanger.

Text Books:

1. R. K. Rajput, Thermal Engineering, Laxmi Publishers, New Delhi, 2014.
2. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2010.

Note: Minimum 12 Experiments taking 6 from each section

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16EE C22

ELECTRICAL MACHINES AND MICROCONTROLLER APPLICATIONS LAB

(Common to BE3/4, Mech. & Prod, V- SEM)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives:

1. To understand the testing of 1-phase transformers.
2. To comprehend various characteristics of DC machines.
3. To understand the characteristics of different AC machines.
4. To learn operations on 8051 microcontroller.
5. To understand basics of interfacing devices with 8051 microcontroller.

Course Outcomes: The student will be able to

1. Test the 1-phase transformer.
2. Know the right instrument and its usage for the given circuit.
3. Identify the suitable machine for required application.
4. Process the data using 8051 microcontroller.
5. Interface the given device with 8051 microcontroller.

List of Experiments:
Cycle -I

1. Magnetization characteristics of a separately excited DC generator.
2. Load characteristics of a shunt generator.
3. Performance characteristics of a shunt motor.
4. Performance characteristics of a compound motor.
5. Speed control of DC shunt motor.
6. O.C. and S.C. tests on single phase transformer.
7. Load test on a three phase induction motor. .
8. Speed control methods of induction motor.
9. To determine the load characteristics of a DC series motor.

Note:
At least **SIX** experiments should be conducted in the semester from cycle - I.

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Cycle -II

1. 8051 Microcontroller Experiments.
2. Data Transfer - Block move, Exchange, sorting, Finding largest element in an array.
3. Arithmetic Instructions :Multi byte operations.
4. Boolean & Logical Instructions (Bit manipulations)
5. Use of JUMP and CALL instructions.
6. Control of stepper Motor using 8051.
7. A/D converter interface with 8051 Microcontroller.
8. D/A converter Interface with 8051 Microcontroller.

Note:
At least **FOUR** experiments should be conducted in the semester from cycle - II.

Text Books:

1. V.K. Mehta, Principles of Electrical Engineering & Electronics, S.Chnad Limited, 1998.
2. Muhammad Ali Mazidi, Tanice Gillispie Mazid, Rolin D. Mckinlay, The 8051 Microcontroller & Embedded Systems, Pearson Education, 2016.

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16ME C25

INDUSTRIAL VISIT

A minimum of two industrial visits will be arranged by department and students have to attend the visits and prepare a data report of their visits to the industries and submit to the department. Students are required to present a seminar based on their report which is evaluated by Head of the Department and two senior faculty to award the grade and these grades are categorized as follows.

Excellent / Very Good / Good / Satisfactory / Unsatisfactory.

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16ME C26

CAD and CAM

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Understand the basic and advanced concepts of computer aided design. Learn the application of CAD in geometric modeling.
2. Students will develop an understanding of the theory and construct the elements of curved surface representation.
3. Explain solid modeling representation schemes and the Euler operators. Understand and be able to perform two-dimensional and three-dimensional geometric transformations on objects.
4. Have an overview of advantages and disadvantages of modeling and analysis packages.

Course Outcomes: After completion of course, the student will be able to

1. Apply design concepts in design , analysis and modeling of entities and curves.
2. Apply surface and solid modeling techniques for the generating various parts and implement transformations on various geometric models for manipulation.
3. Visualize the models through the graphics standards and implement NC,CNC systems and programming.
4. Implement and practice the DNC and AC controls , analyze the manipulator motions, configurations including end effectors, actuators, drives and sensors and programming.
5. Learn and Implement GT and Coding methods and CAPP.
6. Understand and implement FMS,CIMS,RPT ,QC- methods & controls and Turnkey CAD/CAM systems.

UNIT-I: Design Process:

Design criteria, Alternative solutions, Alternative design, Computer aided design and review.

Drafting techniques: Basic geometric elements and their creation.

Geometric modeling: Wire frame entities and their definition, interpolation and approximation curves. Concept of Parametric and non-parametric representation of circle and helix curves,

properties of splines. Synthetic curves: parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Introduction to NURBS.

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UNIT-II: Surface Modeling:
Analytic surfaces: Definition of planar, Ruled , surface of revolution, tabulated cylinder.
Synthetic Surfaces: Cubic and Bezier surfaces.
Solid modeling: C – rep and B – rep approaches.
Design Applications: Mass property calculations, mechanical tolerancing, finite element analysis.
2 D Transformations: Translation, scaling and rotation about arbitrary point, shear and reflection, homogenous representation, concatenation.

UNIT-III: CAD Database and Data Exchange:
CAD database and structure, IGES, STEP and STL format.

Numerical Control of Machine Tools:
Features and elements of NC, Types of NC systems: PTP, Straight Cut and Contouring Introduction to CNC, Typical configurations, Definition of axes, Definition of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, tool length and cutter radius compensation. Manual and computer aided part programming (APT) for simple components. Programming with MACROS.

UNIT-IV: DNC:
Typical configurations, CNC vs DNC, Adaptive control systems, Machining centers, Introduction to FANUC, SINUMERIC controllers.
Industrial robots: Robot anatomy, configurations, controls, drivers, programming methods and applications.

UNIT-V: GT:
Part families, layout, part classification and coding system- OPITZ, MICLASS.
CAPP: Variant and generative process planning.
FMS and CIM: F.M.S equipment, FMS layouts, benefits of FMS. Elements of CIM.

Computer Aided Inspection and QC: Automated inspection- Off-line, On-line, contact (Co-ordinate measuring machine), Non-contact inspection (Machine Vision, Scanning LASER Beam, Photogrammetry).
CAD/CAM integration, Turnkey CAD/CAM systems, Introduction to rapid prototyping technique.

Text Books:

1. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill Inc, New York, 2011.
2. Grover MP and Zimmers EW CAD/CAM Prentice Hall of India, 1989.
3. Rao PN CAD/CAM : Principles and Applications 2nd edition, Tata McGraw Hill, New Delhi, 2004.

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Suggested Reading:

1. Arvid R Eide, Roland D Jenison, Lane H Mashaw, Larry L Northup, Introduction to Engineering Design McGraw Hill 1998.
2. Yoramkoren, Computer Control of Manufacturing Systems McGraw Hill Int, New York, 1994.
3. C. Elanchezhian, T . Sunder Selwyn , G . Shanmuga Sunder, Computer Aided manufacturing , Laxmi Publications (P) Ltd, 2nd edition, New Delhi 2007.

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16ME C27

METAL CUTTING AND MACHINE TOOL ENGINEERING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: Student will learn the

1. Basic understanding of cutting tools, geometry in machining processes.
2. Make students familiar with cutting forces in turning drilling, milling operations.
3. Understand various machine tools, like lathe, drilling, milling shaper, planner,
4. Knowledge of Thread manufacturing and gear manufacturing.
5. Understand un-conventional machining processes like, EDM, ECM.
6. Understand LBM, EBM, ECG and do problems on MRR, Surface finish.

Course Outcomes: Students are able to

1. Grind single point cutting tool with various angles.
2. Perform taper turning and knurling on lathe.
3. Perform drilling and thread cutting operations.
4. Manufacture a gear using milling machine.
5. Do operation on shaper.
6. Exposed to various unconventional processes.

UNIT-I: **Cutting Tool Materials**:
High carbon steel, HSS, Stellite, Carbides, Diamonds, Tool materials properties.
Tool Geometry: Nomenclature of single point cutting tool by ASA& ORS systems, Geometry of drills, milling cutters.

Chip Formation: Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Merchants analysis, Shear angle, Solutions of merchant and Lee & shafer.

UNIT-II: Thermal Aspects of Metal Cutting:
Sources of heat and heat distribution. Various methods of measurement of temperature, cutting fluids and applications.

Tool Wear and Tool Life: Criteria for tool wear, flank and crater wear theories, criteria for tool life in roughing and finishing, Measurement of tool wear, Taylor's tool life equation, factors effecting tool life, Machiniability.
Economics of machining: Tool life for maximum production, minimum cost.

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UNIT-III:Lathes:
Types constructional features, size of lathe, various operations that can be performed on lathes types of lathes, capstan and turret lathes, bar work and chuck work and tool holding devices. Taper turning methods. Thread cutting and accessories of lathe.

Drilling Machines: Types and constructional features and applications, Radial drilling machine, drilling operations.

Milling Machines: Classifications and types various operations on milling machines, Up and down milling. Types of milling cutters and bars. Dividing head, plain, compound and differential indexing.

UNIT-IV: Boring Machines:
Horizontal, Vertical and Jig boring machines and constructional features. Differences between Shaper, Planner and slotter, Quick return mechanisms.

Grinding Machines: Types, Classification Abrasives and bonds used for grinding wheel, Selection of grinding wheel, cylindrical grinding and center less grinding.

Screws and Thread Production: Thread rolling, thread chasing , thread milling and thread grinding. Gear shaping, gear hobbing, gear shaving and gear grinding

UNIT-V: Jigs and Fixtures:
Design principles for location and clamping. Quick clamping devices. Types of jigs and fixtures.

Unconventional machining: Principles of working and applications USM, AJM,EDM, ECM, LBM and EBM (Mechanisms and theory MRR and Process parameters in each case)

Text Books:

1. B.L. JuneJa and Shekon, Fundamentals of Metal Cutting & Machines Tools, Wiley Eastern Ltd. 1987.
2. P.N. Rao, Manufacturing Technology – Metal Culling & Machine Tools, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. M.C. Shaw, Metal Cutting Principles, Clarendon Press, Oxford 1984.

Suggested Reading:

1. Hajra Choudary S.K, Elements of Workshop Technology, Vol. II, Media Pub., New Delhi, 2010.
2. P.C.Pandey& Shan HS Modern Machining process Tata McGraw-Hill Education 1980.
3. A. Bhattacharya Metal Cutting Theory and Practice New Central Book Agency (p) Ltd Calcutta, 1996.

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16ME C28

THERMAL TURBO MACHINES

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. Student will demonstrate basic knowledge by understanding concepts of various gas dynamics equations, necessary for CFD.
2. Student will acquire basic knowledge in designing of nozzles and diffusers used in rockets and aircrafts.
3. Student will come to know the design of ducts, combustion chambers and various types of shocks.
4. Student will come to know the working principles of various rotary compressors like centrifugal compressor and rotary compressor.
5. Student will understand the applications of various steam turbines and velocity triangles in order to calculate power developed by them.
6. Student will demonstrate the basic knowledge in gas turbines and various methods to improve efficiency of gas turbine cycles. Outcomes:

Course Outcomes: At the end of the course, students will be able to

1. Design various configurations of steam nozzles by the principles of gas dynamics which are essential or pre-requisite to computational fluid dynamics.
2. Understand Fanno curves along with shock waves.
3. Understand the importance of Rayleigh curves in gas dynamics.
4. Calculate power required by various types of rotary compressors with the principles of gas dynamics.
5. Specify steam turbine as per the application and also calculate power developed by them.
6. Calculate thermal efficiency of gas turbines with the principles of gas dynamics and suggest suitable methods to improve work output and efficiency of the plant.

UNIT-I:Introduction to Compressible Flows:

Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow. Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers Flow with Shock Waves-Development of Normal Shock waves, governing equations,

UNIT-II: Flow in Constant Area Ducts with Friction-Fanno Flow:

Variation of flow properties, variation of Mach number with duct length, isothermal flow with friction. Prandtl –Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock.

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UNIT-III:Rotodynamic Compressors:
Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities. Thermodynamic cycles and work done, calculation of various efficiencies. Velocity diagrams and prewhirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

UNIT-IV: Steam Turbines:
Introduction to steam nozzles, design for throat area. Classification of steam turbines, Impulse turbine ,compounding of steam turbines, Pressure velocity variations across different compounding turbines, blade efficiency and work done by impulse turbine ,degree of reaction of reaction turbine, blade efficiency and work done by reaction turbine, stage efficiency and nozzle efficiency and simple problems on impulse and reaction turbines.

UNIT V: Gas Turbines:
Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter-cooling, Reheating and Regeneration. Simple problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines..

Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications.

Text books:

1. S M Yahya , Fundamentals of Compressible Flow, New Age International Publishers, 2014.
2. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2010
3. M L Mathur & F S Mehta, Thermal Engineering, Jain Brothers, New Delhi, 201.

Suggested Reading:

1. Dennis G Shepherd , Aerospace Propulsion, Elsevier Publishing Company, New York, 1995.
2. V. Ganeshan Gas Turbines, Tata Mc Graw Hills, New Delhi, 2010.
3. R Yadav, Steam and Gas Turbines, Central Publishing House Ltd, Allahabad, 2003.

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16ME C29

MACHINE DESIGN

Instruction	3 Hours + 1 Tutorial per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. To learn design criteria of machine components, selection of materials and manufacturing process.
2. To learn application of principles to design helical coiled and leaf springs, gears, curved beams, sliding contact and rolling element bearings and IC engine components.
3. To provide the design concepts of helical and leaf springs.
4. To provide the students the knowledge of design of IC engine parts.

Course Outcomes:

1. Graduates demonstrate the ability to design helical, leaf springs for static and fluctuating loads.
2. Graduates have the ability to design gears for power transmission considering beam strength, dynamic factors and wear life.
3. Graduates demonstrate the ability in designing sliding contact bearings, considering power lost in friction, heat dissipation.
4. Graduates have the ability of selection of rolling contact bearings based on load-life relationship.
5. Graduates demonstrate the ability of designing IC engine parts such as piston, connecting rod and crank shaft considering gaseous impulse and thermal aspects.
6. Graduate demonstrate the ability of designing curved beams like C-clamp, crane hooks etc.

UNIT-I: Mechanical Springs:

Introduction, types of springs, Materials used for springs.

Helical Springs: Whal's factor, calculation of stresses, deflection and energy stored in spring. Design for static and fluctuating loads.

Leaf Springs: Stresses and deflection, nipping of Leaf springs. Design for static loads.

UNIT-II: Gears:

Introduction to gear drives, types of gears, materials used for gears. Standards and specification of gears. Design of Spur, Helical, Bevel and Worm gears; Lewis beam strength equation. Dynamic loads on gear tooth. Wear load and design for wear strength.

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UNIT-III: Bearings:
Introduction, classification of bearings, materials used for bearings, properties and types of lubricants.

Design of Sliding Contact Bearings:
Hydrostatic and Hydrodynamic bearings.

Selection of Rolling Contact Bearings: Types of rolling elements and their constructional details. Static and dynamic load carrying capacity. Load-life relationship, selection of bearing, for cyclic loads and speeds.

UNIT-IV: I.C. Engine Parts:
Introduction, Materials used, Design of piston, connecting rod and crank shaft.

UNIT-V: Design of Curved Beams:
Introduction, stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular and trapezoidal sections. Design of C-clamp and crane Hook. Design of chain drives: Power rating of roller chains. Strength of roller chains.

Text Books:

1. Bhandari V.B. Machine Design, Tata Mc Graw Hill Publications, 2010.
2. J.E. Shigley , C.R. Misckhe, Mechanical Engineering Design, Tata Mc Graw Hill Publication, 2010.
3. P. Kannaiah, Machine Design, Science-Tech Publications, 2010.

Suggested Reading:

1. M.F. Spotts, Design of Machine Elements, Prentice Hall, 2013.
2. Robert L. Norton, Machine Design: An Integrated Approach, 2/e Pearson Education, 2013.
3. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Machine Design Data Books:

1. Design Data book by PSG College –2012.
2. Mahadevn .K, Balaveera Reddy. K, 'Design Data Hand Book, 4th Edn., CBS Publishers & Distributors, 2013.
3. Machine Design Data Book, by V.B. Bhandari McGraw hill education, 2015.

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16ME E04

ADVANCED IC ENGINES (Professional Elective – III)

Instruction	3 Hour per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objective (s): Student will understand the

1. Fundamental working principles of diesel/petrol engines.
2. Importance of combustion phenomena in I.C. Engines.
3. Importance of control of pollutants and their remedies.
4. Working principles of analyzers for measurements of pollutants.
5. Concept of alternative fuel technology to improve the performance of the engine.
6. Concepts of recent trends with change of engine configuration.

Course Outcome (s): Student will be able to

1. Evaluate the performance of the diesel/petrol engine.
2. Distinguish abnormal combustion from normal combustion in CI and SI engine.
3. Ascertain the need for formation of various pollutants from IC engines.
4. Determine various pollutants from IC engine with different analyzers .
5. Stress the need for alternative fuels and their technological, environmental and social impacts.
6. Evaluate the performance of IC engine with recent trends with modern concepts like Lean burn, stratification, HCCI and GD.

UNIT-I : Fundamentals of IC Engines:
Classification, Working principles of 2 stroke, 4 stroke SI and CI engines. Performance of IC Engines. Heat balance sheet.

UNIT-II: Combustion Phenomena:
Normal and abnormal combustion phenomenon in SI and CI engines. Cooling, lubrication systems, Battery and magneto ignition systems of IC engines. Working principle of Simple Carburetor and Fuel Injector Combustion Chambers for SI & CI Engine.

UNIT-III: Pollutant Formation And Control:
Engine Variables Affecting Pollutants and their remedies Working Principles of Smoke Analyser, CO/UBHC Analyser and NO_x Analyser–Introduction to emission norms.

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UNIT-IV: Alternative Fuels

Alcohols, Vegetable oils, Bio Diesel Hydrogen, Natural Gas, Liquefied Petroleum Gas and Bio Gas Properties, Suitability, Merits and Demerits as fuels.

UNIT-V: Advances in IC Engines

Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition (HCCI) Engines and GDI concepts.

Text books:

1. Ganeshan, V., Internal Combustion engines, Tata Mc Graw Hills Publishing Co.Ltd, New Delhi 2015.
2. Gill, P.W. and Smith (Jr,J.H, fundamentals of Internal combustion Engines, Oxford & IBH publishing Co.New Delhi, 1967.
3. Heywood, J.B, Internal Combustion engine fundamentals, McGrave Hills, Book Co, New York, 1988.

Suggested Readings:

1. C.F. Taylor and E.S.Taylor, The Internal Combustion Engine in Theory and Practice, M.I.T.Press, 1968.
2. M.L. Mathur and R.P. Sharma, Internal Combustion Engine, Dhanpat Rai & Sons, Delhi, 5th Edition, 1990.
3. V. Ganeshan, Internal Combustion engines, Tata Mc Graw Hills Publishing Co. Ltd., New Delhi 1984.

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16ME E05

COMPUTATIONAL FLUID DYNAMICS (Professional Elective – III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. Understanding of governing equations of fluid flow.
2. Student understand finite difference and finite volume methods to solve fluid flow equations.
3. Issues that arise in the solution of such equations.
4. Various methods to overcome those issues and modern trends in CFD.
5. Get exposure to grid generation.
6. Various boundary conditions and their implementation.

Course Outcomes: At the end of the course, the students are able to

1. Classify basic equations of fluid flow.
2. Choose appropriate boundary conditions.
3. Choose proper numerical technique to solve equations.
4. Critically analyze different mathematical models and computational methods for flow simulations.
5. Interpret computational results.
6. Acquire the required knowledge to take advanced courses in CFD.

UNIT-I: Basic Equations:

Continuity, momentum and energy equations, navier-stokes equations, Heat transfer conduction equations for steady and unsteady flows, steady convection-diffusion equation.

UNIT-II: Models:

Reynolds and Favre averaged N-S equations, Mixing length model, k-epsilon turbulence model.

Classifications of Partial Differential Equations:

Elliptic, parabolic and hyperbolic equations, Initial and boundary value problems.

UNIT-III: Finite Difference Method:

Forward, backward and central difference.

Parabolic partial differential equations: Euler, implicit and crank Nicholson methods, ADI models, Errors, consistency, stability analysis, Vonnumen analysis, Convergence criteria.

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UNIT-IV: Elliptic Partial Differential Equations:
Jacobi, Gauss seidel methods, Viscous incompressible flow, Stream-function-vorticity method.

Introduction to grid generation: Types of grids O, H, C.

UNIT – V: Finite Volume Method:
Finite volume formulation for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows, staggered grid, SIMPLE algorithm.

Text Books:

1. P.S. Ghoshdastidat, Computational Fluid Dynamics & Heat Transfer, Cengage Pub., 1998.
2. J.D. Anderson, Jr., Computational Fluid Dynamics: The Basic with Applications McGraw Hill, Inc., 2012.
3. H. Versteeg and W. Malalasekra, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson,2nd edn. 2011.

Suggested Reading:

1. F. John Wendt (Editor), Computational Fluid Dynamics - An Introduction, Springer – Verlag, Berlin, 1992.
2. Charles Hirsch, Numerical Computation of Internal and External Flows, Vols. I and II. John Wiley & Sons, New York, 1988.
3. Anil W.Date, Introduction to Computational Fluid Dynamics, Cambridge, 2005.

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16ME E06

AUTOMOBILE ENGINEERING (Professional Elective – III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	20 Marks
Credits	3

Course Objectives: The student will learn

1. The anatomy of the automobile in general.
2. The location and importance of each part.
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
4. Suspension, frame, springs and other connections.
5. ignition, controls, electrical systems and ventilation.
6. Emissions, pollution regulations, EURO and BHARATH stages.

Course Outcomes: At the end of the course, the student will be able to

1. Identify the different parts of the automobile.
2. Explain the working of various parts like engine, transmission, clutch, brakes.
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions.
5. Develop a strong base for understanding future developments in the automobile industry.

UNIT-I: Types of automobiles:

Normal, Hybrid and Hydrogen Fuel vehicles. Engine location and its components, chassis layout; crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, Mechanical Fuel Injection system.

UNIT-II: Lubricating Systems:

Wet sump, dry sump and petroil systems - Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds - Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

UNIT-III: Steering Systems:

Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly, recent trends, Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, wheel alignment, Types of Suspension systems, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

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UNIT-IV: Power Train:
Clutches gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system Brakes Systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder and hand brake linkage, Recent Trends.

UNIT-V: Maintenance:
Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment, pollution control technologies used for petrol and diesel engines. Types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – Recent Trends.

Text Books:

1. Crouse & Anglin, Automotive Mechanics, TataMcGraw Hill. Publishing Co. Ltd., New Delhi, Tenth Edition – 2004.
2. Kirpal singh., Automobile Engineering Vol. I & II Standard Publishers, Delhi, 2002.
3. Joseph Heitner, Automotive Mechanics, Affiliated East West Pvt. Ltd. Second Edition, 2006.

Suggested Reading:

1. C.P Nakra, Basic Automobile Engineering, Dhanpat Rai Publishing Co. (P) Ltd., New Delhi, 2003.
2. G.B.S. Narang, Automobile Engineering, Khanna Publishers, New Delhi, 2014.
3. R.K. Rajput, A Textbook of Automobile Engineering, Laxmi Publications, New Delhi, 2012.

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16PE E05

DIGITAL MANUFACTURING (Professional Elective-III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives: Student has to understand the
1. Concepts and architecture of digital manufacturing.
2. Different additive manufacturing processes.

Course Outcomes: By the end of the course, the students will be able to:
1. Understand the concept, architecture and process of digital manufacturing.
2. Relate different additive manufacturing processes as a part of digital manufacturing.
3. Understand the concept of virtual prototyping and importance of reverse engineering in digital manufacturing.
4. Understand Intelligent multi information sensing concept and its application in digital manufacturing.
5. Understand the various digital processing technologies in product lifecycle, digital equipment.
6. Understand future scope, precision, environmental protection of digital manufacturing.

UNIT-I: Overview of Digital Manufacturing Processes:
Concepts and research and development status of digital manufacturing, definition, features and development of digital manufacturing, Conventional and digital manufacturing.
Theory system of digital manufacturing science: Operation mode and architecture of digital manufacturing system , Operation reference mode of digital manufacturing system – architecture of digital manufacturing system.

UNIT-II: Additive Manufacturing Processes Advanced Materials:
Additive manufacturing processes, Engineering polymers, metals, ceramics: Stereolithography, Selective Laser Sintering, Fused Deposition Modeling, Layered object manufacturing Electronic Materials , Bio-printing, Food Printing Advanced materials of Additive Manufacturing for Electronic Materials, Bio-printing, Food Printing, Preprocessing and Post processing in AM.

UNIT-III: Virtual Prototyping:
Introduction to Virtual Prototyping, Basic theory of Virtual Prototyping, Application of Virtual Prototyping in Manufacturing, Virtual Prototyping and Virtual

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Manufacturing Reverse Engineering-Introduction, Basic Theory of Reverse Engineering, Application of Reverse Engineering in Digital Manufacturing.

UNIT-IV: Intelligent Multi Information Sensing:
Concept, The Application of Sensor in the Processing & tool monitoring, Data mining applied to Digital Manufacturing Autonomy of Manufacturing System, Self-Learning of Manufacturing System Intelligent Manufacturing System.

UNIT –V: Key Technology of Digital Manufacturing:
Various Digital Technologies in Product Lifecycle, Digital Equipment and Digital Processing Technology, The Technology of Digital Maintenance and Diagnosis Future Development of Digital Manufacturing Science-precision of Digital Manufacturing, Environmental protection of Digital manufacturing.

Text Books:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012
2. Additive Manufacturing Technologies (2010; Springer) by Brent Stucker, David Rosen, and Ian Gibson ISBN 978-1-4419-1120-9, 2010.
3. Chee Kai Chua, Kah Fai Leong , 3D printing and additive manufacturing: principles and application: fourth edition of rapid prototyping, 2010.

Suggested reading:

1 Lihui Wang and Andrew Yeh Ching Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2 PK. Venuvinod, Ma, W; Rapid prototyping – Laser based and other technologies, Kluwer, 2004.

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16ME E07

HEAT AND MASS TRANSFER (Professional Elective-IV)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. To demonstrate basic knowledge by understanding conduction heat Transfer.
2. Students will acquire the basic knowledge in understanding the principles of convection heat transfer.
3. Student will come to know basic principles of radiation heat transfer.
4. Student will come to know the difference of condensation phenomena and boiling phenomena.
5. Student will understand the working principle of heat exchanger and their effectiveness.
6. Student will come to know mass transfer phenomena in gases and liquids.

Course Outcomes: Students will be able to

1. Apply various laws pertaining to conduction heat transfer.
2. Establish relation between various dimensionless numbers in convection heat transfer.
3. Acquire the basic knowledge in understanding the principles of radiation
4. Evaluate convective heat transfer coefficient for condensation heat transfer
5. Design heat exchangers.
6. Estimate mass diffusion phenomena for industrial processes.

UNIT-I: Conduction in Heat Transfer:

General 3-D Conduction Equation in Cartesian and Cylindrical Coordinates, one dimensional steady state conduction through slabs, hollow cylinders without heat generation. Steady state heat transfer through composite slabs and cylinders, critical radius of insulation for cylinders.

UNIT-II: Convection in Heat Transfer:

Dimensional analysis and its use in free and forced convection, Buckingham " theorem, Physical significance of different dimensionless numbers.
Simple problems on free and forced convection.

UNIT-III: Radiation in Heat Transfer:

Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's black body spectral distribution, Wien's and Steffan Boltzmann law. Concept of surface, space resistances and radiation shields.

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UNIT-IV: Condensation in Heat Transfer:
Convective heat transfer coefficient for laminar condensation, boiling, critical heat flux, Heat Exchangers: Classification, LMTD and NTU Concepts, Simple problems on LMTD and NTU method.

UNIT-V: Mass Transfer:
Applications, Fick's law, three dimensional equation for mass transfer, diffusion coefficient, evaporation process in atmosphere, significance of dimensionless numbers in mass transfer.

Text Books:

1. J.P. Holman, Heat Transfer, McGraw Hill Publication, New Delhi, 2010.
2. Ozisik, Heat Transfer. TMH, 1998.
3. R.K. Rajput, Heat and Mass Transfer, Laxmi Publications, 2010.

Suggested Reading:

1. D.S. Kumar; Heat and Mass Transfer, S K Kataria Publishers, 2015.
2. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International Publications, 2014.
3. Yunus A Cenegal, Heat Transfer: A Practical Approach, Tata McGrahill, 2nd Edn. 1998.

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16ME E08

OBJECT ORIENTED PROGRAMMING WITH C++
(Professional Elective-IV)

Instruction	3 Hours per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. To teach difference between OOP and structured programming.
2. To teach how to use different features of C++.
3. To write programs for simple applications.
4. To understand capability of OOP.
5. To use operator overloading.
6. To create templates and usage of exception handling.

Course Outcomes: Be able to understand

1. The difference between object oriented programming and Structured programming and data types in C++.
2. To program using C++ features such as classes and objects.
3. The write C++ programs for simple applications in mechanical engineering.
4. The overload operators.
5. The use inheritance and polymorphism.
6. Capability to use effectively templates and exception handling.

UNIT-I: Principles of Object Oriented Programming:
Procedure Vs Object Oriented, Paradigm, Basic concepts, benefits, Applications and Object Oriented Languages.
Introduction:
Program structure, Creating, Compiling and Linking of C++ program.
Token, Expression and Control Structures:
Tokens, Keywords, Identifiers and Constants, Data Types, Operators, Precedence, Type Compatibility, Control Structures, New Features of C++.
Functions:
Function Prototype and Parameter Passing, Inline Functions, Default, Constant Arguments, Recursion, Function Overloading.

UNIT-II: Classes and Objects:
Defining classes and Member functions, creating objects, objects and arrays, objects and functions, const with classes, friends to a class, nesting static members of a class.

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Constructors and Destructors:
Type of Constructors, Dynamic Initialization of Objects, Destructors.

UNIT –III: C++ Operator Overloading and Type Conversions:
Fundamentals, restrictions, overloading unary / binary operators, overloading ++ and , overloading special operators, overloading by member functions and friend functions, type conversions.

UNIT-IV: C++ Inheritance:
Defining derived classes, Types of Inheritance, Virtual Base class Abstract Class, function overriding and containership.

Pointers and Polymorphism:
Pointers and Generic pointer, Pointer to Objects and Derived Classes, this pointer, Virtual Functions, Virtual Destructors.

UNIT-V: C++ Templates:
Introduction, function templates and class templates.

C++ Exception Handling:
Conventional error handling mechanism, C++ error handling mechanism, Try, throw, catch, exception handling in classes.

Text Books:

1. Rohit Khurana Object oriented programming with C++, Vikas publications, 2nd edition, 2009.
2. Ashok Kamtani Object Oriented Programming with ANSI and Turbo C++, Pearson Education, 2014.
3. Somshekara & others, Object Oriented Programming with C++, Eastern Economy Edition, 2nd edition, 2012.

Suggested Reading:

1. E. Balagurusamy Object Oriented Programming with C++, McGraw-Hill Education (India), 6th Edition 2013.
2. Bjarne Stroustrup The C++ Programming Language, Pearson Education 5th Edition, 2013.
3. Robert Lafore Object-Oriented Programming in C++ Fourth Edition Sams Publishing, 2002.
4. John Hubbard, Atul Khate, Schaum's Series, Programming with C++ 3rd Edition, 1996.

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16PE E06

MODERN MACHINING AND FORMING PROCESSES
(Professional Elective-IV)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives: Student will learn

1. The importance of non-conventional machining processes.
2. Various non-conventional machining processes and their process parameters.
3. The relative merits, limitations and applications of various non-conventional machining processes.
4. The knowledge regarding working media and its functions of non-conventional machining processes.
5. The concepts of non-conventional forming processes such as rubber pad forming, hydro forming, stretch forming, etc.
6. The concepts of HERF and to provide the description of HERF process.

Course Outcomes: At the end of the course, the students are able to

1. Select the non-conventional machining process for a particular application.
2. Demonstrate the capability of comparison of various non-conventional machining methods.
3. Describe the various non-conventional machining processes.
4. Exhibit the proficiency of selecting working media for various non-conventional machining processes.
5. Exhibit the basic understanding of non-conventional forming processes.
6. Compare various non-conventional forming processes based on their merits, limitations and applicability.

UNIT-I: Mechanical Energy Processes:

Ultrasonic Machining (USM): Introduction, Process description, abrasive slurry, Abrasive materials and their characteristics, Functions of liquid medium in slurry, Types of transducers, effect of process parameters, applications and limitations.

Abrasive Jet Machining (AJM):
Principle of operation, process details, process variables and their effect on MRR and accuracy, advantages, disadvantages and applications.

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Water Jet Machining (WJM):
Schematic diagram, equipment used, advantages and applications.

Abrasive Water Jet Machining (AWJM):
Process, advantages, limitations and applications

UNIT-II: Thermal Processes:
Electro Discharge Machining (EDM):
Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, flushing, mechanism of metal removal, types of power supply circuits, mathematical analysis of metal removal rate (MRR), equations for surface finish, characteristics of spark eroded surfaces, advantages, disadvantages and applications.

Wire EDM:
Process description and applications.

LASER Beam Machining (LBM):
Principle of LASER beam production, materials used, process parameters, advantages, limitations and applications.

Plasma Arc Machining (PAM):
Introduction, equipment used, process description and parameters, types of plasma arc: transferred arc and non transferred arc and process applications.

Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of electron beam, equipment used, advantages, disadvantages and applications.

UNIT-III: Chemical and Other Machining Processes:
Electro-chemical machining (ECM): Schematic of process parameters, function and characteristics of electrolyte, MRR for pure metal and alloys, electrode feed rate (EFR), advantages, limitations and applications.

Chemical Machining: Chemical blanking and chemical milling, advantages, limitations and applications.

ION Etching: Process description, merits, limitations and applications.

UNIT-IV: High Energy Rate Forming Processes (HERF):
Introduction, applications, advantages, **Explosive Forming:**
Principles, explosive materials, Equipment, types of explosive forming, standoff operation and contact operation.

Electro-Hydraulic Forming (EHF): Schematic of process, description and its applications, **Electro-Magnetic Forming (EMF):** Process description, merits, limitations and applications.

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UNIT-V: Other Forming Processes:

Rubber Pad Forming: Principle of the process, process details and its types, Guerin, wheelon, Mar forming and Hydro forming processes and applications

Stretch Forming: Introduction, types of stretch forming, stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming.

Tube spinning: Introduction, methods of tube spinning, backward spinning, forward spinning.

Text Books:

1. P.C. Pandey and H.S. Shah, Modern Machining Process Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980.
2. J Paulo Davim, Modern Machining Technology, A Practical Guide, 1st Edition, Woodhead Publishing in Mechanical Engineering, 1980.
3. Hassan Abdel-Gawad El-Hofy, Advanced Machining Processes, Nontraditional and Hybrid Machining Processes, McGraw Hill Publishing Co. Ltd., 1984.

Suggested Reading:

1. Davies and Austin, Developments in High Speed Metal Forming, The Machinery Publishing Co. Ltd., 1985.
2. Production Technology, HMT, 1984.
3. A. Bhattacharya, New Technology, The Institution of Engineers (India), 1984.

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16PE E07

SURFACE ENGINEERING (Professional Elective-IV)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. To impart knowledge on surface engineering and surface modification methods that will come in handy to solve the industrial problems.
2. This will also serve as a precursor for future research in the same field.
3. Student will understand the basic principles of corrosion and know the methods to reduce the corrosion on mechanical components.
4. Student will understand the role of wear and wear measurement techniques on Engineering components.

Course Outcomes: Students will be able to

1. Demonstrate basic understanding of friction, and be familiar with adhesion theories and the effect of adhesion on friction.
2. Demonstrate basic understanding of wear processes, and able to describe wear mechanisms on engineering components.
3. Demonstrate basic understanding of corrosion and know the methods to reduce the corrosion on engineering components.
4. Design a tribological system for optimal performance, and Justify, critical analysis on surface engineering techniques and surface design for relevant applications.
5. Apply surface engineering principles and methods to modify and improve the properties of surfaces for structural and functional applications.
6. Identify suitable surface processing method from various methods to create surface engineering solutions for specific materials, specific environments and specific applications in modern engineering practice.

UNIT I: Friction:

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II: Wear:

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals - International standards in friction and wear measurements.

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UNIT III: Corrosion

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.

UNIT IV: Surface Treatments

Introduction: Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.

UNIT V: Engineering Materials

Introduction:

Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology, Nano Tribology.

Text Books:

1. G.W.Stachowiak & A.W. Batchelor, Engineering Tribology, Butterworth-Heinemann, UK, 2005.
2. E. Rabinowicz, Friction and Wear of materials, John Willey & Sons, UK, 1995.
3. J. Halling, (Editor) – Principles of Tribology, Macmillian – 1984.

Suggested Readings:

1. J.A. Williams Engineering Tribology, Oxford Univ. Press, 1994.
2. S.K.Basu, S.N. Sengupta & B.B. Ahuja, Fundamentals of Tribology, Prentice - Hall of India Pvt. Ltd., New Delhi, 2005.
3. G. Fontana Corrosion Engineering, McGraw Hill, 1985.

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16ME C30

CAD and CAM LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	50 Marks
CIE	24 Marks
Credits	3

Course Objectives:

1. 3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib, Editing – Move, Pattern, Mirror, Round, Chamfer.
2. Assembly (Coupling, Screw jack) creating assembly from parts assembly constraints.
3. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning , mass property calculations.
4. To learn and develop the skill in creating a component by utilizing the Automated Machines.

Course Outcomes:

1. Draw complex geometries of parts in sketcher mode.
2. Generate freeform shapes in part mode to visualize parts.
3. Create complex engineering assemblies using appropriate assembly constraints.
4. Develop various machine components and generate their orthographic view modeling software.
5. Have a fundamental knowledge of Computer Numerical Control machines.
6. Write part programs using G and M codes for lathe and milling operations.

Detailed Syllabus:

1. Introduction to Solid Works Package, Working with sketch mode and features of Solid Works and applying on various part models.
2. Part modeling of cotter, Knuckle Joints and Couplings.
3. Generating, editing and modifying drawings in SolidWorks.

4-8 Assembly modeling of the following.
(a) Stuffing Box (b) Screw Jack (c) CrossHead (d) Eccentric

9. Specifying tolerances for part and assembly Drawings.
10. Contouring on CNC Milling Machine.
11. Facing on CNC Milling Machine.
12. Rectangular Pocketing on CNC Milling Machine.
13. Circular pocketing on CNC Milling Machine.
14. Step Turning, Taper Turning and Multiple Turning On CNC Lathe Machine
15. Use of CAM software for various Machining Operations.

Text Books:

1. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill Inc , New York, 2011.
2. PN Rao CAD/CAM : Principles and applications 2nd edition, Tata McGraw Hill, New Delhi, 2004.

Note: Any 12 experiments need to be conducted.

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16ME C31

METAL CUTTING AND MACHINE TOOL ENGINEERING LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students will learn
1. To grind single point cutting tool using HSS as cutting tool
2. To do various operations like plain turning, step turning, knurling
3. Have work shop practice on lathe drilling and milling machines
4. The gear cutting and to cut gear on milling machine
5. Measure cutting forces during machining on Lathe machine, milling
6. Unconventional machining operations like EDM & ECM

Course Outcomes: Student is able to
1. Grind single point cutting tool with various angles
2. Perform taper turning and knurling on lathe
3. Perform drilling and thread cutting operations
4. Manufacture a gear using milling machine
5. Do operation on shaper
6. Exposed to various unconventional processes

Experiments:
1. Introduction to Machine Tools, like Lathe, Drilling, Milling and Shaper.
2. Plain and step turning operations on Lathe.
3. Step turning and Knurling on Lathe machine.
4. Taper turning on Lathe.
5. Drilling and Boring on Lathe.
6. Thread Cutting on Lathe.
7. Grinding of Single Point Cutting Tool.
8. Gear Cutting using (a) Plain Indexing. (b) Compound Indexing using universal dividing head.
9. Measurement of Cutting forces machine, during machining on Lathe machine, milling.
10. Finding Shear angle experimentally in turning operation.
11. Grinding flat surfaces using surface grinding machine and measurement of surface finish.
12. Process parameters of Electro Discharge Machining (EDM).

Text Books:

1. B.L. JuneJa and Shekon, Fundamentals of Metal Cutting & Machines Tools, Wiley Eastern Ltd. 1987.
2. P.N. Rao, Manufacturing Technology – Metal Culling & Machine Tools, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.

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16ME C32

THERMAL ENGINEERING LAB

Instruction	3	Hours per week
Duration of End Examination	3	Hours
End Examination	50	Marks
CIE	25	Marks
Credits	2	

Course Objectives:

1. To demonstrate knowledge in evaluating thermal conductivity of metal rod.
2. Student will understand how to evaluate critical heat flux.
3. Student will come to know the mechanism or formation of shock waves in convergent and divergent nozzle.
4. Student will come to know the working principle of axial flow fan and centrifugal blower.
5. Student will understand to evaluate the COP of Refrigeration tutor and AC tutor.
6. Student will come to know to evaluate drag and lift coefficients for contoured bodies.

Course Outcomes: Student will be able to

1. Estimate thermal conductivity of a metal.
2. Estimate the convective heat transfer coefficients for phase change heat transfer.
3. Know pressure distribution across the length of convergent and divergent nozzle.
4. Evaluate the overall efficiency of rotary compressors.
5. Determine COP of Refrigeration and air conditioned tutors.
6. Evaluate drag and lift coefficients for different profiles of automobiles.

Experiments:

1. Determination of Thermal conductivity of metal rod.
2. Determination of critical heat flux for copper wire in water.
3. Determination of convective heat transfer coefficient for condensation and boiling equipment.
4. Determination of pressure distribution for convergent and divergent nozzle
5. Determination of overall efficiency of axial flow fan
6. Determination of overall efficiency of centrifugal blower
7. Determination of COP of refrigerating tutor
8. Determination of COP of air conditioned tutor
9. Determination of humidification and dehumidification processes with AC tutor.

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10. Determination of pressure distribution for a cylinder
11. Determination of pressure distribution for an aerofoil
12. Determination of lift and drag coefficient for different contours.

Text Books:

1. Mahesh M. Rathore, Thermal Engineering, TMH, New Delhi, 2010.
2. R.K. Rajput, Heat Transfer, Laxmi Publication, 2014.

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CHOICE BASED CREDIT SYSTEM
B.E. (MECHANICAL ENGINEERING)

SEMESTER – VII

S. No.	Course Code	Title of the Course	Scheme of Instruction: Hours per week L/T	P/Dg	Scheme of examination: Duration in Hours	Maximum Marks CIE	SEE	Credits
		THEORY						
1	16ME C33	Metrology and Instrumentation	3	–	3	30	70	3
2	16ME C34	Operations Research	3	–	3	30	70	3
3	16PE C10	Production Drawing	1	2	3	30	70	3
4	16PE C11	Production and Operations Management	3	–	3	30	70	3
5	16ME C35	Finite Element Analysis	3/1	–	3	30	70	4
6		Professional Elective - V	3	–	3	30	70	3
		PRACTICALS						
7	16ME C36	Metrology and Instrumentation Lab	–	3	3	25	50	2
8	16ME C37	Computer Aided Engineering Lab	–	3	3	25	50	2
9	16ME C38	Seminar	–	2	–	50	–	1
		TOTAL	17	11		280	520	24

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective-V (3/3)		
SNO	Subj. Code	Name of the Subject
1	16ME E10	Renewable Energy Sources
2	16ME E11	Energy Conservation, Management and Audit
3	16ME E12	Engineering Research Methodology
4	16ME E13	Environmental Pollution

16ME C33

METROLOGY AND INSTRUMENTATION

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarize with limits, fits & tolerances and fundamental concepts of linear and angular measurements.
2. To have knowledge of various precision measuring instruments and concept of limit gauges.
3. To learn the importance of Geometric form and how to measure form errors.
4. To have knowledge in the concepts of classification of instrument errors and their characteristics.
5. To understand the working principles of various instruments used for the measurement of displacement, pressure and temperature.

Outcomes: At the end of the course, students are able to

1. Learn and understand the need for measurement and fundamental concepts of measurement.
2. Demonstrate sound knowledge in gauges design and gauge selection for inspection.
3. Demonstrate an ability to select and use the appropriate measuring instruments to measure surface roughness.
4. Recognize the concepts of errors, strain measurement, classification and instrument characteristics.
5. Apply the skills in measuring various quantities like displacement, pressure & temperature.

UNIT-I

Limits, Fits and Tolerances: Interchangeability, nominal size, limits, tolerances, allowance, fundamental deviation, unilateral and bilateral tolerances, Types of fits, alpha numeric designation of limits/fits, hole and shaft basis systems, selective assembly.

Linear and Angular Measurement: line and end standards, Slip gauges, Tomlinson gauges and Sine bar.

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UNIT-II

Design of Limit Gauges: Taylor's Principle for plan limit gauges, Design of GO and NO GO gauges, Use of Plug, Ring and Snap gauges.

Comparators: Introduction, Dial indicator, Sigma Mechanical comparator, Back pressure type Pneumatic comparator.

Optical Measuring Instruments: Optical projector principle and its uses, Tool maker's Microscope principle and its uses, interferometry.

UNIT-III

Straightness, Flatness and Roundness Measurement: Definitions, measurement by beam comparator, straight edge, spirit level, and bench centers.

Surface Roughness Measurements: Roughness and waviness, numerical assessment of surface roughness by CLA, RMS, Rz values, Surface roughness measurement by Profilometer, Taylor Hobson Talysurf, ISI symbols for indication of surface finish.

UNIT-IV

Screw Thread Metrology: Basic terminology of screw thread, measurement of effective diameter by 2 wire and 3 wire methods, Best wire size.

Gear Tooth Metrology: Spur Gear nomenclature, Gear tooth thickness measurement by gear tooth vernier.

Instrumentation: Static and Dynamic characteristics of instruments, Types of errors, Strain measurement with strain gauges, gauge factor, Rosette Gauges.

UNIT-V

Transducers: Displacement measurement by L.V.D.T, Pressure measurement by Bourdon pressure gauge, bulk modulus pressure gauge, pirani gauge, Temperature measurement by thermo couples, Laws of thermo electricity, Types of materials used in thermocouples.

Text Books:

1. R.K. Jain, "Engineering Metrology", Khanna Publications, 1996.
2. Doeblin, "Measurement Systems Application and Design", TMH, 5/ e., 2004.
3. Beckwith, Buck, Lienhard, "Mechanical Measurements", PEA, 3rd Indian Reprint, 2001.

Suggested Reading:

1. I.C. Gupta., "Engineering Metrology", Dhanpat Rai Pub., New Delhi, 1984.
2. Rega Rajendra," Principles of Engineering Metrology", Jaico Publishing House, Mumbai, 2008.
3. V.S.R. Murti, "Metrology and Surface Engineering", Frontline Publications, 2011.

16MEC34

OPERATIONS RESEARCH

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Students will come to know the formulation of LPP models
2. Students will understand the Algorithms of Graphical and Simplex Methods
3. Students will understand the Transportation and Assignment techniques
4. Students will come to know the procedure of Project Management along with CPM and PERT techniques
5. Students will understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, the students were able to

1. Formulate a managerial decision problem into a mathematical model;
2. Apply transportation problems in manufacturing industries;
3. Build and solve assignment models and travelling salesmen problems.
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing and queuing theory concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, Degeneracy in Simplex, Duality in Simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method. Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem. Degeneracy in Transportation. Profit Maximization in Transportation.

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UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems, Travelling salesman problems.

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.
Queuing Theory: Introduction, Kendal's Notation, single channel - poisson arrivals - exponential service times

Text Books:

1. Harody, A. Taha, "Operations Research-An Introduction", 6/e, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. Harvey M. Wagner, "Principles of Operations Research", 2/e, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, "Operations Research", 2/e, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013.

16PE C10

PRODUCTION DRAWING

Instruction	1 Lecture + 2 Drawing Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	2

Objectives: Students will understand

1. The need and the importance of production drawing
2. How to make part drawing from given assembly drawings and prepare process sheets.
3. Indication of size, form and positional tolerances on the drawing sheets
4. Surface finish and heat treatment process on the drawing sheets.
5. Notations, symbols and abbreviations on production drawings

Outcomes: On completion of the course the students will develop abilities to

1. Draw part drawings from given assembly drawings of machine parts.
2. Indicate tolerance values on the parts drawn on sheet as per alpha numeric codes for given assembly drawings
3. Indicate form tolerances and position tolerances on the parts drawn on the sheet as per universally accepted norms for a given assembly drawing
4. Indicate values of surface finish and heat treatment process on the parts drawn for a given assembly drawings.
5. Write process sheet for the part that is drawn from given assembly drawing and interpret production drawing and process sheet.

UNIT-I

Parts-I: Format of drawing sheet, title block, columns for materials, Processes, parts list, conventional representation of parts: screwed joints, welded joints, springs, gears.

UNIT-II

Parts II: Elements of electrical, hydraulic and pneumatic circuits, machine tool elements, methods of indicating notes on drawing

UNIT-III

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/ fits, types of fits, Interchangeability and selective assembly, Exercises involving selection/interpretation of fits and calculation of limits, dimensional chains.

UNIT-IV

Production Drawing: Conventional practices of indicating tolerance on size and geometrical form, position, surface finish, surface treatments, part drawing from assembled drawings (Stuffing box, Screw jack, I.C engine connecting rod, Revolving center, Square tool post, Single tool post, Universal coupling, Flange coupling, Steam engine cross head, Drill jig (plate type), Eccentric, Hydraulic cylinder), specification and indication of above features on the drawings, calculation of limits suggesting suitable fits for mating parts

UNIT-V

Assignments: Sketches of conventional representation of parts described with syllabus at (1) process sheets, tolerances and finishes obtainable from different processes. Study of IS 2709 on limits and fits

NOTE: Tolerance charts to be provided in the examination hall for calculation of limits

Text Books:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, "Production Drawing", New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, "Production Drawing Practice", Hitech Publishers, 2001.

Suggested Reading:

1. R.L. Murthy, "Precision Engineering in Manufacturing", New Age International Private Ltd., 1996
2. Venkata Reddy, "Production Drawing", New Age International, ISBN 978-81-224-2288-7, 2009
3. Faraздak Haideri, "Machine Drawing & Computer Graphics", Nirali Prakashan, ISBN 978-93-8072-527-7

16PE C11

PRODUCTION AND OPERATIONS MANAGEMENT

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy
3. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
4. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
5. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

Outcomes: At the end of the course, the student will be able to

1. Identify and evaluate the processes, tools and principles of production and operations management to better understand the logistics and supply chain operations
2. Demonstrate the ability to apply mathematical forecasting techniques
3. Identify future challenges and directions that relate to production and operations management to effectively and efficiently respond to market changes
4. Apply the tasks, tools and underlying principles of operations management in the manufacturing and service sectors to improve organizational performance
5. Explain and evaluate the quality process in manufacturing and service sector to improve the operational performance

UNIT-I

Production & Operations Management: Introduction: Types of Production Systems, job shop, batch, flow shop

Plant Location and Layout: Factors affecting plant location, plant layout objectives, types of layouts, merits and demerits.

Work Study: Introduction to method study and work measurement, standard time calculations, work sampling, wages and incentives, types of incentive plans.

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UNIT-II

Forecasting: Introduction, forecasting objectives and uses, demand patterns, qualitative models, market survey, Delphi method, quantitative models, moving average, weighted moving average, simple exponential smoothing, trend adjusted exponential smoothing, simple regression.

Forecast Errors: Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error (MFE), Mean Absolute Percentage Error (MAPE)

UNIT-III

Aggregate Planning and Master Scheduling: Introduction, objectives of aggregate planning, cost in aggregate planning, strategies in aggregate planning, master production scheduling

Materials Requirement Planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials.

UNIT-IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs, deterministic inventory models, basic EOQ model, production model without shortages, purchase model with instantaneous replenishment and with shortages, production model with shortages, inventory model with price breaks, fixed order quality system, periodic review system.

UNIT-V

Quality Control: Introduction, quality gurus and their contributions, quality tools, process capability, quality control by control charts, control charts for variables and attributes, sampling plans, operating characteristic curve, introduction to total quality management

Text Books:

1. Stevenson, "Operation Management", Mc-Graw Hill International.
2. Joseph Monks, "Operations Management", TMH Publishers, New Delhi, 2004.
3. S. Buffa Elwood, "Modern Production /Operations Management", John Wiley Publishers, Singapore, 2002.

Suggested Reading:

1. Everrete E. Adama & Ronald J. Ebert, "Production & Operations Management", 5/e, Prentice Hall of India, 2005.
2. R. Panneer Selvam, "Production and Operations Management," 2/e, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. S.N. Chary, "Production and Operations Management", 3/e, Tata McGraw Hill, 2006.

16ME C35

FINITE ELEMENT ANALYSIS

Instruction	3 Lecture – 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:

1. Equip the students with the Finite Element Analysis fundamentals and formulations
2. Enable the students to formulate the axial, truss , beam and circular shaft problems
3. Enable the students to formulate 2D problems with special cases
4. Enable the students to formulate quadrilateral element, use of numerical integration, Gaussian quadrature and one dimensional dynamic problems
5. Enable the students to understand the convergence requirements, heat transfer , formulate 3D problems and perform engineering simulations using Finite Element Analysis software (ANSYS)

Outcomes: At the end of the course a student will be able to

1. Apply FE method for solving field problems using Virtual work and Potential energy formulations
2. Analyze linear problems like axial, trusses , beam problem and circular shaft problems
3. Analyze 2D structural problems using CST element and analyze plane stress, plane strain and axi-symmetric problems with triangular elements.
4. Write shape functions for 4 node quadrilateral isoparametric elements, apply numerical integration, Gaussian quadrature and to estimate natural frequencies for stepped bar
5. Check for convergence requirements. Solve linear 1D and 2D heat conduction and convection heat transfer problems, formulate 3D elements, apply finite element analysis software for engineering solutions

UNIT-I

Fundamental Concepts: Introduction to finite element method, stresses and equilibrium, boundary conditions, strain – displacement and stress – strain relationship

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One Dimensional Problem: Different co-ordinate systems and shape functions, virtual work and potential energy approach, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, analysis of axial element and quadratic element

UNIT-II

Analysis of Trusses: Element stiffness matrix for a truss member, Analysis of plane truss with two degrees of freedom at each node,

Analysis of Beams: element stiffness matrix for two nodes (two degrees of freedom per node

Analysis of Frames: Analysis of frames with two translations and rotational degrees of freedom per node, Analysis of circular shaft subjected to torsion

UNIT-III

2D Triangular Elements: Plane stress, plane strain and axisymmetry ,finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modeling of axisymmetric solids subjected to axisymmetric loading with triangular elements

UNIT-IV

Quadrilateral Elements and Numerical Integration: Two dimensional four noded isoparametric elements, numerical integration and Gauss quadrature

Dynamic Analysis: Formulation of finite element model, element mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam

UNIT-V

Heat Transfer Analysis: Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate, Formulation of time dependent field problems, application to one dimensional heat flow in a rod

3 D Elements and FEA Software: Introduction to finite element formulation of three dimensional problems in stress analysis, convergence requirements

Introduction to Finite Element analysis Software: Modeling, analysis and post processing

Text Books:

1. G. Ramamurthy, "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Ltd., New Delhi, 2009.
2. Tirupathi R Chandrupatla and Ashok D Belagundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India, 1997
3. Daryl L. Logan, "A First Course in the Finite Element Method", Cengage Learning, 2011.

Suggested Reading:

1. S.S. Rao, "The Finite Element Method in Engineering", Pergamon Press, 1989.
2. L. J. Segerlind, "Applied Finite Element Analysis", Wiley Eastern, 1984.
3. J.N. Reddy, "An Introduction to Finite Element Method", McGraw-Hill. 1984.
4. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt., "Concepts and Applications of Finite Element Analysis", 4/e, Wiley.

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16ME E10

RENEWABLE ENERGY SOURCES (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn the

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of geothermal energy and bio-energy
5. Merits and demerits of tidal energy, wave energy and OTEC

Outcomes: At the end of the course, the students are able to

1. Understand the depletion and of environmental impact conventional sources of energy and will suggest suitable renewable energies in place of conventional energies
2. Determine the principles of absorption
3. Understand the problems associated with utilizing the wind energy
4. Describe the physics of geothermal resources and describe how biomass is currently used as a source of energy
5. Explain the physical principles of wave energy, tides and the environmental impact of OTEC plants

UNIT-I

Energy Sources: Statistics on conventional energy sources and supply in developing countries - Definition-Concepts of RES - Limitations of RES - Classification of RES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources - comparison of these energy sources

UNIT-II

Solar Energy: Solar Radiation – Solar Thermal Collectors – Flat Plate and Concentrating Collectors and their limitations – Comparison - Solar Applications-Solar thermal power plant – Space based solar power – advantages and limitations of solar thermal energy – PV cells - PV materials - solar satellite system-advantages and disadvantages

UNIT-III

Wind Energy: Merits and demerits-Wind power plant-site selection - Power formula – Betz's limit – Effect of velocity on power generation - classification of wind power plants- Horizontal axis and vertical axis windmills -Working principle - New developments.

UNIT-IV

Geothermal Energy: Layers in earth-Classification of resources of Geothermal Energy – working principle.

Biomass Energy: Biomass-Raw materials-Source, Composition, Conversion technologies – Direct combustion- Pyrolysis—Gasification, Biomass gasifiers – float and fixed dome types-Common operational problems, causes and remedies relating to a biogas plant-Economical, social, environmental and health benefits of bio gas utilization

UNIT-V

Wave, Tidal and OTEC Energy: Difference between tidal and wave power generation-Tidal power plant – principle of Operation-single basin and double basin tidal plants- advantages and limitations, OTEC power plants- Open and closed OTEC Cycles- advantages and limitations -Environmental impacts of OTEC.

Text Books:

1. S. Hasan Saeed and D.K. Sharma, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2014.
2. Dr. R.K. Singal, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2005.
3. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.

Suggested Reading:

1. K. M. Mittal, "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Shali Habibulla, "Non-Conventional Energy Sources", State Institute of Vocational Education, Hyderabad, 2005.
3. Ashok V Desai, "Non-Conventional Energy", Wiley Eastern Ltd, New Delhi, 2003.

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16ME E11

ENERGY CONSERVATION, MANAGEMENT AND AUDIT

(Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To make the students to know the importance of energy sector in country's development
2. To identify various auditing services
3. To prepare the organizational structure energy policy
4. To get the concept of management in process industries
5. To explain how to take tax considerations

Outcomes: Students will be able to

1. Know energy scenario both India and world
2. Review and asses the various audit tools
3. Understand energy policy planning and take energy management as a profession
4. Analyze energy security, codes, standards,
5. Arrange the financial arrangements for industries

UNIT-I

Global & Indian Energy Scenario: Basics of Energy and its various forms - Classification of Energy sources- Applications of Non - Conventional and Renewable Energy Sources - Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns

UNIT-II

Energy Audit: Material and Energy Balance - Energy Action Planning - Energy Monitoring and Targeting - Types of energy audit, Energy Auditing Services Basic Components of an Energy Audit Specialized Audit Tools Industrial Audits Commercial Audits Residential Audits Indoor Air Quality.

Energy Management: Program Organizational Structure Energy Policy Planning Audit Planning Educational Planning Strategic Planning, The Value of Energy Management The Energy Management Profession Some Suggested Principles of Energy Management. Energy Management Systems Justification of EMCSs Systems Integration.

UNIT-III

Energy Efficiency in Thermal Utilities - Fuels and Combustion - Boilers -Steam System - Furnaces - Insulation and Refractory - FBC Boilers -Cogeneration - Waste heat recovery - Compressed Air System. - Diesel Generating System

Energy Efficiency in Electrical Utilities - Electrical Systems -Electric Motors - Lighting System - Energy Efficient Technologies in Electrical Systems

Energy Performance Assessment for Equipment and Utility systems - Turbines (Gas, Steam) - Heat Exchangers - Fans and Blowers - Pumps and Pumping System- Water Pumps - Compressors.

HVAC Systems - Refrigeration System. - Cooling Tower

UNIT-IV

Waste Heat Recovery: Waste Minimization and Resource Conservation - Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act. Economics of Waste-Heat Recovery, Energy management in water and waste water treatment – solid waste treatment- air pollution control systems . Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration –

UNIT-V

Performing Financial Analysis: Introduction General Characteristics of Capital Investments Sources of Funds Tax Considerations Time Value of Money Concepts Project Measures of Worth Economic Analysis-Financing Energy Management Projects Introduction Financial Arrangements: A Simple Example Financial Arrangements: Details and Terminology Applying Financial Arrangements: A Case Study "Pros" & "Cons"

Text Books:

1. CB Smith, "Energy Management Principles", Pergamon Press., New York, 1981.
2. W R Murphy, G McKay, "Energy Management", Butterworth Heinemann, 2007.
3. W.C. Turner, "Energy Management Handbook", 5/e, Marcel Dekker, Inc, New York, 2005.
4. W. C. Turner, W. J. Kennedy, "Guide to Energy Management, B. L. Capehart", CRC Press, New York, 2005.

Suggested Reading:

1. Trivedi, PR, Jolka KR, "Energy Management", Commonwealth Publication, New Delhi, 1997
2. Witte, Larry C. "Industrial Energy Management & Utilization", Hemisphere Publishers, Washington, 1988.
3. Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of energy efficiencies, 2005.

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16MEE12

ENGINEERING RESEARCH METHODOLOGY

(Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. **To make the students to formulate the research problem**
2. **To identify various sources for literature review and data collection.**
3. **To prepare the research design**
4. **To equip the students with good methods to analyze the collected data**
5. **To explain how to interpret the results and report writing**

Outcomes: At the end of the course, the students are able to

1. **Define research problem**
2. **Review and asses the quality of literature from various sources.**
3. **Understand and develop various research designs.**
4. **Analyze problem by statistical techniques: ANOVA, F-test, Chi-square**
5. **Improve the style and format of writing a report for technical paper/ Journal report**

UNIT – I:

Research Methodology: Objectives and Motivation of Research, Types of Research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research Approaches, Significance of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information-primary, secondary, tertiary, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT – III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Steps in sample design.

UNIT – IV

Data Collection: Collection of primary data, Secondary data, Measures of central tendency-mean, mode, median, Measures of dispersion- Range, Mean deviation, Standard deviation, Measures of asymmetry (skewness), Important parametric tests -z, t, F, Chi-Square, ANOVA significance

UNIT – V

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation- Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Books:

1. C.R Kothari, "Research Methodology Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011

Suggested Reading:

1. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
2. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.
3. Naval Bajjai, "Business Research Methods", Pearson, 2011.

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16ME E13

ENVIRONMENTAL POLLUTION (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectivities: Student will understand

1. the need for control of different types of pollution levels
2. the factors causing water pollution and its remedial methods
3. the importance of disposal of solid waste, related laws and regulations
4. the need for control of air pollution from industry
5. the factors affecting sound pollution

Outcomes: Student will be able to identify

1. factors affecting global warming
2. the method of reducing water contamination
3. the methods of disposal of nuclear waste, related law and regulation
4. the method of reduction of air pollution from industry
5. the methods of controlling sound pollution

Unit-I

Pollution & Environmental Ethics: Environmental ethics, environmental risk analysis, global warming, environmental impact and economic assessment, environmental laws and environmental economics, economic growth versus environment

Unit-II

Water Pollution: Water pollution, Measurement of water quality, water supply, water treatment, collection of waste water, waste water treatment, ground water contamination, treatment, utilization and disposal, water pollution laws and regulations, oil pollution, soil pollution

Unit-III

Solid Waste Management: Solid waste management, solid waste disposal, reuse, recycling and recovery, hazardous waste, nuclear and radioactive waste, hazardous and radioactive waste laws, regulations

Unit-IV

Air Pollution: Air pollution from factories, air pollution from internal combustion engines, Factors affecting air pollution, pollution analyzers, Control, remedies, measurement of air quality, air pollution from thermal power plants, meteorology.

Unit-V

Noise Pollution: Ambient noise levels, noise standards, noise pollution, biological and behavioural effects of noise, magnitude of risk, effect of noise on non-living things, noise pollution control.

Text Books

1. C.S.Rao, "Environmental Pollution Control Engineering", New Age International (P) Limited, Publishers, New Delhi, 2006
2. N.H. Gopal Dutt, "Environmental Pollution and Control", Neelkamal Publishers, New Delhi, 2005

Suggested Reading:

1. Jeremy Colls, "Air Pollution", Span Press, 2002
2. S.K. Agarwal, "Noise Pollution", APH Publishing, New Delhi, 2005
3. R.K. Khitoliya, "Environmental Pollution", Chand Publishers, New Delhi, 2014

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16MEC36

METROLOGY AND INSTRUMENTATION LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives:

1. To choose the proper measuring instrument for the precise measurement of Length, Height and diameter
2. To select the proper measuring instrument for the angular measurement.
3. To indentify gear & screw thread parameters using optical projector and tool makers microscope.
4. To familiarize with limits, fits and tolerances for gauge selection and design.
5. To understand the working principles in the measurement of Flatness, Roundness and Surface roughness.

Outcomes: At the end of the course, the students were able to

1. Identify methods and devices for measurement of length, height and diameter.
2. Acquire the knowledge about angular measurement and various measuring instruments.
3. Recognize & measure the gear and screw thread parameters using profile projector and tool maker microscope.
4. Demonstrate the sound knowledge in gauges selection, design and measurement.
5. Acquire adequate knowledge in the measurement of flatness, roundness and surface roughness.

Experiments:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope – Diameter of thin wire and single point cutting tool angle.
4. Measurement with Dial Indicator and its calibration.
5. Measurement of angles with Sine bar and clinometers.

6. Measurement of roundness errors with bench centers.
7. Measurement of flatness errors of a surface plate with precision spirit level.
8. Measurement with optical profile projector.
9. Design of Plug gauge for a given hole.
10. Design of Snap gauge for a given shaft.
11. Surface roughness measurement by Taylor Hobson -Talysurf.
12. Measurement of Gear tooth thickness by gear tooth vernier.
13. Displacement measurement with LVDT.

Note: Student should complete a minimum of 10 experiments.

Suggested Reading:

1. I.C. Gupta, "Engineering Metrology", Dhanpat Rai Pub., New Delhi, 1984.
2. B.C. Nakra & K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e, McGrawhill, 2014

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16ME C37

COMPUTER AIDED ENGINEERING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives: Study FEA package and model

1. Trusses , Bars of constant cross section area, tapered cross section area and stepped bar
2. Simply supported and clamped beam subjected to UDL, UVL and Point load
3. Stress analysis of a rectangular plate with a circular hole, axisymmetric problems
4. Buckling and Dynamic analysis
5. Steady state and Transient heat transfer analysis

Outcomes: At the end of the course a student should be able to:

1. Apply basics of Theory of Elasticity to continuum problems.
2. Formulate finite elements like beam elements for linear static structural analysis.
3. Develop models for 2D and axisymmetric finite elements and 1D heat transfer
4. Solve problems of limited complexity in buckling and dynamic analysis
5. Utilize finite element software to simulate practical problems

List of Excercises:

1. Analysis of plane truss & spatial truss with various cross sections and materials
2. Beam analysis with different sections, different materials for different loads.
3. Static analysis of plate with a hole.
4. Plane stress, plane strain and axisymmetric loading on the in plane members.
5. Static analysis of connecting rod with tetrahedron and brick elements.
6. Static analysis of flat and curved shell due to internal pressure.
7. Buckling analysis of plates, shells and beams to estimate BF and modes.

8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
9. Harmonic analysis of a shaft and transient analysis of plate.
10. Steady state heat transfer analysis of chimney and transient analysis of castings.
11. Non linear analysis of cantilever beam.
12. Coupled field analysis

Note: 1. Student should complete a minimum of 10 experiments.
2. Any of FEA software ANSYS/ABAQUS/NASTRAN/NISA/ CAEFEM/ADINA may be used.

Suggested Reading:

1. Tadeusz. A. Stolarski, Y. Nakasone, S. Yoshimoto, "Engineering Analysis with ANSYS Software", 1/e, Elsevier Butterworth-Heinemann publications, 2007.
2. ANSYS Inc., "User Manuals for Release 15.0"

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16ME C38

SEMINAR

Instruction	3 Hours per week
Duration of Semester End Examination	--
SEE	--
CIE	50 Marks
Credits	2

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall preferably be from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
CHOICE BASED CREDIT SYSTEM
B.E. (MECHANICAL ENGINEERING)

SEMESTER – VIII

S. No.	Course Code	Title of the Course	Scheme of Instruction: Hours per week L/T	P/D	Scheme of Examination: Duration in Hours	Maximum Marks CIE	SEE	Credits
		THEORY						
1		Professional Elective – VI	3	–	3	30	70	3
2		Open Elective – I	3	–	3	30	70	3
3		Open Elective – II	3	–	3	30	70	3
		PRACTICALS						
4	16ME C39	Project Seminar	–	3	–	50	–	2
5	16ME C40	Project	6	–	–	50	100	6
		TOTAL	15	3		190	310	17

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE Semester End Examination

Professional Elective-VI (3/3)		
SNO	Subj. Code	Name of the Subject
1	16ME E15	Power Plant Engineering
2	16ME E16	Principles of Entrepreneurship
3	16ME E17	Innovations, Protection and Legal Aspects
4	16PE E11	Supply Chain Management
5	16ME E18	Nano Science and Technology

Open Elective – I (3/3)			Open Elective – II (3/3)		
S. No	Subj. Code	Name of the Subject	S. No.	Subj. Code	Name of the Subject
1	16CE O02	Disaster Mitigation and Management	1	16IT O01	Object Oriented Programming using JAVA
2	16IT O06	Principles of Internet of Things	2	16PY O01	History of Science and Technology
3	16EE O03	Energy Auditing	3	16CE O05	Waste Management
4	16EC O07	Systems Automation and Control	4	16EC O05	MEMS and its Applications
5	16CS O06	Basics of Artificial Intelligence	5	16CS O07	Basics of Cyber Security

16ME E15

POWER PLANT ENGINEERING (Professional Elective– VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn
1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plants, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics, environmental and safety aspects of power plant operation.

Outcomes: At the end of the course, the student will be able to
1. Select the suitability of site for a power plant.
2. Propose ash handling, coal handling method in a thermal power plant
3. Understand the water cycle, flow-sheet of hydro-power plant and types of dams and spillways
4. Explain working principle of different types of nuclear power plant.
5. Know the various factors of plant load and economy and safety aspects of power plants

UNIT - I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants

Steam power plant: Plant Layout, types of coals, coal handling equipment, Ash and Dust handling systems

UNIT II

Steam Power Plant: Combustion Process - Overfeed and Underfeed stokers-traveling grate stokers, spreader stokers, retort stokers- single retort and multi-Retort - Pulverized fuel burning systems – components – burners – Unit and Bin - working

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UNIT III

Hydro Electric Power Plant: Hydrological cycle, flow measurement, Hydrographs – flow/mass duration curve - drainage area characteristics, Types of hydroelectric power plants- working - storage and pondage - classification and working of dams and spill ways.

UNIT - IV

Nuclear Power Plant: Nuclear fuel - breeding and fertile materials - types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Gas cooled Reactor-Radioactive waste disposal.

UNIT - V

Power Plant Economics and Environmental Considerations:

Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises-Fixed cost and variable cost-methods to find depreciation cost. Effluents from power plants and Impact on environment – pollutants - Pollution control.

Text Books:

1. R.K. Rajput, "A Text Book of Power Plant Engineering", 4/e, Laxmi Publications (P) Ltd., New Delhi, 2015.
2. P.K. Nag, "Power Plant Engineering", 4/e, McGraHill Education(India) Private Limited, New Delhi, 2014.
3. S.C. Arora and S. Domukundwar, "A Course in Power Plant Engineering", Dhanpat Rai & Sons, New Delhi, 2005.

Suggested Reading:

1. R. Yadav, "Fundamentals of Power Plant Engineering", Central Publishing House, Allahabad, 2012.
2. R.K. Hegde, "Power Plant Engineering", Pearson Education India, 2015.
3. P.C. Sharma, "A Text Book of Power Plant Engineering", S.K. Kataria & sons, New Delhi, 2016.

16MEE16

PRINCIPLES OF ENTREPRENEURSHIP (Professional Elective - VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Concept and procedure of idea generation
2. The nature of industry and related opportunities and challenges
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Analyse ideas for new and innovative products or services
2. Identify opportunities and deciding nature of industry
3. Analyze the feasibility of a new business plan and preparation of Business plan
4. Use project management techniques like PERT and CPM
5. Analyze behavioral aspects and use time management matrix

UNIT-I

Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, women entrepreneurs, need of innovation in entrepreneurial journey, Conception and evaluation of ideas and their sources.

UNIT-II

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Entrepreneurship and Engineering, Small Scale Industry in India, Objectives, Linkage among small, medium and large scale industries, Types of enterprises, Corporate Social Responsibility

UNIT-III

Formulation of Business Plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis,

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Marketing Analysis, Feasibility studies, Executive Summary. Selection of Technology, Collaborative interaction for Technology development

UNIT-IV

Project Management: During construction phase, project organization, project planning, execution and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden, environmental issues.

UNIT-V

Behavioral Aspects of Entrepreneurs: Personality, determinants, Maslow's Hierarchy of needs. Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Mc Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
3. G.S. Sudha, "Organizational Behavior", National Publishing House, 1996.

16ME E17

INNOVATIONS, PROTECTION AND LEGAL ASPECTS

(Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture and techno-business aspects of IPR

Outcomes: At the end of the course, a student:

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Will be capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IPR and converting creativity into IPR and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR). IPR in India – Genesis and Development, IPR abroad. Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document. How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models. Differences between a utility model and a patent. Trade secrets and know-how agreements

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UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights coveed by copyright? Copy rights in computer programming.

UNIT-V

Geographical indications: Introduction, definition, difference between GI and trademark, difference between GI and appellation of origin, GI as factors of rural development, developing a geographical indication and protection

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition, Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra;" Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

Suggested Reading:

1. Cronish W.R1 "Intellectual Property; Patents, copyright, Trad and Allied rights", Sweet & Maxwell, 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, "A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs", 4/e, ,Sweet, Maxwell.

16PE E11

SUPPLY CHAIN MANAGEMENT (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. The awareness about transportation and warehouse management systems.
2. The designing supply chain networks.
3. The concept of demand and supply and integrating it with supply chain management.
4. The planning and managing inventories.
5. The pricing and revenue management

Outcomes: At the end of the course, the student is able to

1. Plan an effective transportation and warehouse management systems
2. Design an effective supply chain networks
3. Integrate and optimize demand and supply gaps
4. Apply inventory management techniques
5. Understand and design pricing and revenue management systems

UNIT-I

Concept of SCM: Concept of Logistics Management, Supply Chain, Types of supply chain, functions in SCM, Transportation Management, Warehousing Management, Warehouse management systems.

UNIT-II

Designing the Supply Chain Network: Designing the distribution network, Network Design, Network Design in an uncertain environment.

UNIT-III

Planning and Demand: Planning demand & supply in a supply chain, demand forecasting, aggregate planning, planning supply & demand.

UNIT-IV

Planning & Managing Inventories in a Supply Chain: managing economies of scale, cycle inventory, and managing uncertainty safety inventory optimal level of product availability

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UNIT-V

Sourcing, Transporting & Pricing Products: sourcing decisions, transportation, pricing & revenue management. Coordination & technology in the supply chains, coordination in supply chain, information technology and supply chain.

Text Books:

1. N. J. Kumar & Mukesh Bhatia, "Supply Chain Management", Neha publishers & Distributors, 2010.
2. Michael H. Hugos, "Essentials of Supply Chain Management", 3/e, John Wiley & Sons, Inc, Hoboken, New Jersy, 2011.
3. Sunil Chopra & Peter Meindl, "Supply Chain Management – Strategy, Planning and Operation", Pearson Education, Inc., Upper Saddle River, New Jersey, 2003.

Suggested Reading:

1. Martin Christopher, "Logistics & Supply Chain Management", 5/e, Financial Times Series, 2010.
2. Dobler Donald. W, David.N.Burt, "Purchasing & supply Management Text & Cases", McGraw-Hill, 1996.
3. A.K. Chitale, R.C. Gupta, "Materials Management-Text and Cases", Prentice-Hall Of India Pvt. Limited, 2007.

16MEE18

NANO SCIENCE AND TECHNOLOGY (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Nanotechnology approach and challenges
2. Materials and characterization procedures
3. Zero and One dimensional Nano structures
4. Various Fabrication Techniques
5. Special nano materials and Nano biomaterials

Outcomes: At the end of the course, students will

1. Understand the developments and challenges in nano technology
2. Understand magnetic and electronic properties and its microstructure
3. Learn synthesis and characterization techniques of Zero and One dimensional Nano structures and their applications
4. Study various Nano Material Fabrication Techniques
5. Understand the applications of special nano materials and nano bio materials

UNIT-I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in nanotechnology, proximal probe technologies

UNIT-II

Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, Ferroelectric materials, Polymer materials, GaAs& InP (III-V) group materials, Nanotribology and materials, characterization using Scanning Probe Microscope, AFM and Friction force microscopy

UNIT-III

Nano Structures: Zero dimensional Nanostructure, synthesis procedure by heterogeneous method, characterization techniques, properties and applications particles

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One dimensional Nanostructures: Nanowires, Nanotubes and its Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires

UNIT-IV

Nano Fabrication: Introduction, Basic fabrication techniques by Lithography, thin film deposition and doping, MEMS fabrication techniques, Nano fabrication techniques by E-beam, Nano-imprint fabrication, Epitaxy and strain engineering

UNIT-V

Special Nano Materials: Introduction, Synthesis procedure by metal-polymer, metal ceramic and polymer ceramic, Characterization procedures, applications

Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, applications

Text Books:

1. Dieter Vollath, "Nanomaterials: An introduction to Synthesis, properties and applications", Wiley, 2013
2. Guozhong Cao, "Nanostructures and Nano Materials, Synthesis properties and applications", Imperial College Press
3. Carl C Koch, "Nano materials Synthesis, Properties and applications", Jaico Publishing House

Suggested Reading:

1. Willia Tilsey Atkinson, "Nano Technology", Jaico Publishing House
2. George W. Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009
3. T. Pradeep, "Nano: Essentials-understanding Nano Science and Technology", TMH, 2007

16CE O02

DISASTER MITIGATION AND MANAGEMENT (Open Elective - I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Outcomes: At the end of the course the students are able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various

participatory approaches/strategies and their application in disaster management.

UNIT-I:
Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:
Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:
Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT-IV:
Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects-gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V:
Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction. DRR

programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh,"Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, "Government of India, "National disaster management plan, Part I and II"
2. K. K. Ghosh,"Disaster Management", APH Publishing Corporation, 2006.
3. "Hazards, Disasters and your community: A booklet for students and the community", Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

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16IT O02

PRINCIPLES OF INTERNET OF THINGS (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To provide an overview of Internet of Things, building blocks of IoT and real-world applications.
2. To explore various IOT enabling technologies.
3. To facilitate students, understand Python scripts for IoT platform.
4. To identify steps in IOT design Methodology.
5. To introduce about the Raspberry Pi device, its interfaces and Django Framework.

Outcomes: Upon completing this course, students will be able to:

1. Comprehend the terminology, protocols and communication models of IoT.
2. Define the various IoT enabling technologies and differentiate between M2M and IoT.
3. Acquire the basics of Python Scripting Language used in developing IoT applications.
4. Describe the steps involved in IoT system design methodology.
5. Design simple IoT systems using Raspberry Pi board and interfacing sensors with Raspberry Pi.

UNIT-I

Introduction & Concepts: Introduction to Internet of Things- Definitions & Characteristics ofIoT, Physical Design of IOT-Physical Layer, Network Layer, Transport Layer, Application Layer, Things in IoT, IoT Protocols, Logical Design of IOT-IoTFunctional Blocks, IoT Communication Models-Request-reponse,Publisher-Subscriber,Push-Pull,Exclusive Pair, IoT Communication APIs-REST API, Websocket API,

UNIT-II

IOT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates. Differences and similarities between IOT and M2M,

Domain Specific IoT's – IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT-III

Introduction to Python–Motivation for using Python for designing IoT systems, Language features of Python, Data types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling, data/time operations, classes, Exception handling.

UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-V

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi about the Raspberry Pi board, Raspberry Pi interfaces-Serial, SPI, I2C, Other IoT Devices pcDuino, BeagleBone Black, Cubieboard. Python Web Application Framework: Django Framework-Roles of Model, Template andView

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.

Suggested Reading:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications.

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Web Resources:

1. The Internet of Things - Article
   https://dl.acm.org/citation.cfm?id=1862541
2. Internet of Things - Tutorial
   http://archive.eurescom.eu/~pub/about-eurescom/message_2009_02/Eurescom_message_02_2009.pdf
3. Publications on The Internet of Things
   http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf

16EE O03

ENERGY AUDITING (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To know the concept of Energy auditing.
2. To understand the formulation of efficiency for various engineering systems
3. To explore the different ways to design various technologies for efficient engineering systems.

Outcomes: After completion of this course, students will be able to:

1. Know the current energy scenario and importance of energy auditing.
2. Understand the concepts of energy auditing.
3. Evaluate the performance of existing engineering systems
4. Explore the methods of improving energy efficiency in different engineering systems
5. Design different energy efficient devices.

UNIT-I

Basics of Energy and its Various Forms: Overview of engineering, elements Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bio energy, bio mass energy conservation, elements of geothermal energy, sources of geothermal energy, sources of chemical energy, fuel cells, Energy Scenario in India.

UNIT-II

Energy Auditing-I: Introduction: Need for energy audit, directions for the study of energy auditing, inclusions for energy auditing, types of energy audit: preliminary audit, general/mini audit, investment-grade/ comprehensive audit. Major energy consuming equipments and systems, energy audit team, energy auditing methodology: preliminary and detailed. Process flow diagram, energy audit report format

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UNIT-III

Energy Auditing-2: For Buildings: Energy auditing instruments, energy efficiency, energy auditing for buildings: stages in programs, surveying, measurements and model analysis. Energy audit form of commercial buildings, checklist for energy saving measures

UNIT-IV

Energy Efficient Technologies-I: Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure;

UNIT-V

Energy Efficient Technologies-II: Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper

Text Books:

1. Umesh Rathore, 'energy management', Kataria publications, 2nd ediiton. 2014.
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
3. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/ civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.

Suggested reading:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

16EC O07

SYSTEM AUTOMATION AND CONTROL (Open Elective - 1)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: This course aims to

1. Learn the concepts industrial control systems
2. Learn how to measure the physical parameters in industry
3. Learn the applications of Robots in industry.

Outcomes: After completion of this course, students will be able to:

1. Understand various process control systems.
2. Measure the physical parameters in the industry.
3. Design PID controllers
4. Understand the role of digital computers in automation
5. Understand the applications of Robots

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented. Introduction to Automatic Control theory.

Sensors: Motion, Position, Force, Level sensors and Thermo couples.

UNIT-II

Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.

Measurement Techniques and Hardware: Typical Sensor outputs, Bridgemeasurements, Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III

Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, PD, PI, PID Controllers, Analog and Digital methods of Control.

Controller Hardware: Analog and Digital Controllers.

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UNIT-IV

Digital Computers as Process Controllers: Use by Digital Computer for process control, Information required by the computer, Information required by the process, Computer interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.

Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications.

Trouble shooting System failures: Preliminary stepsand other troubleshooting aids.

Text Books:

1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested reading:

1. Kuo BC. "Automatic Control Systems", 9/e
2. AK Sawhney, "A course on Electrical and Electronic Measurements and Instrumentation".

16CS O09

BASICS OFARTIFICIAL INTELLIGENCE (Open Elective - I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The objectives of this course are

1. Provide a strong foundation of fundamental concepts in Artificial Intelligence.
2. Discuss the various paradigms involved in solving an AI problems which involve perception, reasoning and learning
3. Apply the AI concepts to build an expert system to solve the real-world problems.

Outcomes: On Successful completion of this course, student will be able to

1. Differentiate between a rudimentary Problem and an AI problem, it's Characteristics and problem-solving Techniques.
2. Compare and contrast the various knowledge representation schemes of AI.
3. Understand and analyze the various reasoning and planning techniques involved in solving AI problems.
4. Understand the different learning techniques.
5. Apply the AI techniques to solve the real-world problems.

UNIT-I

Introduction: Definition, history, applications.

Problem Solving: AI problems, AI Technique, Defining problem as a State-Space Search, Problem Characteristics, Heuristic Search Techniques: Generate-and-test, Hill Climbing, Constraint Satisfaction.

UNIT-II

Knowledge Representation (Logic): Representing facts in logic, proposition logic, predicate logic, resolution and unification.

Knowledge Representation (Structured): Declarative representation, Semantic nets, procedural representation, frames.

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UNIT - III

Reasoning: Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster-Shafer Theory.

Planning: Components, goal stack planning, nonlinear planning, hierarchical planning.

UNIT - IV

Learning: Introduction, Rote learning, learning by taking advice, learning in problem solving and learning from examples: Decision tree.

Intelligent Agents: Classification, Working of an agent, single agent and multi agent systems, multi agent application.

UNIT - V

Expert System: Representing and Using Domain Knowledge, Expert systems shells, Explanation, Knowledge Acquisition.

Perception and Action: Real Time Search, Vision, Speech Recognition, **Action:** Navigation, Manipulation, Robot architectures.

Text Books:

1. Elaine Rich, Kevin Night, Shivashankar B Nair, "Artificial Intelligence", 3/E, 2008
2. Russell Norvig, "Artificial Intelligence-Modern Approach", 3/E, 2010.

Suggested Reading:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2012.
2. Nelson M. Mattos, "An Approach to Knowledge Base Management", Springer Berlin Heidelberg, 1991.

Online Resources / Weblinks / NPTEL Courses:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

16IT O01

OBJECT ORIENTED PROGRAMMING USING JAVA

(Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To facilitate learning Exception handling and Multithreading mechanisms.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize with event driven GUI programming and Database connectivity.

Outcomes: Upon completing this course, students will be able to

1. Understand Object-Oriented concepts.
2. Create Java applications using sound OOP practices e.g. Inheritance, Interfaces, Packages, and Inner classes.
3. Implement Exception Handling and Multithreading concepts in java programs.
4. Develop programs using the Java Collection API and Stream classes.
5. Design and Develop GUI applications with the integration of event handling, JDBC.

UNIT-I

OOP concepts – Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms.

Introduction to Java: Java's Magic: The Byte code, The Java Buzzwords, Simple Java Programs, Java Primitive Types, Arrays: How to create and define arrays, Basic Operators, Control statements.

Introducing Classes: Declaring objects, methods, Constructors, this keyword, Method Overloading and Constructor Overloading, Objects as parameters, Returning objects, Use of static and final keywords.

UNIT-II

Inheritance: super and subclasses , Member access rules ,super keyword, Method overriding, Dynamic method dispatch , Abstract classes, using final with inheritance , Introduction to Object class.

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

Interfaces : Defining and implementing interfaces, Nested Interfaces.

Strings Handling: String & StringBuffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives.

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT-III

Exception Handling in Java: what are Exceptions? Exception types, Usage of try, catch, throw, throws and finally clauses, writing your own exception classes.

Multithreading in Java: The java Thread Model, How to create threads, Thread class in java, Thread priorities, Thread synchronization.

Generics: What are Generics? Generic classes, bounded types, Generic methods and interfaces.

UNIT-IV

Collections Framework: Overview of Collection Framework, Commonly used Collection classes – ArrayList, LinkedList, HashSet, LinkedHashSet, TreeSet. Collection Interfaces –Collection, List, Set, SortedSet, Accessing a collection via an Iteration,Storing user-defined classes in collections, Map Interfaces and Classes, Using a comparator. Legacy classes – Vector, Hashtable, The Enumeration interface.

Input/Output : How to read user input (from keyboard) using scanner class,Stream classes, InputStream, OutputStream, FileInputStream, FileOutputStream, Reader and Writer, FileReader, FileWriter classes. File class.

UNIT-V

GUI Design and Event Handling: Component, Container, window, Frame classes. Working with Frame window GUI Controls, Layout Managers, Introduction to Swings, Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces, Handling button click events, Adapter classes. Writing GUI Based applications.

Database Handling in Java: Java Database Connectivity (JDBC) using MySQL.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 8/e, Tata McGraw Hill Publications, 2011.
2. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I, Fundamentals", 8/e, Prentice Hall, 2008.

Suggested Reading:

1. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2/e, Oxford University Press, 2014.
2. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4/e, Tata McGraw-Hill Publishing company Ltd., 2010.
3. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide" 2/e, O'Reilly, 2005

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html.
2. http://nptel.ac.in/courses/106106147/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/lecture-notes/

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16PY O01

HISTORY OF SCIENCE AND TECHNOLOGY (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To enable students to understand science as a socio-cultural product in specific socio-historical contexts.
2. To expose students to philosophical, historical and sociological perspectives to look at science as a practice deeply embedded in culture and society.
3. To inculcate the scientific culture and ethics in the development of technologies.

Outcomes:

1. Demonstrate knowledge of broad concepts in the history of science, technology ranging over time, space and cultures.
2. Recognize the values of a wide range of methodologies, conceptual approaches and the impact of competing narratives within the history of science, technology.
3. Identify, locate and analyze relevant primary and secondary sources in order to construct evidence-based arguments.
4. Think independently and critically, using appropriate methodologies and technologies to engage with problems in the history of science, technology.
5. Demonstrate academic rigor and sensitivity to cultural and other diversity, and understanding of the ethical implications of historical and scientific enquiry within a global context.

UNIT-I

Science - The Beginning (through 599 BC): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions, Civilization, Major advances.

Science in Antiquity (600 BC - 529 AD): Philosophy, a precursor to science, Hellenistic world and the Roman Empire, Other cultures of the period, major advances.

UNIT-II

Medieval Science (530 AD - 1452 AD): The decline of science in Europe, Science in China, Science and mathematics in India, Arab science, revival of science in Europe, technology revolution of the Middle ages, Major advances.

The Renaissance and the Scientific Revolution (1453 AD – 1659 AD): Renaissance, Scientific Revolution, Technology, Major advances.

UNIT-III

Scientific Method: Measurement and Communication (1660 AD – 1734): European domination, The scientific method, Major advances.

The Industrial Revolution (1735 AD – 1819 AD): Industrial Revolution, Rise of the engineer, Major Advances.

UNIT-IV

Science and Technology in the 19th Century (1820 AD – 1894 AD): philosophical basis of 19th-century science, Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 AD – 1945 AD): The growth of 20th century science, New philosophies, Quantum reality, Energy sources, Electricity: a revolution in technology, Major advances.

UNIT-V

Big Science and the Post-Industrial Society (1946 AD – 1972 AD): Big science, Specialization and changing categories, Technology changes society, Major advances.

The Information Age (1973 AD – 2015 AD): Information and society, Globalization, The post-industrial society, Problems of the Information age, Major Advances.

Text Books:

1. Bryan Bunch and Alexander Hellemans, "The History of Science and Technology", Houghton Mifflin Company (New York), 2004
2. JD Bernal, "Science in History", 4 Volumes, Eklavya Publishers, 2012

Suggested Readings:

1. "The 100 Most Influential Scientists of All Time", Edited by Kara Rogers, Britannica Educational Publishing, 2010
2. Alberto Hernandez, "A Visual History of Science and Technology", The Rosen Publishing Group, 2016.

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16EE O05

WASTE MANAGEMENT (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To imbibe the concept of effective utilization of any scrap
2. To Become familiar with the processes of all disciplines of engineering.
3. To learn the technique of connectivity from waste to utility.

Outcomes: After completion of this course, students will be able to

1. Understand the various processes involved in allied disciplines of engineering
2. Infer the regulations of governance in managing the waste
3. Distinguish the nature of waste materials concerned to the particular branch of engineering
4. Explore the ways and means of disposal of waste material
5. Identify the remedies for the disposal of a selected hazardous waste material

UNIT-I

Introduction to Waste Management: Relevant Regulations Municipal solid waste (management and handling) rules; hazardous waste (management and handling) rules; biomedical waste handling rules; fly ash rules; recycled plastics usage rules; batteries (management and handling) rules. Municipal Solid Waste Management – Fundamentals Sources; composition; generation rates; collection of waste; separation, transfer and transport of waste; treatment and disposal options.

UNIT-II

Hazardous Waste Management : Fundamentals Characterization of waste; compatibility and flammability of chemicals; fate and transport of chemicals; health effects, Radioactive Waste Management – Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

UNIT-III

Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies. Physicochemical Treatment of Solid and Hazardous Waste Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapor extraction, air stripping, chemical oxidation), ground water contamination and remediation.

UNIT-IV

Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT-V

Landfill design aspects: Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration

Text Books:

1. John Pichtel, "Waste Management Practices", CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham, P.L. and Evans, J.C., "Hazardous Waste Management", McGraw Hill International Editions, New York, 1994
3. Richard J. Watts, "Hazardous Wastes - Sources, Pathways, Receptors", John Wiley and Sons, New York, 1997

Suggested Reading:

1. Kanti L.Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, 1999.
2. S.C.Bhatia, "Solid and Hazardous Waste Management", Atlantic Publishers & Dist, 2007

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16EC O05

MEMS AND ITS APPLICATIONS (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: This course aims to:

1. Provide knowledge of semiconductors, various materials used for MEMS.
2. Introduce various Electrostatic and Thermal Sensors and Actuators.
3. Educate on the applications of MEMS to various disciplines.

Outcomes: Upon completion of this course, students will be able to:

1. Select various materials used for MEMS.
2. Design the micro devices and systems using the MEMS fabrication process.
3. Understand the operation of different Sensors and Actuators.
4. Design the micro devices and systems using Polymer MEMs.
5. Apply different MEMS devices in various disciplines.

UNIT-I

Introduction: The History of MEMS Development, The Intrinsic Characteristics of MEMS: Miniaturization, Microelectronics Integration, Parallel Fabrication with Precision, Devices: Sensors and Actuators- Energy Domains and Transducers, Sensors Considerations, Sensor Noise and Design Complexity: Actuators Considerations.

UNIT-II

Introduction to Micro Fabrication: Overview of Micro fabrication, Overview of Frequently used Micro fabrication Processes: Photolithography, Thin Film Decomposition, Thermal Oxidation of Silicon, Wet Etching, Silicon Anisotropic Etching, Plasma Etching and Reactive Etching, Doping, Wafer Dicing, Wafer Bonding, Microelectronics Fabrication Process Flow, Silicon based MEMS Processes, Packaging and Integration, Process Selection and Design.

UNIT-III

Electrostatic Sensing and Actuation: Introduction to Electrostatic Sensors and Actuators, Parallel: Plate Capacitor, Applications of Parallel Plate Capacitors, Interdigitated Finger Capacitors, Applications of Combe- Drive Devices: Inertia Sensors, Actuators.

Thermal Sensing and Actuation: Introduction to Thermal Sensors, Thermal Actuators, Fundamentals of Thermal Transfer, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications- Inertia Sensors, Flow Sensors, Infrared Sensors.

UNIT-IV

Piezoresistive Sensors: Origin and Expression of Peizoresistivity, Piezoresistive Sensor Materials: Metal Strain Gauges, Single crystal Silicon, Polycrystalline Silicon, Applications of Piezoresistive Sensors:Inertial sensors, Pressure Sensors, Tactile Sensors, flow Sensors.

Piezoelectric Sensors: Introduction, Properties of Piezoelectric Materials, Applications- Inertia Sensors, Acoustic Sensors, Tactile Sensors, Flow Sensors.

UNIT-V

Polymer MEMS: Introduction, Polymers in MEMS- Polyimide, SU-8, Liquid Crystal Polymer(LCP), Representative Applications- Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors.

Case Studies of Selected MEMS Products: Blood Pressure (BP) Sensor, Microphone, Acceleration Sensor and Gyros.

Text Books:

1. Chang Liu, "Foudations of MEMS", 2/e, Pearson Education Inc., 2012.
2. Tai Ran Hsu, "MEMS & Micro Systems Design and Manufacture", Tata McGraw Hill, 2002.

Reference Books:

1. P. Rai-Choudary, "MEMS and MOEMS Technology and Applications", PHI publications, 2009.
2. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC press, 2001.

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16CS O07

BASICS OF CYBER SECURITY (Open Elective – II)

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	3	

Objectives: The main objectives of this course are:

1. To Identify and present indicators that a cybercrime has occurred and understand methods and tools used in cybercrimes.
2. To collect, Process, Analyze and Present Computer Forensics Evidence.
3. To understand the legal perspectives and Organizational implications of Cyber Security

Outcomes: On Successful completion of this course, student will be able to:

1. Discuss different types of cybercrimes and analyze legal frameworks to deal with these cybercrimes.
2. Describe Tools used in cybercrimes and laws governing cyberspace.
3. Analyze and resolve cyber security issues.
4. Recognize the importance of digital evidence in prosecution.
5. Analyze the commercial activities in the event of significant information security incidents in the Organization.

UNIT - I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cyber crime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective, A Global Perspective of Cyber Crime.

UNIT - II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT - III

Cyber Security: The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber Law, Technology and Students: The Indian Scenario.

UNIT - IV

Understanding Cyber Forensics: Introduction ,Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

UNIT - V

Cyber Security: Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, 2011.
2. Kevin Mandia, Chris Prosise, "Incident Response and Computer Forensics", Tata McGraw Hill, 2006.

Suggested Reading:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, "Cyber Security and Cyber Laws", Paperback, 2018.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.

Online Resources:

1. https://www.edx.org/learn/cybersecurity
2. https://www.coursera.org/courses?query=cyber%20security
3. https://swayam.gov.in/course/4002-cyber-law

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16ME C39

PROJECT SEMINAR

Instruction	3 Hours per week
Duration of Semester End Examination	——
SEE	
CIE	50 Marks
Credits	2

The objective of 'Project Seminar' is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/ Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks: Max. Marks: 50

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

16ME C40

PROJECT

Instruction	6 Hours per week
Duration of Semester End Examination	——
SEE	100 Marks
CIE	50 Marks
Credits	6

The object of Project is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/ Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 50)
CIE (Continuous Internal Evaluation) Max. Marks: 50

Evaluation by	Max.Marks	Evaluation Criteria / Parameter
Department Review Committee	05	Review 1
	08	Review 2
	12	Submission
Supervisor	05	Regularity and Punctuality
	05	Work Progress
	05	Quality of the work which may lead to publications
	05	Report Preparation
	05	Analytical / Programming / Experimental Skills

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Guidelines for awarding marks in SEE: (Max. Marks: 100)

Max. Marks: 100

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project ● Innovations ● Applications ● Live Research Projects ● Scope for future study ● Application to society
	20	Viva-Voce

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
OPEN ELECTIVE subjects offered by MED
(to be handled by MED faculty)

S.No.	Semester	Open Elective
UNDER CBCS SCHEME		
1.	SEMESTER – VII & SEMESTER – VIII	16ME O01 : Entrepreneurship 16ME O02 : Robotics 16ME O03 : Human Rights and Legislative Procedures 16ME O04 : Intellectual Property Rights 16ME O05 : Nano Materials and Technology 16ME O06 : Research Methodologies 16ME O07 : Introduction to Operations Research 16ME O08 : Industrial Administration and Financial Management 16ME O09 : Organizational Behaviour 16ME O10 : 3D Printing 16ME O11 : Essentials of Management

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18MT CO1

MATHEMATICS– I
(Common to all branches and except for Bio-Tech)

Instruction	3 L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits	4

Course Objectives:

1. To solve linear system of equations using Matrix Methods.
2. To know the convergence of the Series.
3. To represent the function in series form.
4. To know the Partial Derivatives and use them to interpret the way a function of two variables behaves.
5. To learn Vector Differential Operator and its Physical interpretations on Scalars and vector functions.
6. To solve improper integrals.

Course Outcomes: On the successful completion of this course student shall be able to

1. Solve system of linear equations and identify the Eigen values and Eigen vectors in engineering problems.
2. Check the series convergence.
3. Find the evolutes of the given curves.
4. Expand and find extreme values of functions of two variables.
5. Understanding the significance of gradient, divergence and curl.
6. An ability to solve the problems and interpret in geometrical approach.

UNIT-I: Matrices:
Rank of the matrix, Echelon form, System of linear equations, Linearly dependence and independence of vectors, Eigenvalues, Eigenvectors, Properties of eigenvalues, Cayley-Hamilton theorem, Quadratic forms, Diagonalization of Matrices, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic forms.

UNIT-II: Sequences and Series:
Definition of Convergence of sequence and series. Tests for convergence of series: comparison test, limit comparison test, D'Alembert ratio test, Raabes test, Cauchy's n^{th} root test, logarithmic test, alternative series, absolute and conditional convergence.

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UNIT-III: Calculus:
Rolle's Theorem, Lagranges Mean value theorem, Cauchy's mean value theorem (without proofs). Curvature, radius of curvature, Evolutes and involutes , Fourier series, half range sine and cosine series.

UNIT-IV: Multivariable Calculus (Differentiation):
Functions of two variables, Partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions (Chain rule), Change of variables, Jacobian, Higher order partial derivatives, Taylor's series of functions of two variables, Maximum and minimum values of functions two variables, Lagrange's multipliers method.

UNIT-V: Vector Calculus (Differentiation):
Scalar and vector fields, Gradient of a scalar field, Directional derivative, Divergence and Curl of a vector field, vector identities. Improper integrals: Beta and Gamma functions and their properties.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Suggested Reading:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. R.K. Jain, S.R.K. Iyengar, Advanced engineering mathematics Narosa Publications, 5th edition, 2016. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

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18PY C03

INTRODUCTION TO MECHANICS AND ELECTROMAGNETIC THEORY
(for Civil, Mech & Prod)

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:
The objectives of the course is to make the student

1. Understands the fundamentals of oscillations and ultrasonics.
2. Gains knowledge of rigid body dynamics.
3. Learns the basics of electrostatics.
4. Understands the fundamentals of magnetostatics.
5. Familiar with electromagnetic waves.

Course Outcomes:
At the end of the course, the student will be able to

1. Describe the types of oscillations and analyze them.
2. Develop the concepts of dynamics and apply them to solve the related problems.
3. Analyze the role of different laws in electrostatics.
4. Discuss the significance of magnetostatics.
5. Develop the concepts related to electromagnetic behavior.

UNIT- I :Oscillations:
Simple harmonic motion, Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly- damped oscillators; Forced oscillations and resonance.
Ultrasonics: Production of ultrasonics by piezoelectric and magnetostriction methods – Detection of ultrasonics – Determination of ultrasonic velocity in liquids – Applications.

UNIT-II: Rigid body Dynamics:
Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples, two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor.

UNIT- III :Electrostatics in Vaccum:

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction, Boundary conditions of electric field and electrostatic potential.

UNIT - IV : Magnetostatics:

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities: ferromagnetic, paramagnetic and diamagnetic materials, B-H curve.

UNIT- V : Electromagnetic Waves:

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves, Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples.

TEXT BOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text BookEngineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGahill Education Publications, 2013.
3. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

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18CS C01

Programming for Problem Solving
(Common to All Programs)

Instruction	3 Periods per week
Duration of Semester-End Examination	3 Hours
Semester-End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives

1. Identification of computer components, Operating environments, IDEs
2. Understanding the steps in problem solving and formulation of algorithms to problems.
3. Develop programming skills as an means of implementing an algorithmic solution with appropriate control anddata structures.
4. Develop intuition to enable students to come up with creative approaches to problems.
5. Manipulation of text data using files.

Course Outcomes: At the end of the course, students will be able to:

1. Identify the computing environments.
2. Formulate solutions to problems and represent them using algorithms/ Flowcharts.
3. Choose proper control statements and data structures to implement the algorithms.
4. Trace the programs with test the program solution.
5. Decompose a problem into modules and use functions to implement the modules.
6. Develop applications using file I/O.

UNIT -I

Introduction to computers and Problem Solving: Components of a computer, Operating system, compilers, Program Development Environments, steps to solve problems, Algorithm, Flowchart / Pseudocode with examples.

Introduction to programming: Programming languages and generations, categorization of high level languages.

Introduction to C: Introduction, structure of C program, keywords, identifiers, Variables, constants, I/O statements, operators, precedence and associativity.

UNIT – II

Introduction to decision control statements: Selective, looping and nested statements.

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Functions: Introduction, uses of functions, Function definition, declaration, passing parameters to functions, recursion, scope of variables and storage classes.

Case study:

UNIT – III

Arrays: Introduction, declaration of arrays, accessing and storage of array elements, 1-dimensional array, Searching (linear and binary search algorithms) and sorting(selection and Buble) algorithms, 2-D arrays, matrix operations.

Strings: Introduction, stringsrepresentation, string operations with examples.

Case study:

UNIT – IV

Pointers: Understanding computer's memory, introduction to pointers, declaration pointer variables, pointer arithmetic, pointers and strings, array of pointers, function pointers, array of function pointers, dynamic memory allocation, advantages and drawbacks of pointers.

Structures: Structure definition, initialization and accessing the members of a structure, nested structures, structures and functions, self- referential structures, unions and enumerated data types.

UNIT-V

Files: Introduction to files, file operations, reading data from files, writing data to files, error handing during file operations.

Preprocessor Directives: Types of preprocessor directives, examples.

Suggested Reading:

1. A.K Sharma **"Computer Fundamentals and Programming"**, 2nd Edition, University Press, 2018.
2. PradeepDey and Manas Ghosh, **"Programming in C"**, Oxford Press, 2nd Edition, 2017.

References:

1. Byron Gottfried, Schaum's"**Outline of Programming with C**", McGraw-Hill.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
4. ReemaTharaja **"Introduction to C Programming"**, Second Edition, OXFORD Press,2015.
5. https://www.tutorialspoint.com/cprogramming/index.htm
6. https://onlinecourses.nptel.ac.in/noc18-cs10/preview.

18EG C01

ENGLISH

(Common to all branches)

Instruction	2Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation:	20 Marks
Credits	2

Course Objectives:

1. To enable the students to understand the role and importance of communication and to develop their basic communication skills in English.
2. To equip the students with basics of writing correct sentences to coherent paragraphs.
3. To equip the students with techniques of writing a précis and an essay by using accurate grammar and appropriate vocabulary.
4. To train the students to describe, define and classify processes and to draft formal reports by adhering to the proper structure.
5. To develop the reading skills and reading comprehension techniques of the students.
6. To develop the students reading, writing, grammatical, lexical and communicative competence.

Course Outcomes:

1. The students will understand the nature, process and types of communication and will communicate effectively without barriers.
2. The students will write correct sentences and coherent paragraphs.
3. The students will know how to condense passages by writing précis and write essays by using accurate grammar and appropriate vocabulary.
4. The students will demonstrate advanced writing skills by drafting formal reports.
5. The students will apply their reading techniques and analyze reading comprehension passages.
6. The students will become effective communicators and will display their advanced skills of reading and writing and use correct grammar and appropriate vocabulary in all contexts.

UNIT-IUnderstanding Communication in English:
Introduction, nature and importance of communication.Process of communication.Basic types of communication - verbal and non-verbal.Barriers to communication.Intrapersonal and interpersonal communication.Johari Window
Vocabulary &Grammar: The concept of Word Formation. Importance of proper punctuation.Articles.

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UNIT- II Developing Writing Skills I:
Types of sentences.Use of phrases and clauses in sentences.Cohesion and coherence.Paragraph writing.Organizing principles of paragraphs in documents.Vocabulary & Grammar: Cohesive devices. Root words from foreign languages and their use in English. Prepositions.

UNIT- III Developing Writing Skills II:
Techniques for writing precisely. Précis Writing. Essay Writing.
Vocabulary and Grammar: Subject-verb agreement. Noun-pronoun agreement Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Redundancies, Clichés.

UNIT- IV Developing Writing Skills III:
Describing, Defining, Classifying, Providing examples or evidence.Writing introduction and conclusion.
Report writing – Importance, structure and elements of style of formal reports.
Vocabulary and Grammar: Misplaced modifiers. Synonyms, antonyms.

UNIT-VDeveloping Reading Skills:
The reading process, purpose, different kinds of texts. Reading comprehension.Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.
Vocabulary and Grammar : Words often Confused. Standard abbreviations.

Text Books:

1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan, 2017.
2. Swan Michael,Practical English Usage.OUP. 1995.

Suggested Readings:

1. Wood F.T,Remedial English Grammar, Macmillan,2007
2. Zinsser William,On Writing Well, Harper Resource Book, 2001
3. Sanjay Kumar and PushpLata,Communication Skills.Oxford University Press, 2011.

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18PY C06

MECHANICS AND ELECTROMAGNETIC LABORATORY
(for Civil, Mech & Prod)

Instruction:	3 Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits:	1.5

Course Objectives:

The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments.
2. Understand the various kinds of oscillators.
3. Analyze the behavior of magnetic and dielectric materials.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the concept of errors and find the ways to minimize the errors
2. Demonstrate the various kinds of oscillations.
3. Determine the loss of energy of a ferromagnetic material and its uses in electrical engineering .
4. Understand the suitability of dielectric materials in engineering applications.
5. Use LCR circuits in different applications.

Experiments

1. *e/m* of Electron by Thomson's Method.
2. B-H curve – Determination of Hall coefficient, carrier concentration & mobility of charge carriers of given semiconductor specimen.
3. Stewart & Gee's.
4. Mutual induction.
5. Dielectric constant – Determination of dielectric constant of given PZT sample.
6. Error analysis – Estimation of errors in the determination of time period of a torsional pendulum.
7. Helmholtz's resonator.
8. Compound pendulum.
9. Flywheel.
10. Coupled oscillator.
11. LCR circuit.
12. Melde's experiment.
13. Young's modulus.
14. Viscosity by oscillating disc (Lamp scale method).

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15. Ultrasonic interferometer – Determination of velocity of ultrasonics in a given liquid.

SUGGESTED READING:

1. *Engineering Physics Manual* by Department of Physics, CBIT, 2016.
2. S.K. Gupta, *Engineering Physics Practical*, Krishna's Educational Publishers, 2014.
3. O.P. Singh, V. Kumar and R.P. Singh, *Engineering Physics Practical Manual*, Ram Prasad & Sons Publications, 2009.
4. Indu Prakash, Ram Krishna and A.K. Jha, *A Text Book of Practical Physics*, Kitab Mahal Publications, 2012.

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18CS C02

Programming for Problem Solving
(Programming Lab – I)
(Common to All Programs)

Instruction	4 Periods per week
Duration of Semester-End Examination	3 Hours
Semester-End Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate C programming constructs to implement algorithms.
4. Identification and rectification of coding errors in program.
5. Develop applications in a modular fashion.
6. Manage data using files.

Course Outcomes:

At the end of the course students will be able to:

1. Identify and setup program development environment.
2. Implement the algorithms using C programming language constructs.
3. Identify and rectify the syntax errors and debug program for semantic errors.
4. Analyze the results to evaluate the solutionsof the problems.
5. Solve problems in amodular approach using functions.
6. Implement file operations with simple text data.

Lab experiments

1. Familiarization with programming environment.
2. Simple computational problems using arithmetic expressions.
3. Problems involving if-then-else structures.
4. Iterative problems e.g., sum of series.
5. 1D Array manipulation.
6. 2D arrays and strings.
7. Matrix problems, String operations.
8. Simple functions.
9. Recursive functions.
10. Pointers and structures.
11. Dynamic memory allocation and error handling.
12. File handling.

Design the experiments in such a way that the students will be able to end up the solution for a real world problem that uses most of the concepts of C programming language. For example: A banking application where it uses the concepts of operators, control structures, switch case for menu, structures, functions, error handling, files etc.

Suggested Reading:

1. Pradeep Dey and Manas Ghosh, "**Programming in C**", Oxford Press, 2nd Edition, 2017.
2. ReemaTharaja "**Introduction to C Programming**", Second Edition, OXFORD Press,2015.

References:

1. https://www.tutorialspoint.com/cprogramming/index.htm
2. https://www.w3resource.com/c-programming/programming-in-c.php
3. https://www.w3schools.in/c-tutorial/

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18ME C02

WORKSHOP/ MANUFACTURING PRACTICE

Instruction	1T-4P Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits	3

Course Objectives:

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive & team work attitude to get things right the first time.
3. To provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. To advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.
6. Engineering Skill development with regard to making components, system integration and assembly to form a useful device.

Course Outcomes – (Laboratory): Student will be able to

1. Fabricate components with their own hands.
2. Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. Assembling different components, student will be able to produce small mechanisms/devices of their interest.
4. Gain practical skills of carpentry, tinsmithy, fitting, house wiring.
5. Gain knowledge of different Engineering Materials and Manufacturing Methods.
6. Understand trades and techniques used in Workshop and chooses the best material/ manufacturing process for the application.

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List of Exercises

CYCLE 1

Exercises in Carpentry

1. To plane the given wooden piece to required size
2. To make a lap joint on the given wooden piece according to the given dimensions.
3. To make a dove tail-joint on the given wooden piece according to the given dimensions.

Exercises in Tin Smithy

4. To make a rectangular box from the given sheet metal with base and top open. Solder the corners.
5. To make a scoop.
6. To make a pamphlet box.

Exercises in Fitting

7. To make a perfect rectangular MS flat and to do parallel cuts using Hack saw
8. To make male and female fitting using MS flats-Assembly1
9. To make male and female fitting using MS flats-Assembly2

Exercises in House Wiring

10. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by a bell push
11. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
12. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.

CYCLE 2

Exercises in Casting

1. Study of Sand casting processand its applications.
2. Green sand moulding practice for a single piece pattern
3. Green sand moulding practice for a split pattern with a horizontal core

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Exercises in Welding

4. Study of gas welding equipment and process. Identification of flames, makingof Butt joint with gas welding.
5. Study of Arc welding process, making Butt joint with DCSP, DCRP
6. Study of Arc welding process, making Lap joint with A.C

Exercises in Machine shop

7. Study of Machine Tools like Lathe, Drilling, Milling and Shaper.
8. Facing, Plain turning and Step turning operations on Lathe machine.
9. Knurling and Taper turning on Lathe machine

Open ended Exercise:

1. Student should produce a component /mechanism by applying the knowledge of any one trade or combination of trades.

TextBooks:

(i) HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
(ii) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.

Suggested Reading:

(i) Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology –I" Pearson Education, 2008.
(ii) Roy A. Lindberg, "Processes and Materials of Manufacture", 4^{th} edition, Prentice Hall India, 1998.
(iii) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

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18EG C02

ENGLISH LAB
(Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
Continuous Internal Evaluation:	15 Marks
Credits	1

Course Objectives:
1. To introduce students to phonetics and the different sounds in English.
2. To familiarize the students with the software and give them sufficient practice in correct pronunciation.
3. To enable students to speak English correctly with focus on stress and intonation.
4. The students will enhance their listening skills by practicing IELTS and TOEFL material.
5. To help students overcome their inhibitions while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
6. To help students to understand team work, role behavior and to develop their ability to discuss in groups and make oral presentations.

Course Outcomes:
1. The students will differentiate the speech sounds in English.
2. The students will interact with the software and understand the nuances of pronunciation in English.
3. The students will speak with the proper tone, intonation and rhythm and apply stress correctly.
4. The students will demonstrate their listening skills by analyzing the IELTS and TOEFL listening comprehension texts.
5. The students will speak with clarity and confidence.
6. The students will work in teams and discuss various topics and demonstrate their presentation skills through posters.

Exercises
1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs . The syllable: types of syllables, consonant clusters.
3. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.

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4. **Rhythm &Intonation** : Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – practice with IELTS and TOEFL material.
6. **Situational dialogues and role play** – Dialogue writing, – Role behavior and role enactment.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
9. **Poster presentation** – Theme, poster preparation, team work and presentation.

Suggested Reading

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 201.
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016.

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18MT CO3

MATHEMATICS– II

(Common to all branches and except for Bio-Tech)

Instruction	3 L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits	4

Course Objectives

1. To evaluate double and triple integrals of various functions and their significance.
2. To evaluate vector line, surface and volume integrals.
3. To know the relevant method to solve higher order differential equations.
4. To evaluate complex integration.
5. To evaluate real and definite integrals.
6. To know the methods to solve real life problems.

Course Outcomes: On the successful completion of this course student shall be able to

1. Find the areas, volumes and surface of solids revolution.
2. Use Greens, Gauss and Stoke's theorems to find the surface and volume integrals.
3. Able to solve solutions of differential equations with initial and boundary value problems.
4. Solve the problems on analytic functions, Cauchy's theorem and Cauchy's integral formula.
5. Real and complex integrals by using Cauchy's theorems.
6. Solve physical and engineering problems.

UNIT-I: Multivariable Calculus (Integration):

Applications of definite integrals to evaluate surface areas and volumes of revolutions. Double integrals, Change of order of integration, Triple integrals, Change of variables in integrals, Applications: areas and volumes, Centre of mass and Gravity (constant and variable densities).

UNIT-II: Vector Integral Calculus:

Line, Surface and Volume integrals, Green's theorem in a plane, Gauss's divergence theorem and Stroke's theorem (without proof).

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First Order Ordinary Differential Equations: Exact first order differential equations , Integrating factors, Linear first order equations , Bernoulli's, Riccati's and Clairaut's differential equations ,Orthogonal trajectories of a given family of curves.

UNIT-III: Ordinarydifferential equations of higher orders:
Solutions of higher order linear equations with constants coefficients, Method of variation of parameters, solution of Euler-Cauchy equation. Ordinary point, singular point and regular singular point, Power Series solution. Legendre Polynomial of first kind (without proof), Rodrigues formula, Generating function, recurrence relations, orthogonality of Legendre polynomials, Bessel's function of first kind (without proof), recurrence relations and problems.

UNIT- IV: Complex Variables –I :
Differentiation, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof).

UNIT- V: Complex Variables – II:
Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, Laurent's series, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine. Improper real integrals with singular points on the upper half plane.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Suggested Reading:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. R.K. Jain, S.R.K. Iyengar, Advanced engineering mathematics Narosa Publications,5th edition,2016.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

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18CY C01

CHEMISTRY

(Common to all branches)

Instruction:	3L−1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives

1. The aim of framing the syllabus is to impart intensive and extensive knowledge of the subject so that students can understand the role of chemistry in the field of engineering.
2. This syllabus helps at providing the necessary introduction of the inorganic chemistry principles and concepts of chemical bonding involved in a comprehensive manner understandable to the students aspiring to become practicing engineers.
3. Thermodynamic and Electrochemistry units give conceptual knowledge about spontaneous processes and how can they be harnessed for producing electrical energy and efficiency of systems.
4. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
5. New materials lead to discovering of technologies in strategic areas like defense and space research for which an insight into nano and composite materials of modern chemistry is essential.

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations & Ionic Equilibria.
3. List major chemical reactions that are used in the synthesis of molecules.
4. Apply the various methods used in treatment of water for domestic and industrial use.

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5. Discuss the various Engineering materials & Drug synthesis & their applications.

UNIT-I Atomic and molecular structure:

Molecular Orbital theory - atomic and molecular orbitals.Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Energy level diagrams of diatomics (H_2, He_2^+, N_2, O_2, O_2^-, CO, NO). Pi- molecular orbitals of butadiene , benzene and their aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

UNIT-II Use of free energy in chemical equilibria and Ionic Equilibria:

Use of free energy in chemical equilibria :Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy(criteria of spontaneity).Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials –electrochemical series.Nernst equation and its applications.Potentiometric Acid base & Redox Titrations.Numericals.

Ionic Equilibria: Solubility product, Determination of solubility product, Applications of solubility product- Determination of solubilities of sparingly soluble salts; Predicting precipitation reactions; Precipitation of an insoluble salt; Precipitation of soluble salts ; Inorganic analysis .Numericals.

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures , Symmetry and chirality, Stereoisomers - Configurational isomers (Geometrical&Optical isomers), Conformational isomers - Newman and sawhorse representations of n-butane ,enantiomers (lactic acid), diastereomers (Tartaric acid) , optical activity, absolute configurations , Sequence rules for R&S notation.

Organic reactions

Types of Organic reactions:

Substitution Reactions- Electrophilic substitution (Nitration of Benzene) ;Nucleophilic Substitution(S_N1& S_N2) ; Free Radical Substitution(Halogenation of Alkanes)

Additions Reactions:

Electrophilic Addition – Markonikoff's rule

Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Free radical Addition - Anti Markonikoff's rule (Peroxide effect)

Eliminations-E_1 and E_2 (dehydrohalogenation of alkyl halides)

Oxidation with $KMno_4$, $K_2Cr_2O_7$; **Reduction** with $LiAlH_4$,$NaBH_4$

Cyclization (Diels - Alder reaction)

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UNIT–IV Water Chemistry:

Hardness of water – Types, units of hardness, Disadvantages of hard water , Boiler troubles - scales & sludge formation , causes and effects , Softening of water by ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination , Ozonisation & UV radiation.

UNIT-V Engineering Materials and Drugs:

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol gel method. Carbon nanotubes and their applications.

Composite materials- Definition, types of composites, fibre reinforced, glass fibre reinforced and carbon fibre reinforced composites and applications.

Conducting polymers- Definition, classification and applications.

Drugs-Introduction,Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Mali, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition(2011).
4. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C. Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & CompanyLtd.,46th edition(2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

18CE C01

ENGINEERING MECHANICS

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. The objective of this course is to understand the resolution of forces and to obtain resultant of all force systems, to understand moment of a force and equilibrium conditions of static loads for smooth and frictional surface
2. To obtain centroid, centre of gravity and moment of inertia for various regular and composite areas and bodies.
3. To understand the basic structural analysis, principles of virtual work and energy methods.
4. To know the basic concepts of dynamics and analysis as a particle and rigid bodies.
5. To understand the work energy principles, impulse momentum and their applications and to know the concept of simple harmonic motion and free vibration.

Course Outcomes: The students will be able to

1. Solve problems dealing with forces in plane and space force systems, draw free body diagrams to analyze various problems in equilibrium, for smooth and frictional surface.
2. Determine centroid and moment of inertia for elementary, composite areas and bodies.
3. Analyze simple trusses for forces in various members of a truss.
4. Solve problem in kinematics and kinetics of particles and rigid bodies.
5. Analyze body motion using work energy principles, impulse and momentum approach and able to apply the concepts of simple harmonic motion and free vibrations in dynamics.

Unit–I: Resolution, Resultant and Equilibrium of force system and Friction: Concepts of force, System of forces, components of forces in a plane and in space systems.Resultant of force systems.Moment of forces and its applications.Couples and its applications.Equilibrium of Force systems. Free body diagrams, equation of equilibrium of coplanar and spatial force systems. Static indeterminacy. Types of friction, Laws of friction, application of friction to a single body & connecting systems, wedge friction.

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Unit–II: Centroid, centre of gravity and moment of Inertia:
Centroid of simple figures from first principle, centroid of composite sections. Centre of gravity and its implications, Definition of Area moment of Inertia, Moment of inertia of plane section from first principles, Theorems of moment of inertia, moment of inertia of standard sections and composite sections, Mass moment of inertia of rectangular and circular plates, cylinder, cone & sphere.

Unit–III: Analysis of simple trusses, Virtual work and Energy methods:
Analysis of simple trusses using method of joints, methods of sections. Determine if a member is in tension or compression, zero force members. Virtual displacements, Principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom.Conservative forces and potential energy, energy equation for equilibrium.

Unit–IV: Particle Dynamics:
Rectilinear and curvilinear translation using rectangular, normal and tangential components.Relative and constrained motion. Newton's 2nd Law, rectangular and path coordinates. Basic terms, general principles in dynamics, D'Alembert's principle and its application in plane motion and connected bodies.Instantaneous centre of rotation in plane motion and simple problems.

Unit–V: Work- Energy, Impulse-momentum and Mechanical Vibrations:
Equation of work energy for translation and fixed axis rotation, work energy principles applied to particle motion, connected systems. Introduction to linear impulse momentum, principle of conservation of linear momentum, Impact, direct and oblique. Introduction to vibration, free and forced vibrations, simple harmonic motion, simple pendulum and compound pendulum.

Text Books:

1. Reddy Vijaykumar K. and J. Suresh Kumar," Singer's Engineering Mechanics Statics and Dynamics", B. S. Publications 2011.
2. A. Nelson, "Engineering Mechanics", Tata McGraw Hill, New Delhi, 2010.

Suggested Reading:

1. Irving H. Shames, "Engineering Mechanics", 4th Edition, Prentice Hall, 2006.
2. F. P. Beer and E. R .Johnson, "Vector Mechanics for engineers, Vol. I - Statics, Vol. II - Dynamics",
   9thedition, Tata McGraw Hill, 2011.
3. R. C. Hibbeler, "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press, 2006.

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18ME C01

ENGINEERING GRAPHICS AND DESIGN

Instruction	1T+4D Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits	3

Course Objectives:

1. to prepare to design a system, component, or process to meet desired needs within realistic constraints.
2. to prepare the student to communicate effectively.
3. to prepare the student to use the techniques, skills, and modern engineering tools necessary for engineering practice.
4. to get exposure to a CAD package.

Course Outcomes:

1. Introduction to engineering design and its place in society.
2. Exposure to the visual aspects of engineering design.
3. To become familiar with engineering graphics standards.
4. Exposure to solid modelling.
5. Exposure to computer-aided geometric design.
6. Exposure to creating working drawings.
7. Exposure to engineering communication.

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views;
Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Coordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory).

UNIT-1 Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute;

UNIT-2 Orthographic Projections:
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes (without traces) ; Projections of planes inclined Planes;
Introduction to CAD package:
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

UNIT-3 Projections of Regular Solids:
Projection of Prism, Cylinder, Pyramid and Cone : Simple position, axis inclined to one of the reference plane only. Customization & CAD Drawing: consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT-4 Sections and Sectional Views of Right Angular Solids:
Sections of solids in simple position Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.
Annotations, layering & other functions:
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); rinting documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and twodimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

UNIT-5 Isometric Projections:
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Viceversa, Conventions;

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Demonstration of a simple team design project:

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; geometric dimensioning and tolerancing;

Use of solid-modeling software for creating associative models at the component and assembly levels; (Examples of specific components to the branch of study may be included).

Text Books:

1. N.D.Bhatt, Elementary Engineering Drawing, Charotar Publishers,2012.
2. K.L.Narayana and P.K.Kannaiah, –Text Book of Engineering Drawing Scitech Publications, 2011.
3. Basanth Agrawal and C M Agrawal –Engineering Drawing 2e –, McGraw-Hill Education(India) Pvt.Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., –Engineering drawing Pearson, 2ndedition, 2009.
2. K.Veenugopal, –Engineering Drawing and Graphics + Autocad New Age International Pvt.Ltd,2011.
3. Bhattacharya. B, –Engineering Graphics I. K. International Pvt.Ltd, 2009.

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18EE C01

BASIC ELECTRICAL ENGINEERING

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. To understand the behavior of different circuit elements R,L & C, and the basic concepts of electrical circuit analysis.
2. To know the concepts of AC circuits, RMS value, Average value, Phasor analysis etc., 3. To understand the basic principle of operation of Transformer and DC machines.
4. To understand the basic principle of operation of DC machines and AC machines.
5. To know about different types of electrical wires and cables, domestic and industrial wiring.
6. To understand safety rules and methods of earthing.

Course Outcomes: At the end of the course, the student will be able to

1. Acquire the concepts of Kirchhoff's laws and network theorems and able to get the solution of simple dc circuits.
2. Obtain the steady state response of RLC circuits and also determine the different powers in AC circuits.
3. Acquire the concepts of principle of operation of Transformers and DC machines.
4. Acquire the concepts of principle of operation of DC machines and AC machines.
5. Acquire the knowledge of electrical wiring and cables and electrical safety precautions.
6. Recognize importance of earthing and methods of earthing and electrical installations.

UNIT-I: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kircholff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Time-domain analysis of first order RL and RC circuits.

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UNIT-II: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III: Transformers

Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation, Auto transformer

UNIT-IV: DC and AC Machines

DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt, series and compound generators. DC Motors: Classification, Torque equation, Characteristics, Efficiency, Speed Control of Series and Shunt Motors. Three - Phase Induction Motors: Construction, Principle of operation, Torque equation, torque-slip characteristics, Power stages, speed control of induction motors.

UNIT-V: Electrical Installations

Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Earthing, Elementary calculations for energy consumption.

Text books:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, –Basic Electrical Engineering .Tata McGraw Hill, 2010.
2. V. D. Toro, –Electrical Engineering Fundamentals Prentice Hall India, 1989.
3. D.C. Kulshreshtha, –Basic Electrical Engineering McGraw Hill,2009
4. P.V.Prasad, S.sivanagaraju, R.Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013.

18EE C02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
Continuous Internal Evaluation:	15 Marks
Credits	1

Course Objectives:

1. To acquire the knowledge of different types of electrical elements.
2. To verify the basic electrical circuit laws and theorems.
3. To determine the parameters and power factor of a coil.
4. To calculate the time and frequency responses of RLC circuits
5. To determine the characteristics of Transformers.
6. To determine the characteristics of dc and ac machines.

Course Outcomes: At the end of the course, the students are expected to

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the circuit analysis techniques.
4. Determine the parameters of the given coil.
5. Understand the basic characteristics of transformer.
6. Understand the basic characteristics of dc and ac machines.

List of Laboratory Experiments/Demonstrations:

1. Demonstration of Measuring Instruments and Electrical Lab components
2. Verification of KCL and KVL.
3. Time response of RL and RC circuits.
4. Calculation of permittivity of a choke or coil by Wattmeter Method.
5. Verification of Thevenin's and Norton's theorems.
6. Turns ratio /voltage ratio verification of 1-Ph Transformers.
7. OC and SC tests on a given 1-Ph Transformer.
8. Observation of Excitation Phenomenon in Transformer.
9. Measurement of 3-Ph power in a balanced system (By 2- Wattmeter method).
10. Measurement of 3-Ph Energy by an Energy Meter (Demonstration of Principle).
11. Load test of DC Shunt motor.
12. Speed control of DC Shunt motor.
13. Load test of 3-Ph Induction motor.
14. Demonstration of LT Switchgear Equipment/Components.
15. Demonstration of cut - out section of Machines like DC Machine, Induction Machine, etc.

Note: at least **TEN** experiments should be conducted in the semester.

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18CY C02

CHEMISTRY LAB

(Common to all branches)

Instruction:	3 Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits:	1.5

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory
2. The student should be conversant with the principles of volumetric analysis and identification of organic functional groups.
3. To apply various instrumental methods to analyze the chemical compounds and to improve understanding of theoretical concepts.

Course Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

1. Estimate rate constants of reactions from concentration of reactants/ products as a function of time.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
3. Synthesize a small drug molecule and Identify the organic compounds.
4. understand importance of analytical instrumentation for different chemical analysis.
5. Perform interdisciplinary research such that the findings benefit the common man.

Chemistry Lab

1. Estimation of temporary and permanent hardness of water using EDTA solution.
2. Estimation of amount of chloride in water.
3. Determination of rate constant for the reaction of hydrolysis of methyl acetate (first order).
4. Estimation of amount of HCl Conductometerically using NaOH solution.

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5. Estimation of (a) amount of CH_3 COOH Conductometerically using NaOH solution. (b) amount of HCl and CH_3 COOH present in the given mixture of acids Conductometerically using NaOH solution.
6. Estimation of amount of HCl Potentiometrically using NaOH solution.
7. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution.
8. Distribution of acetic acid between n-butanol and water.
9. Synthesis of drug - Aspirin.
10. Organic Chemistry- Identification of Functional groups - neutral group (carbonyl groups-acetaldehyde and acetone); acidic group(benzoic acid) ; basic group (aniline).
11. Determination of surface tension of organic solvents (ethanol, ethyl acetate).
12. Determination of Viscosity.

TEXT BOOKS

1. J. Mendham and Thomas ,"Vogel' s text book of quantitative chemical analysis", Pearson education Pvt.Ltd., New Delhi , 6th ed. 2002.

SUGGESTED READINGS

1. Dr. Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

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18MT C05

MATHEMATICS – III

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:

1. To form PDE and to find its solution.
2. To solve wave and heat equations.
3. To learn the Laplace and Inverse Laplace transforms for solving engineering problems.
4. To learn Fourier transform and Z-transforms for solving engineering problems.
5. Learning the basic concepts of probability and Statistical Analysis.

Outcomes:

On successful completion of this course, the students shall be able to

1. Solve Linear and Non-Linear PDE's.
2. Solve One-Dimension Wave and Heat equations and Two Dimension Laplace equation.
3. Find Laplace transform and inverse Laplace transform and can solve Linear Differential equations.
4. Find the solutions ofvarious Transforms.
5. Find moments of discrete and continuous random variables as well as familiar with distribution.

UNIT - I

Partial Differential Equations: Formation of Partial Differential Equations, Solution of First Order Linear Partial Differential Equations by Lagrange's Method, Solution of First Order Non-linear Partial Differential Equationby Standard types and Charpits Method.

UNIT - II

Applications of Partial Differential Equation: Solution by Method of Separation of Variables, Solution of One dimensional Wave equation, One dimensional Heat equation, Two dimensional Laplace equation and its related problems.

UNIT - III

Laplace Transform: Laplace Transform of standard functions, Linearity property, change of scale property, Shifting theorems, Laplace Transform of Periodic Function, Unit step function and Unit impulse function. Transforms of derivatives, Transforms of integrals, Multiplication by $t^n$and division by t. Inverse Laplace Transform properties, Inverse Laplace Transform by partial fractions and Convolution theorem. Applications of Laplace Transform (Solution of Linear Differential Equations).

UNIT - IV

Fourier Transforms and Z-Transforms:

Fourier Transforms: Fourier integral theorem (statement), Complex form of Fourier integrals, Fourier transforms, Inverse Fourier Transforms, Fourier Sine and Cosine transforms, Inverse Fourier Sine and Cosine Transforms. Properties of Fourier transforms: Linear property, change of scale property, shifting property and Modulation theorem.

Z-Transforms:Z-transforms of standard functions, linearity property, damping rule, shifting theorems, multiplication by 'n', initial and final value theorems. Inverse Z-Transform:Inverse Z-transform by Convolution theorem, partial fractions. Z-transform application to difference equations.

UNIT - V

Basic Statistics: Random variable, discrete probability distribution and continuous probability distribution. Expectation, Addition theorem and Multiplication theorem of expectation, properties of variance. Poisson distribution (Mean, variance, MGF& CGF), Normal distribution (Mean, variance, MGF& CGF), Properties of Normal distribution, Areas of under normal curve. Correlation and regression.

Textbooks:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9/e, John Wiley & Sons, 2006.
2. B.S. Grewal, "Higher Engineering Mathematics", 35/e, Khanna Publishers, 2000.
3. Sheldon Ross, "A First Course in Probability", 9/e, Pearson publications, 2014.

Suggested Reading:

1. S. J. Farlow, "Partial Differential Equations for Scientists and Engineers", Dover Publications, 1993.
2. Ian Snedon, "Elements of Partial Differential equations", McGraw Hill, 1964.
3. S.C.Gupta, V.K.Kappoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.

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18MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
The objectives of the course are
1. To demonstrate the importance of Managerial Economics in decision making.
2. To understand the importance of project evaluation in achieving a firm's objective.
3. To explain the concept of Accountancy and provided knowledge on preparation and analysis of Final accounts.

Outcomes:
At the end of the course a student will be able to
1. Apply fundamental knowledge of Managerial economics concepts and tools.
2. Understand various aspects of demand analysis and forecasting.
3. Analyze production and cost relationships to make best use of resources available.
4. Analyze different opportunities and come out with best feasible capital investment decisions
5. Apply accountancy concepts and conventions and preparation of final accounts

UNIT - I
Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its scope, importance, relationship with other subjects, its usefulness to engineers - Basic concepts of Managerial economics

UNIT - II
Demand and Supply Analysis: Demand Analysis - Concept of demand, determinants, Law of demand, its assumptions, Elasticity of demand, price, income and cross elasticity, Concept of supply, determinants of supply, law of supply, Demand Forecasting – simple numerical problems

UNIT - III
Production and Cost Analysis: Theory of Production, Production function - input-output relations - laws of returns - internal and external economies of scale.
Cost Analysis: Cost concepts - fixed and variable costs - explicit and implicit costs - out of pocket costs and imputed costs - Opportunity cost - Cost output relationship – Firm and industry, types of market structures, Break-even analysis, numerical problems.

UNIT - IV
Accountancy: Book-keeping, principles and significance of double entry book keeping, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments

UNIT - V
Capital Budgeting: Introduction to capital budgeting, Methods: traditional and discounted cash flow methods, Introduction to working capital management, Numerical problems

Text Books:
1. Mehta P.L., "Managerial Economics – Analysis, Problems and Cases", Sultan Chand and Son's Educational publishers, 2016.
2. Maheswari S.N., "Introduction to Accountancy", 11/e, Vikas Publishing House, 2013.
3. Panday I.M., "Financial Management", 11/e, Vikas Publishing House, 2015

Suggested Reading:
1. Varshney and KL Maheswari, "Managerial Economics", Sultan Chand, 2014
2. M.Kasi Reddy and S.Saraswathi, "Managerial Economics and Financial Accounting", PHI Pvt Ltd, 2007.
3. A.R.Aryasri, "Managerial Economics and Financial Analysis", McGraw-Hill, 2013

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MATERIAL SCIENCE AND METALLURGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

Student will understand

1. Structure property relations, analyze the failures of metals and their prevention.
2. Fatigue, creep and diffusion mechanisms.
3. Classification of steels and their application .
4. Working principle of various heat treatment operations
5. Principles of extractive metallurgy.

Outcomes:

At the end of the course a student will be able to

1. Understand the imperfections of crystals.
2. Understand crack propagation by fatigue, creep deformation and diffusion theory.
3. Understand the importance of steel in engineering applications.
4. Understand to the methods of improvement of mechanical properties by various heat treatment operations
5. Understand the methods of production of various metals by extractive metallurgy

UNIT - I

Plastic deformation: Imperfections in crystals, dislocation in crystals, types of dislocations, effect of slip and twinning on the plastic deformation, cold and hot working, strain hardening and Bauchinger effect, recovery, recrystallization, grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, modes of fracture, Griffith theory of brittle fracture, crack propagation, ductile fracture, fracture under combined stress.

UNIT - II

Fatigue: S–N curve, Structure of fatigue fracture specimen. Fatigue crack propagation, effect of metallurgical variables on fatigue of metal, low cycle fatigue, experimental determination of fatigue strength (RR–Moore Test).

Creep: Creep strength, creep curve, creep deformation mechanisms, creep test.

Diffusion: Fick's law of diffusion, application of diffusion theory in mechanical engineering.

UNIT - III

Structure of Alloys: study of eutectic, eutectoid, peritectic and peritectoid reactions, Iron–Iron Carbide equilibrium diagram, construction and interpretation.

Types of plain carbon steels, cast irons and their properties and characteristics.

UNIT - IV

Heat Treatment: Annealing, normalising, hardening, tempering, Construction and interpretation of T–T–T diagram, austempering and martempering, case hardening, carburizing, nitriding, carbo–nitriding, flame hardening, induction hardening.

UNIT - V

Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, cast iron by cupola furnace, Method of production of steel by Bessemer converter, L.D process and electric arc process.

Alloy Steels: Effects of alloying elements like nickel, chromium, manganese, silicon tungsten, and titanium, Study about stainless steels, HSS, brass, bronze; their composition and properties.

Polymers and Ceramics: Polymerization, thermoplastics and thermosetting plastics, elastomers, resins. Types and applications of ceramics

Text Books:

1. V. Raghavan, "Materials Science and Engineering", 4/e, Prentice Hall of India Ltd., 2005.
2. S.H. Avner, "Introduction to Physical Metallurgy", 2/e, Tata McGraw Hill Publishers, 2005.

Suggested Reading:

1. S.P. Nayak, "Engineering Metallurgy and Material Science", 6/e, Charoter Publishing House, 2005.
2. E. Dieter, "Mechanical Metallurgy", 3/e,Metric Edition, Tata McGraw Hill, 2005.
3. K.L. Kakani, "Material Science", New Age Publications (P) Ltd., 2008.

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18ME C04

MECHANICS OF MATERIALS

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:

1. Student is exposed to the concept of different types of loads, stresses, strains and analysis of members for axial loads.
2. Student will acquire knowledge in drawing bending and shear force diagrams of beams of various loads and configurations.
3. Student becomes familiar with methods of evaluation of deflection of beams of various configurations and stresses that arise due to simple bending.
4. Student is exposed to the concept of shear stresses in beams, principal stresses, strains and phenomenon of torsion.
5. Student will acquire knowledge in estimating stresses for thin, thick cylindrical shells and buckling of columns.

Outcomes:

At the end of the course a student will be able to

1. Determine stresses and strains in members subjected to axial loads and temperature changes.
2. Draw shear force, bending moment diagrams for different types of beams and calculate stresses and strains due to simple bending.
3. Determine slope and deflection for various configurations of beams using different methods. analyze stress, strain and deflection due to torsion in circular members.
4. Analyze shear stress distribution in different sections of beams and find out principal stresses and strains.
5. Find out stresses and strains in thin, thick cylindrical shells and also able to calculate critical buckling loads in columns and struts.

UNIT - I

Stresses and Strains: Definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity. Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars.

UNIT - II

Beams: Definition of bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams; simple theory of bending, moment of resistance, modulus of section.

UNIT - III

Slopes and Deflections: Slope and deflection calculations of cantilever, simply supported beams subjected to point loads and uniformly distributed loads with Macaulay's and double integration methods.
Torsion: Derivation of torsion formula for circular sections, power transmission, effect of combined bending and torsion.

UNIT - IV

Shear Stresses in beams: Distribution of shear stresses in rectangular, I-section, T-section, solid and hollow circular sections.
Compound stresses: principal stresses and strains. Mohr's circle of stress.

UNIT - V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures. Stresses in compound cylinders. **Columns and struts:** Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

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Text Books:

1. S.S.Rattan, "Strength of Materials", 3/e, Tata Mc-Graw Hill, 2016.
2. S. Ramamrutham, "Strength of Materials", Dhanpatrai and Sons, 1993.
3. G.H.Ryder, "Strength of Materials", 3/e, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, "Strength of Materials", Vikas Publication, 2003.
2. James M Gere, "Mechanics of materials", 8/e, cengage learning, 2013.
3. R.C. Hibbeler, "Mechanics of Materials", 9/e, Pearson, 2018

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18ME C10

FLUID PRINCIPLES AND HYDRAULIC MACHINES

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives: Students will
1. Learn properties of fluids, laws related to fluid flow and their applications.
2. Understand the principles and problems associated with impact force of jet on the vanes
3. Understand various principles and performance characteristics related to Reciprocating pumps.
4. Come to know the working principles and performance characteristics of Centrifugal pumps.
5. Learn the working principle and efficiencies of hydraulic turbines.

Outcomes: At the end of the course, a student will be able to
1. Determine the various properties of fluid and their applications
2. Understand the methodology in calculation of impact force exerted by the jet on the vanes
3. Acquire the knowledge of the functionality and performance of Reciprocating pumps.
4. Understand the working, estimate the performance and testing of Centrifugal pumps.
5. Acquire knowledge in the functionality, performance and testing of hydraulic turbines.

UNIT - I

Properties and Laws of Fluid Flow: Fluids- Fluid properties- Pressure, Density, Specific weight, Specific volume, Dynamic and Kinematic viscosity -Laws of fluid flow-Continuity theorem-Bernoulli's theorem-Venturimeter-Notches-Pitot tube - Darcy's equation - Impulse-momentum equation and applications

UNIT - II

Hydraulic Machines: Classification- Lay-out of hydraulic power plant- working principle- Impact force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) at the centre of a fixed symmetrical curved vane (iii) at one end of fixed symmetrical and unsymmetrical curved vanes (iv) flat vertical vane moving in the direction of jet (v) a series of flat vertical moving vanes (vi) at the centre of symmetrical moving curved vanes (vii) symmetrical curved vanes moving in the same direction as that of jet at inlet (viii) at one end of a series of un-symmetrical moving curved vanes. (Numerical problems for above cases only)

UNIT - III

Reciprocating Pumps: Classification- working principle- single and double acting pumps- discharge, work done and power required to drive the pumps- slip, % slip and negative slip- Variation of pressure head in the suction and delivery pipes due to acceleration of piston- Variation of pressure head due to friction in the suction and delivery pipes- Indicator diagrams- Ideal and actual diagrams- Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes- Air vessels-Function of air vessels- Work saved by fitting air vessels to single and double acting pumps- Discharge of liquid into and out of air vessels-Performance characteristic curves.

UNIT - IV

Centrifugal Pumps: Classification- Working principle- Comparison over reciprocating pumps-Velocity triangles- Manometric head- work done per second- Head equivalent of work done- Manometric, mechanical and overall efficiencies- Pressure rise in the impeller- Minimum starting speed- Specific speed- Physical significance of specific speed- Model testing- Conditions of similarity of CF pumps- Priming- Performance characteristic curves.

UNIT - V

Hydraulic Turbines: Classification- Impulse and reaction turbines-Construction and working of Pelton wheel, Francis turbine and Kaplan turbine- Velocity triangles- Work done (power developed)- Hydraulic, Mechanical and Overall efficiencies- Maximum efficiency- Specific speed- Physical significance of specific speed-Unit testing -Unit quantities- Model testing of turbines- Conditions for similarity of turbines- Performance characteristic curves.

Text Books:

1. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publication (P) Ltd., New Delhi, 2004.
2. R.S. Khurmi and N. Khurmi, "Hydraulics, Fluid Mechanics and Hydraulic Machines", 20/e, S. Chand publishing, 2014

Suggested Reading:

1. P.N. Modi, and. S.M.Seth, "Hydraulics and Fluid Machines", Standard Book House, New Delhi, 2004.
2. S.Rammamrutham, "Hydraulics, Fluid Mechanics and Fluid Machines", Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., "Fluid Mechanics and Turbomachines", PHI Learning Private Limited, New Delhi, 2009.

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With Effect from the Academic Year 2019 – 2020

18EC M01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	------
Credits	0

Objectives: The course will introduce the students to

1. The history of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Outcomes: After successful completion of the course the students will be able to

1. Understand the making of the Indian Constitution and its features.
2. Have an insight into various Organs of Governance - composition and functions.
3. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
4. Be aware of the Emergency Provisions in India.
5. Understand the Right To equality, the Right To freedom and the Right To Liberty.

UNIT - I

Constitution of India: Introduction and salient features, Constitutional history, Directive principles of state policy - Its importance and implementation.

UNIT - II

Union Government and its Administration: Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States, Parliamentary form of government in India. **President:** role, power and position.

UNIT - III

Emergency Provisions in India: National emergency, President rule, Financial emergency

UNIT – IV

Local Self Government: District's Administration Head: Role and Importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
Panchayati Raj: Introduction, Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and officials.

UNIT – V

Scheme Of The Fundamental Rights & Duties: Fundamental Duties - the legal status.
Scheme of the Fundamental Rights: To Equality, to certain Freedom under Article 19, to Life and Personal Liberty under Article 21.

Text Books:

1. "The Constitution of India", 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1/e, 2015.

Suggested Reading:

1. M. P. Jain, "Indian Constitution Law", 7/e, Lexis Nexis, 2014.
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

Reddy
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Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana

18EE A01

INDIAN TRADITIONAL KNOWLEDGE

Instruction	2	Hours per week
Duration of Semester End Examination	2	Hours
SEE	50	Marks
CIE	------	
Credits	0	

Objectives: The course will introduce the students to

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Outcomes: After successful completion of the course the students will be able to

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

UNIT - I

Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT - II

Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India

Indian Languages and Literature-II: Northern Indian languages & literature

UNIT - III

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV

Fine Arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT – V

Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Text Books:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450-494-X, 2006
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014

Suggested Reading:

1. Kapil Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN-10: 8171880649, 1994
2. Karan Singh, "A Treasury of Indian Wisdom: An Anthology of Spiritual Learn", ISBN: 978-0143426158, 2016.

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18ME C05

MATERIAL SCIENCE AND METALLURGY LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: Students will
1. Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heattreatment operations.
4. Understand differences between different heat treatment methods.
5. Understand the relation between micro structure and properties.

Outcomes: At the end of the course, a student will be able to
1. Identify crystal structure of various metals.
2. Measure hardness and can correlate with microstructure.
3. Perform a suitable heat treatment operation based on desired properties.
4. Underlines the importance of grain size in evaluating the desired mechanical properties.
5. Correlate the heat treatment methods and the mechanical properties obtained.

List of the Experiments
1. Study of: Metallurgical Microscope, Allotropes of Iron, Iron-Iron carbide diagram, Procedure for specimen preparation.
2. Observations for the following specimens - i) Low carbon steels,
   ii) Medium carbon steels, iii) Eutectoid steels, iv) High Carbon steels, v)Stainless steels, vi) Case carburized, vii)HSS, viii) White cast iron, ix) Gray cast iron, x) allenble iron, xi)Spheroidal iron,
   xii) Al–Si alloy and determination of grain size using Image Analyzer.
3. Preparations of the following specimens : i) α – β Brass, ii) Normalised steel iii) Medium carbon steel iv) Nodular cast iron v) Grey cast iron.
4. Heat Treatment Processes
   i) Annealing
   ii) Normalizing
   iii) Hardening.

Text Books:

1. V. Raghavan, "Materials Science and Engineering", 4/e, Prentice Hall of India Ltd., 2005.
2. S.H. Avner, "Introduction to Physical Metallurgy", 2/e, Tata McGraw Hill Publishers, 2005.

Suggested Reading:

1. S.P. Nayak, "Engineering Metallurgy and Material Science", 6/e, Charoter Publishing House, 2005.
2. E. Dieter, "Mechanical Metallurgy", 3/e, Metric Edition, Tata McGraw Hill, 2005.
3. K.L. Kakani, "Material Science", New Age Publications (P) Ltd., 2008.

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18ME C06

MECHANICS OF MATERIALS LAB

Instruction	2	Hours per week
Duration of Semester End Examination	2	Hours
SEE	35	Marks
CIE	15	Marks
Credits	1	

Objectives: Students will

1. Demonstrate an understanding of tension, and the relationship between stress, strain and application of Hooke's law.
2. Demonstrate an understanding of types of beams, deflections and measurement of material property through deflections.
3. Demonstrate an understanding of torsion and deformations resulting from torsion.
4. Demonstrate the understanding of hardness and its measurement using different scales like Brinnel and Rockwell.
5. Demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

Outcomes: At the end of the course, a student will be able to

1. Draw stress-strain curve for an isotropic material and understand the salient features of it.
2. Determine the Young's modulus of various beam materials by conducting load-deflection test and.

rigidity modulus of a given shaft specimen by torsion test.

3. Able to find out Young's modulus and shear modulus for mechanical components like leaf spring and closely coiled helical spring through load-deflection test respectively.
4. Evaluate hardness of different materials using different scales
5. Find the compressive and crushing strengths of concrete cubes and bricks.

List of the Experiments

1. Uni-axial tension test using UTM.
2. Brinell's and Rockwell's hardness tests.
3. Load-deflection test on a leaf spring to find out the young's modulus of leaf material.
4. Deflection test on a helical spring to determine the rigidity modulus.
5. Torsion of shaft to determine the rigidity modulus of shaft material.
6. Defection test on a cantilever beam to determine the Young's modulus.
7. Deflection test on a simply supported beam to determine the Young's modulus.
8. Deflection test on propped cantilever to determine the Young's modulus.
9. Deflection test on continuous beam to determine the Young's modulus.
10. Crushing and compression test on bricks and concrete cubes.
11. Measuring mechanical strain in a cantilever beam using strain gages and to compare the results with theoretical strain values calculated from an equation derived from solid mechanics.
12. To measure load (tensile/compressive) using load cell on tutor.

Text Books:

1. S.S.Rattan, "Strength of Materials", 3/e, Tata Mc-Graw Hill, 2016.
2. S. Ramamrutham, "Strength of Materials", Dhanpatrai and Sons, 1993.
3. G.H.Ryder, "Strength of Materials", 3/e, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, "Strength of Materials", Vikas Publication, 2003.
2. James M Gere, "Mechanics of materials", 8/e, cengage learning, 2013.
3. R.C. Hibbeler, "Mechanics of Materials", 9/e, Pearson, 2018.

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18ME C11

FLUID PRINCIPLES AND HYDRAULIC MACHINES LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: Students will
1. Determine discharge of fluid flow.
2. Verify fluid laws like Bernoulli's equation and determine losses through pipes.
3. Determine impact force of jet on the vanes
4. Demonstrate knowledge in evaluating performance characteristics of pumps.
5. Evaluate the performance characteristics of turbines.

Outcomes: On completion of the course, the students will be able to
1. Carry out discharge measurements
2. Determine the energy loss in conduits
3. Calculate forces and work done by a jet on fixed or moving, flat and curved blades.
4. Evaluate the performance characteristics of pumps.
5. Demonstrate the characteristics curves of turbines.

List of the Experiments:
1. Verification of Bernoulli's equation.
2. Determination of Darcy's friction factor and nature of water flow through pipes.
3. Determination of Cd for V- notch.
4. Determination of Cd for rectangular notch.
5. Determination of Cd for Venturimeter.
6. Determination of Cd for Orifice meter.
7. Determination of impact force of jet on fixed flat and fixed curved vanes.
8. Performance and characteristic curves of Reciprocating pump.
9. Performance and characteristic curves of Centrifugal pump.
10. Performance and characteristic curves of Self-priming pump.
11. Performance and characteristic curves of Gear pump.
12. Performance and characteristic curves of Pelton wheel.
13. Performance and characteristic curves of Francis Turbine under constant speed and variable speed conditions.
14. Performance and characteristic curves of Kaplan turbine under constant speed and variable speed conditions.

Note: A minimum 12 Experiments need to be conducted.

Text Books:

1. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publication (P) Ltd., New Delhi, 2004.
2. R.S. Khurmi and N. Khurmi, "Hydraulics, Fluid Mechanics and Hydraulic Machines", 20/e, S. Chand publishing, 2014

Suggested Reading:

1. P.N. Modi, and. S.M.Seth, "Hydraulics and Fluid Machines", Standard Book House, New Delhi, 2004.
2. S.Ramamrutham, "Hydraulics, Fluid Mechanics and Fluid Machines", Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., "Fluid Mechanics and Turbomachines", PHI Learning Private Limited, New Delhi, 2009.

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18CS C05

BASICS OF DATA STRUCTURES

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	20 Marks
Credits	2

Objectives: To introduce

1. Basic linear and non-linear data structures.
2. Analyzing the performance of operations on data structures.
3. Different sorting and searching techniques and their complexities.

Outcomes: The Student will be able to

1. Understand the basic concepts of data structures.
2. Understand the notations used to analyze the performance of algorithms.
3. Choose and apply an appropriate data structure for a specified application.
4. Understand the concepts of recursion and its applications in problem solving.
5. Demonstrate a thorough understanding of searching and sorting algorithms.

UNIT - I

Introduction: Data Types, Data structures, Types of Data Structures, Operations, ADTs, Algorithms, Comparison of Algorithms, Complexity, Time- space tradeoff.

Recursion: Introduction, format of recursive functions, recursion Vs. Iteration, examples.

UNIT - II

Linked Lists: Introduction, Linked lists and types, Representation of linked list, operations on linked list, Comparison of Linked Lists with Arrays and Dynamic Arrays.

UNIT - III

Stacks and Queues: Introduction to stacks, applications of stacks, implementation and comparison of stack implementations. Introduction to queues, applications of queues and implementations, Priority Queues and applications.

UNIT - IV

Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree, Conversion of General Trees to Binary Trees, Representations of Trees, Tree Traversals, Binary search Tree.

UNIT - V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees.

Searching and Sorting: Linear searching, binary Searching, sorting algorithms- bubble sort, selection sort, quick sort, heap sort.

Text Books:

1. Narasimhakarumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, 2017
2. S. Sahni and Susan Anderson-Freed, Fundamentals of Data structures in C,E.Horowitz, Universities Press, 2nd Edition.
3. ReemaThareja, Data Structures using C, Oxford University Press.

Suggested Reading:

1. D.S.Kushwaha and A.K.Misra, Data structures A Programming Approach with C, PHI.
2. Seymour Lipschutz, Data Structures with C, Schaums Outlines, Kindle Edition

Online Resources:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-1#DS

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18ME C07

KINEMATICS OF MACHINES

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:
Students will acquire knowledge in
1. Fundamental definitions of kinematics of mechanism.
2. Drawing velocity and acceleration diagrams for various mechanisms
3. Working principles of brake and dynamometers
4. Drawing displacement diagrams for various types of followers with various types of motions.
5. Estimation of transmission of power by belts and application of various gears and gear trains.

Outcomes:
At the end of the course, student will be able to understand
1. Basic elements of mechanisms and their motion characteristics.
2. Designing a suitable mechanism depending on application.
3. Principles involved in functioning of brake and dynamometer
4. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Selecting gear and gear train depending on application.

UNIT - I
Introduction: Definition of link, element, pair, kinematic chain, mechanism and machine. Grubler's criterion, single and double slider chains, inversions of quadratic chain, inversions of single and double slider crank chains. Mechanism with lower pairs and straight line motion mechanism, Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT - II
Analysis of mechanisms: Graphical methods to find velocities of mechanisms, instantaneous centre, body centre and space centre. Kennedy's theorem, graphical determination of acceleration of different mechanisms including Coriolis component of acceleration, analytical method to find the velocity and acceleration, analysis of four bar mechanism with turning pairs, Freudenstein's method for synthesis of four bar linkage.

UNIT - III
Laws of Friction: Friction in screw threads, pivots, collars, Clutches - Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link.
Brakes and Dynamometers: Block or shoe, band and block, internal expanding shoe brake, Prony, rope brake, belt transmission, torsion dynamometers.

UNIT - IV
Cams: Types of cams and followers, displacement diagrams for followers, uniform motion, parabolic motion, simple harmonic motion, cycloidal motion, drawing cam profile with knife edge follower, translating roller follower and translating flat follower. Cams of specified contours, tangent cam with roller follower, circular arc (convex) cam with roller follower.

UNIT - V
Gears: Classification of gears, spur gears, nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycliodal tooth profile. **Helical Gears:** Helical gear tooth relations, contact of helical gear teeth,
Gear trains: Gear trains–simple and compound, reverted and epicyclic gear trains. Differential of an Automobile.

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Text Books:

1. Thomas Bevan, "Theory of Machines", CBS Publishers, 2009.
2. S.S. Rattan, "Theory of Machines", 4/e, Tata McGraw Hill Publishers, 2013.
3. J.E.Shigley, "Theory of Machines", 3/e, Tata Mc.Graw Hill Publishers, New Delhi, 2005.

Suggested Reading:

1. C.S. Sharma and Kamlesh Purohit, "Theory of Mechanisms and Machines", PHI Learning Pvt. Limited, 2006.
2. Amitabh Ghosh and A.K.Mallik, "Theory of Machines", 3/e, East West Publications, 2009.

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18ME C08

THERMODYNAMICS

Instruction	3	Lecture – 1 Tutorial Hours per week
Duration of Semester End Examination	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	4	

Objectives:
Students will understand

1. Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
2. The importance and application of first law of thermodynamics.
3. The principles associated with second law of thermodynamics.
4. Properties of pure substances and use of Mollier diagram.
5. Various air standard cycles, vapour power cycles and their importance.

Outcomes:
At the end of the course a student will be able to

1. Estimate the temperature of different scales of thermometers.
2. Apply the first law of thermodynamics to various thermodynamic processes.
3. Understand the meaning of perpetual motion of machine of second kind and its significance.
4. Read data from steam tables, Mollier diagram and its applications.
5. Distinguish working principles of various air standard cycles, vapour power cycles and determine air–fuel ratios required for combustion of fuels

UNIT - I
Introduction: Thermodynamics, Macroscopic and Microscopic approaches, thermodynamic systems, properties, processes and cycles, thermodynamic equilibrium, quasi – static process, measurement of pressure, Zeroth law of thermodynamics and its significance, measurement of temperature, reference points, ideal gas equation.

UNIT - II
First Law of Thermodynamics: Concept of heat and work, first law of thermodynamics for closed system, energy- a property of the system, application of first law to various thermodynamic processes like isobaric, isochoric, isothermal, adiabatic and polytropic, definition of enthalpy, PMM1, first law applied to flow processes, application of SFEE to nozzle and diffuser, throttling device, turbine and compressor.

UNIT - III
Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin–Planck and Clausius statements of second law of thermodynamics, PMM2, equivalence of Kelvin-Planck and Clausius statement, reversible and irreversible processes, Carnot theorem, Clausius inequality, calculation of entropy change during various thermodynamic processes, principle of entropy increase, T–S diagrams, application of entropy principle for mixing of two fluids. Helmholtz and Gibb's functions.

UNIT - IV
Thermodynamic Properties of Fluids: Properties of pure substances, p– v diagram, p–T diagram, p–v–T surface, T–s diagram, h–s diagram, dryness fraction, use of steam tables, Maxwell relations.

UNIT - V
Air Standard Cycles: Air standard cycles - Otto, Diesel, Dual Combustion Cycles, working principle, derivation of expression for air standard efficiency, comparison of otto, diesel and dual cycles-for the same compression ratio, for the same maximum pressure and temperature.
Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle.
Fuels and Combustion: Characteristics of an ideal fuel, classification of fuels, Stoichiometric air-fuel ratio, equivalence ratio, relation between volumetric and gravimetric analysis.

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Text Books:

1. P.K. Nag, "Engineering Thermodynamics", 5/e, Tata McGraw Hill Publishers, 2013.
2. D.S. Kumar, "Thermal science and Engineering", 4/e, S. K.Kataria and Sons, 2013.
3. D.P.Mishra, "Engineering Thermodynamics", Cengage Learning, 2012.
4. Y.A. Cengel and M.A. Boles, "Thermodynamics: An Engineering Approach", 7/e, Tata McGraw Hill Publishers, 2014.

Suggested Reading:

1. R.K. Rajput, "Thermal Engineering", 8/e, Laxmi Publications (P) Ltd, 2011.
2. Mahesh M Rathore, "Thermal Engineering", Tata McGraw Hill Publishers, 2013.

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18ME C09

PRINCIPLES OF MANAGEMENT

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
To make the students to
1. Understand basic fundamentals and insights of management
2. Understand the nature and purpose of planning
3. Gain the knowledge about the frame work of organizing
4. Understand the essence and significance of directing
5. Recognize the importance of controlling and its outcomes

Outcomes:
At the end of the course, student will be able to understand
1. Identify and evaluate the principles of management
2. Demonstrate the ability to have an effective and realistic planning
3. Identify the nature and the type of organization
4. Apply the tools and techniques of directing
5. Explain and evaluate the necessity for controlling and further refinement of an organization.

UNIT - I
Management: Definition of management, science or art, manager vs entrepreneur; managerial roles and skills:. Evolution of management, Basic management theories by FW Taylor, Henry Fayol, Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management

UNIT - II
Planning: Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies. Strategic Management, Planning Tools and Techniques, Planning plant location and layout. Decision making steps & processes.

UNIT - III
Organizing: Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management

UNIT - IV
Directing: Individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT - V
Controlling: system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:
1. S.P. Robins and M. Coulter, "Management", 10/e., Prentice Hall India, 2009.
2. JAF Stoner, RE Freeman and DR Gilbert, "Management", 6/e., Pearson Education, 2004.

Suggested Reading:
1. P.C. Tripathy & P.N. Reddy, "Principles of Management", Tata McGraw Hill, 1999
2. Harold Koontz and Cyril O'Donnell "Principles of Management", Tata McGraw Hill, 2017

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18PE C03

METAL CASTING AND WELDING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
To enable the students to
1. Impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting
2. Provide adequate knowledge of molding sand properties, melting furnaces , defects and quality test methods conducted on casted components
3. Provide knowledge of various special casting processes
4. Impart knowledge of various arc welding processes
5. Provide knowledge about other welding processes, weldability and defects in welding

Outcomes:
At the end of the course a student will be able to
1. Design the pattern, gating system and riser for a simple casting,
2. Understand various properties of molding sand, furnaces used in foundry, and defects in casting
3. Describe various special casting processes
4. Describe various arc welding processes.
5. Compare various arc, resistance, solid state and other welding processes.

UNIT - I
Pattern design and Methoding: Introduction, classification, pattern design: types of patterns, pattern materials, pattern allowances, gating system, purpose, elements, requirements, types of gates, choke, gating ratio, types of gating systems, gating system design, Risering: purpose, requirements, chvorinov's rule, optimum shape and dimensions of riser, riser design by Caine's method, modulus method and NRL method.

UNIT - II
Moulding, Melting, Defect Analysis and Inspection Techniques: Moulding sand: ingredients, types of sand clays, additives, moulding sand preparation, required properties, Core: purpose, core prints, core sand preparation, core preparation, chaplets, types of cores, net force on the core Melting furnaces: Cupola, Induction and Arc furnace, casting defects and remedies, inspection and testing of castings

UNIT - III
Special Casting Processes: Gravity die casting pressure die casting, centrifugal casting, shell moulding, investment casing, continuous casting, slush casting, lost foam process, squeeze casting, vacuum moulding ,CO_2 moulding and ceramic moulding

UNIT - IV
Arc Welding: Introduction, classification of welding processes, physics of arc, DCSP, DCRP, AC, arc initiation, arc stability, parts of arc, arc length characteristics, static V-I characteristics of power sources, duty cycle, shielded metal arc welding, submerged arc welding, Gas tungsten arc welding, Plasma arc welding, Atomic Hydrogen welding.

UNIT - V
Other Welding Processes: Resistance welding: spot, projection, seam, butt and percussion welding, Oxy-Acetylene welding, Thermit welding, laser beam welding, electron beam welding, Soldering and Brazing, weld defects, solid state welding, forge welding, friction welding, ultrasonic welding, explosive welding, weldability, effect of various parameters on weldability and weld defects

Text Books:

1. P.N. Rao, "Manufacturing Technology", 3/e, Vol. 1, Tata McGraw Hill Publishers, 2011.
2. Amitabh Ghosh and Mallick, "Manufacturing science", 4/e, Assoc. East West Press Pvt. Ltd., 2011.
3. Schey, "Introduction to Manufacturing Processes", 2/e, McGraw-Hill Education.

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Suggested Reading:

1. Roy A. Lindberg, "Materials and Process of Manufacturing", 5/e, Prentice Hall of India, 1992.
2. Serope Kalpak Jian, "Manufacturing Engineering and Technology", Addition, Wesley Publishing company, 2006.
3. Mikell P. Grover, "Fundamentals of Modern Manufacturing Materials", 3/e, Processes and Systems, Wiley A.

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18CE M01

ENVIRONMENTAL SCIENCE

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	------
Credits	0

Objectives: To enable the student

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Become aware about the importance of eco system and biodiversity for maintaining ecological balance
3. To identify the importance of interlinking of food chain
4. Learn about various attributes of pollution management and waste management practices.
5. To make the students contribute for capacity building of nation for arresting and/or managing environmental

Outcomes: At the end of the course, the student should have learnt

1. To define environment, identify the natural resources and ecosystems and contribute for the conservation of bio-diversity.
2. To suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
3. To relate the social issues and the environment and contribute for the sustainable development.
4. To follow the environmental ethics.
5. To contribute for the mitigation and management of environmental disasters.

UNIT - I

Environmental Studies: Definition, Scope and importance, need for public awareness.
Natural Resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT - II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems

UNIT - III

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards
Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V

Social Issues and the Environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu,"Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006.

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18CS C08

BASICS OF DATA STRUCTURES LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives:

1. Design and construct simple programs by using the concepts of data structures as abstract data type.
2. To have a broad idea about how efficiently pointers can be used in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To strengthen the practical ability to apply suitable data structure for real time applications.

Outcomes: The Student will be able to

1. Implement the abstract data type.
2. Implement linear data structures such as stacks, queues using array and linked list.
3. Understand and implement non-linear data structures such as trees, graphs.
4. Implement various kinds of searching, sorting and traversal techniques.
5. Identify the suitable data structure for real world problem.

List of Experiments for Non-CSE/IT:

1. Implementation of operations on arrays
2. Implementation of Stack.
3. Implementation of Queue.
4. Implementation of basic operations on Single Linked List.
5. Implementation of Searching techniques.
6. Implementation of Sorting Techniques
7. Case study like Banking System, Students Marks Management, Canteen Management etc

Text Books

1. Brian W Kernighan, Dennis Ritchie, "C Programming Language", 2/e, PH PTR.
2. Richard M Reese, "Understanding and Using C Pointers O'Reily", 2013.

WebLinks

https://nptel.ac.in/courses/106102064/

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SOFT SKILLS LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives: The course will introduce the students to

1. Imbibe an impressive personality, etiquette, professional ethics & values, effective time management & goal setting.
2. Understand the elements of professional update & upgrade through industry exposure in a mini-live project. Understand confidence building strategies and thereby to make effective presentations through PPTs.
3. Learn what constitutes proper grooming and etiquette in a professional environment. Acquire the necessary skills to make a smooth the practical ability to apply suitable data structure for real time applications.

Outcomes: After successful completion of the course the students will be able to

1. Be assertive and set short term and long term goals. Also learn to manage time effectively and deal with stress.
2. Win in professional communication situations and participate in group discussions with confidence. Write abstracts.
3. Write effective resumes. Plan, prepare and face interviews confidently.
4. Adapt to corporate culture by being sensitive - personally and sensible - professionally. Draft an SOP.
5. Apply the soft skills learnt in the mini-live project, by collecting and analyzing data and making oral and written presentations on the same.

Exercise 1:
Main Topics: Thinking Skills, Personality Development – Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.
Flipped Sessions: Personal Sensitivity & Professional Sensibility (Reading & Discussion)
Writing Input: Writing to Express - Drafting & Delivering a Speech (Free Writing Exercise)

Exercise 2:
Main Topics: Advanced Group Discussion with Case studies : Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
Flipped Sessions: Importance of Professional Updating & Upgrading (Reading & Discussions)
Writing Input: Writing with Precision - Writing Abstracts

Exercise 3:
Main Topics: Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews. Resume' writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skills.
Flipped Sessions: Mock Interviews (Video Sessions & Practice)
Writing Input: Writing to Reflect - Resume Writing

Exercise 4:
Main Topic: Corporate Culture – Grooming and etiquette, communication media, academic ethics and integrity
Flipped Sessions: Corporate Culture, Etiquette & Grooming (Video Sessions & Practice through Role-play)
Writing Input: Writing to Define - Writing an effective SOP.

Exercise 5:
Main Topic: Mini Project – General/Technical. Research, developing a questionnaire, data collection, analysis, written report and project seminar. Elements & Structure of effective presentation. Presentation tools – Body language, Eye-contact, Props & PPT.
Flipped Sessions: Effective Presentations (Video & Writing Sessions, Practice through Emulation)
Writing Input: Writing to Record - Writing minutes of meeting.

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Suggested Reading:

1. Madhavi Apte , "A Course in English communication", Prentice-Hall of India, 2007
2. Dr. Shalini Verma, "Body Language- Your Success Mantra", S Chand, 2006
3. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010
4. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004

* Flipped Class-room: Students explore the concept first and then trainer explains it, students work on their own.

Web Resources:

1. https://www.goskills.com/Soft-Skills
2. https://www.trainerbubble.com
3. https://www.skillsconverged.com

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18PE C04

METAL CASTING AND WELDING LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Objectives:
To enable the students to
1. Deploy the knowledge to prepare the mould for a single piece and split patterns.
2. Impart the knowledge of properties of the moulding sand and analyze the same.
3. Develop knowledge of the bead geometry and study effect of the input parameters.
4. Identify and distinguish the types of the flame in gas welding and applications
5. Develop knowledge to use TIG, MIG and Spot welding machines and experiment with them.

Outcomes:
Students will be able to
1. Prepare the mould for a single piece and split patterns.
2. Test the moulding sand and analyze the same.
3. Test the bead geometry and correlate the results to the input parameters.
4. Distinguish the type of the flame and recommend for different materials.
5. Use TIG, MIG and Spot welding machines and experiment with them.

List of the Experiments:
Casting
1. Design and manufacturing of a simple pattern with various allowances.
2. Green sand moulding practice for a single piece pattern.
3. Green sand moulding practice for a split pattern with a horizontal core.
4. Moulding sand testing: GCS, GSS, DCS and DSS Permeability and shatter index.
5. Finding out the GFN, Moisture content and clay content for a given sand sample.
6. Melting and Pouring of Aluminum.
7. Dimensional inspection and visual inspection of the casting and analysis of dimensional variation and defects.

Welding
1. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
2. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
3. Study of resistance welding process and plot the variation of spot area with time and current variation.
4. Study of TIG welding process and plotting cooling curve in TIG welding process.
5. Study of SAW Welding process and finding out deposition efficiency of the process.
6. Study of MIG welding process and testing of weld bead formed by MIG welding.

Note: Minimum 10 Experiments need to be conducted by choosing any 5 from each section.

Text Books:

1. P.N.Rao, "Manufacturing Technology", 3/e, Vol.1, Tata McGraw Hill Publ., 2011.
2. Amitabh Ghosh and Mallick, "Manufacturing Science", 4/e, Assoc. East West Press Pvt. Ltd., 2011.

Suggested Reading:

1. Schey, "Introduction To Manufacturing Processes" , 2/e, McGraw -Hill Education.
2. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addition, Wesley Publishing Company, 2006.
3. Mikell P.Grover, "Fundamentals of Modern Manufacturing Materials", 3/e, Processes and Systems, Willey A.

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16ME C20

DYNAMICS OF MACHINES

Instruction	3 Hours + 1 Tutorial per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. To find static and dynamic forces on planar mechanisms.
2. To know the causes and effects of unbalanced forces in machine members.
3. To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

Course Outcomes:

1. Graduates are expected to demonstrate the ability of the analysis of forces in mechanism which provide them the required inputs to design the systems which withstand operating conditions
2. Graduates are expected to understand the turning moment diagram, cyclic fluctuation in speed, fluctuation in energy and get the ability of designing flywheel.
3. Graduates are expected to understand gyroscopic and centrifugal actions of vehicles and will be able to reckon additional bearings reactions due to gyroscopic and centrifugal effects
4. Graduates will have ability to control speed using governors
5. Graduates will have ability to identify the unbalance in rotor and engines and will get the knowledge of balancing.
6. Graduates will understand the concepts of vibration thereby they are able to design the systems free from ill effects of vibration.

UNIT-I: Static and Dynamic Force Analysis:
Force analysis of Four bar and slider crank mechanisms: Study of dynamically equivalent system, Inertia forces on connecting rod.
Flywheels: Functions, Turning moment diagrams, flywheels analysis for I.C. Engines and Presses.

UNIT-II: Gyroscope: Gyroscopic couple, gyroscopic effects on vehicles.
Governors: Classification of governors, Watt, Porter, Hartnell and Hartung governors, Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

UNIT-III: Balancing of Rotating masses:
Forces on bearings due to rotating shaft carrying several masses in several planes. Determination of balance masses from the forces on the bearings.
Balancing of Reciprocating masses: Shaking forces in single cylinder engine, Partial balancing of reciprocating engine. Balancing of two cylinder locomotive engine. Balancing of multi cylinder in-line engines. Balancing of radial engines by direct and reverse cranks method.

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UNIT-IV: Vibrations:
Vibrations of Single degree freedom system, (axial, transverse and torsional). Equivalent system of combination of springs, stepped shaft, whirling speed of shafts.

Damped vibrations:
Types of damping. Vibrations with viscous damping.

Forced vibrations:
Vibrations with harmonically applied force with viscous damping. Dynamic magnifier, Resonance, Vibration isolation and Transmissibility

UNIT-V:Two degree freedom systems: Natural frequencies and modes of vibration

Approximate Methods: Dunkerley and Rayleigh's methods

Multi rotor system :Holzers method

Text Books:

1. S.S. Rattan, *Theory of Machines*, Tata-Mc Graw Hill, 1995.
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines & Mechanisms*, Oxford University Press, 2003.
3. Benson H. Tangue, Principles of Vibration, 2nd Edn., Oxford University Press, 2007

Suggested Reading:

1. A. Ghosh and Mallick, *Theory of mechanisms and machines*, Affiliated to E-W Press, 1988.
2. Ashok G Ambedkar, Mechanism and Machine Theory, PHI, 2013
3. Robert L. Norton, *Design of Machinery*, Tata Mc Graw Hill, 2005.
4. J.S. Rao and Gupta, 'Theory and Practice of Mechanical Vibrations, PHI, 1984
5. Theory of Vibration with Application, J.J. Thompson, Dec-2002

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16ME C21

APPLIED THERMODYNAMICS & HEAT TRANSFER

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. To demonstrate basic knowledge by understanding the basic working principles of reciprocating air compressor and its applications in engineering.
2. Students will come to know the working principle of diesel and petrol engine, their combustion phenomena and problems pertaining to abnormal combustion
3. Student will understand the configurational features of IC engine like ignition system and injection system
4. To demonstrate basic knowledge by understanding different modes of heat transfer
5. Students will understand the basic principles of radiation
6. Student will understand the working principles of parallel and counter-flow heat exchangers

Course Outcomes: Students will be able to

1. Estimate power required for reciprocating air compressor, used for many engineering applications.
2. Evaluate the performance of diesel and petrol engines and suggest some suitable methods for remedy of abnormal combustion
3. Understand the importance of accessories of IC engines
4. Apply appropriate equations depending on mode of heat transfer
5. Distinguish the radiation heat transfer from other modes of heat transfer
6. Design heat exchangers with the basic knowledge acquired in heat exchangers

UNIT-I: Reciprocating Air Compressors:
Single stage and multi stage compressors with and without clearance volume, work done, various Efficiencies of multi stage compression.

UNIT-II: Internal Combustion Engines:

Classification, Working principles of 2 stroke, 4 stroke SI and CI engines. Performance of IC Engines. Heat balance sheet.

UNIT-III: Combustion Phenomena:

Normal and abnormal combustion phenomenon in SI and CI engines. Cooling, lubrication systems, Battery and magneto ignition systems of IC engines. Working principle of Simple Carburetor and Fuel Injector

UNIT-IV: Modes of heat transfer:
General 3-D conduction equation in Cartesian and cylindrical coordinates, one dimensional steady state conduction through slabs, hollow cylinders without heat generation, critical radius of insulation for cylinders.
Convection: Free and forced convection, dimensionless numbers and their physical significance, simple problems on free and forced convection

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UNIT-V: Radiation: Various laws of radiation, concept of black-body, surface resistance, space resistance, radiation shield.

Heat Exchangers: Classification, LMTD and NTU Concepts
Concept of Condensation and boiling

Text Books:

1. Mahesh M. Rathore, "Thermal Engineering," TMH, New Delhi, 2010
2. Ganeshan, V., " Internal Combustion Engines", Tata Mcgraw Hill Publishing, New Delhi,2015
3. Holman, J.P., "Heat Transfer", McGraw Hill Publication, New Delhi,

Suggested Reading:

1. R.K. Rajput.," Thermal Engineering", Laxmi Publishers, New Delhi, 2014
2. D.S. Kumar; Heat Transfer S K Kataria Publishers, 2015
3. R.K. Rajput, 'Heat Transfer', Laxmi Publications, 2014

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16ME C22

DESIGN OF MACHINE ELEMENTS
(USAGE OF DATA BOOK IS COMPULSORY)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

1. To understand the basics of mechanics of materials and design of machine elements for static and fatigue strength, rigidity and wear criterions, use of codes and standards.
2. To know the principles of ergonomic design.
3. To learn the principles to design shafts, keys, belt drives, joints and couplings.
4. To Develop and solve mechanical component design problems based upon given data and requirements

Course Outcomes: Students will able to

1. Select material based on type of load and manufacturing considerations.
2. Design the components subjected to static loads.
3. Design the components subjected to fluctuating loads.
4. Become familiar with mechanical elements like shafts, keys, couplings and pulleys.
5. Become familiar with permanent types of joints and their design concepts.
6. Become familiar with detachable joints and power screws.

UNIT-I : Introduction:

Materials used in machine design and their specifications to Indian standards. . Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations. Preferred numbers. Value analysis. Analysis of Stress and Strain: Definition of stress and strain, Types of loading, direct normal stress, Bending stress, Torsional stress, Crushing and bearing stresses, Biaxial stress and triaxial stress. Theories of elastic failure, Stress concentration factor, Factor of safety, Design of components for static loads.

UNIT-II: Design for Fatigue and Impact Loads:

Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

UNIT-III: Design of keys:

Design of Shafts, Solid, hollow, stepped shafts and splined shafts under torsion and bending loads.

Design of couplings – Muff and Split muff Couplings, Flange, Flexible and Marine type of couplings.

Design of belt drive systems , selection of belts and design of pulleys.

UNIT-IV: Design of Riveted Joints:

Types of joints, efficiency of the joints, structural joints, and joints subjected to direct and eccentric loads.

Design of welded joints - types of joints, joints subjected to direct and eccentric loading.

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UNIT-V: Design of Machine Elements:

Design of cotter and knuckle joints.
Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints.
Design of power screws and screw jack.

Text Books:

1. V.B. Bhandari, *Machine Design*, Tata Mc Graw Hill Publication, 2010.
2. J.E. Shigley, C.R. Mischne, *Mechanical Engineering Design*, Tata Mc Graw Hill Publications, 2011.
3. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Suggested Reading

4. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2013
5. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2010
6. M.F. Spotts, *Design of Machine Elements*, Prentice Hall of India, 2013.

Machine Design Data Books:

1. Design Data Hand book for Mechanical Engineers, K. Mahadevan, K. Balaveera Reddy, CBS Publisher 3rd Edition.
2. Design Data book by PSG College – 2012

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16ME E01

REFRIGERATION AND AIR CONDITIONING (Elective-I)

Instruction	3Hours per week
Duration of Semester End Examination	3Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. Students will acquire the basic knowledge about the importance of refrigeration, its applications in aircraft refrigeration
2. To demonstrate basic knowledge of vapor compression refrigeration system , cascade and compound refrigeration
3. Student will understand various types of absorption refrigeration systems like ammonia, Electrolux and lithium bromide refrigeration systems
4. Students will acquire the basic knowledge on various psychrometric processes
5. Student will understand the importance of comfort air conditioning
6. Students will acquire knowledge in estimating air conditioning loads

Course Outcomes:

1. Students will be able to differentiate refrigeration from air conditioning
2. Students will be able to understand merits and demerits of vapor compression refrigeration system over air refrigeration system
3. Student will be able to know the importance of absorption refrigeration system over vapor refrigeration system
4. Students will be able to apply a suitable sychrometric process depending on requirement or application
5. Student will be able to know the condition necessary for comfort condition
6. Student will be able to estimate the load required for AC system depending on application

UNIT-I: Introduction to Refrigeration:
Application of Refrigeration, Definition of COP, Tonne of Refrigeration, Designation, Carnot cycle, Eco-friendly Refrigerants
Properties of Refrigerants:

Air Refrigeration Systems:
Analysis of Bell-Coleman Cycle, Application to aircraft refrigeration, Simple cooling system, Bootstrap simple evaporating system, Regenerative cooling system and Reduced ambient cooling system.

UNIT-II: Vapour compression system:
Working principle and analysis of Simple vapor compression Refrigeration cycle.
Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system. Low temperature refrigeration system (with single load system), Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages

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UNIT-III: Vapour Absorption Refrigeration System:
Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system
Steam Jet Refrigeration:
Principle of working, Analysis of the system, Advantages, limitations and applications.

UNIT-IV: Psychrometry:
Psychrometric properties, Psychrometric chart, construction, Representation of Various Psychrometric processes on the chart,

Introduction to Air Conditioning:
Requirements of comfort air conditioning, Thermodynamics of human body, ASHRE comfort chart, Effective temperature

UNIT-V: Cooling Load Calculations in Air Conditioning:
Concept of by pass factor, Sensible heat factor, Apparatus Dew Point, Various Heat Load
Design of air conditioning systems:
Simple Problems on Summer, Winter and Year Round Air conditioning systems Energy conservation in air conditioned building,

Air Conditioning Systems:
Components of air conditioner equipments, Humidifier, Dehumidifier, Filter.

Text Books

1. Arora C.P., " *Refrigeration and Air conditioning*", Tata McGraw Hill, New Delhi, 2004.
2. Stocker, W.S., "*Refrigeration and Air conditioning*", McGraw Hill, New Delhi, 2004.
3. R.K. Rajput, "*Refrigeration and Air Conditioning*" Laxmi Publications, New Delhi, 2007

Suggested Reading

1. V.K. Jain, "*Refrigeration and Air Conditioning*", S Chand & Company, New Delhi, 2004.
2. Manohar Prasad, "*Refrigeration and Air Conditioning*", New Age International, Allahabad, 2007.
3. Edward G Pita, Air conditioning Principles and Sytems; An Energy Approach,4th edn,PHI,2012

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16ME E02

MECHANICAL VIBRATIONS (Professional Elective-I)

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. To gain the knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2. To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.
3. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.

Course Outcomes:

1. Ability to construct a Free Body Diagram, formulates the equations of motion, analytically solves the equations of motion for arbitrary linear single-degree-of-freedom systems in undamped, damped cases.
2. Ability to analyze the basic principles of vibration isolation and absorption and ability to apply them to the design of mechanical systems such as automotive suspensions.
3. Ability to formulate the equations of motion analytically solves the equations of motion for arbitrary linear two -degree-of-freedom systems in undamped, damped, free and forced cases.
4. Ability to analyze normal mode vibration, coordinate coupling and orthogonal property of modeshape.
5. Ability to differentiate discrete and continuous systems, formulate equation of motion and solve for string, bar and beams in continuous systems.
6. Ability to understand vibration measuring instruments, display and recording to elements, frequency analysis.

UNIT-I: Free Vibration Analysis-Single Degree of Freedom Systems Undamped and Damped Translation and Torsional Systems:
Different methods for equation of motion- Energy method, Rayleigh method, principal of virtual work, principal of conservation energy, Rayleigh's method. Viscously damped free vibration, logarithmic decrement, coulomb damping,

UNIT-II: Harmonically Excited Vibration:
Forced harmonic vibration, Rotating unbalance, whirling of rotating shafts, support motion, vibration isolation, energy dissipated by damping. Equivalent viscous damping, structural damping.

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UNIT-III: Damped and Undamped Vibrations of two Degree of Freedom System:
Free and forced vibration analysis of two degree of freedom system-different methods for the formulation of equation equations of motion, natural frequencies,
Normal mode vibration. Coordinate coupling and principal coordinates, semi definite systems, influence coefficients-flexibility, stiffness. Eigen values and Eigen vectors, orthogonal properties of Eigen vectors, repeated roots, modal matrix.

UNIT-IV: Vibrations of Continuous Systems:
Vibrations of strings, bars and beams, formulation of equation of motion, characteristic equation, identification of node and mode shape.

UNIT-V: Vibration Measurements and Applications:
Vibration pickup, Vibrometer, accelerometer. Transducers, piezoelectric transducers, Electrodynamic transducers. Vibration exciters, mechanical and electro dynamic shakers. Frequency measuring instruments.

Text Books:

1. Theory of Vibration with Application, J.J. Thomson, Dec-2002
2. S.S. Rao ,Mechanical vibration, 4th edn, Pearson. 2009
3. G.S. Grover & Nigam ,Mechanical Vibrations,Nem Chand & Bros, 6th edn,1998

Suggested Reading:

1. V.P. Singh , Mechanical vibration, Dhanpath Rai &Co.,3rd edn,2006
2. Graham Kelley,S., Mechanical vibration – Schaums Outline Series, TMH
3. F.S. Tse, Morse & Hinkle ,Mechanical vibration, Allyn and Bacon, 1978

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16PE E02

PRODUCT DESIGN AND PROCESSES PLANNING (Professional Elective-I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. The Product Design and Process Functions
2. The essence of innovation in product development
3. The Human Machine Interactions (ergonomics)
4. The various Intellectual Property Rights
5. The interaction between Design, Manufacturing, Quality and Marketing
6. The awareness about overall view of Process Planning

Course Outcomes:

1. Have overall view of Product Design and Process Planning
2. Apply creativity techniques in Product Development
3. Applying ergonomically enabled concepts in developing a new product
4. Have awareness and apply Intellectual Property Rights
5. Integrate various stages of developing a new product
6. Develop and execute an effective Process Plan

UNIT-I: Product Design and Process Design:
Functions, Essential factors of product design, Selection of right product, Systematic procedure of product innovation, function of design, value of appearance, colors and laws of appearance.

UNIT-II: Product Selection and Evaluation:
Need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques, collection of ideas. Selection criteria - screening ideas for new products using evaluation techniques. Principles of ergonomics, Anthropometry, Design with Human Machine Interaction (HMI)

UNIT-III: New Product Planning and Development:
Interaction between the functions of design, manufacture, and marketing, design and material selection, Steps for introducing new products after evaluation, Product life cycle, Research and new product development

UNIT-IV: Intellectual Property Rights (IPR):
Patents, definitions, Types of Patent, Patent search, Patent laws, International code for patents, Trademark, Trade Secret, Copy Rights and Industrial Design

UNIT-V: Process Selection and Planning:
Process selection, process planning, process sheets, Selection of manufacturing process, estimation of machining time in various cutting operations, Estimation of costs for manufacture, value engineering in product design, Group technology, concepts of concurrent engineering

Text Books:

1. Niebel BW & Draper AB, *Production Design & Process Engg*, McGraw Hill, Kogakusha, 1974
2. K. G. Swift & J. D. Booker, *Process Selection*: From Design to Manufacture", Butterworth-Heinemann Ltd; 2nd Revised edition, 2003
3. Bhaskaran Gopalakrishnan, *Product Design and Process Planning in CE (Design & Manufacturing*", Chapman and Hall publishers, 1994

Suggested Reading:

1. Harry Nystrom, *Creativity and Innovation*, John Wiley & Sons,
2. Brain Twiss, *Managing Technological Innovation*, Pittman Publications, 1992
3. Harry, B.Waton, *New Product Planning*, Prentice Hall Inc., 1992
4. Chitale, A. K. & Gupta RC., *Product Design & Manufacturing*, PHI, 1997

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16PE E01

POWDER PROCESSING – (Professional Elective-I)

Instruction	: 3 Hours per week
Duration of Semester End Examination	: 3 Hours
Semester End Examination	: 70 Marks
Continuous Internal Evaluation	: 30 Marks
Credits	: 3

Course Objectives: To understand the different

1. Powder processing methods
2. Powder properties & characteristics
3. Powder mixing & compaction methods.
4. Powder Sintering methods.
5. Post Sintering processes
6. Testing's of sintered parts.

Course Outcomes: Students will be able to

1. Know the fundamentals in powder manufacturing methods
2. Characterize the Powders in different techniques
3. Suggest appropriate compaction technique for a particular powder
4. Suggest appropriate sintering technique for a particular powder
5. Choose correct post sintering processes
6. Have ability to choose the appropriate testing for sintered parts.

UNIT-I : Introduction:
Importance and advantages of powder processing.
Powder Manufacture: Comminution, solid state reduction, electrolysis, thermal decomposition, and Atomization (water atomization, oil atomization, gas atomization, centrifugal atomization).

UNIT-II : Powder Properties, Characterization, And Mixing:
Chemical composition, particle shape, powder density, particle size, size distribution compressibility, green strength, Blending and mixing. Compaction: Compact size, tool materials, design of sintered part, Olivetti process hot pressing, injection moulding, cold iso-static pressing, and hot iso-static pressing.

UNIT-III: Sintering:
Theory of sintering, Sintering practice – furnace design, furnace atmospheres, vacuum sintering, control of shrinkage, liquid phase sintering, activated sintering, and loose powder sintering.

UNIT-IV: Post-Sintering Operations: Re-press and re-enter, hot re-press, hot forge in a closed die, sizing, coining, HIP, steam treatment, infiltration, and impregnation. Heat treatment, hardening, and tempering, surface hardening, electro-plating, and other coatings. Deburring, machining and joining. Sinter forging.

UNIT-V: Testing of Sintered Parts and Applications:
Porous bearings, filters Magnetic Materials, super alloys, High speed steels, Stainless steels, ODS materials, Production of Near-net shapes, rapidly solidified powders, and spray forming. Manufacturing of Cutting tools, forming dies using powder metallurgy.

Text books:

1. J. S. Hirsch horn: Introduction to Powder Metallurgy, American Powder Metallurgy Institute, Princeton, NJ. 1976.
2. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi, 2008.
3. E.P. DeGarmo, J.T. Black, R.A. Kosher, Materials and processes in manufacturing – 8th Ed., PrenticeHall, 1997.

Suggested Reading:

1. Roy A. Lindberg, Processes and materials of manufacture – 4th Ed., Prentice Hall of India Pvt. Ltd., NewDelhi, 1995
2. H.H. Hausner – Hand book of powder metallurgy.
3. ASM Hand Book, vol. 7: Powder Metallurgy, ASM International.
4. Powder Metallurgy Technology, Cambridge International Science Publishing, 2002

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16 ME E04

HYDRAULIC MACHINES (Professional Elective-II)

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
Semester End Examination	70	Marks
Continuous Internal Evaluation	30	Marks
Credits	3	

Course Objectives: The student will

1. Learn laws related to Fluid Machinery
2. Demonstrate his/her knowledge of principles and problems associated with reciprocating pumps
3. Understand various principles related to rotary pumps
4. Come to know the working principles of Hydraulic turbines
5. Learn the performance characters and selection of turbines.
6. Understand the fundamental principles of hydraulic systems

Course Outcomes: Student will

1. Be able to apply the various fluid laws to different hydraulic machines
2. Be able to understand the methodology of selection of reciprocating pumps
3. Acquire the knowledge the functionality of rotary pumps
4. Understand the selection procedure and estimate the power developed by various hydraulic turbines
5. Compare the performance of hydraulic turbines and pumps based on characteristics curves
6. Acquire knowledge the functionality of various hydraulic systems

UNIT-I: Hydraulic Machines:
Classification- Impulse-momentum equation- Lay-out of hydraulic power plant- working principle- Impact jet on vanes- Force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) at the centre of a fixed symmetrical curved vane (iii) at one end of fixed symmetrical curved vanes (iv) flat vertical vane moving in the direction of jet (v) a series of flat vertical moving vanes (vi) symmetrical curved vanes moving in the same direction as that of jet at inlet (vii) at one end of a series of un-symmetrical moving curved vanes

UNIT-II: Reciprocating Pumps:
Classification- working principle- single and double acting pumps- discharge, work done and power required to drive the pumps- slip, % slip and negative slip- Variation of pressure head in the suction and delivery pipes due to acceleration of piston- Variation of pressure head due to friction in the suction and delivery pipes- Indicator diagrams- Ideal and actual diagrams- Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes- Air vessels- Function of air vessels- Work saved by fitting air vessels to single and double acting pumps- Discharge of liquid into and out of air vessels- Performance characteristic curves

UNIT-III: Centrifugal Pumps:
Classification- Working principle- Comparison over reciprocating pumps-Velocity triangles- Manometric head- work done per second- Head equivalent of work done- Manometric, mechanical and overall efficiencies- Pressure rise in the impeller- Minimum starting speed- Specific speed- Physical significance of specific speed- Model testing- Conditions of similarity of CF pumps- Priming- Performance characteristic curves

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UNIT-IV: Hydraulic Turbines:
Classification- Impulse and reaction turbines- Construction and working of Pelton wheel, Francis turbine and Kaplan turbine- Velocity triangles- Work done (power developed)- Hydraulic, Mechanical and Overall efficiencies- Maximum efficiency-Specific speed- Physical significance of specific speed- Unit testing -Unit quantities- Model testing of turbines- Conditions for similarity of turbines- Performance characteristic curves

UNIT-V: Hydraulic Systems (appliances):
Working of hydraulic press- accumulator- intensifier- Ram- jack- lift- direct acting hydraulic lift- Suspended hydraulic lift- crane- air lift pump- gear wheel pump

Text Books:

1. Bansal, R.K., "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publication (P) Ltd., New Delhi,2004
2. Modi, P.N. and Seth. S.M., "Hydraulics and Fluid Machines", Standard Book House, New Delhi, 2004
3. Ramamrutham, S., "Hydraulics,Fluid Mechanics and Fluid Machines", Dhanpat Rai and Sons, New Delhi,2004

Suggested Reading:

1. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi,2004
2. White, Frank. M., Fluid Mechanics, 5th Edn., McGraw Hill 2003.
3. Madan Mohan Das., "Fluid Mechanics and Turbo machines", PHI Learning Private Limited, New Delhi, 2009

16PE E03

NON-DESTRUCTIVE TESTING AND EVALUATION (Professional Elective - II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: Student has to understand the

1. Need, basic concepts and technologies of Non Destructive Testing (NDT)
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Course Outcomes: At the end of the course, the students will be able to demonstrate

1. The knowledge of different NDT techniques.
2. Clear understanding of liquid penetrant inspection and magnetic particle inspection.
3. View and interpret radiographs, utilize the various principles of radiography for different components of different shapes.
4. The knowledge of acoustic emission for NDT and the instrumentation used for NDT.
5. The ability to analyze and prepare a technical report.
6. The knowledge of latest research, developments and trends in NDT.

UNIT-I: Liquid Penetrate Inspection:
Principles of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system , solvent removable system, surface preparation and cleaning, penetrate application, development, advantages limitations, and applications.
Magnetic Particle Instruction:
Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages and limitations.

UNIT-II: Eddy Current Testing:
Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

UNIT-III: Ultrasonic Testing:
Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, Immersion testing , sensitivity and calibration, Reference standards, Surface condition, Applications.

UNIT-IV: Radiography:
Principle and uses of radiography, limitation principle, radiation sources, production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadow formation enlargement and distortion, radio graphic film and paper, Xeroradiography, fluoroscopy, exposure factors, radiographic screens, identification markers and image quality indicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

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UNIT-V: Acoustic Emission:
Physical Principles, Sources of emission, instrumentation and applications, Other NDT Techniques: Neuron radiography, Laser induced ultrasonic, surface analysis, and thermography.

Text Books:

1. Barry Hull & Vernon John, *Non Destructive Testing*, 1988.
2. H J Frissell (Editorial Coordinator), Non-*Destructive Evaluation and quality control*, ASM handbook-International Publication USA, 1989.
3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hall of India. Delhi

Suggested Reading:

1. *Non-Destructive Examination and Quality Control*, ASM International, Vol.17, 9th edition (1989)
2. J. Prasad and C. G. K. Nair, *Non-Destructive Test and Evaluation of Materials*, Tata McGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical *Non Destructive Testing*, Alpha Science International Limited, 3 rd edition (2002).
4. T.Rangachari, J. Prasad and B.N.S. Murthy, *Treatise on non-destructive testing and evaluation*, Navbharath Enterprises, Vol.3, (1983)

16PE E04

PLASTICS, CERAMICS AND COMPOSITE MATERIALS (Professional Elective-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: To make the students to

1. Understand various types of plastics, their properties and uses
2. Understand various methods of manufacturing plastic components
3. Understand types of ceramics, refractoriness, their uses.
4. Familiarize with white wares ceramic coatings and glass.
5. Understand the manufacturing processes of ceramics.
6. Understand composites and their uses

Course Outcomes: Students should able to

1. Describe about types of plastics, their properties and uses
2. Suggest the suitable method of manufacturing a plastic component.
3. Describe about types of ceramics, refractoriness, their uses.
4. Express the details about white wares ceramic coatings and glass.
5. Suggest the suitable method of manufacturing processes of ceramics.
6. Describe about types composites and their uses

UNIT I: Introduction to polymers:
Plastics and elastomeres, polymerization, degree of polymerization thermoplastics and thermosetting plastics, properties and applications of various thermo and thermosetting plastics, mechanical properties of plastics and their influencing parameters.

UNIT II: Manufacturing Methods of Plastics:
Injection moulding, Extrusion, calendering, thermoforming, Blow moulding, compaction moulding, transfer moulding

UNIT III: Introduction to Ceramics, Classification of Ceramic Materials , Conventional and Advanced; Refractories:
Classification of Refractories, Modern trends and developments, Basic raw materials, Elementary idea of manufacturing process technology, Flow diagram of steps necessary for manufacture, basic properties and areas of application

UNIT IV: White wares:
Classification and type of White wares, Elementary idea of manufacturing process technology including body preparation, basic properties and application area;. Ceramic Coatings : Types of glazes and enamels, Elementary ideas on compositions, Process of enameling & glazing and their properties. Glass: Definition of glass, Basic concepts of glass structure, glass manufacturing processes, Different types of glasses. Application of glasses.

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UNIT V: Fundamentals of composites:

Need for composites – enhancement of properties – classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers. Manufacturing methods of composites.

Text Books:

1. Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems" Wiley publications, 6th edition'2015.
2. Kalpak Jain "Manufacturing Engineering and Technology" Pearson publications, 7th edition 2013
3. P.N. Rao, Manufacturing Technology, Vol.-I, McGraw Hills Publication, 4th Edn., 2016

Suggested Reading:

1. R.K.Rajput 'a text book of Manufacturing Technology", laxmi Pub., Vol-I, 2007
2. P.C. Sharma, 'A Text book of production Technology', S. Chand & Co., Pvt.Ltd., 8th Edn 2014.

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16MT EO4

PROBABILITY AND NUMERICAL METHODS (Professional Elective-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Exam	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3 Credits

Course Objectives:
1. To compute the statistical averages& different properties.
2. To study the probability distributions for stochastic data.
3. To understand for finding solution of non-linear equations
4. To study the process of calculating the value of the numerical derivative of a functions & numerical integration of a given data.
5. To identify the solution for initial value problem numerical differential equations

Course Outcomes: On the successful completion of this course, the student shall be able to
1. Analyse the statistical averages and different properties for probability function.
2. Fit the probability distribution for the random data.
3. Solve the non-linear equations for finding the roots.
4. Solving the Differentiation & Integration for numerical data.
5. Solving the ordinary differential equations using single & multi-step methods

UNIT I: Random Variables: Mathematical Expectation, Variance, Co-Variance, and its properties, Probability function, Moments, mgf, cgf and its properties.

UNIT II: Probability Distributions: Discrete distribution: Binomial, Poison distributions, finding Mean and Variance through mgf. Continuous distribution: Normal distribution, Exponential & Uniform distributions.

UNIT III: Solution For Non-Linear Equations: Algebraic & transcendental equations, Bisection method, Regular False Method and Newton Raphson method, interpolation, Newton's forward and backward formulas.

UNIT IV: Numerical Differention & Integration: Numerical differentiation using numerical forward & backward interpolation formula, Numerical integration: Simpson's 3/8th rule, Weddle's rule.

UNIT V: Numerical Solution Of Oridinary Differential Equations: Picard's method, Euler's method, R.K method (fourth order) and Milne Thompson's method (predictor & corrector)

Text Books:

1. S.C Gupta and V.K.Kapoor, Fundamentals of Mathematical statistics, S.Chand& Co.2006 Publishers.
2. M.K.Jain, S.R.K Iyengar and R.K.Jain: Numerical methods for Scientific and Engineering Computation. New Age International publications, 2008.

Suggested Reading:

1. Miller and Freund, Probability and Statistics for Engineers, Pearson, 2005.
2. Numerical Methods by S.S.Shastry, PHI Learning Pvt. Ltd.

16ME C23

DYNAMICS AND VIBRATIONS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	02

Course Objectives:

1. To demonstrate basic principle and exposure to evaluate CAM Follower Motion and Gyroscopic effects.
2. Students will understand the importance of static and dynamic balancing
3. Students will acquire the knowledge in evaluating the stability of dynamic systems.

Course Outcomes: Students will be able to

1. Evaluate the effect of gyroscopic couple
2. Evaluate the effect of CAM Follower Motions in machines
3. Estimate the performance of governors
4. Evaluate the static and dynamic balancing of rotating masses
5. Estimate the natural frequency of different un-damped vibrating systems
6. Estimate the natural frequency of different damped vibrating systems

List of experiments:

(1) To study the motion of follower with the given profile of the cam. (To plot the n-q (Follower displacement Vs Angle of rotation) curves for different cam follower pairs.

(2) To study the gyroscopic effect on a rotating disc.

(3) Determination of the frequency of torsional vibration.

(4) Static and Dynamic balancing in a Rotating mass system.

(5) Study the effect of varying mass on the centre of sleeve in porter governor.

(6) Study the effect of varying the initial spring compression in Hartnell governor.

(7) Undamped torsional vibrations of double rotor system.

(8) To study the longitudinal vibrations of helical coiled spring.

(9) To study the undamped forced vibration of spring mass system.

(10) To study the force damped vibration of spring mass system.

(11) Determination of critical speed of the given shaft with the given end conditions. (Whirling of Shafts)

(12) Frequency response of spring mass system with damping.

Text Books:

1. S. Rattan, *Theory of Machines*, Tata-Mc Graw Hill, 1995.
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines & Mechanisms*, Oxford University Press, 2003

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16ME C24

APPLIED THERMODYNAMICS & HEAT TRANSFER LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives

1. To demonstrate basic knowledge and exposure to determine valve and port diagram and also to evaluate the performance of the petrol engine and diesel engine
2. Student will determine the importance of heat balance sheet of IC engine n
3. Students will acquire knowledge in evaluating the performance of multi-stage reciprocating compressor
4. To demonstrate knowledge in evaluating thermal conductivity and heat transfer coefficient under natural convection phenomena and forced convection phenomena
5. Students will understand the basic concepts of radiation heat transfer
6. Student will understand the effectiveness of parallel and counter flow heat exchanger

Course Outcomes: Students will be able to

1. Evaluate the performance of petrol and diesel engine
2. Estimate the heat losses in heat balance sheet of and IC engine
3. Evaluate the performance of multi stage reciprocating air compressor and its importance over single stage air compressor
4. Estimate the effect of insulation on conduction heat transfer and also estimate the value of convection heat transfer coefficients under different scenario
5. Determine Steffan and Boltzman constant and emissivity in radiation heat transfer
6. Estimate the properties of radiating body and effectiveness of heat exchangers .

Applied Thermodynamics:

1. Determination of Valve timing diagram and Port diagram of IC engine.
2. Determination of Performance characteristics of a multi-cylinder petrol engine.
3. To conduct Morse test on multi cylinder petrol engine.
4. To conduct performance test on a variable compression ratio petrol engine.
5. To conduct performance test on single cylinder diesel engine.
6. To conduct heat balance test on single cylinder diesel engine.
7. To determine volumetric efficiency, isothermal efficiency of multi -stage reciprocating air compressor.

Heat Transfer:

1. Determination of Thermal conductivity of insulating powder.
2. Determination of thermal conductivity of composite wall.
3. Determination of convective heat transfer coefficient under Natural and Forced convection phenomena using pin-fin apparatus.
4. Determination of Emissivity of a given plate.
5. Determination of the value of Stefan-Boltzman constant.
6. Determination of Heat transfer coefficient in parallel and counter flow heat exchanger

Text Books:

1. R.K. Rajput, " Thermal Engineering", Laxmi Publishers, New Delhi, 2014
2. Mahesh M. Rathore, "Thermal Engineering," TMH, New Delhi, 2010

Note: Minimum 12 Experiments taking 6 from each section

16EE C22

ELECTRICAL MACHINES AND MICROCONTROLLER APPLICATIONS LAB
(Common to BE3/4, Mech. & Prod, V- SEM)

Instruction	1T + 2 Periods per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
1. To understand the testing of 1-phase transformers.
2. To comprehend various characteristics of DC machines.
3. To understand the characteristics of different AC machines.
4. To learn operations on 8051 microcontroller
5. To understand basics of interfacing devices with 8051 microcontroller

Course Outcomes: The student will be able to
1. Test the 1-phase transformer.
2. Know the right instrument and its usage for the given circuit.
3. Identify the suitable machine for required application.
4. Process the data using 8051 microcontroller
5. Interface the given device with 8051 microcontroller

List of Experiments:

Cycle -I
1. Magnetization characteristics of a separately excited DC generator.
2. Load characteristics of a shunt generator.
3. Performance characteristics of a shunt motor.
4. Performance characteristics of a compound motor.
5. Speed control of DC shunt motor.
6. O.C. and S.C. tests on single phase transformer.
7. Load test on a three phase induction motor. .
8. Speed control methods of induction motor.
9. To determine the load characteristics of a DC series motor.

Note: At least **SIX** experiments should be conducted in the semester from cycle - I

Cycle -II
1. 8051 Microcontroller Experiments
2. Data Transfer - Block move, Exchange, sorting, Finding largest element in an array
3. Arithmetic Instructions :Multi byte operations
4. Boolean & Logical Instructions (Bit manipulations)
5. Use of JUMP and CALL instructions.
6. Control of stepper Motor using 8051
7. A/D converter interface with 8051 Microcontroller
8. D/A converter Interface with 8051 Microcontroller

Note: At least **FOUR** experiments should be conducted in the semester from cycle - II

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16PE C05

INDUSTRY VISIT

A minimum of two industrial visits will be arranged by department and students have to attend the visits and prepare a data report of their visits to the industries and submit to the department. Students are required to present a seminar based on their report which is evaluated by Head of the Department and two senior faculty to award the grade and these grades are categorized as follows.

Excellent / Very Good / Good / Satisfactory / Unsatisfactory

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16ME C26

CAD AND CAM

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. Understand the basic and advanced concepts of computer aided design. Learn the application of CAD in geometric modeling.
2. Students will develop an understanding of the theory and construct the elements of curved surface representation.
3. Explain solid modeling representation schemes and the Euler operators. Understand and be able to perform two-dimensional and three-dimensional geometric transformations on objects.
4. Have an overview of advantages and disadvantages of modeling and analysis packages.

Course Outcomes: After completion of course, the student will able to

1. Apply design concepts in design , analysis and modeling of entities and curves
2. Apply surface and solid modeling techniques for the generating various parts and implement transformations on various geometric models for manipulation.
2. Visualize the models through the graphics standards and implement NC,CNC systems and programming
3. Implement and practice the DNC and AC controls , analyze the manipulator motions, configurations including end effectors, actuators, drives and sensors and programming.
4. Learn and Implement GT and Coding methods and CAPP.
5. Understand and implement FMS,CIMS,RPT ,QC- methods & controls and Turnkey CAD/CAM systems.

UNIT-I: Design Process:
Design criteria, Alternative solutions, Alternative design, Computer aided design and review
Drafting techniques: Basic geometric elements and their creation
Geometric modeling: Wire frame entities and their definition, interpolation and approximation curves. Concept of Parametric and non-parametric representation of circle and helix curves,
properties of splines. Synthetic curves: parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Introduction to NURBS.

UNIT-II: Surface Modeling:
Analytic surfaces: Definition of planar, Ruled , surface of revolution, tabulated cylinder.
Synthetic Surfaces: Cubic and Bezier surfaces.
Solid modeling: C – rep and B rep approaches
Design Applications: Mass property calculations, mechanical tolerancing, finite element analysis.
2 D Transformations: Translation, scaling and rotation about arbitrary point, shear and reflection, homogenous representation, concatenation

UNIT-III: CAD Database and Data Exchange:
CAD database and structure, IGES, STEP and STL format

Numerical Control of Machine Tools:
Features and elements of NC, Types of NC systems: PTP, Straight Cut and Contouring
Introduction to CNC , Typical configurations, Definition of axes, Definition of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, tool length and cutter radius compensation. Manual and computer aided part programming (APT) for simple components. Programming with MACROS..

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UNIT-IV: DNC:
Typical configurations ,CNC vs DNC, Adaptive control systems, Machining centers. Introduction to FANUC, SINUMERIC controllers.
Industrial robots:
Robot anatomy, configurations, controls, drivers, programming methods and applications.

UNIT-V: GT:
Part families, layout, part classification and coding system- OPTIZ, MICLASS .
CAPP: Variant and generative process planning.
FMS and CIM: F.M.S equipment, FMS layouts, benefits of FMS., Elements of CIM.
Computer Aided Inspection and QC:
Automated inspection- Off-line, On-line, contact (Co-ordinate measuring machine), Non-contact inspection (Machine Vision, Scanning LASER Beam, Photogrammetry)
CAD/CAM integration, Turnkey CAD/CAM systems, Introduction to rapid prototyping technique.

Text Books:

1. Ibrahim Zeid, CAD/ CAM "theory and practice" , McGraw Hill Inc , New York, 2011
2. Grover MP and Zimmers EW "CAD/CAM" Prentice Hall of India, 1989
3. Rao PN "CAD/CAM : Principles and applications" 2nd edition, Tata McGraw Hill, New Delhi, 2004

Suggested Reading:

1. Arvid R Eide , Roland D Jenison, Lane H Mashaw, Larry L Northup, "Introduction to Engineering Design" McGraw Hill 1998
2. Yoramkoren, "Computer Control of Manufacturing Systems" McGraw Hill Int, New York, 1994
3. Elanchezhian C Sunder Selwyn , T Shanmuga Sunder G" Computer Aided manufacturing" , Laxmi Publications P) Ltd, 2nd edition, New Delhi 2007

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16PE C06

MACHINE TOOL ENGINEERING

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
Semester End Examination	70	Marks
Continuous Internal Evaluation	30	Marks
Credits	3	

Course Objectives: Student will learn the

1. To provide the basic understanding of cutting tools, geometry in machining process
2. To make students familiar with cutting forces in turning drilling, milling operations.
3. To make the students to understand various machine tools, like lathe, drilling, milling shaper, planner
4. To make a knowledge of Thread manufacturing and gear manufacturing

Course Outcomes: Students are able to

1. Select tool geometry for various materials
2. Calculate forces in turning, drilling and milling processes
3. Identify the machine tools for manufacturing various components
4. Understand thread cutting and gear cutting operations
5. Select grinding wheel and Automats
6. Work on shaper, planner and grinding machines

UNIT-I: Orthogonal and Oblique Cutting:
Cutting forces in turning, drilling milling and grinding, Merchant's analysis, Shear angle, friction angles. Experimental methods for estimation of shear angle, cutting forces and power, types of chips. Built up edge phenomena and its effects. Chip breakers. Sources of heat, its distribution and measurement. Different types of cutting fluids.

UNIT-II: Tool Wear and Tool Life:
Criteria for tool wear, flank and crater wear theories, criteria for tool life in roughing and finishing, Measurement of tool wear, Taylor's tool life equation, factors effecting tool life. Machiniability, Single point cutting tool design; Geometry, tool nomenclature. American, DIN, max. rake system. Interrelation between normal rake and orthogonal rake, tool signature, effect of basic tool angles on its performance. Selection of size and angles of S.I. Tools, from tools. Design feature of multipoint cutting tools.

UNIT-III: Lathe:
Types constructional features, size of lathe, various operations that can be performed on lathes types of lathes, capstan and turret lathes, bar work and chuck work and tool holding devices. Taper turning methods. Thread cutting and accessories of lathe

Automats:
Single spindle and multiple spindle automats, Swiss type of automats, constructions and features of these machines.

UNIT-IV: Drilling Machines:
Types and constructional features and applications, Radial drilling machine, drilling operations

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Milling Machines:
Classifications and types various operations on milling machines, Up and down milling, Types of milling cutters and bars. Dividing head, plain, compound and differential indexing.
Boring machines: Horizontal, Vertical and Jig boring machines and constructional features.
Thread production: Thread rolling, thread chasing , thread milling and thread grinding

UNIT-V : Shaping, Planing & Slotting Machines:
Types, Constructional features, Types of work done on it. Quick return motion, manipulation of cutting speeds and feeds, work and tool holding devices, comparison of these machines.

Gear Cutting Machines:
Methods of gear cutting, types and classification of gear hobbing, gear shaping machines Bevel gear cutting

Grinding Machines:
Types, Classification Abrasives and bonds used for grinding wheel, Selection of grinding wheel, cylindrical grinding and center less grinding

Text Books:

1. B.L. Juneja and Shekon, *"Fundamentals of Metal Cutting & Machines Tools"*, Wiley Eastern Ltd. 1987.
2. P.N. Rao, *"Manufacturing Technology – Metal Cutting & Machine Tools"*, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. M.C. Shaw, "Metal Cutting Principles", Clarendon Press, Oxford 1984

Suggested Reading:

1. Hazra Choudary, "Workshop Technology", Vol. II, Media Pub., New Delhi.
2. Kibbe Richard R, Meyer, R.D, Neely etal, 'Machine Tool Practices, 9th Edition, PHI, 2014.
3. Jain & Chitale, Text Book of Production Engineering, 2nd Edition, PHI, 2014

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16PE C07

ADDITIVE MANUFACTURING (Professional Elective-III)

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
Semester End Examination	70	Marks
Continuous Internal Evaluation	30	Marks
Credits	3	

Course Objectives:

1. To make students understand the basic concepts of various rapid prototyping technologies.
2. To understand and apply criterion for selecting appropriate RPT technique for any given application.
3. To competently use tools to explore digital manufacturing techniques and CAD modeling software
4. To understand the stl file generation and manipulations
5. Explain and summarize the principles and key characteristics of RP technologies and commonly used RP systems.
6. To make students understand typical rapid tooling processes for quick batch production of plastic and metal parts

Course Outcomes: After completion of course, the student will able to

1. Explain the process chain of Additive manufacturing and other rapid manufacturing Processes and their classification, advantages and disadvantages.
2. Critically explore technologies used for Additive manufacturing in terms of their parameters, application, limitations, materials, equipment, outcomes and implications and their comparison.
3. Compare different Additive manufacturing processes and select a subtractive or an AM process for a particular application for product development of engineering components.
4. Describe various CAD issues for rapid prototyping and related operations for STL model manipulation, formulate and solve typical problems on reverse engineering.
5. Identify different post processing techniques involved after rapid prototyping
6. Explore the applications of Additive manufacturing in different industries

UNIT-I: Introduction to rapid manufacturing:
Customization and mass customization, types of mass customization. Classification of fundamental fabrication processes (additive/subtractive/formative), Difference between AM and CNC. Process chain for Additive Manufacturing(AM) processes. Classification of additive (layered) Manufacturing processes. Advantages and Limitations of AM.

UNIT-II: Extruder Deposition System:
Laminated object manufacturing, shaped deposition manufacturing and modular configuration. Photo polymerization, Stereo lithography apparatus & Solid ground curing -Working principles and their applications, advantages and disadvantages. Laser sintering based technologies and their related details. Direct metal laser Sintering process.

UNIT-III: Pre-processing in AM:
Pre-processing of CAD model- STL conversion, STL error diagnostics, STL file Repairs: Generic Solution. Newly Proposed Formats.
Support generation, transformations, slicing, surface preparation of materials, pre-heating of powders.
Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, Rhino, STL View 3 Data Expert and 3 D doctor.

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UNIT-IV: Post processing in AM:
Post processing equipment support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern,
Property enhancements using non–thermal and thermal techniques.
Rapid Tooling:
Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Rapid Tooling Classification: **Indirect Rapid Tooling Methods**: Arc Spray Metal Deposition, Investment Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM , LOM Tools, EOS Direct Tool Process

UNIT-V: AM Applications:
Application in Design, Engineering, Analysis & Planning, Application in Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture.
RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Forensic Science.

Text Books:

1. Gibson I, Rosen DW and Stucker B; Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing , Springer , 2010
2. Chee Kai Chua, Kah Fai Leong , 3D printing and additive manufacturing : principles and application: fourth edition of rapid prototyping
3. Venuvinod, PK; Ma, W; Rapid prototyping – Laser based and other technologies, Kluwer , 2004

Suggested Reading:

1 Rapid tooling : Technologies and industrial applications by Jacob, Paul F
2 Andreas Gebhardt, Understanding Additive Manufacturing,Hanses,2012
3 Alain Brnard, Georges Talliander,Additive Manufacturing,Wiley,2014

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16ME C29

MACHINE DESIGN

Instruction	4 Theory Periods per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

1. To learn design criteria of machine components, selection of materials and manufacturing process.
2. To learn application of principles to design helical coiled and leaf springs, gears, curved beams, sliding contact and rolling element bearings and IC engine components.
3. To provide the design concepts of helical and leaf springs.
4. To provide the students the knowledge of design of IC engine parts.

Course Outcomes:

1. Graduates demonstrate the ability to design helical, leaf springs for static and fluctuating loads.
2. Graduates expected to have an ability to design gears for power transmission considering beam strength, dynamic factors and wear life.
3. Graduates demonstrate the ability in designing sliding contact bearings, considering power lost in friction, heat dissipation.
4. Graduates are expected to have the ability of selection of rolling contact bearings based on load-life relationship.
5. Graduates demonstrate the ability of designing IC engine parts such as piston, connecting rod and crank shaft considering gaseous impulse and thermal aspects.
6. Graduate demonstrate the ability of designing curved beams like C-clamp, crane hooks etc.

UNIT-I: Mechanical Springs:

Introduction, types of springs, Materials used for springs.

Helical Springs:

Whal's factor, calculation of stresses, deflection and energy stored in spring. Design for static and fluctuating loads.

Leaf Springs:

Stresses and deflection, nipping of Leaf springs. Design for static loads.

UNIT-II: Gears:

Introduction to gear drives, types of gears, materials used for gears. Standards and specification of gears. Design of Spur, Helical, Bevel and Worm gears: Lewis beam strength equation. Dynamic loads on gear tooth. Wear load and design for wear strength.

UNIT-III: Bearings:

Introduction, classification of bearings, materials used for bearings, properties and types of lubricants.

Design of Sliding Contact Bearings:

Hydrostatic and Hydrodynamic bearings.

Selection of Rolling Contact Bearings: Types of rolling elements and their constructional details. Static and dynamic load carrying capacity. Load-life relationship, selection of bearing, for cyclic loads and speeds.

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UNIT-IV: I.C. Engine Parts: Introduction. Materials used. Design of piston, connecting rod and crank shaft.

UNIT-V: Design of Curved Beams: Introduction, stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular and trapezoidal sections. Design of C-clamp and crane Hook. Design of chain drives: Power rating of roller chains. Strength of roller chains.

Text Books:

1.Bhandari V.B. Machine Design, Tata Mc Graw Hill Publications, 2010.
2.J.E. Shigley , C.R. Misckhe, Mechanical Engineering Design, Tata Mc Graw Hill Publication, 2010.
3.P. Kannaiah, Machine Design, Science-Tech Publications, 2010

Suggested Reading:

1. M.F. Spotts, Design of Machine Elements, Prentice Hall, 2013.
2. Robert L. Norton, Machine Design: An Integrated Approach, 2/e Pearson Education, 2013.
3. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Machine Design Data Books:

1. Design Data book by PSG College –2012
2. Mahadevn .K, Balaveera Reddy. K, 'Design Data Hand Book, 4[th] Edn., CBS Publishers & Distributors, 2013.
4. Machine Design Data Book, by V.B. Bhandari McGraw hill education, 201

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16PE E06

WORK SYSTEM DESIGN (Professional Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: Student will

1. Understand work system design concepts
2. Learn method study techniques
3. Conceptualize work measurement tools and techniques
4. Learn job evaluation and merit rating
5. Understand principles of ergonomics
6. Learn the concepts of production planning & control

Course Outcomes: At the end of the course, the student is able to

1. Use work study techniques to improve productivity
2. Apply method study recording techniques
3. Implement work measurement and time study tools
4. Execute job evaluation and merit rating techniques
5. Apply ergonomical principles in product design
6. Use concepts of production planning & control in industry

UNIT-I :Work Study:
Introduction, Basic Concepts, importance, Scope, procedure and benefits.
Productivity, Basic Concept and principles, Production Vs productivity, Productivity improvement techniques.

UNIT-II: Method Study:
Introduction, Steps involved in method study
Recording Techniques-Outline Process Chart, Flow process charts, Two handed process chart, Multiple activity chart, SIMO chart, flow diagram, string diagram, Travel chart, Cycle graph and Chronocycle graph, Therbligs, Principle of Motion Economy

UNIT-III: Work Measurement:
Introduction, Techniques of work, Measurement, Time study, Standard data, analytical estimation. Time study-objectives and uses of Time study. Time Study Equipments, Procedure for Time study, Allowances and types, Calculation of standard time.

UNIT-IV: Methods of Job and Performance Evaluation:
Job evaluation and Merit rating, various methods of job evaluation, performance Appraisal system, Wage Incentive systems.
Line balancing: Line balancing in production and assembly lines-Heuristic and other methods of line balancing.

UNIT-V: Ergonomics and economics: Ergonomic design, Ergonomic evaluation methods, cognitive ergonomics, participative ergonomics. Social sustainability for work systems.
Production planning & Control: Objectives of production planning and control- functions of production planning and control. Types of production – continuous and intermittent, job shop, batch and mass production systems.

Text Books:

1. O.P. Khanna, Industrial Engineering and Management, Dhanpat Rai Pub.,
2. M.S. Mahajan Industrial Organization & Management, Nirali Prakashan Pub.
3. Gerald Nadler 'Work System Design: The ideals concept by McGraw Hill Publisher
4. Mikell P. Groover, 'Work system and The Methods Measurement and Management of Work', Pearson Prentice Hall, 2007

Suggested Readings:

1. Industrial Management, Deepak Kumar Bhattacharya, Vikas Pub., 2011.
2. Industrial Engineering & Management by S. Chand
3. Introduction to work study, ILO Publication

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16ME E06

COMPUTATIONAL FLUID DYNAMICS (Professional Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

1. Understanding of governing equations of fluid flow.
2. Student understand finite difference and finite volume methods to solve fluid flow equations.
3. Issues that arise in the solution of such equations.
4. Various methods to overcome those issues and modern trends in CFD.
5. Get exposure to grid generation.
6. Various boundary conditions and their implementation.

Course Outcomes: At the end of the course, the students were able to

1. Classify basic equations of fluid flow
2. Choose appropriate boundary conditions
3. Choose proper numerical technique to solve equations.
4. Critically analyze different mathematical models and computational methods for flow simulations
5. Interpret computational results.
6. Acquire the required knowledge to take advanced courses in CFD.

UNIT-I: Basic Equations:
Continuity, momentum and energy equations, navier-stokes equations, Heat transfer conduction equations for steady and unsteady flows, steady convection-diffusion equation.

UNIT-II: Models:
Reynolds and Favre averaged N-S equations, Mixing length model, k-epsilon turbulence model
Classifications of Partial Differential Equations:
Elliptic, parabolic and hyperbolic equations, Initial and boundary value problems

UNIT-III: Finite Difference Method:
Forward, backward and central difference
Parabolic partial differential equations:
Euler, implicit and crank Nicholson methods, ADI models, Errors, consistency, stability analysis, Vonnumen analysis, Convergence criteria.

UNIT-IV: Elliptic Partial Differential Equations:
Jacobi, Gauss seidel methods, Viscous incompressible flow, Stream-function-vorticity method
Introduction to grid generation- types of grids O, H, C

UNIT – V: Finite Volume Method:
Finite volume formulation for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows, staggered grid, SIMPLE algorithm.

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Text Books:

1. P.S. Ghoshdastidar, Computational Fluid Dynamics & Heat Transfer, Cengage Pub.,
2. J.D. Anderson, Jr., *Computational Fluid Dynamics: The Basic with Applications* McGraw Hill, Inc., 2012
3. H. Versteeg and W. Malalasekra, *An Introduction to Computational Fluid Dynamics*: The Finite Volume Method, Pearson,2nd edn. 2011

Suggested Reading:

1. John F. Wendt (Editor), *Computational Fluid Dynamics - An Introduction*, Springer – Verlag, Berlin, 1992
2. Charles Hirsch, *Numerical Computation of Internal and External Flows*, Vols. I and II. John Wiley & Sons, New York. 1988
3. Anil W.Date, Introduction to Computational Fluid Dynamics, Cambridge

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16ME E07

AUTOMOBILE ENGINEERING (Professional Elective – III)

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	20 Marks
Credits	3

Course Objectives: The student will learn

1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4. Suspension, frame, springs and other connections
5. Ignition, controls, electrical systems and ventilation
6. Emissions, pollution regulations, EURO and BHARATH stages

Course Outcomes: At the end of the course, the student will be able to

1. Identify the different parts of the automobile
2. Explain the working of various parts like engine, transmission, clutch, brakes
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions
5. Develop a strong base for understanding future developments in the automobile industry
6. Formation of pollutants in I.C Engines & Their remedial methods to control them

UNIT I: Types of automobiles:
Normal, Hybrid and Hydrogen Fuel vehicles. Engine location and its components, chassis layout; crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, Mechanical Fuel Injection system.

UNIT II: Lubricating Systems:
Wet sump, dry sump and petroil systems - Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds - Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

UNIT III: Steering systems:
Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly, recent trends, Wheel and tyres: Tyre construction, specification, Tyre wear and causes, wheel balancing, wheel alignment, Types of Suspension systems, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

UNIT IV: Power Train:
Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system
Brakes Systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder and hand brake linkage, Recent Trends

UNIT V: Maintenance:
Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment, pollution control technologies used for petrol and diesel engines. Types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – Recent Trends.

Text Books:

1. *Crouse & Anglin, Automotive Mechanics*, TataMcGraw Hill. Publishing Co. Ltd., New Delhi, Tenth Edition – 2004
2. Kirpal singh., *Automobile Engineering Vol. I & II* Standard Publishers, Delhi.
3. R.K. Rajput, *A Textbook of Automobile Engineering*, Laxmi Publications, New Delhi, 2012

Suggested Reading:

1. Joseph Heitner, *Automotive Mechanics*, Affiliated East West Pvt. Ltd.
2. C.P Nakra, *Basic Automobile Engineering*, Dhanpat Rai Publishing Co(P) Ltd., New Delhi, 2003.
3. G.B.S. Narang, *Automobile Engineering*, Khanna Publishers, New Delhi, 2014

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QUALITY AND RELIABILITY ENGINEERING (Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: Student will understand the

1. Concepts of quality and associated techniques
2. process control for variables and attributes
3. Conceptualization of design for quality
4. Experimental design & quality techniques
5. Reliability and its influence in engineering
6. Conceptualization of the design for reliability & maintainability

Course Outcomes: At the end of the course, the student is able to

1. Apply quality improvement techniques
2. Use control charts for variables and attributes
3. Implement designing for quality
4. Apply experimental design and Taguchi methods
5. Use techniques of reliability engineering
6. Implement reliability & maintainability in industry

UNIT-I: **Introduction**: Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost, Quality improvement process through Bar Chart, cause and effect diagram, parato analysis, scatter diagram etc.,.

UNIT-II Process Control for Variables and Attributes: Causes of Variation, Control Charts for Variables (Mean and Range) Xchart and R chart, Control Chart Patterns and Corrective Actions, Control Charts for Attributes (p-chart, c-chart,) acceptance Sampling Plans, Producer's Simple and Consumer's risk, types of Sampling Plans and their demerits, operating Characteristic Curve, Average Outgoing Quality Curve), Errors in Making Inferences from Control Charts (Type I and II errors)

UNIT-III: **Designing for Quality**: Introduction to Concurrent Engineering, Quality Function Deployment (QFD), and Failure Mode and Effect Analysis (FMEA) - Concept, methodology and Application Experimental Design and Taguchi method: Fundamentals – factorial experiments – Taguchi method – Loss function – experiments – S/N ratio and performance measure- Orthogonal arrays.

UNIT-IV

Reliability Engineering: Reliability function, Failures rate, Mean Time Between Failures (MTBF), Mean Time To Failure (MTTF), mortality curve, availability, maintainability, system effectiveness. Introduction to probability distributions.

Time to failure distributions: Reliability evaluation of two-state device networks-series, parallel, Standby redundant systems, Reliability evaluation.

UNIT-V

Design For Reliability and Maintainability: Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, failure analysis, determination of causes, assessments of effects, computation of criticality index, corrective action, system analysis of down-time, reliability under preventive maintenance, repair vs replacement, replacement models, proactive, preventive, predictive maintenance, optimization techniques for system reliability with redundancy, heuristic methods applied to optimal system reliability.

Text Books:

1. Quality Assurance and Total Quality Management, by K C Jain and A K Chitale, Publisher: Khanna Publishers
2. Statistical *Quality* Control, by M. Mahajan, Publisher: Dhanpat Rai & Co. (P) ltd.
3. Statistical Methods for Quality, Reliability and Maintainability by K. Muralidharan and A. Syamsunder, PH Publications

Text Books:

1. Quality Control & Application, by B. L. Hanson & P. M. Ghare, Publisher: Prentice Hall of India
2. Reliability Engineering, by Srinath L. S., Publisher :Affiliated East West Press.
3. Statistical *Quality* Control, by Eugene L. Grant and Richard S. Leavenworth, Publisher :Tata McGraw-Hill Publishing Company ltd.
4. Quality and Reliability Engineering by Tirupathi R. Chandraputla, Cambridge Univ. Press, New Delhi

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16ME E10

TURBO MACHINES (Professional Elective-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: Student will

1. Learn the fundamentals of turbo machinery and its importance
2. Learn principles and equations of turbo machinery
3. Know about velocity triangle and power developed by steam turbines
4. Familiarize the working principles of axial flow compressor
5. Understand the working principle of Centrifugal compressor and its performance
6. Learn the power required for Rotary compressors and power developed by Gas turbines

Course Outcomes: Students are able understand

1. The principle of turbo machinery
2. Apply gas dynamics equations depending upon applications
3. Estimate the power developed by steam turbines
4. Find efficiency, pressure rise and degree of reaction of axial flow compressor
5. Analyze the slip factor and performance of centrifugal compressor
6. Understand cycles and improve the cycle efficiency in gas turbines

UNIT -I Introduction:
Definition and parts of turbo machines and its classifications, Comparison with positive displacement machines, Efficiencies of turbomachines, Static and Stagnation states,overall isotropic efficiency, stage efficiency (their comparison) and poly tropic efficiency for both compression and expansion processes.

UNIT – II Energy Exchange in Turbo Machines:
Euler's turbine equation, Alternate form of Euler's turbine equation, Components of energy transfer, Degree of Reaction, General Analysis of Turbo machines: Radial flow compressors – general analysis and Expression for degree of reaction, Problems.

UNIT-3 Steam Turbines:
Introduction to steam nozzles, design for throat area. Classification of steam turbines, Impulse turbine, compounding of steam turbines, Pressure velocity variations across different compounding turbines, blade efficiency and work done by impulse turbine ,degree of reaction of reaction turbine, blade efficiency and work done by reaction turbine, stage efficiency and nozzle efficiency and simple problems on impulse and reaction turbines

UNIT-4 Rotodynamic Compressors:
Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities. Thermodynamic cycles and work done, calculation of various efficiencies. Velocity diagrams and pre-whirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

UNIT -5 Gas Turbines :
Application and classification of Gas turbine, Thermal efficiency of joule cycle, Maximum pressure ration in terms of temperature ratio, optimum pressure ratio for maximum work output with or without considering machine efficiencies .Improvements of gas turbine plant performance-Inter cooling, Reheating and regeneration. Simple problems on joule cycle.

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Air Craft Propulsion:
Aircraft engine types, Turbo jet engines, ram jet and Pulse jet engines.
Rocket Propulsion:
Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications

Text Books:

1. V. Kadambi and Manohar Prasad, An Introduction to Energy Conversion, Volume III, Turbo machinery, , New Age International Publishers, reprint 2008.
2. S. M. Yahya, Turbines, Compressors & Fans, Tata McGraw HillCo. Ltd., 2nd edition, 2002
3. S. L.Dixon,Fluid Mechanics & Thermodynamics of Turbo machines, Elsevier (2005).

Suggested Reading:

1. D. G. Shepherd Principals of Turbo machines, the Macmillan Company.
2. B.K. Venkanna, Turbo machine,. PHI, New Delhi 2009
3. M. S. Govindgouda and A. M.Nagaraj,Text Book of Turbo machines, M. M. Publications, 4Th Ed, 2008

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16ME E09

Object Oriented Programming through C++ (Professional Elective-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
1. To teach difference between OOP and structured programming
2. To teach how to use different features of C++.
3. To write programs for simple applications.
4. To understand capability of OOP.
5. To use operator overloading
6. To create templates and usage of exception handling

Course Outcomes: Be able to understand
1. The difference between object oriented programming and Structured programming and data types in C++.
2. To program using C++ features such as classes and objects.
3. The write C++ programs for simple applications in mechanical engineering.
4. The overload operators
5. The use inheritance and polymorphism
6. Capability to use effectively templates and exception handling.

UNIT-I: Principles of Object Oriented Programming:
Procedure Vs Object Oriented, Paradigm, Basic concepts, benefits, Applications and Object Oriented Languages.
Introduction:
Program structure, Creating, Compiling and Linking of C++ program.
Token, Expression and Control Structures:
Tokens, Keywords, Identifiers and Constants, Data Types, Operators, Precedence, Type Compatibility, Control Structures, New Features of C++.
Functions:
Function Prototype and Parameter Passing, Inline Functions, Default, Constant Arguments, Recursion, Function Overloading.

UNIT-II: Classes and Objects:
Defining classes and Member functions, creating objects, objects and arrays, objects and functions, const with classes, friends to a class, nesting static members of a class,
Constructors and Destructors:
Type of Constructors, Dynamic Initialization of Objects, Destructors.

UNIT –III: C++ Operator Overloading and Type Conversions:
Fundamentals, restrictions, overloading unary / binary operators, overloading ++ and --, overloading special operators, overloading by member functions and friend functions, type conversions.

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UNIT-IV: C++ Inheritance:
Defining derived classes, Types of Inheritance, Virtual Base class Abstract Class, function overriding and containership.
Pointers and Polymorphism:
Pointers and Generic pointer, Pointer to Objects and Derived Classes, this pointer, Virtual Functions, Virtual Destructors.

UNIT-V: C++ Templates:
ntroduction, function templates and class templates
C++ Exception Handling:
Conventional error handling mechanism, C++ error handling mechanism, Try, throw, catch, exception handling in classes.

Text Books:

1. RohitKhurana "Object oriented programming with C++", Vikas publications, 2nd edition
2. Ashok Kamtani 'Object Oriented Programming with ANSI and Turbo C++", Pearson Education, 2014.
3. Somshekara & others, Object Oriented Programming with C++, Eastern Economy Edition, 2nd edition.

Suggested Reading:

1. E. Balaguruswamy "Object Oriented Programming with C++" ,McGraw-Hill Education (India), 6th Edition 2013
2. Bjarne Stroustrup "The C++ Programming Language",Pearson Education 5th Edition (2013)
3. Robert Lafore "Object-Oriented Programming in C++ "Fourth Edition Sams Publishing,2002
4. John Hubbard, Atul Khate, Schaum's Series, 'Programming with C++' 3rd Edition

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16PE E08

MODERN MACHINING AND FORMING PROCESSES (Professional Elective-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: Student will learn

1. The importance of non-conventional machining processes
2. Various non-conventional machining processes and their process parameters
3. The relative merits, limitations and applications of various non-conventional machining processes
4. The knowledge regarding working media and its functions of non-conventional machining processes
5. The concepts of non-conventional forming processes such as rubber pad forming, hydro forming, stretch forming, etc.,
6. The concepts of HERF and to provide the description of HERF process

Course Outcomes: At the end of the course, the students are able to

1. Select the non-conventional machining process for a particular application
2. Demonstrate the capability of comparison of various non-conventional machining methods
3. Describe the various non-conventional machining processes
4. Exhibit the proficiency of selecting working media for various non-conventional machining processes
5. Exhibit the basic understanding of non-conventional forming processes
6. Compare various non-conventional forming processes based on their merits, limitations and applicability

UNIT-I: Mechanical Energy Processes:

Ultrasonic Machining (USM): Introduction, Process description, abrasive slurry, Abrasive materials and their characteristics, Functions of liquid medium in slurry, Types of transducers, effect of process parameters, applications and limitations

Abrasive Jet Machining (AJM):
Principle of operation, process details, process variables and their effect on MRR and accuracy, advantages, disadvantages and applications

Water Jet Machining (WJM):
Schematic diagram, equipment used, advantages and applications

Abrasive Water Jet Machining (AWJM):
Process, advantages, limitations and applications

UNIT-II: Thermal Processes:

Electro Discharge Machining (EDM):
Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, flushing, mechanism of metal removal, types of power supply circuits, mathematical analysis of metal removal rate (MRR), equations for surface finish, characteristics of spark eroded surfaces, advantages, disadvantages and applications

Wire EDM:
Process description and applications

LASER Beam Machining (LBM):
Principle of LASER beam production, materials used, process parameters, advantages, limitations and applications,

Plasma Arc Machining (PAM):

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Introduction, equipment used, process description and parameters, types of plasma arc: transferred arc and non transferred arc and process applications,

Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of electron beam, equipment used, advantages, disadvantages and applications.

UNIT-III: Chemical and Other Machining Processes:

Electro-chemical machining (ECM): Schematic of process parameters, function and characteristics of electrolyte, MRR for pure metal and alloys, electrode feed rate (EFR), advantages, limitations and applications

Chemical Machining: Chemical blanking and chemical milling, advantages, limitations and applications

ION Etching: Process description, merits, limitations and applications.

UNIT-IV: High Energy Rate Forming Processes (HERF):

Introduction, applications, advantages, **Explosive Forming:**

Principles, explosive materials, Equipment, types of explosive forming, standoff operation and contact operation.

Electro-Hydraulic Forming (EHF): Schematic of process, description and its applications, **Electro-Magnetic Forming (EMF):** Process description, merits, limitations and applications

UNIT-V: Other Forming Processes:

Rubber Pad Forming: Principle of the process, process details and its types, Guerin, wheelon, Mar forming and Hydro forming processes and applications,

Stretch Forming: Introduction, types of stretch forming, stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming.

Tube spinning: introduction, methods of tube spinning, backward spinning, forward spinning.

Text Books:

1. P.C. Pandey and H.S. Shah, *Modern Machining Process* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980
2. J Paulo Davim, *Modern Machining Technology, A Practical Guide*, 1st Edition, Woodhead Publishing in Mechanical Engineering
3. Hassan Abdel-Gawad El-Hofy, *Advanced Machining Processes, Nontraditional and Hybrid Machining Processes*, McGraw Hill Publishing Co. Ltd.,

Suggested Reading:

1. Davies and Austin, *Developments in High Speed Metal Forming*, The Machinery Publishing Co. Ltd., 1985
2. Production Technology, HMT
3. A. Bhattacharya, *New Technology*, The Institution of Engineers (India), 1984

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16PE E09

SURFACE ENGINEERING (Elective-IV)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Objectives:

1. To impart knowledge on surface engineering and surface modification methods that will come in handy to solve the industrial problems.
2. This will also serve as a precursor for future research in the same field.
3. Student will understand the basic principles of corrosion and know the methods to reduce the corrosion on mechanical components.
4. Student will understand the role of wear and wear measurement techniques on Engineering components.

Outcomes: Students will

1. demonstrate basic understanding of friction, and be familiar with adhesion theories and the effect of adhesion on friction.
2. demonstrate basic understanding of wear processes, and able to describe wear mechanisms on engineering components.
3. demonstrate basic understanding of corrosion and know the methods to reduce the corrosion on engineering components.
4. be able to design a tribological system for optimal performance, and Justify, critical analysis on surface engineering techniques and surface design for relevant applications.
5. Apply surface engineering principles and methods to modify and improve the properties of surfaces for structural and functional applications.
6. Identify suitable surface processing method from various methods to create surface engineering solutions for specific materials, specific environments and specific applications in modern engineering practice.

UNIT I: Friction

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II: Wear

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals - International standards in friction and wear measurements

UNIT III: Corrosion

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.

UNIT IV: Surface Treatments

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.

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UNIT V: Engineering Materials

Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology, Nano Tribology.

Text Books:

1. G.W.Stachowiak & A.W .Batchelor , "Engineering Tribology", Butterworth-Heinemann, UK, 2005
2. Rabinowicz.E, "Friction and Wear of materials", John Willey & Sons ,UK,1995
3. Halling, J. (Editor) – "Principles of Tribology ", Macmillian – 1984

Suggested Readings

1. Williams J.A, "Engineering Tribology", Oxford Univ. Press, 1994.
2. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd , New Delhi, 2005
3. Fontana G., "Corrosion Engineering", McGraw Hill, 1985

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16ME C30

CAD AND CAM LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evluation	30 Marks
Credits	2

Course Objectives:
1. 3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib , Editing Move, Pattern, Mirror, Round, Chamfer
2. Assembly (Coupling, Screw jack) creating assembly from parts – assembly constraints
3. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning , mass property calculations
4. To learn and develop the skill in creating a component by utilizing the Automated Machines.

Course Outcomes:
1. Draw complex geometries of parts in sketcher mode.
2. Generate freeform shapes in part mode to visualize parts.
3. Create complex engineering assemblies using appropriate assembly constraints.
4. Develop various machine components and generate their orthographic view modeling software
5. Have a fundamental knowledge of Computer Numerical Control machines.
6. Write part programs using G and M codes for lathe and milling operations

Detailed Syllabus:

1. Introduction to Solid Works Package, Working with sketch mode and features of Solid Works and applying on various part models
2. Part modeling of cotter, Knuckle Joints and Couplings
3. Generating, editing and modifying drawings in SolidWorks.

4-8 Assembly modeling of the following

(a) Stuffing Box (b) Screw Jack (c) CrossHead (d) Eccentric

9. Specifying tolerances for part and assembly Drawings
10. Contouring on CNC Milling Machine
11. Facing on CNC Milling Machine
12. Rectangular Pocketing on CNC Milling Machine
13. Circular pocketing on CNC Milling Machine
14. Step Turning, Taper Turning and Multiple Turning On CNC Lathe Machine
15. Use of CAM software for various Machining Operations

Text Books:

1. Ibrahim Zeid, CAD/ CAM "theory and practice", McGraw Hill Inc , New York, 2011
2. Rao PN "CAD/CAM : Principles and applications" 2nd edition, Tata McGraw Hill, New Delhi, 2004

Note: Any 12 experiments need to be conducted

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16PE C08

MACHINE TOOL ENGINEERING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evluationa	30 Marks
Credits	2

Course Objectives: Students will learn

1. To grind single point cutting tool using HSS as cutting tool
2. to do various operations like plain turning, step turning, knurling
3. have work shop practice on lathe drilling and milling machines
4. the gear cutting and to cut gear on milling machine
5. measure cutting forces during machining on Lathe machine, milling
6. unconventional machining operations like EDM & ECM

Course Outcomes: Student is able to

1. grind single point cutting tool with various angles
2. perform taper turning and knurling on lathe
3. perform drilling and thread cutting operations
4. to manufacture a gear using milling machine
5. do operation on shaper
6. exposed to various unconventional processes

Experiments:

1. Introduction to Machine Tools, like Lathe, Drilling, Milling and Shaper.
2. Plain and step turning operations on Lathe
3. Step turning and Knurling on Lathe machine
4. Taper turning on Lathe
5. Drilling and Boring on Lathe
6. Thread Cutting on Lathe
7. Grinding of Single Point Cutting Tool
8. Gear Cutting using (a) Plain Indexing (b) Compound Indexing
9. Measurement of Cutting forces during machining on Lathe machine and Milling machine
10. Finding Shear angle experimentally in turning operation
11. Step turning and facing on CNC Lathe
12. Taper turning on CNC Lathe
13. Multiple turning in ball shape on CNC Lathe
14. Contouring on CNC milling machine
15. Pocketing (rectangular and circular)
16. Drilling Cycles on Milling machine

Text Books:

1. B.L. JuneJa and Shekon, "Fundamentals of Metal Cutting & Machines Tools", Wiley Eastern Ltd. 1987.
2. P.N. Rao, "Manufacturing Technology – Metal Culling & Machine Tools", Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.

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16PE C09

ADDITIVE MANUFACTURING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	30 Marks
Credits	2

Course objectives:

1. Use commercial software for digitizing free-form geometry.
2. Capture digital data from a difficult to design object and make a manufactured model.

Course outcomes: The intended outcomes of the course are:

1. Select and use correct CAD formats in the manufacture of a 3D printed part.
2. Set up and fabricate a 3D part using an additive manufacturing machine.
3. Ability to understand and use modern rapid prototyping systems;
4. Capacity to select the processing parameters best suited to the production of prototype quality
5. Identify, characterize and select the ideal materials for a given Rapid Prototyping system.
6. Gain confidence to operate the 3d printing machine

List of Experiments:

1. Introduction to RP machine , Machine Specifications, Materials
2. Review of modeling of resin and metal parts in cad software.
3. Stl file Generation (stitching, orientation, scaling, etc.,) in magics/Idea maker software.
4. Slicing of stl files
5. Obtaining the tool path data and sending it to RP Machines
6. 3d printing of jigs, fixtures and other manufacturing tools
7. Demonstration of rapid tooling using fused deposition modeling
8. Prototyping of petrol engine Connecting rod
9. Fabrication of Components of Screw jack and assembling them
10. Removing the supports & post processing (cleaning the surfaces)
11. Post curing of fabricated resin parts
12. Reverse engineering: from scanner to model validation (solid works)

Text Books:

1. Gibson I, Rosen DW and Stucker B; Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing , Springer , 2010
2. Chee Kai Chua, Kah Fai Leong , 3D printing and additive manufacturing : principles and application: fourth edition of rapid prototyping

Note: Any 10 experiments need to be conducted

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16ME C33 With Effect from the Academic Year 2019 - 2020

METROLOGY AND INSTRUMENTATION

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarize with limits, fits & tolerances and fundamental concepts of linear and angular measurements.
2. To have knowledge of various precision measuring instruments and concept of limit gauges.
3. To learn the importance of Geometric form and how to measure form errors.
4. To have knowledge in the concepts of classification of instrument errors and their characteristics.
5. To understand the working principles of various instruments used for the measurement of displacement, pressure and temperature.

Outcomes: At the end of the course, students are able to

1. Learn and understand the need for measurement and fundamental concepts of measurement.
2. Demonstrate sound knowledge in gauges design and gauge selection for inspection.
3. Demonstrate an ability to select and use the appropriate measuring instruments to measure surface roughness.
4. Recognize the concepts of errors, strain measurement, classification and instrument characteristics.
5. Apply the skills in measuring various quantities like displacement, pressure & temperature.

UNIT-I

Limits, Fits and Tolerances: Interchangeability, nominal size, limits , tolerances, allowance, fundamental deviation, unilateral and bilateral tolerances, Types of fits, alpha numeric designation of limits/fits, hole and shaft basis systems, selective assembly.

Linear and Angular Measurement: line and end standards, Slip gauges, Tomlinson gauges and Sine bar.

UNIT-II

Design of Limit Gauges: Taylor's Principle for plan limit gauges, Design of GO and NO GO gauges, Use of Plug, Ring and Snap gauges.

Comparators: Introduction, Dial indicator, Sigma Mechanical comparator, Back pressure type Pneumatic comparator.

Optical Measuring Instruments: Optical projector principle and its uses, Tool maker's Microscope principle and its uses, interferometry.

UNIT-III

Straightness, Flatness and Roundness Measurement: Definitions, measurement by beam comparator, straight edge, spirit level, and bench centers.

Surface Roughness Measurements: Roughness and waviness, numerical assessment of surface roughness by CLA, RMS, Rz values, Surface roughness measurement by Profilometer, Taylor Hobson Talysurf, ISI symbols for indication of surface finish.

UNIT-IV

Screw Thread Metrology: Basic terminology of screw thread, measurement of effective diameter by 2 wire and 3 wire methods, Best wire size.

Gear Tooth Metrology: Spur Gear nomenclature, Gear tooth thickness measurement by gear tooth vernier.

Instrumentation: Static and Dynamic characteristics of instruments, Types of errors, Strain measurement with strain gauges, gauge factor, Rosette Gauges.

UNIT-V

Transducers: Displacement measurement by L.V.D.T, Pressure measurement by Bourdon pressure gauge, bulk modulus pressure gauge, pirani gauge, Temperature measurement by thermo couples, Laws of thermo electricity, Types of materials used in thermocouples.

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Text Books:

1. R.K. Jain, Engineering Metrology, Khanna Publications, 1996.
2. Doeblin, "Measurement Systems Application and Design", TMH, 5/e., 2004.
3. Beckwith, Buck, Lienhard, "Mechanical Measurements", PEA, 3rd Indian Reprint, 2001.
4. Anand Bewoore & Vinay Kulkarni , "Metrology & Management", McGrawhill Education India, 2014.
5. B.C. Nakra & K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e., McGrawhill, 2014

Suggested Reading:

1. IC Gupta , "Engineering Metrology", Dhanpat Rai Pub., New Delhi, 1984.
2. Raga Rajendra," Principles of Engineering Metrology", Jaico Publishing House, Mumbai, 2008.
3. VSR Murti, 'Metrology and Surface Engineering', Frontline Publications, 2011.

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OPERATIONS RESEARCH

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Students will come to know the formulation of LPP models
2. Students will understand the Algorithms of Graphical and Simplex Methods
3. Students will understand the Transportation and Assignment techniques
4. Students will come to know the procedure of Project Management along with CPM and PERT techniques
5. Students will understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, the students were able to

1. Formulate a managerial decision problem into a mathematical model;
2. Apply transportation problems in manufacturing industries;
3. Build and solve ssignment models and travelling salesmen problems.
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing and queuing theory concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, Degeneracy in Simplex, Duality in Simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems, Travelling salesman problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Queuing Theory: Introduction, Kendal's Notation, single channel - poisson arrivals - exponential service times

Text Books:

1. Hamdy, A. Taha, "Operations Research-An Introduction", 6/e, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. Harvey M. Wagner, "Principles of Operations Research", 2/e, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, "Operations Research", 2/e, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013.

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PRODUCTION DRAWING

Instruction	1 Lecture + 2 Drawing Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	2

Objectives: Students will understand

1. The need and the importance of production drawing
2. How to make part drawing from given assembly drawings and prepare process sheets.
3. Indication of size, form and positional tolerances on the drawing sheets
4. Surface finish and heat treatment process on the drawing sheets.
5. Notations, symbols and abbreviations on production drawings

Outcomes: On completion of the course the students will develop abilities to

1. Draw part drawings from given assembly drawings of machine parts.
2. Indicate tolerance values on the parts drawn on sheet as per alpha numeric codes for given assembly drawings
3. Indicate form tolerances and position tolerances on the parts drawn on the sheet as per universally accepted norms for a given assembly drawing
4. Indicate values of surface finish and heat treatment process on the parts drawn for a given assembly drawings.
5. Write process sheet for the part that is drawn from given assembly drawing and interpret production drawing and process sheet.

UNIT-I

Parts-I: Format of drawing sheet, title block, columns for materials, Processes, parts list, conventional representation of parts: screwed joints, welded joints, springs, gears.

UNIT-II

Parts II: Elements of electrical, hydraulic and pneumatic circuits, machine tool elements, methods of indicating notes on drawing

UNIT-III

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/fits, types of fits, Interchangeability and selective assembly, Exercises involving selection/interpretation of fits and calculation of limits, dimensional chains.

UNIT-IV

Production Drawing: Conventional practices of indicating tolerance on size and geometrical form, position, surface finish, surface treatments, part drawing from assembled drawings (Stuffing box, Screw jack, I.C engine connecting rod, Revolving center, Square tool post, Single tool post, Universal coupling, Flange coupling, Steam engine cross head, Drill jig (plate type), Eccentric, Hydraulic cylinder), specification and indication of above features on the drawings, calculation of limits suggesting suitable fits for mating parts

UNIT-V

Assignments: Sketches of conventional representation of parts described with syllabus nr (I) process sheets, tolerances and finishes obtainable from different processes. Study of IS 2709 on limits and fits

NOTE: Tolerance charts to be provided in the examination hall for calculation of limits

Text Books:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, "Production Drawing", New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, "Production Drawing Practice", Hitech Publishers, 2001.

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Suggested Reading:

1. R.L. Murthy, "Precision Engineering in Manufacturing", New Age International Private Ltd., 1996
2. Venkata Reddy, "Production Drawing", New Age International, ISBN 978-81-224-2288-7, 2009
3. Farazdak Haideri, "Machine Drawing & Computer Graphics", Nirali Prakashan, ISBN 978-93-8072-527-7
4. Doeblin, "Measurement Systems Application and Design", TMH, 5/e, 2004.

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PRODUCTION AND OPERATIONS MANAGEMENT

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	3	

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
3. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
4. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
5. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

Outcomes: At the end of the course, the student will be able to

1. Identify and evaluate the processes, tools and principles of production and operations management to better understand the logistics and supply chain operations
2. Demonstrate the ability to apply mathematical forecasting techniques
3. Identify future challenges and directions that relate to production and operations management to effectively and efficiently respond to market changes
4. Apply the tasks, tools and underlying principles of operations management in the manufacturing and service sectors to improve organizational performance
5. Explain and evaluate the quality process in manufacturing and service sector to improve the operational performance

UNIT-I

Production & Operations Management: Introduction: Types of Production Systems, job shop, batch, flow shop

Plant Location and Layout: Factors affecting plant location, plant layout objectives, types of layouts, merits and demerits.

Work Study: Introduction to method study and work measurement, standard time calculations, work sampling, wages and incentives, types of incentive plans.

UNIT-II

Forecasting: Introduction, forecasting objectives and uses, demand patterns, qualitative models, market survey, Delphi method, quantitative models, moving average, weighted moving average, simple exponential smoothing, trend adjusted exponential smoothing, simple regression.

Forecast Errors: Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error (MFE), Mean Absolute Percentage Error (MAPE)

UNIT-III

Aggregate Planning and Master Scheduling: Introduction, objectives of aggregate planning, cost in aggregate planning, strategies in aggregate planning, master production scheduling

Materials Requirement Planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials.

UNIT-IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs, deterministic inventory models, basic EOQ model, production model without shortages, purchase model with instantaneous replenishment and with shortages, production model with shortages, inventory model with price breaks, fixed order quality system, periodic review system ,

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UNIT-V

Quality Control: Introduction, quality gurus and their contributions, quality tools, process capability, quality control by control charts, control charts for variables and attributes, sampling plans, operating characteristic curve, introduction to total quality management

Text Books:

1. Stevenson, "Operation Management", Mc-Graw Hill International.
2. Joseph Monks, "Operations Management", TMH Publishers, New Delhi, 2004.
3. Buffa Elwood S, "Modern Production /Operations Management", John Wiley Publishers, Singapore, 2002.

Suggested Reading:

1. Everrete E. Adama & Ronald J. Ebert, "Production & Operations Management", 5/e, Prentice Hall of India, 2005.
2. Panneer Selvam R, "Production and Operations Management," 2/e, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut,2009
4. S.N. Chary, "Production and Operations Management", 3/e, Tata McGraw Hill, 2006.

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16PE C12

TOOL ENGINEERING

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:
Students will understand

1. Various tool materials available including new materials like plastics
2. How to design simple tools independently as required by the industry like single point cutting tool, milling cutter, form tool and broaching tool
3. Design principles related to common tools used in manufacturing practices like drilling, reaming and tapping
4. The fundamentals of Tool Design that apply to different areas of sheet metal forming like blanking, drawing , plastics and mould design etc.
5. The fundamental concepts of Jigs and fixtures along with design principles

Outcomes:
At the end of the course, the students will be able to

1. Understand the importance of cutting tool materials
2. Design simple tools independently like single point cutting tool, milling cutter, form tool and broaching tool
3. Suggest appropriate tool geometry, tool material for manufacturing process like drilling, reaming and tapping
4. Design the tools for various operations like blanking, piercing, drawing and forging, mould design etc.
5. Design jigs and fixtures based on requirements.

Unit-I
Introduction to Tool Engineering: Role and importance of tool engineering in industries, tool engineering functions, duties of a tool engineer.
Tools : Types, classification, features and applications, Properties of Cutting tool materials, types of cutting tool material -- Major constituents , relative characteristics and their applications, ISO classification and coding of carbide tools, coated tools, modern cutting tool materials and their applications, Introduction to plastics, their properties and commonly used plastics as tooling materials and their applications.

Unit-II
Design of Tools: Design of single point cutting tools, Design of flat and circular form tools, Design elements of a milling cutter, types of milling cutters, forces and power estimation, , Design of milling cutters.
Introduction to Broaching Operation: Types of broaches - pull, push broach, geometry of broach, and design of broaching tool and manufacturing of broaches.

Unit-III
Twist Drill Geometry: Design and manufacturing of twist drill, effect of variation of angles on torque and thrust forces and sharpening of twist drills.
Reamers: Types of reamers, geometry of a reamer, reaming allowance, tolerance disposition, design and manufacture of reamers
Taps and Dies: Types, geometry, calculation of tapping drill diameters, design and manufacturing of taps and dies.

Unit-IV
Introduction to Press Tools and Various Sheet Metal Forming Operations: Design of die set for blanking and piercing operations, design of bending dies, design of die set for deep drawing operation, design of die set for forging operation, design of dies for metal spinning operation.
Fundamentals of Plastic Products and Mould Design: Plastics product design – Concepts, Essential factors and Principles.

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Injection Mould Design- Mould design concepts, mould elements, parting line and parting surface, mould alignment, Feed system- Sprue, runner, gate & position of gate - runner ,
Blow Mould Design - Types of blow moulds - extrusion - injection and stretch blow moulds ,blow ratio - parison design - pinch off design - parting line.
Extrusion Die Design- Principles of Extrusion- Die Geometry – Die swell. Introduction to mould flow software, performing simulations.

Unit-V

Jigs & Fixtures: Design principles and construction features, locating methods associated with flat, cylindrical, internal and external surfaces, type of locating pins, requirements and choice of locating systems, redundant location, fool proofing, setting blocks, types of clamping devices and their basic elements, quick action clamps and nuts, equalizing and multiple clamping pneumatics, hydraulic, magnetic, electrical and vacuum clamping, types of drill jigs and their classification, drilling bushings, indexing jigs, design of fixtures for turning, grinding, welding and milling, economic analysis of jigs and fixtures.

Text Books:

1. Cyril Donaldson, George H. LeCain, V. C. Goold and Joyjeet Ghose, "Tool Design", 4/e, Tata McGraw Hill Education Private Limited, New Delhi, 2012.
2. David Spitler, Jeff Lantrip, John Nee and David A. Smith, "Fundamentals of Tool Design", 5/e, Society of Manufacturing Engineers, 2003.

Suggested Reading:

1. P. C. Sharma, "A Textbook of Machine Tools and Tool Design", S.Chand (G/L) & Company Ltd, 2005.
2. Amitabha Battacharya and Inyong Ham, "Design of Cutting Tools Use of Metal Cutting Theory", ASTME Pub., Michigan, USA.
3. Surender Keshav & Umesh Chandra, "Production Engineering Design (Tool Design)", Satya Prakashan, New Delhi-1994.

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RENEWABLE ENERGY SOURCES (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn the

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of geothermal energy and bio-energy
5. Merits and demerits of tidal energy, wave energy and OTEC

Outcomes: At the end of the course, the students are able to

1. Understand the depletion and of environmental impact conventional sources of energy and will suggest suitable renewable energies in place of conventional energies
2. Determine the principles of absorption
3. Understand the problems associated with utilizing the wind energy
4. Describe the physics of geothermal resources and describe how biomass is currently used as a source of energy
5. Explain the physical principles of wave energy, tides and the environmental impact of OTEC plants

UNIT-I

Energy Sources: Statistics on conventional energy sources and supply in developing countries - Definition-Concepts of RES - Limitations of RES - Classification of RES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources - comparison of these energy sources.

UNIT-II

Solar Energy: Solar Radiation – Solar Thermal Collectors – Flat Plate and Concentrating Collectors and their limitations – Comparison - Solar Applications- Solar thermal power plant – Space based solar power – advantages and limitations of solar thermal energy – PV cells - PV materials - solar satellite system-advantages and disadvantages

UNIT-III

Wind Energy: Merits and demerits-Wind power plant-site selection - Power formula – Betz's limit – Effect of velocity on power generation - classification of wind power plants- Horizontal axis and vertical axis windmills - Working principle - New developments.

UNIT-IV

Geothermal Energy: Layers in earth-Classification of resources of Geothermal Energy – working principle.
Biomass Energy: Biomass-Raw materials-Source, Composition, Conversion technologies – Direct combustion-Pyrolysis—Gasification, Biomass gasifiers –float and fixed dome types-Common operational problems, causes and remedies relating to a biogas plant-Economical, social, environmental and health benefits of bio gas utilization

UNIT V

Wave, Tidal and OTEC Energy: Difference between tidal and wave power generation-Tidal power plant – principle of Operation-single basin and double basin tidal plants- advantages and limitations, OTEC power plants- Open and closed OTEC Cycles- advantages and limitations -Environmental impacts of OTEC.

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Text Books:

1. S. Hasan Saeed and D.K. Sharma, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2014.
2. Dr. R.K. Singal, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2005.
3. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.

Suggested Reading:

1. Mittal K M, "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd. New Delhi, 2003.
2. Shali Habibulla, "Non-Conventional Energy Sources", State Institute of Vocational Education, Hyderabad, 2005.
3. Ashok V Desai, "Non-Conventional Energy", Wiley Eastern Ltd, New Delhi, 2003.

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16ME E11

ENERGY CONSERVATION, MANAGEMENT AND AUDIT (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To make the students to know the importance of energy sector in country's development
2. To identify various auditing services
3. To prepare the organizational structure energy policy
4. To get the concept of management in process industries
5. To explain how to take tax considerations

Outcomes: Students will be able to

1. Know energy scenario both India and world
2. Review and asses the various audit tools
3. Understand energy policy planning and take energy management as a profession
4. Analyze energy security, codes, standards,
5. Arrange the financial arrangements for industries

UNIT-I

Global & Indian Energy Scenario: Basics of Energy and its various forms - Classification of Energy sources- Applications of Non - Conventional and Renewable Energy Sources - Energy needs of growing economy- Energy sector reform, Energy and Environment: Global Environmental Concerns

UNIT-II

Energy Audit: Material and Energy Balance - Energy Action Planning - Energy Monitoring and Targeting - Types of energy audit, Energy Auditing Services Basic Components of an Energy Audit Specialized Audit Tools Industrial Audits Commercial Audits Residential Audits Indoor Air Quality

Energy Management: Program Organizational Structure Energy Policy Planning Audit Planning Educational Planning Strategic Planning, The Value of Energy Management The Energy Management Profession Some Suggested Principles of Energy Management, Energy Management Systems Justification of EMCSs Systems Integration

UNIT-III

Energy Efficiency in Thermal Utilities - Fuels and Combustion - Boilers -Steam System - Furnaces - Insulation and Refractory - FBC Boilers -Cogeneration -Waste heat recovery- Compressed Air System. - Diesel Generating System

Energy Efficiency in Electrical Utilities - Electrical Systems -Electric Motors - Lighting System - Energy Efficient Technologies in Electrical Systems

Energy Performance Assessment for Equipment and Utility systems - Turbines (Gas, Steam) - Heat Exchangers - Fans and Blowers - Pumps and Pumping System- Water Pumps - Compressors. HVAC Systems - Refrigeration System, - Cooling Tower

UNIT-IV

Waste Heat Recovery: Waste Minimization and Resource Conservation - Energy Management in Process Industries. Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act. Economics of Waste-Heat Recovery, Energy management in water and waste water treatment – solid waste treatment- air pollution control systems . Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration –

UNIT-V

Performing Financial Analysis: Introduction General Characteristics of Capital Investments Sources of Funds Tax Considerations Time Value of Money Concepts Project Measures of Worth Economic Analysis-Financing Energy Management Projects Introduction Financial Arrangements: A Simple Example Financial Arrangements: Details and Terminology Applying Financial Arrangements: A Case Study "Pros" & "Cons"

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Text Books:

1. CB Smith, "Energy Management Principles", Pergamon Press., New York, 1981
2. W R Murphy, G McKay, "Energy Management", Butterworth Heinemann, 2007.
3. "Energy Management Handbook", W.C. Turner, 5/e, Marcel Dekker, Inc, New York, 2005.
4. "Guide to Energy Management, B. L. Capehart", W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.

Suggested Reading:

1. Trivedi, PR, Jolka KR, "Energy Managemnent", Commonwealth Publication, New Delhi, 1997
2. Witte, Larry C, "Industrial Energy Management & Utilization", Hemisphere Publishers, Washington, 1988.
3. Diamant, RME, "Total Energy", Pergamon, Oxford, 1970.
4. Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of energy efficiencies, 2005.
5. Hamies, "Energy Auditing and Conservation; Methods Measurements, Management & Case study," Hemisphere, Washington, 1980.
6. "General Aspects of Energy Management and Audit", National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management)

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16ME E12

ENGINEERING RESEARCH METHODOLOGY (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To make the students to formulate the research problem
2. To identify various sources for literature review and data collection.
3. To prepare the research design
4. To equip the students with good methods to analyze the collected data
5. To explain how to interpret the results and report writing

Outcomes: At the end of the course, the students are able to

1. Define research problem.
2. Review and asses the quality of literature from various sources.
3. Understand and develop various research designs.
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Improve the style and format of writing a report for technical paper/ Journal report

UNIT – I:

Research Methodology: Objectives and Motivation of Research, Types of Research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research Approaches, Significance of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information-primary, secondary, tertiary, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT – III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Steps in sample design

UNIT – IV

Data Collection: Collection of primary data, Secondary data, Measures of central tendency-mean, mode, median, Measures of dispersion- Range, Mean deviation, Standard deviation, Measures of asymmetry (skewness), Important parametric tests -z, t, F, Chi-Square, ANOVA significance

UNIT – V

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation- Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Books:

1. C.R Kothari, "Research Methodology Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011

Suggested Reading:

1. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
2. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.
3. Naval Bajjai, "Business Research Methods", Pearson, 2011.

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16ME E14

With Effect from the Academic Year 2019 - 2020

FINITE ELEMENT METHODS (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Equip the students with the Finite Element Analysis fundamentals and formulations
2. Enable the students to formulate the axial, truss and beam problems
3. Enable the students to formulate 2D problems with special cases
4. Enable the students to formulate quadrilateral element, use of numerical integration, Gaussian quadrature and one dimensional dynamic problems
5. Enable the students to understand the convergence requirements, heat transfer , formulate 3D problems and perform engineering simulations using Finite Element Analysis software (ANSYS)

Outcomes: At the end of the course a student will be able to

1. Apply FE method for solving field problems using Virtual work and Potential energy formulations
2. Analyze linear problems like axial, trusses and beam problems
3. Analyze 2D structural problems using CST element and analyze plane stress, plane strain and axi-symmetric problems with triangular elements.
4. Write shape functions for 4 node quadrilateral isoparametric elements, apply numerical integration, Gaussian quadrature and to estimate natural frequencies for stepped bar
5. Check for convergence requirements, Solve linear 1D and 2D heat conduction and convection heat transfer problems, formulate 3D elements, apply finite element analysis software for engineering solutions

UNIT - I

Fundamental Concepts: Introduction to finite element method, stresses and equilibrium, boundary conditions, strain – displacement and stress – strain relationship

One Dimensional Problem: Different co-ordinate systems and shape functions, virtual work and potential energy approach, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, analysis of axial element and quadratic element

UNIT - II

Analysis of Trusses: Element stiffness matrix for a truss member, Analysis of plane truss with two degrees of freedom at each node

Analysis of Beams: element stiffness matrix for two nodes (two degrees of freedom per node),

Analysis of Frames: Analysis of frames with two translations and rotational degrees of freedom per node

UNIT - III

2D Triangular Elements: plane stress, plane strain and axisymmetry, finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Finite element modeling of axisymmetric solids subjected to axisymmetric loading with triangular elements

UNIT - IV

Quadrilateral Elements and Numerical Integration: Two dimensional four noded isoparametric elements, numerical integration and Gauss quadrature

Dynamic Analysis: Formulation of finite element model, element mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar

UNIT - V

Heat Transfer Analysis: Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate

3 D Elements and FEA Software: Introduction to finite element formulation of three dimensional problems in stress analysis, convergence requirements

Introduction to Finite Element Analysis Software: Modeling, analysis and post processing

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Text Books:

1. Ramamurthy, G., "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Ltd., New Delhi, 2009.
2. Tirupathi R., Chandrupatla and Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Practice Hall of India, 1997.
3. Daryl L. Logan, "A First Course in the Finite Element Method", Cengage Learning, 2011.

Suggested Reading:

1. Rao S. S., "The Finite Element Method in Engineering", Pergamon Press, 1989.
2. Segerlind L. J., "Applied Finite Element Analysis", Wiley Eastern, 1984.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt., "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley

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16ME C36

METROLOGY AND INSTRUMENTATION LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives:

1. To choose the proper measuring instrument for the precise measurement of Length, Height and diameter
2. To select the proper measuring instrument for the angular measurement.
3. To indentify gear & screw thread parameters using optical projector and tool makers microscope.
4. To familiarize with limits, fits and tolerances for gauge selection and design.
5. To understand the working principles in the measurement of Flatness, Roundness and Surface roughness.

Outcomes: At the end of the course, the students were able to

1. Identify methods and devices for measurement of length, height and diameter.
2. Acquire the knowledge about angular measurement and various measuring instruments.
3. Recognize & measure the gear and screw thread parameters using profile projector and tool maker microscope.
4. Demonstrate the sound knowledge in gauges selection, design and measurement.
5. Acquire adequate knowledge in the measurement of flatness, roundness and surface roughness.

Experiments:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope – Diameter of thin wire and single point cutting tool angle.
4. Measurement with Dial Indicator and its calibration.
5. Measurement of angles with Sine bar and clinometers.
6. Measurement of roundness errors with bench centers.
7. Measurement of flatness errors of a surface plate with precision spirit level.
8. Measurement with optical profile projector.
9. Design of Plug gauge for a given hole.
10. Design of Snap gauge for a given shaft.
11. Surface roughness measurement by Taylor Hobson -Talysurf.
12. Measurement of Gear tooth thickness by gear tooth vernier.
13. Displacement measurement with LVDT.

Note: Student should complete a minimum of 10 experiments.

Suggested Reading:

1. IC Gupta, "Engineering Metrology", Dhanpat Rai Pub., New Delhi, 1984.
2. Beneakra & K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e, McGrawhill, 2014

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16PE C13

MANUFACTURING ENGINEERING LAB

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
SEE	50	Marks
CIE	25	Marks
Credits	2	

Objectives:
Students will learn

1. Various concepts of Manufacturing Processes and selection of right manufacturing process and materials
2. The concepts of process sheets
3. Various CAD packages
4. The Bill of Materials and MRP concepts
5. Limits, tolerances and fits in manufacturing

Outcomes:
Students able to

1. Apply right manufacturing techniques and choose the right material
2. Operate different machine tools
3. Prepare process sheets and Bill of Material
4. Apply limits, fits and tolerances while manufacturing components
5. Prepare CAD drawings

Part-1: Manufacturing Mini Product: Study of all manufacturing facilities available in various manufacturing related laboratories, manufacturing cases.

Part-2: Manufacturing Major Product: One/two of the following items have to be manufactured by a group of maximum two members using all the production facilities and processes as far possible and assembly techniques with fits and tolerances using CAD system, various exercises have to be allotted to different groups of students by the lab faculty

1. V block with U clamp
2. Dia test indicator stand
3. Simple Jig
4. Simple fixture
5. Simple die set
6. Simple tail stock mechanism
7. Lathe tool post
8. Milling Machine Arbor
9. Pipe vice
10. Paper Punch (double punch)
11. Hydraulic Cylinder
12. Gear box (Spur, Helical or Worm)

Suggested Reading:

1. P. N. Rao, "Manufacturing Technology – Metal Cutting & Machine Tool", Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. Jain K.C., Chitale, A.K., "Production Engineering", 2/e, PHI, 2014.

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PROJECT SEMINAR

Instruction	3 Hours per week
Duration of Semester End Examination	----
SEE	----
CIE	50 Marks
Credits	2

The objective of 'Project Seminar' is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks:

Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

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16ME E15

POWER PLANT ENGINEERING (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plants, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics, environmental and safety aspects of power plant operation.

Outcomes: At the end of the course, the student will be able to

1. Select the suitability of site for a power plant.
2. Propose ash handling, coal handling method in a thermal power plant
3. Understand the water cycle, flow-sheet of hydro-power plant and types of dams and spillways
4. Explain working principle of different types of nuclear power plant.
5. Know the various factors of plant load and economy and safety aspects of power plants

UNIT - I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants
Steam power plant: Plant Layout, types of coals, coal handling equipment, Ash and Dust handling systems

UNIT II

Steam Power Plant: Combustion Process - Overfeed and Underfeed stokers-traveling grate stokers, spreader stokers, retort stokers- single retort and multi-Retort - Pulverized fuel burning systems – components – burners - Unit and Bin - working

UNIT III

Hydro Electric Power Plant: Hydrological cycle, flow measurement, Hydrographs – flow/mass duration curve - drainage area characteristics, Types of hydroelectric power plants- working - storage and pondage - classification and working of dams and spill ways.

UNIT - IV

Nuclear Power Plant: Nuclear fuel - breeding and fertile materials - types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Gas cooled Reactor-Radioactive waste disposal,

UNIT - V

Power Plant Economics and Environmental Considerations:
Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises-Fixed cost and variable cost-methods to find depreciation cost, Effluents from power plants and Impact on environment – pollutants - Pollution control.

Text Books:

1. R.K. Rajput, "A Text Book of Power Plant Engineering", 4/e, Laxmi Publications (P) Ltd., New Delhi, 2015
2. P.K. Nag, "Power Plant Engineering", 4/e, McGraHill Education(India) Private Limited, New Delhi, 2014.
3. S.C. Arora and S. Domkundwar, "A Course in Power Plant Engineering", Dhanpat Rai & Sons, New Delhi, 2005.

Suggested Reading:

1. R. Yadav, "Fundamentals of Power Plant Engineering", Central Publishing House, Allahabad, 2012.
2. R.K. Hegde, "Power Plant Engineering", Pearson Education India, 2015.
3. P.C. Sharma, "A Text Book of Power Plant Engineering", S.K. Kataria & sons, New Delhi, 2016.

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PRINCIPLES OF ENTREPRENEURSHIP (Professional Elective - VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand
1. Concept and procedure of idea generation
2. The nature of industry and related opportunities and challenges
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:
1. Analyse ideas for new and innovative products or services
2. Identify opportunities and deciding nature of industry
3. Analyze the feasibility of a new business plan and preparation of Business plan
4. Use project management techniques like PERT and CPM
5. Analyze behavioral aspects and use time management matrix

UNIT-I
Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, women entrepreneurs, need of innovation in entrepreneurial journey, Conception and evaluation of ideas and their sources,

UNIT-II
Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Entrepreneurship and Engineering, Small Scale Industry in India, Objectives, Linkage among small, medium and large scale industries, Types of enterprises, Corporate Social Responsibility

UNIT-III
Formulation of Business Plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary, Selection of Technology, Collaborative interaction for Technology development

UNIT-IV
Project Management: During construction phase, project organization, project planning, execution and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden, environmental issues.

UNIT-V
Behavioral Aspects of Entrepreneurs: Personality: determinants, Maslow's Hierarchy of needs, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior
Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:
1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:
1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Mc Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
3. G.S. Sudha, "Organizational Behavior", National Publishing House, 1996.

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16ME E17

INNOVATIONS, PROTECTION AND LEGAL ASPECTS (Professional Elective - VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn
1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture and techno-business aspects of IPR

Outcomes: At the end of the course, a student
1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Will be capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IPR and converting creativity into IPR and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Geographical indications: Introduction, definition, difference between GI and trademark, difference between GI and appellation of origin, GI as factors of rural development, developing a geographical indication and protection

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

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Text Books:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra;" Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

Suggested Reading:

1. Cronish W.R1 "Intellectual Property; Patents, copyright, Trad and Allied rights", Sweet & Maxwell, 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, "A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs", 4/e, .Sweet, Maxwell

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16PE E11

With Effect from the Academic Year 2019 - 2020

SUPPLY CHAIN MANAGEMENT (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. The awareness about transportation and warehouse management systems.
2. The designing supply chain networks.
3. The concept of demand and supply and integrating it with supply chain management.
4. The planning and managing inventories.
5. The pricing and revenue management

Outcomes: At the end of the course, the student is able to

1. Plan an effective transportation and warehouse management systems
2. Design an effective supply chain networks
3. Integrate and optimize demand and supply gaps
4. Apply inventory management techniques
5. Understand and design pricing and revenue management systems

UNIT-I

Concept of SCM: Concept of Logistics Management, Supply Chain, Types of supply chain, functions in SCM, Transportation Management, Warehousing Management, Warehouse management systems.

UNIT-II

Designing the Supply Chain Network: Designing the distribution network, Network Design, Network Design in an uncertain environment.

UNIT-III

Planning and Demand: Planning demand & supply in a supply chain, demand forecasting, aggregate planning, planning supply & demand.

UNIT-IV

Planning & Managing Inventories in a Supply Chain: managing economies of scale, cycle inventory, and managing uncertainty safety inventory optimal level of product availability

UNIT-V

Sourcing, Transporting & Pricing Products: sourcing decisions, transportation, pricing & revenue management. Coordination & technology in the supply chains, coordination in supply chain, information technology and supply chain.

Text Books:

1. N. J. Kumar & Mukesh Bhatia, "Supply Chain Management", Neha publishers & Distributors, 2010.
2. Michael H. Hugos, "Essentials of Supply Chain Management", 3/e, John Wiley & Sons, Inc, Hoboken, New Jersy, 2011.
3. Sunil Chopra & Peter Meindl, "Supply Chain Management – Strategy, Planning and Operation", Pearson Education, Inc., Upper Saddle River, New Jersey, 2003.

Suggested Reading:

1. Martin Christopher, "Logistics & Supply Chain Management", 5/e, Financial Times Series, 2010.
2. Dobler Donald W, David.N.Burt, "Purchasing & supply Management Text & Cases", McGraw-Hill, 1996.
3. Chitale A.K. Gupta R.C, "Materials Management-Text and Cases", Prentice-Hall Of India Pvt. Limited, 2007.

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16PE E12

With Effect from the Academic Year 2019 - 2020

TOTAL QUALITY MANAGEMENT (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
Student will understand
1. The essence of total quality management in design and manufacturing a product
2. The various principles and concepts of total quality management
3. The various technical tools of quality like control charts and ANOVA etc
4. The quality information system
5. The awareness about measuring and satisfying customer needs

Outcomes:
At the end of the course, the student is able to
1. Apply TQM techniques in engineering applications
2. Use various theories and principles related to TQM
3. Use statistical techniques in TQM
4. Have awareness and use quality information system and innovative systems
5. Deal with customer grievances and satisfying the customers

UNIT-I
Strategic Quality Management: Quality policies, quality goals, obstacle to achieving successful strategic quality management, Organization for quality role of {Top, middle, work force team (Quality Circles)}, Developing a quality work culture, Maslow need theory, Herzberg two factor theory, Theory X, Y & Z methods to create and maintain awareness of quality, provide evidence of management leadership, types of self development and empowerment programmes, methods of participations means of inspiring action, recognition and rewards, Supplier quality rating plans (lot plot plan, OC curve, parent analysis), assignment of supplier capability, methods of evaluating supplier products, contract management (Joint economic plan, joint technological forecasting

UNIT-II
Design for Quality: Basic functional requirements of quality, design for (reliability, safety, cost and product performance), concurrent engineering (DFMA) value engineering, support for quality improvement processes (block diagram, brain storming, cause effect analysis, pareto analysis), quality function deployment, reliability analysis, failure rate, failure pattern of complex products (bath tub curve), weibull distribution relationship between part and the system, exponential reliability, availability, FMEA (Fracture Mode and Effect Analysis), Design for experiments: Factorial experiments, construction fractional designs

UNIT-III
Technical Tools for Quality: Analysis of variance (ANOVA), 4 factor ANOVA experiment, 2 levels, analysis of means, Techniques for online quality: data collection plan, variable and attribute charts, interpreting the control charts, Techniques for offline quality control: background to Taguchi method (quality loss and loss function, controllable factor, and non controllable factors in parameter performance, tolerance design
Taguchi analysis techniques: net variation and contribution ratio, estimation of process performance, accumulating analysis, performance measures, Taguchi tolerance design and tolerance (re) design

UNIT-IV
Quality Information System: Scope of Quality Information System, differences between QIS and MIS, creating new software (steps, types, defects) reports on quality (operational and executive reports), features of QIS software, software for inspection
Inspection System: Operational sorting and correlation sorting, AQL, LTPD, AOQL, Nondestructive test, Audit systems: (quality improvement planning and implementation, describing quality function, process control system, control of measurement system, material identification and control, drawing and specification control, process corrective action), the concept of POKAYOKE

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UNIT-V

Measure of Customer Needs: The need to measure customer satisfaction, importance of proper packaging, customer processing and installation of product, dealing with customer complaints, using weibull analysis, field feedback, parameter to measure customer (dis)satisfaction, problems with the customer satisfaction system
Beyond TQM: Difficulties in implementing TQM system, rating your quality system, JIT system, the people side of TQM system, system integration, Kansei engineering and flexibility in manufacturing

Text Books:

1. L. Suganthi, Anand A. Samuel, "Total Quality Management", PHI Learning Pvt. Ltd., 2004.
2. H.G. Menon, "TQM in view Production Manufacturing", McGraw Hill Publishers

Suggested Reading:

1. Joel E. Ross & Susan Perry, "Total Quality Management: Text, Cases, and Readings", 3/e, CRC Press, 1999
2. John S Oakland, "Total Quality Management: The route to improving performance", A Butterworth-Heinemann Title, 2/e, 1994
3. Jankiraman, "Total Quality Management: Text and Cases", PHI Learning Private Limited-New Delhi; 1 edition (2006)

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DISASTER MITIGATION AND MANAGEMENT (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Outcomes: At the end of the course the students are able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT- III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT- IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and

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national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh,"Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, "Government of India, "National disaster management plan, Part I and II"
2. K. K. Ghosh,"Disaster Management", APH Publishing Corporation, 2006.
3. "Hazards, Disasters and your community: A booklet for students and the community", Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

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16IT O02

PRINCIPLES OF INTERNET OF THINGS (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To provide an overview of Internet of Things, building blocks of IoT and real-world applications.
2. To explore various IOT enabling technologies.
3. To facilitate students, understand Python scripts for IoT platform.
4. To identify steps in IOT design Methodology.
5. To introduce about the Raspberry Pi device, its interfaces and Django Framework.

Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the terminology, protocols and communication models of IoT.
2. Define the various IoT enabling technologies and differentiate between M2M and IoT.
3. Acquire the basics of Python Scripting Language used in developing IoT applications.
4. Describe the steps involved in IoT system design methodology.
5. Design simple IoT systems using Raspberry Pi board and interfacing sensors with Raspberry Pi.

UNIT-I

Introduction & Concepts: Introduction to Internet of Things- Definitions & Characteristics ofIoT, Physical Design of IOT-Physical Layer, Network Layer, Transport Layer, Application Layer, Things in IoT, IoT Protocols, Logical Design of IOT-IoTFunctional Blocks, IoT Communication Models-Request-reponse,Publisher-Subscriber,Push-Pull,Exclusive Pair, IoT Communication APIs-REST API, Websocket API,

UNIT-II

IOT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates. Differences and similarities between IOT and M2M, Domain Specific IoT's – IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT-III

Introduction to Python Motivation for using Python for designing IoT systems, Language features of Python, Data types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling, data/time operations, classes, Exception handling.

UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-V

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi about the Raspberry Pi board, Raspberry Pi interfaces-Serial, SPI, I2C, Other IoT Devices pcDuino, BeagleBone Black, Cubieboard, Python Web Application Framework: Django Framework-Roles of Model, Template andView

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.

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Suggested Reading:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications.

Web Resources:

1. The Internet of Things - Article
   https://dl.acm.org/citation.cfm?id=1862541
2. Internet of Things - Tutorial
   http://archive.eurescom.eu/~pub/about-eurescom/message_2009_02/Eurescom_message_02_2009.pdf
3. Publications on The Internet of Things.
   http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf

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16EE O03

ENERGY AUDITING (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
1. To know the concept of Energy auditing
2. To understand the formulation of efficiency for various engineering systems
3. To explore the different ways to design various technologies for efficient engineering systems.

Outcomes: After completion of this course, students will be able to:
1. Know the current energy scenario and importance of energy auditing.
2. Understand the concepts of energy auditing.
3. Evaluate the performance of existing engineering systems
4. Explore the methods of improving energy efficiency in different engineering systems
5. Design different energy efficient devices.

UNIT-I

Basics of Energy and its Various Forms: Overview of engineering, elements Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bio energy, bio mass energy conservation, elements of geothermal energy, sources of geothermal energy, sources of chemical energy, fuel cells, Energy Scenario in India.

UNIT-II

Energy Auditing-1: Introduction: Need for energy audit, directions for the study of energy auditing, inclusions for energy auditing, types of energy audit: preliminary audit, general/mini audit, investment-grade/ comprehensive audit. Major energy consuming equipments and systems, energy audit team, energy auditing methodology: preliminary and detailed. Process flow diagram, energy audit report format

UNIT-III

Energy Auditing-2: For Buildings: Energy auditing instruments, energy efficiency, energy auditing for buildings: stages in programs, surveying, measurements and model analysis. Energy audit form of commercial buildings, checklist for energy saving measures

UNIT –IV

Energy Efficient Technologies-I: Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure;

UNIT-V

Energy Efficient Technologies-II: Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper

Text Books:

1. Umesh Rathore, 'energy management', Kataria publications, 2nd edition, 2014.
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
3. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.

Suggested reading:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

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16EC O07

SYSTEM AUTOMATION AND CONTROL (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: This course aims to
1. Learn the concepts industrial control systems
2. Learn how to measure the physical parameters in industry
3. Learn the applications of Robots in industry.

Outcomes: After completion of this course, students will be able to:
1. Understand various process control systems.
2. Measure the physical parameters in the industry.
3. Design PID controllers
4. Understand the role of digital computers in automation
5. Understand the applications of Robots.

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.
Sensors: Motion, Position, Force, Level sensors and Thermo couples.

UNIT-II

Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.
Measurement Techniques and Hardware: Typical Sensor outputs, Bridgemeasurements. Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III

Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, PD, PI, PID Controllers, Analog and Digital methods of Control.
Controller Hardware: Analog and Digital Controllers.

UNIT-IV

Digital Computers as Process Controllers: Use by Digital Computer for process control, Information required by the computer, Information required by the process, Computer Interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.
Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications.
Trouble shooting System failures: Preliminary stepsand other troubleshooting aids.

Text Books:
1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested reading:
1. Kuo BC, "Automatic Control Systems", 9/e
2. AK Sawhney, "A course on Electrical and Electronic Measurements and Instrumentation".

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16CS O09

BASICS OF ARTIFICIAL INTELLIGENCE (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The objectives of this course are

1. Provide a strong foundation of fundamental concepts in Artificial Intelligence.
2. Discuss the various paradigms involved in solving an AI problems which involve perception, reasoning and learning
3. Apply the AI concepts to build an expert system to solve the real-world problems.

Outcomes: On Successful completion of this course, student will be able to

1. Differentiate between a rudimentary Problem and an AI problem, it's Characteristics and problem-solving Techniques.
2. Compare and contrast the various knowledge representation schemes of AI.
3. Understand and analyze the various reasoning and planning techniques involved in solving AI problems.
4. Understand the different learning techniques.
5. Apply the AI techniques to solve the real-world problems.

UNIT - I

Introduction: Definition, history, applications.

Problem Solving: AI problems, AI Technique, Defining problem as a State-Space Search, Problem Characteristics. Heuristic Search Techniques: Generate–and–test, Hill Climbing, Constraint Satisfaction.

UNIT - II

Knowledge Representation (Logic): Representing facts in logic, proposition logic, predicate logic, resolution and unification.

Knowledge Representation (Structured): Declarative representation, Semantic nets, procedural representation, frames.

UNIT - III

Reasoning: Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster-Shafer Theory.

Planning: Components, goal stack planning, nonlinear planning, hierarchical planning.

UNIT - IV

Learning: Introduction, Rote learning, learning by taking advice, learning in problem solving and learning from examples: Decision tree.

Intelligent Agents: Classification, Working of an agent, single agent and multi agent systems, multi agent application.

UNIT - V

Expert System: Representing and Using Domain Knowledge, Expert systems shells, Explanation, Knowledge Acquisition.

Perception and Action: Real Time Search, Vision, Speech Recognition, **Action:** Navigation, Manipulation, Robot architectures.

Text Books:

1. Elaine Rich, Kevin Night, Shivashankar B Nair, "Artificial Intelligence", 3/E, 2008
2. Russell Norvig, "Artificial Intelligence-Modern Approach", 3/E, 2010.

Suggested Reading:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2012.
2. Nelson M. Mattos, "An Approach to Knowledge Base Management", Springer Berlin Heidelberg, 1991.

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Online Resources / Weblinks / NPTEL Courses:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

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16IT O01

OBJECT ORIENTED PROGRAMMING USING JAVA (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To facilitate learning Exception handling and Multithreading mechanisms.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize with event driven GUI programming and Database connectivity.

Outcomes:

Upon completing this course, students will be able to

1. Understand Object-Oriented concepts.
2. Create Java applications using sound OOP practices e.g. Inheritance, Interfaces, Packages, and Inner classes.
3. Implement Exception Handling and Multithreading concepts in java programs.
4. Develop programs using the Java Collection API and Stream classes.
5. Design and Develop GUI applications with the integration of eventhandling, JDBC.

UNIT-I

OOP concepts - Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms.

Introduction to Java: Java's Magic: The Byte code, The Java Buzzwords, Simple Java Programs, Java Primitive Types, Arrays: How to create and define arrays, Basic Operators, Control statements.

Introducing Classes: Declaring objects, methods, Constructors, this keyword, Method Overloading and Constructor Overloading, Objects as parameters, Returning objects, Use of static and final keywords.

UNIT-II

Inheritance: super and subclasses , Member access rules ,super keyword, Method overriding, Dynamic method dispatch , Abstract classes, using final with inheritance , Introduction to Object class.

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

Interfaces : Defining and implementing interfaces, Nested Interfaces.

Strings Handling: String & StringBuffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives.

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes. Local and anonymous inner classes.

UNIT-III

Exception Handling in Java: what are Exceptions? Exception types, Usage of try, catch, throw, throws and finally clauses, writing your own exception classes.

Multithreading in Java: The java Thread Model, How to create threads, Thread class in java, Thread priorities, Thread synchronization.

Generics: What are Generics? Generic classes, bounded types, Generic methods and interfaces.

UNIT-IV

Collections Framework: Overview of Collection Framework, Commonly used Collection classes – ArrayList, LinkedList, HashSet, LinkedHashSet, TreeSet, Collection Interfaces –Collection, List, Set, SortedSet, Accessing a collection via an Iteration,Storing user-defined classes in collections, Map Interfaces and Classes. Using a comparator. Legacy classes – Vector, Hashtable, The Enumeration interface.

Input/Output : How to read user input (from keyboard) using scanner class,Stream classes, InputStream, OutputStream, FileInputStream, FileOutputStream, Reader and Writer, FileReader, FileWriter cl asses. File class.

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UNIT-V

GUI Design and Event Handling: Component, Container, window, Frame classes. Working with Frame window GUI Controls, Layout Managers, Introduction to Swings, Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces, Handling button click events, Adapter classes. Writing GUI Based applications.

Database Handling in Java: Java Database Connectivity (JDBC) using MySQL.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 8/e, Tata McGraw Hill Publications, 2011.
2. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I, Fundamentals", 8/e, Prentice Hall, 2008.

Suggested Reading:

1. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2/e, Oxford University Press, 2014.
2. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4/e, Tata McGraw-Hill Publishing company Ltd., 2010.
3. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide" 2/e, O'Reilly, 2005

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html.
2. http://nptel.ac.in/courses/106106147/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/lecture-notes/

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16PY O01

HISTORY OF SCIENCE AND TECHNOLOGY (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To enable students to understand science as a socio-cultural product in specific socio-historical contexts.
2. To expose students to philosophical, historical and sociological perspectives to look atscience as a practice deeply embedded in culture and society.
3. To inculcate the scientific culture and ethics in the development of technologies.

Outcomes:

1. Demonstrate knowledge of broad concepts in the history of science, technology ranging over time, space and cultures.
2. Recognize the values of a wide range of methodologies, conceptual approaches and the impact of competing narratives within the history of science, technology.
3. Identify, locate and analyze relevant primary and secondary sources in order to construct evidence-based arguments.
4. Think independently and critically, using appropriate methodologies and technologies to engage with problems in the history of science, technology.
5. Demonstrate academic rigor and sensitivity to cultural and other diversity, and understanding of the ethical implications of historical and scientific enquiry within a global context.

UNIT- I

Science - The Beginning (through 599 BC): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions,Civilization,Major advances.

Science in Antiquity (600 BC - 529 AD): Philosophy, a precursor to science, Hellenistic world and the Roman Empire. Other cultures of the period, major advances.

UNIT- II

Medieval Science (530 AD - 1452 AD): The decline of science in Europe , Science in China, Science and mathematics in India, Arab science, revival of science in Europe, technology revolution of the Middle ages, Major advances.

The Renaissance and the Scientific Revolution (1453 AD – 1659 AD): Renaissance, Scientific Revolution, Technology, Major advances.

UNIT- III

Scientific Method: Measurement and Communication (1660 AD – 1734): European domination, The scientific method, Major advances.

The Industrial Revolution (1735 AD – 1819 AD): Industrial Revolution, Rise of the engineer, Major Advances.

UNIT- IV

Science and Technology in the 19th Century (1820 AD – 1894 AD): philosophical basis of 19th-century science, Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 AD – 1945 AD): The growth of 20thcentury science, Newphilosophies, Quantum reality, Energy sources, Electricity: a revolution intechnology, Majoradvances.

UNIT- V

Big Science and the Post-Industrial Society (1946 AD – 1972 AD): Big science, Specialization and changing categories, Technology changes society, Major advances.

The Information Age (1973 AD – 2015 AD): Information and society, Globalization, The post-industrial society,Problems of the Information age, Major Advances

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Text Books:

1. Bryan Bunch and Alexander Hellemans, "The History of Science and Technology", Houghton Mifflin Company (New York), 2004
2. JD Bernal, "Science in History", 4 Volumes, Eklavya Publishers, 2012

Suggested Readings:

1. "The 100 Most Influential Scientists of All Time", Edited by Kara Rogers, Britannica Educational Publishing, 2010
2. Alberto Hernandez, "A Visual History of Science and Technology", The Rosen Publishing Group, 2016

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16EE O05

With Effect from the Academic Year 2019 – 2020

WASTE MANAGEMENT (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To imbibe the concept of effective utilization of any scrap
2. To Become familiar with the processes of all disciplines of engineering.
3. To learn the technique of connectivity from waste to utility.

Outcomes:

After completion of this course, students will be able to

1. Understand the various processes involved in allied disciplines of engineering
2. Infer the regulations of governance in managing the waste
3. Distinguish the nature of waste materials concerned to the particular branch of engineering
4. Explore the ways and means of disposal of waste material
5. Identify the remedies for the disposal of a selected hazardous waste material

UNIT-I

Introduction to Waste Management: Relevant Regulations Municipal solid waste (management and handling) rules; hazardous waste (management and handling) rules: biomedical waste handling rules; fly ash rules; recycled plastics usage rules; batteries (management and handling) rules. Municipal Solid Waste Management – Fundamentals Sources; composition: generation rates: collection of waste; separation, transfer and transport of waste; treatment and disposal options.

UNIT-II

Hazardous Waste Management : Fundamentals Characterization of waste; compatibility and flammability of chemicals; fate and transport of chemicals; health effects, Radioactive Waste Management – Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

UNI-III

Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies, Physicochemical Treatment of Solid and Hazardous Waste Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapor extraction, air stripping, chemical oxidation); ground water contamination and remediation

UNIT-IV

Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT-V

Landfill design aspects: Landfill design for solid and hazardous wastes: leachate collection and removal; landfill covers; incineration

Text Books:

1. John Pichtel, "Waste Management Practices", CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham, P.L. and Evans, J.C., "Hazardous Waste Management", McGraw Hill International Editions, New York, 1994
3. Richard J. Watts, "Hazardous Wastes - Sources, Pathways, Receptors", John Wiley and Sons, New York, 1997

Suggested Reading:

1. Kanti L.Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, 1999.
2. S.C.Bhatia, "Solid and Hazardous Waste Management", Atlantic Publishers & Dist, 2007

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16EC O05

MEMS AND ITS APPLICATIONS (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
This course aims to:
1. Provide knowledge of semiconductors, various materials used for MEMS.
2. Introduce various Electrostatic and Thermal Sensors and Actuators.
3. Educate on the applications of MEMS to various disciplines.

Outcomes:
Upon completion of this course, students will be able to:
1. Select various materials used for MEMS.
2. Design the micro devices and systems using the MEMS fabrication process.
3. Understand the operation of different Sensors and Actuators.
4. Design the micro devices and systems using Polymer MEMs.
5. Apply different MEMS devices in various disciplines.

UNIT- I
Introduction: The History of MEMS Development, The Intrinsic Characteristics of MEMS: Miniaturization, Microelectronics Integration, Parallel Fabrication with Precision, Devices: Sensors and Actuators- Energy Domains and Transducers, Sensors Considerations, Sensor Noise and Design Complexity: Actuators Considerations.

UNIT- II
Introduction to Micro Fabrication: Overview of Micro fabrication, Overview of Frequently used Micro fabrication Processes: Photolithography, Thin Film Decomposition, Thermal Oxidation of Silicon, Wet Etching, Silicon Anisotropic Etching, Plasma Etching and Reactive Etching, Doping, Wafer Dicing, Wafer Bonding, Microelectronics Fabrication Process Flow, Silicon based MEMS Processes, Packaging and Integration, Process Selection and Design.

UNIT- III
Electrostatic Sensing and Actuation: Introduction to Electrostatic Sensors and Actuators, Parallel: Plate Capacitor, Applications of Parallel Plate Capacitors, Interdigitated Finger Capacitors, Applications of Comb-Drive Devices: Inertia Sensors, Actuators.
Thermal Sensing and Actuation: Introduction to Thermal Sensors, Thermal Actuators, Fundamentals of Thermal Transfer, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications- Inertia Sensors, Flow Sensors, Infrared Sensors.

UNIT- IV
Piezoresistive Sensors: Origin and Expression of Peizoresistivity, Piezoresistive Sensor Materials: Metal Strain Gauges, Single crystal Silicon, Polycrystalline Silicon, Applications of Piezoresistive Sensors:Inertial sensors, Pressure Sensors, Tactile Sensors, flow Sensors.
Piezoelectric Sensors: Introduction, Properties of Piezoelectric Materials, Applications- Inertia Sensors, Acoustic Sensors, Tactile Sensors, Flow Sensors.

UNIT- V
Polymer MEMS: Introduction, Polymers in MEMS- Polyimide, SU-8, Liquid Crystal Polymer(LCP), Representative Applications- Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors.
Case Studies of Selected MEMS Products: Blood Pressure (BP) Sensor, Microphone, Acceleration Sensor and Gyros.

Text Books:
1. Chang Liu, "Foundations of MEMS", 2/e, Pearson Education Inc., 2012.
2. Tai Ran Hsu, "MEMS & Micro Systems Design and Manufacture", Tata McGraw Hill, 2002.

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Reference Books:

1. P. Rai-Choudary, "MEMS and MOEMS Technology and Applications", PHI publications, 2009.
2. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC press, 2001.

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16CS O07

BASICS OF CYBER SECURITY (Open Elective – II)

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	3	

Objectives: The main objectives of this course are:

1. To identify and present indicators that a cybercrime has occurred and understand methods and tools used in cybercrimes.
2. To collect, Process, Analyze and Present Computer Forensics Evidence.
3. To understand the legal perspectives and Organizational implications of Cyber Security

Outcomes: On Successful completion of this course, student will be able to:

1. Discuss different types of cybercrimes and analyze legal frameworks to deal with these cybercrimes.
2. Describe Tools used in cybercrimes and laws governing cyberspace.
3. Analyze and resolve cyber security issues.
4. Recognize the importance of digital evidence in prosecution.
5. Analyze the commercial activities in the event of significant information security incidents in the Organization.

UNIT - I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cyber crime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective, A Global Perspective of Cyber Crime.

UNIT - II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector. **Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT - III

Cyber Security: The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber Law, Technology and Students: The Indian Scenario.

UNIT - IV

Understanding Cyber Forensics: Introduction ,Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

UNIT - V

Cyber Security: Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, 2011.
2. Kevin Mandia, Chris Prosise, "Incident Response and Computer Forensics", Tata McGraw Hill, 2006.

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Suggested Reading:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, "Cyber Security and Cyber Laws", Paperback, 2018.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.

Online Resources:

1. https://www.edx.org/learn/cybersecurity
2. https://www.coursera.org/courses?query=cyber%20security
3. https://swayam.gov.in/course/4002-cyber-law

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16PE C15

SEMINAR

Instruction	3 Hours per week
Duration of Semester End Examination	----
SEE	----
CIE	50 Marks
Credits	2

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summaryand Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall preferably be from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

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16PE C16

PROJECT

Instruction	6 Hours per week
Duration of Semester End Examination	----
SEE	100 Marks
CIE	50 Marks
Credits	6

The object of Project is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include;

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 50)

CIE (Continuous Internal Evaluation) Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Department Review Committee	05	Review 1
	08	Review 2
	12	Submission
Supervisor	05	Regularity and Punctuality
	05	Work Progress
	05	Quality of the work which may lead to publications
	05	Report Preparation
	05	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in SEE:

(Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study
	20	Viva-Voce

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19MEC 101

COMPUTER AIDED MODELING AND DESIGN

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students

1. Understand the basics of computer aided design
2. Gain the knowledge on design process
3. Explain the uses of wireframe and surface entities
4. Learn and apply various geometric transformations
5. Understand various advanced modeling concepts

Outcomes: At the end of the course, student will be able to

1. Understand the design process, visualize models through graphics standards and apply principles of computer graphics like geometric transformations, windowing and clipping
2. Recognize various wireframe entities and model them
3. Apply surface modelling techniques for generating various parts
4. Differentiate various solid modelling techniques
5. Understand various advanced modelling concepts like parametric and variational modelling , feature based design, interference detection

UNIT - I

Introduction: Criteria for selection of CAD workstations, Shigley's design process, Design criteria, Geometric modelling, Entities, 2d and 3d primitives, Computer Aided Design, Iterative Design, CAD process

Geometric Transformations: 2d Translation, Scaling, Rotation, Reflection and shearing, Homogeneous Coordinates, Rotation and Scaling about arbitrary points, 3D transformations, Windowing - View ports -Clipping transformations

Graphics Standards: GKS, IGES, PDES and their relevance

UNIT – II

Modeling of Curves: Curve representation, Analytic curves- Lines, and Circles, Ellipse, and Conics, Synthetic curves – Cubic, Bezier, B-Splines, and Non Uniform Rational B-Splines, Curve Manipulations,

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UNIT - III

Surface Modeling: Surface representation, Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Synthetic Surface: Cubic, Bezier, B-spline, Coons surface.

UNIT - IV

Solid Modeling Techniques: Boundary Representation (B-rep) & Constructive Solid Geometry (CSG), Graph Based Models, Boolean Models, Primitive Instancing, Cell Decomposition & Spatial Occupancy Enumeration

UNIT - V

Advanced Modeling Concepts: Feature Based Modeling, Assembly Modeling, Conceptual Design and Top down design, Parametric and Variational Modeling, Feature recognition, Design by Features, Computer Aided Design of Mechanical parts and Interference Detection by Motion analysis

Text Books:

1. Ibrahim Zeid, "CAD/CAM Theory and Practice", Mc Graw Hill, 1998.
2. Foley, Van Dam, Feiner and Hughes, "Computer Graphics Principles and Practice", 2/e., Addison Wesley, 2000.

Suggested Reading:

1. E. Michael, "Geometric Modelling", John Wiley & Sons, 1995.
2. Hill Jr, F.S., "Computer Graphics using open GL", Pearson Education, 2003.

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19MEC 102

COMPUTER INTEGRATED MANUFACTURING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students

1. To understand the role of computers in manufacturing
2. To provide an in-depth understanding of manufacturing and database systems
3. To provide an understanding of needs of the market and design the product
4. To design and develop material handling, storage and retrieval systems for specific cases of manufacturing
5. To develop CIM systems for current manufacturing scenario by using computer and networking tools.

Outcomes: At the end of the course, student will be able to

1. Select the necessary computing tools for development of product
2. Use appropriate database systems for manufacturing a product and store the same for future use
3. Use modern manufacturing techniques and tools including principles of networking
4. Apply the concepts of lean manufacturing and agile manufacturing
5. Apply the latest technology of manufacturing systems and software for the development of a product.

UNIT - I

Basic Concepts of CIM: The meaning of Manufacturing, Types of Manufacturing; CIM Definition, Elements of CIM, CIM wheel, concept or technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life-cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development (IPD), Product Life-Cycle Management (PLM), Collaborative Product Development.

UNIT - II

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

UNIT - III

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II), Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine–Component Group Analysis, Similarity Coefficients-Based Approaches, Evaluation of Cell Design. Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits

UNIT – IV

Introduction to Networking: Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration.

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT - V

Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems.

Text Books:

1. S.Kant Vajpayee: "Principles of Computer Integrated Manufacturing", Prentice Hall India
2. Nanua Singh: "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley

Suggested Reading:

1. P.Radhakrishnan, S.Subramanyam: "CAD/CAM/CIM", New Age International
2. Alavudeen, Venkateshwaran: "Computer Integrated Manufacturing", Prentice Hall India.

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19MEC 103

RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives: To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Outcomes: At the end of the course, student will be able to

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT-II

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing

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a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT-III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT-IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT-V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004.

Suggested Reading:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010.

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19MEE 101

ADVANCED MACHINE DESIGN (Programme Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to understand the

1. Failure theories of engineering components
2. Fatigue life estimation by S-N approach
3. LEFM approach
4. Fatigue from variable amplitude loading
5. Surface failure

Outcomes: At the end of the course, student will be able to

1. Predict failure of engineering components using failure theories
2. Identify and explain the types of fractures of engineered materials and their characteristic features
3. Understand LEFM approach
4. Estimate life of components using stress life and strain life
5. Categorize different types of surface failure

UNIT - I

Introduction: Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples. Fatigue of Materials: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features

UNIT - II

Stress-Life (S-N) Approach: S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach. Strain-Life(å-N)approach: Monotonic stress-strain behavior, Strain controlled test methods, Cyclic stress-strain behavior, Strain based approach to life estimation, Determination of strain life

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fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by å-N approach

UNIT - III

LEFM Approach: LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects. Notches and their effects: Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach. Neuber's rule.

UNIT - IV

Fatigue from Variable Amplitude Loading: Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.

UNIT - V

Surface Failure: Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.

Text Books:

1. Ralph I. Stephens, Ali Fatemi, Robert and Henry O. Fuchs, "Metal Fatigue in Engineering", John Wiley NewYork, Second edition. 2001.
2. Jack. A. Collins, "Failure of Materials in Mechanical Design", John Wiley, NewYork 1992.
3. Robert L. Norton, "Machine Design", Pearson Education India, 2000

Suggested Reading:

1. S. Suresh, "Fatigue of Materials", Cambridge University Press, 1998.
2. Julie. A. Benantine, "Fundamentals of Metal Fatigue Analysis", Prentice Hall, 1990.
3. "Fatigue and Fracture", ASM Hand Book, Vol 19, 2002.

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19MEE 102

ADVANCED VIBRATIONS AND ACOUSTICS (Programme Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to understand the

1. Knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2. Evaluate damping in vibrating structure.
3. Develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.
4. Knowledge on fundamentals of acoustics, measuring techniques.
5. Knowledge on vibration and noise measuring instruments.

Outcomes: At the end of the course, student will be able to

1. Predict response of a SDOF system, damped or undamped, subjected to simple harmonic excitations. They will be able to obtain Step Response Spectrum of SDOF systems for such excitations
2. Write differential equations of motion for MDOF systems, should be able to obtain the Eigen-values and mode shapes of natural vibrations and response to harmonic excitations, able to measure damping in the system using logarithmic decrement and half power method.
3. Obtain the frequency and mode shapes for string, rod and beam using continuous systems.
4. Understand basic concept of acoustics, source of models, and measuring of noise.
5. Understand vibration and noise measuring instruments.

Unit 1

Review of Mechanical Vibrations: Free and harmonically forced vibration of single degree of freedom systems with and without damping.
Transient Vibration of Single Degree-of Freedom Systems: Impulse excitation, Arbitrary excitation; step excitation, Laplace transforms formulation.Convolution (Duhamel's) integral, impulse response function.

Unit 2

Multi Degree of Freedom Systems: Free and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their

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properties, mode summation method, use of Lagrange's equations to derive the equations of motion.

Measurement of Damping Capacity and their Interpretation of Damping Coefficient: damping factor, logarithmic decrement, and half power band width.

Unit 3

Continuous Systems: Vibrating string, longitudinal vibration of rods, beams–Differential equation of motion, solution by the method of separation of variables, forced vibration of simply supported beam subjected to concentrated harmonic force at a point, Mode summation method.

Unit 4

Fundamentals of Acoustics: The homogeneous acoustic wave equation-1-D,3-D,Fundamental acoustic source models: Monopoles, Dipoles, Monopoles near rigid, reflecting, ground plane, Sound radiation from a vibrating piston mounted in a rigid baffle, Noise measuring units: decibels, frequency analysis bandwidths, The measurement of sound power, sound pressure levels, sound intensity levels, frequency response function, Sound power models-constant power. Sound power evaluation methods,

Unit 5

Noise and Vibration Measuring Instruments: Transducers: piezoelectric, electrodynamic. Vibration pickups: Vibrometer, accelerometer, velometer. Frequency measuring instruments, Vibration exciters: Mechanical exciter, Electrodynamic shaker and impact hammer. Microphones: Condenser, dynamic. Sound intensity probe, Sound level meter.

Text Books:

1. W.T. Thomson, "Theory of Vibrations with applications", George Allen and Unwh Ltd. London, 1981.
2. S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.
3. Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition

Suggested Reading:

1. S. Timoshenko, "Vibration problems in Engineering", Wiley, 1974.
2. Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley Eastern Ltd., 1987.
3. Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II. Chemical Publishing Co., New York, 1977.
4. M.P. Norton and D.G. Karczub., "Fundamentals of Noise and vibration analysis for engineers", Cambridge university press.,2/e, 2003.

19MEE 103

OPTIMIZATION TECHNIQUES (Programme Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The students will

1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques and game theory

Outcomes: At the end of the course, student will be able to

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queing and inventory concepts in industrial applications
5. Apply sequencing models and game theory in industries

UNIT-I

Operations Research: Definition, scope, Models, Linear programming problems, Formulation, Graphical Method, Simplex Method, and Duality in simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT-III

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward

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path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT - IV

Queuing Theory: Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two Machines, processing 'n' jobs through three machines. Game Theory – definition saddle point Principle of Dominance.

Text Books:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008

Suggested Reading:

1. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
2. Pannerselvam, "Operations Research", Prentice Hall of India 2010
3. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

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19MEE 104

AUTOMATION (Programme Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to understand

1. Basic concepts of automation & its significance in manufacturing industries.
2. Automated flow lines.
3. Conceptualize & design following assembly line balancing.
4. About automated material handling systems
5. Effective design and appropriate tests & inspection systems

Outcomes: At the end of the course, student will be able to

1. Conceptualize and design automated flow lines.
2. Implement line balancing concepts in production and assembly lines
3. Understand and develop automated material handling system suitable for plant operations.
4. Design, implement and use and appropriate automated inspection facility.
5. Design and develop an automated production system for manufacturing a product using futuristic technologies

UNIT - I

Introduction: Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.

UNIT - II

Analysis of Automated Flow Lines: Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations. General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.

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UNIT - III

Assembly Systems and Line Balancing: The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines. *Automated Assembly Systems:* Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine.

UNIT - IV

Automated Materials Handling: The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/ Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing.

UNIT - V

Automated Inspection and Testing: Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. Modeling Automated Manufacturing Systems: Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models. The Future Automated Factory: Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact.

Text Books:

1. Mikell P.Grover, Automation, "Production Systems and Computer Integrated Manufacturing", Pearson Education Asia, 2012.
2. Nanua Singh, "Systems Approach to Computer-Integrated Design and Manufacturing", Wiley India Pvt Ltd, New York, 1995.

Suggested Reading:

1. C.Ray Asfahl, "Robots and Manufacturing Automation", John Wiley and Sons New York, 1995.
2. Stephen J. Derby, "Design of Automatic Machinery", Special Indian Edition, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai, 1998
3. N.Viswanadham and Y.Narahari, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Pvt. Ltd, 1980.

19MEE 105

DESIGN FOR MANUFACTURING AND ASSEMBLY
(Programme Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to
1. Understand the need for design of a product
2. Understand the selection of material on the basis of manufacturing process
3. To familiarize various fabrication procedures
4. To reduce the manufacturing / process time
5. Make design according to ergonomics

Outcomes: At the end of the course, student will be able to
1. Understand the product development cycle
2. Know the manufacturing issues that must be considered in the mechanical engineering design process
3. Know the effect of manufacturing process and assembly operations on the product
4. Know the principles of assembly to minimize the assembly time
5. Be familiar with tools and methods to facilitate development of manufacturing mechanical designs

UNIT - I
Introduction: Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

UNIT - II
Properties of Engineering Materials: Selection of Materials – I, Selection of Materials – II, Case Studies – I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies – II

UNIT - III
Selection of Manufacturing Processes: Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy,

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Design for Polymer Processing, Co- selection of Materials and Processes, Case-Studies – III

UNIT - IV

Design for Assembly: Review of Assembly Processes, Design for Welding – I, Design for Welding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies - IV

UNIT - V

Design for Reliability: Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization

Text Books:

1. M F Ashby and K Johnson, "Materials and Design - The art and science of material selection in product design", Butterworth-Heinemann, 03.
2. G Dieter, Engineering "Design - a materials and processing approach", McGraw Hill, NY,
3. M F Ashby, "Material Selection in Mechanical Design", Butterworth-Heinemann, 1999.
4. K.G.Swift and J.D.Booker, "Process Selection from Design to Manufacture", Wiley Publishers, New York, 1997.

Suggested Reading:

1. T H Courtney, "Mechanical Behavior of Materials", McGraw Hill, NY, 00.
2. G Boothroyd, P Dewhurst and W Knight, "Product design for manufacture and assembly", John Wiley, NY: Marcel Dekkar, 1994.
3. J G Bralla, "Handbook for Product Design for Manufacture", McGraw Hill, NY, 1998.

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19MEE 106

INDUSTRIAL ROBOTICS (Programme Elective II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand the

1. Principle of working of a robot , types and specifications
2. Transformations, various types of representations, kinematics of robots
3. Singularities, jacobian and trajectory planning of a robot to prepare the robot for various tasks
4. Design, working of sensors and controllers for finding position and orientation of various industrial robots
5. Robot vision for image acquisition and processing and plan for various tasks and programming

Outcomes: At the end of the course, student will be able to understand the

1. Principle of working of a robot , types and prepare specifications for various requirements.
2. Transformations, kinematics of robots to find out the position and orientation.
3. Singularities, avoiding singularities while designing, find jacobian and trajectory planning of a robot to prepare the robot for various tasks
4. dynamic analysis using various formulations and design the robots
5. Working of sensors and controllers for finding position and orientation, analyze robot vision for image acquisition and processing and plan for various tasks and programming.

UNIT - I

Overview of Robot Subsystems: Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping, Pneumatic, hydraulic and electrical actuators, applications of robots, specifications and requirements of different industrial robots.

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UNIT – II

Direct Kinematics: Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics

UNIT - III

Inverse Kinematics: Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks, sensor based motion planning: The Bug Algorithm, The Tangent Bug Algorithm, The Incremental Voronoi Graph

UNIT - IV

Analysis of RP and RR Type Robots: Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangean and Newton-Euler formulations of RR and RP type planar robots, , Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, force feedback, hybrid control

UNIT - V

Sensors and Controllers: Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder.

Robot Vision: Image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features

Text Books:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.

Suggested Reading:

1. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, "Robotics, control, sensing, Vision and Intelligence", McGraw Hill International, 1987
2. Steve LaValle, "Planning Algorithms", Cambridge Univ. Press, New York, 2006.
3. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, 2005.

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19MEC 104

INTEGRATED DESIGN AND MANUFACTURING LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To make the students to
1. Generate the part and assembly models using cad software
2. Create automated drawing and apply proper annotations on them.
3. Write different part programs for different components to be machined on lathe and milling machine
4. Understand the reverse engineering concept
5. Understand the stl file generation and manipulations

Outcomes: At the end of the course, student will be able to
1. Generate complex components in the part module and assemble them by using suitable constraints.
2. Generate engineering drawing and apply size, form and positional tolerances on the drawing
3. Write part programs using G and M codes for lathe and milling operations for various components.
4. Differentiate additive and subtractive methods of manufacturing and their integration to build the component
5. Gain confidence to operate the 3d printing machine.

List of Experiments:
1. Part modeling of simple and complex components by using various features of the software
2. Assembly modeling of components using different constraints
3. Creation of Engineering drawing details and adding various annotations and generation of automated BOM.
4. Specifying tolerances for part and assembly Drawings
5. Writing of CNC programming for creation of Contours and Pockets
6. Surface Roughing of Crane Hook
7. Manufacturing of Bottle Die
8. Taper Turning and Multiple Turning on CNC Lathe Machine.
9. Introduction to RP machine, Machine Specifications, Materials, Stl file generation
10. Slicing of stl files and obtaining the tool path data and sending it to RP machines

11. Demonstration of rapid tooling using fused deposition modeling.
12. Conversion of physical model to digital data format to demonstrate Reverse Engineering

Note: Out of the above 12 experiments, any 10 experiments have to be carried out.

Suggested Reading :

1. Solidworks Essentials, "Solidworks" *By* Dassault Systems

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19MEC 105

VIBRATION AND ACOUSTICS LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To make the students to

1. Determine mass moment of inertia from vibrating systems.
2. Evaluate damping in vibrating structure.
3. Evaluate natural frequencies and mode shapes for continuous system.
4. Gain the knowledge on using impact hammer.
5. Gain knowledge on fundamentals of acoustics, measuring techniques.

Outcomes: At the end of the course, student will be able to

1. Predict response of a SDOF system, damped or undamped, subjected to simple harmonic excitations. They will be able to obtain Step Response Spectrum of SDOF systems for such excitations
2. Measure damping in the system using logarithmic decrement and half power method.
3. Obtain the frequency and mode shapes for beam using continuous systems.
4. Understand basic concept of acoustics, source of models, and measuring of noise.
5. Understand vibration and noise measuring instruments.

List of Experiments:

1. To find damping coefficient and undamped natural frequencies of an under-damped single degree of freedom system from its response to an initial displacement.
2. SDOF system to harmonic excitation applied to the mass for different values of damping factor.
3. To find fundamental natural frequency of a cantilever beam by free vibration and find the damping by logarithmic decrement, plot number of cycles Vs damping.
4. To find FRF and damping for cantilever beam, giving impact test.
5. The response of a cantilever beam by sinusoidal excitation. Plotting FRF curve and phase plot.
6. Determining the oscillation frequency of a string as a function of the string length and tension
7. Determining the wavelength of standing sound waves

8. Demonstration on stroboscope for natural frequencies of beam.
9. Sloshing due to vibration of partially filled liquid cylinder.
10. Measure the sound pressure (in Pa) and sound pressure level (in dB) as a function of distance from a simple source consisting of a small boxed loudspeaker producing white noise.
11. Directivity patterns.

Text Books:

1. Yvan, "Mechanical Vibrations, Applications to Equipment", Willey Publications, 2017.
2. H. Ginsberg. Jerry, "Acoustics, A Text Book for Engineers and Physicists", Springer International Publishers, 2014.

Suggested Reading:

1. G.K.Grover, "Mechanical Vibrations", Nem Chad and Brothers, 1996.
2. Finch, "Introduction to Acoustics", Pearson Education India; 1/e., 2016

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19ECA 101

VALUE EDUCATION

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: This course aims to:

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Outcomes: After completion of the Course, students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive

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Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books : Self-management and Good health; internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

Text Books:

1. Chakroborty, S.K. "Values & Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998.

Suggested Reading:

1. Jaya Dayal Goyandaka, "Srimad Bhagavad Gita with Sanskrit Text, Word Meaning and Prose Meaning", Gita Press, Gorakhpur, 2017.

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19TA 101

PEDAGOGY STUDIES

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	————
Credits	0

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

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UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

Suggested Reading:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

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19CEA 101

DISASTER MITIGATION AND MANAGEMENT

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	——— -
Credits	0

Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Outcomes: At the end of the course the students are able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various

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participatory approaches/strategies and their application in disaster management

UNIT-I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT-IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh,"Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, "Government of India, "National disaster management plan, Part I and II"
2. K. K. Ghosh,"Disaster Management", APH Publishing Corporation, 2006.
3. "Hazards, Disasters and your community: A booklet for students and the community", Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

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19EEA 101

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	————
Credits	0

Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

Outcomes: At the end of the course the students are able to

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).
The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-

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crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

Text Books:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. *M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015*

Suggested Reading:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN- 10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007.
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1, 2005.

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19MEC 106

FINITE ELEMENT TECHNIQUES

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to

1. Understand finite element analysis fundamentals and formulations
2. Formulate the axial, truss, beam and 2D problems
3. Formulate the heat conduction and dynamics problems, understand the use of numerical integration and Gauss quadrature
4. Understand the convergence requirements and 3D problems
5. Perform engineering simulations using finite element analysis software (ANSYS)

Outcomes: At the end of the course, Student will be able to

1. Apply FE method for solving field problems using virtual work and potential energy formulations
2. Analyze linear problems like axial, truss and beam, torsional analysis of circular shaft
3. Analyze 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve the problems.
4. Evaluate the eigen values and eigen vectors for stepped bar, formulate 3 D elements, check for convergence requirements
5. Solve linear 1 D and 2 D heat conduction and convection heat transfer problems, Use of FEA software ANSYS for engineering solutions

UNIT - I

Introduction to Finite Element Method of Solving Field Problems: Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. **Potential Energy Approach:** Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

UNIT - II

Analysis of Trusses: Analysis of plane truss with number of unknowns not exceeding two at each node.

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Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element
Analysis of Frames: Analysis of frames with two translations and a rotational degree of freedom at each node.

UNIT - III
Two Dimensional Stress Analysis: Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.
Convergence requirements and geometric isotropy

UNIT - IV
Steady State Heat Transfer Analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.
Time Dependent Field Problems: Application to one dimensional heat flow in a rod.
Dynamic Analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.
Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT - V
Three Dimensional Problems in Stress Analysis: 3D elements: Introduction to tetrahedron and brick elements.
Introduction to thin and thick plates
Introduction to non-linear formulation through FE.

Text Books:

1. R. Tirupathi, Chandrupatla and A.D Ashok,"Introduction of Finite Element in Engineering", Prentice Hall of India, 2004
2. S.S. Rao,"The Finite Element Methods in Engineering", 2/e Pergamon Press, 2001.
3. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003

Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley and sons,2009
2. K.J Bathe, "Finite element procedures", 2/e,Prentice Hall of India,2007
3. D.L. Logan, "First course in finite element method", (5/e). Mason, OH: South Western, Cengage Learning, 2011.

19MEC 107

MECHANICAL DESIGN AND ANALYSIS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to

1. Develop the necessary skills to understand and analyze problems in pressure vessels
2. Achieve fundamental understanding of the theory of bending of flat plates with various loading and boundary conditions
3. Understand design principles of a component and structures using fracture mechanics approaches
4. Enable the importance of vibrations in mechanical design to understand the basic concepts of matrix algebra and understand the different mode extraction methods in vibrations
5. Understand the fundamental concepts various algorithms used for dynamic analysis

Outcomes: At the end of the course, Student will be able to

1. Apply knowledge of mathematics, sciences and computations in solving the stresses & strains in pressure vessels
2. Demonstrate the ability to identify, formulate and solve problems for a given flat plate bending applications
3. Design a system or a component to meet the desired needs of fracture mechanics
4. Understand, solve various Eigen value and Eigen vectors and will understand different mode extraction methods to calculate frequencies
5. Understand methods in solving single degree freedom dynamic analysis problems

UNIT - I

Design of Pressure Vessels: Introduction and selection of materials for pressure vessels, stresses in thick walled cylindrical pressure vessels subjected to both internal and external pressures, shrink fit stresses in built up cylinders, auto frettage of thick cylinders, thermal stresses and their significance.

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UNIT - II

Stresses in Flat Plates: Introduction, Bending of plate in one direction, Bending of plate in two perpendicular directions, Thermal stresses in plates, Bending of circular plates of constant thickness, Bending of uniformly loaded plates of constant thickness

UNIT - III

Fracture Mechanics: Introduction, Modes of fracture failure Griffith Analysis, Energy release rate, Stress Intensity Factor: SIF's for edge and centre line crack, Fracture toughness, Elastic plastic analysis through J-integral method: Relevance and scope, Definition of J-integral, Path independence, Strain Energy Release Rate Vs J-integral

UNIT - IV

Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence method. Subspace iteration and Lanczo's method, Component mode synthesis

UNIT - V

Dynamic Analysis: Direct integration method, Central difference method, Wilson-q method, Newmark method, Mode superposition, Single degree of freedom system response, Rayleigh damping. (Note: The related algorithms and codes to be practiced by students)

Text Books:

1. John, V. Harvey, "Pressure Vessel Design: Nuclear and Chemical Applications", Affiliated East West Press Pvt. Ltd., 1969.
2. Prasanth Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, New Delhi-1999.
3. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2003.

Suggested Reading:

1. G.Ramamurti, "Computer Aided Mechanical Design and Analysis", Tata Mc Graw Hill-1992.
2. J. Bathe, "Finite Element Procedures", Prentice Hall of India-1996.

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19MEE 206

COMPUTATIONAL FLUID DYNAMICS (Programme Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Basic equations and concept of CFD
2. Concept of pdes and finite difference methods
3. Various types of grid generation and errors in numerical solution
4. Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods
5. Importance of FVM

Outcomes: At the end of the course, student will be able to

1. Derive CFD governing equations and turbulence models
2. Apply elliptical, parabolic and hyperbolic pdes and forward, backward and center difference methods
3. Understand errors, stability, consistency and develop O,H and C grid generated models
4. Evaluate the use of Crank-Nihcolson, Implicit and Explicit methods and analyze problem by Jacobi, Gauss Seidel and ADI methods
5. Solve conduction and convection problems using FVM.

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT - III

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference

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UNIT - IV

Finite Difference Solutions: Finite difference solutions - Crank Nicholson, Implicit and Explicit, ADI - Jacobi, Gauss Seidel, solution for Viscous incompressible flow using Stream function – Vorticity method

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm

Text Books:

1. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill, Inc., 2015.
2. H.K.Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015

Suggested Reading:

1. K. Muralidhar and T. Sundararajan, "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.
2. S.V. Patankar, "Numerical Heat transfer and Fluid flow", Hemisphere Publishing Company, New York,1980.

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19MEE 107

MECHANICS OF COMPOSITE MATERIALS

(Programme Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Basics of composite materials, types of fibers and reinforcements.
2. Evaluation of material properties using micro-mechanics approach and semi-empirical relations..
3. Analysis of laminates using classical laminate plate theory.
4. Failure analysis of an orthotropic lamina.
5. Analysis of composite beams and plates for simple cases.

Outcomes: At the end of the course, student will be able to

1. Understand different types of composites and their fabrication methods.
2. Characterize a UD lamina using micromechanics.
3. Analyze a given laminate for strains and stress.
4. Decide the failure of a UD lamina.
5. Design simple composite beams and plates.

UNIT - I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT - II

Micromechanics of lamina and mechanical properties: Prediction of elastic constants, thermal properties, moisture properties using mechanics of materials approach. Halpin-Tsai equations for elastic constants. Mechanics of load transfer from matrix to fiber.

UNIT - III

Macro-mechanical Analysis: Introduction, Hooke's law for different types of materials, Hooke's law for 2D UD lamina, relationship between compliance and stiffness matrix to engineering elastic constants of a lamina, engineering constants of an angle lamina. Laminate code, stress-strain relationships for a laminate using CLT, force and moment resultants related to mid-plane strains and curvatures.

UNIT - IV

Strength and fracture: Tensile and compressive strength's of unidirectional fiber composites, fracture modes in composites: single and multiple fractures, de-bonding, fiber pullout and de-lamination. Interlaminar stresses and edge effects.

Strength of an orthotropic lamina: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;

UNIT - V

Composite Beams: comparison of CLT to Isotropic beam theory, effective axial and flexural rigidities of rectangular composite beams.

Governing equations of thin –plate theory: equations of equilibrium for symmetric laminates and specially orthotropic laminate. Levy –Navier solution applied to specially orthotropic laminates.

Text Books:

1. R.M. Jones, "Mechanics of Composite Materials", Mc Graw Hill Co., 1967
2. B.D. Agarwal et.al, "Analysis and performance of fiber composites", 3/e, Wiley sons., 2013
3. P.K. Mallick, "Fiber Reinforced Composites Materials",
4. Taylor & Francis, "Manufacturing, and Design", 3/e, 2007

Suggested Reading:

1. Ever J Barbero, "Introduction to composite materials design", Taylor &Francis, 1999.
2. M.W. Hyer, "Stress Analysis of Fibre Reinforced Composite Materials", McGraw Hill Co., 1998.
3. Carl. T. Herakovich, "Mechanics of Fibrous Composites", John Wiley Sons Inc, New York, 1998.

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19MEE 108

FRACTURE MECHANICS (Programme Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Classification of fracture
2. Importance of crack tip
3. Experimental setup while performing standard test
4. About R curve
5. Fatigue crack propagation.

Outcomes: At the end of the course, student will be able to

1. Analyze the fracture mechanism
2. Gain familiarity with the different modes of failure under the presence of crack
3. Establish specimen size in accordance with the standard procedures
4. Distinguish between Plane stress fracture toughness and Plane strain fracture toughness
5. Accomplish the relationship between crack propagation and stress intensity factor

UNIT - I

Introduction: Crack in a structure – Griffith criterion

Mechanism of Fracture and Crack Growth: cleavage fracture – ductile fracture – fatigue cracking – service failure analysis

UNIT - II

Elastic Crack Tip Stress Field: Solution to crack problems – effect of finite size – stress intensity factor – special cases

Crack Tip Plastic Zone: Irwin plastic zone correction – actual shape of plastic zone

UNIT - III

Energy Principle: Energy release rate – criterion for crack growth – J integral

Plane Strain Fracture Toughness: Standard test – size requirement – nonlinearity

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UNIT - IV

Plane Stress and Transitional Behavior: concept of plane stress – R curve concept – thickness effect – plane stress testing

Elastic Plastic Fracture: crack tip opening displacement.

UNIT - V

Fatigue Crack Propagation: Crack growth and stress intensity factor – factors affecting crack propagation – variable amplitude service loading and its numerical – retardation model

Text Books:

1. David Broek , "Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers , The Hague – 1984.
2. Prashant Kumar., "Elements of fracture mechanics", Mc Graw Hill Education (India) Private Limited, New Delhi - 2014.

Suggested Reading:

1. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", 3/e, Taylor and Francis Group, 2005.
2. R.N.L.Smith, "Basic Fracture Mechanics", Butterworth Heinemann Publications, 1991.
3. K. Ramesh," e-Book on Engineering Fracture Mechanics", IIT Madras, 2007. URL: http://apm.iitm.ac.in/smlab/kramesh/book_4.htm
4. K. R.Y. Simha, "Fracture Mechanics for Modern Engineering Design", Universities Press (India) Limited, 2001

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19MEE 109

MULTI BODY DYNAMICS (Programme Elective – IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Equations of motions in 3D for a multibody systems
2. Implementation and demonstration methods for formulation of motion equations in interconnected bodies
3. Constrained differential equations
4. Static and dynamic analysis in a multibody systems
5. Modeling and simulation of multibody dynamic systems

Outcomes: At the end of the course, student will be able to

1. Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motions.
2. Implement and analyze methods of formulating equations of motion for interconnected bodies.
3. Write programs to solve constrained differential equations for analyzing multi-body systems.
4. Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis.
5. Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems

UNIT - I

Introduction: The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints.

UNIT - II

Basic Principles for Analysis of Multi-body Systems: The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations

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UNIT-III

Dynamics Of Planar Systems: Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints.

UNIT-IV

Kinematics of Rigid Bodies in Space: Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters.

UNIT-V

Kinematic Analysis of Spatial Systems: Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems.

Text Books:

1. J. Wittenburg, J., "Dynamics of Systems of Rigid Bodies", B.G. Teubner, Stuttgart, 1977.
2. T.R. Kane and D.A. Levinson, "Dynamics: Theory and Applications", McGraw-Hill Book Co., 1985.
3. P.E. Nikravesh, "Computer Aided Analysis of Mechanical Systems", Prentice-Hall Inc., Englewood Cliffs, J,1988.
4. R.E. Roberson, and R. Schwertassek,"Dynamics of Multibody Systems", Springer-Verlag,Berlin, 1988.

Suggested Reading:

1. R.K.Turton, "Principles of Turbomachinery", E & F N Spon Publishers, London & New York.
2. Dennis G. Shepherd, "Principles of Turbomachines", Macmillan, 2007

19MEE 110

TRIBOLOGY IN DESIGN (Programme Elective - IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Material properties which influence the tribological characteristics of surfaces
2. Concepts of wear
3. Lubrication aspects of machine components.
4. Analytical behavior of different types bearings
5. Design of bearings based on analytical /theoretical approach.

Outcomes: At the end of the course, student will be able to

1. Understand surface topography and model a rough engineering surface.
2. Understand friction and wear aspects of machine.
3. Decide upon lubricants and lubrication regimes for different operating conditions.
4. Understand Hertz contact and rough surface contact.
5. Select material/surface properties based on the tribological requirements

UNIT - I

Topography of Surfaces: Surface features -Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions - Thermal considerations in sliding contact

UNIT - II

Wear: Types of wear – Mechanism of various types of wear – Laws of wear – Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements –Laser methods – instrumentation - International standards in friction and wear measurements.

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UNIT - III

Lubricants and Properties: Lubricants and their physical properties- Viscosity and other properties of oils – Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication-Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT - IV

Reynolds and Sommerfield boundary conditions: Reynolds Equation - Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfield boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings- Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing-Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT - V

Rolling Contact Bearings: Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings.

Text Books:

1. E. Rabinowicz, "Friction and Wear of materials", John Willey &Sons, UK,1995
2. A. Cameron,"Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981
3. J. Halling, "Principles of Tribology" , Mac Millan - 1984.

Suggested Reading:

1. Kenneth C Ludema and Layo Ajay, "Friction, wear , lubrication", A text book in Tribology, 2e, CRC Press, Taylor and Francis Group, 2019
2. Ross Beckett, "Engineering Tribology", Larsen and Keller Education, 2017.
3. Stachon Iak, Andrew W Batchelor, "Engineering Tribology", 4e, Butterworth – Heinemann, 2015.

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19MEE 111

FAILURE ANALYSIS AND DESIGN (Programme Elective – IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn

1. Design methodology and various aspects involved in design process
2. Creative and inventive problem solving techniques
3. Different types of design processes, concepts of reliable and robust design
4. Concept of buckling of cylinders under various loading conditions
5. Fundamentals of fracture, fracture types and concepts of fatigue crack growth, fatigue life prediction and various stress theories of failure, crack propagation concepts under combined loading, fracture toughness of weld metals.

Outcomes: At the end of the course, student will be able to

1. Apply the concepts of design processes
2. Provide solutions by inventive problem solving techniques
3. Develop reliable and robust design
4. Analyze the behavior of buckling of cylinders under various loading conditions
5. Predict the fracture behavior under static and fatigue loads , apply the crack propagation concepts , fracture toughness of weld metals

UNIT - I

Importance of design: The design process-Considerations of Good Design – Morphology of Design –Organization for design- Computer Aided Engineering – Concurrent Engineering – Product and process cycles –Market Identification – Competition Bench marking. Identification of customer needs- customer requirements- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics.

UNIT - II

Creativity and Problem Solving: Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts-

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Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Design for Reliability –Introduction to Robust Design-Failure mode Effect Analysis.

UNIT-III

Buckling Phenomenon: Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT-IV

Theories of Failure: Failure analysis and determination of stress patterns from plastic flow observations – Dynamic loading– Fracture types in tension—Fatigue crack growth– Fatigue life prediction- Cumulative fatigue damage-Stress theory of failure vessels-Thermal stress fatigue

UNIT-V

Fracture Mechanics: Introduction –Through cracks emanating from holes – Corner cracks at holes – Cracks approaching holes-Combined loading-Fatigue crack growth binder- Mixed mode loading-Fracture toughness of weld metals-Service failure analysis

Text Books:

1. Dieter and E. George, "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.
2. David Broek, "Elementary Engineering Fracture Mechanics", Fifthoff and Noerdhoff International Publisher, 1978.
3. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.

Suggested Reading:

1. G. Pahl and W. Beitz,,"Engineering Design", Springer – Verlag, NY. 1984.
2. Prashant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
3. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.

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19MEC 108

COMPUTER AIDED ENGINEERING LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To make the students
1. Model one and two-dimensional elements in ANSYS
2. Understand vibration, harmonic and transient analysis
3. Carry out buckling analysis
4. Analyze forming and sheet metal operations by FEA
5. Model crack element

Outcomes: At the end of the course, student will be able to
1. Understand the applications of one and two-dimensional elements
2. Solve engineering problems
3. Find buckling factors
4. Understand industrial applications of forming and sheet metal operations
5. Find fracture toughness

List of Exercises:
1. Introduction to Finite Element Analysis Software
2. Statically indeterminate reaction force analysis and determination of Beam stresses and Deflection
3. Static analysis of a corner bracket
4. Analysis of cylindrical shell under pressure
5. Bending of a circular plate using axisymmetric shell element.
6. Vibration analysis of a simply supported beam
7. Harmonic analysis of plates and shells
8. Transient analysis of vehicle crash
9. Buckling analysis of shells
10. Analysis of forming
11. Analysis of sheet metal operation
12. Stress intensity factor in cracked plates

Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

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Text Books:

1. R. Tirupathi, Chandrupatla and B.D. Ashok, "Introduction of Finite Element in Engineering", Prentice Hall of India, 2004
2. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003

Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley and sons,2009
2. S.S. Rao, ,"The Finite Element Methods in Engineering", 2 /e, Pergamon Press, 2001.

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19MEC 206

COMPUTATIONAL FLUID DYNAMICS LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To acquaint the student with

1. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
2. Simulation of laminar, turbulent, internal flow, steady and unsteady problems
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of thermal related problems

Outcomes: At the end of the course, student will be able to

1. Analyze laminar flow problems in plates and pipes
2. Solve steady and unsteady flow past a cylinder
3. Perform analysis for free and forced convection
4. Evaluate the effect of angle of attack and velocity on NACA aerofiol
5. Simulate compressible flow in a nozzle, premixed combustion

List of Experiments:

1. Laminar Flow over Flat plate
2. Laminar Pipe Flow
3. Steady Flow past a Cylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Aerofoil.
9. Study of compressible flow through a nozzle
10. Partially premixed combustion analysis
11. Supersonic flow over a wedge
12. Study of flow over wind turbine blade/flow through bifurcation artery

Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

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Text Books:

1. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill, Inc., 2015.
2. H.K.Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015.

Suggested Reading:

1. J.H. Ferziger and M. Peric, "Computational Methods for Fluid Dynamics", Springer.
2. K. Muralidhar and T. Sundararajan T, "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.

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19MEC 109

MINI PROJECT WITH SEMINAR

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Outcomes: Students are able to

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

- As part of the curriculum in the II- semester of the programme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter disciplinary/ industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
- All the investigations are clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

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Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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19EGA 101

ENGLISH FOR RESEARCH PAPER WRITING

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	————
Credits	0

Objectives: The Course will introduce the students to

1. Understand the nuances of language and vocabulary in writing a Research Paper.
2. Develop the content, structure and format of writing a research paper.
3. Produce original research papers without plagiarism.

Outcomes: After successful completion of the course, the students will be able to

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT - I

Academic Writing : Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT - II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT - III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT - IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

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UNIT - V

Research Paper Publication: Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Books:

1. C. R Kothari, Gaurav, Garg, "Research Methodology Methods and Techniques", 4/e, New Age International Publishers.

Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. "MLA Hand book for writers of Research Papers", 7/e, East West Press Pvt. Ltd, New Delhi
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers", Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

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19EGA 102

INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: The Course will introduce the students to

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement. to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Outcomes: After successful completion of the course, the students will be able to

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT - I

History of making of the Indian constitutions: History, Drafting Committee (Composition & Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT - II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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UNIT - III

Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions

Union Executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT - IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role. Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT - V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1/e, 2015.
2. M. P. Jain, "Indian Constitution Law", 7/e, Lexis Nexis, 2014

Suggested Reading:

1. "The Constitution of India", 1950 (Bare Act), Government Publication
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

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19EGA 103

STRESS MANAGEMENT BY YOGA

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	
Credits	0

Objectives: The Course will introduce the students to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

Outcomes: After successful completion of the course, the students will be able to

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

UNIT-I

Meaning and Definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT-II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT-III

Concept of Stress According to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

UNIT-IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

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UNIT - V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. "Yogic Asanas for Group Training - Part-I": Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

Suggested Reading:

1. Nagendra H.R nad Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

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19EGA 104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	————
Credits	0

Objectives: The Course will introduce the students to

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awaken wisdom among them.

Outcomes: After successful completion of the course, the students will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT - I

Neetisatakam – Holistic Development of Personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT - II

Neetisatakam – Holistic Development of Personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV

Statements of Basic Knowledge - Shrimad Bhagavadgeetha: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT - V

Role of Bhagavadgeetha in the Present Scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. "Srimad Bhagavad Gita" , Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Suggested Reading:

1. "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Online Resources:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (CAD/CAM) – Mechanical Engineering - 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective	3	--	3	30	70	100	3
5.	Elective	3	--	3	30	70	100	3
6.	Elective	3	--	3	30	70	100	3
7.	Laboratory	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	18	09		340	360	700	25

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1		30	70	100	4
2.	Core	3	1		30	70	100	4
3.	Core	3	1		30	70	100	4
4.	Elective	3	--		30	70	100	3
5.	Elective	3	--		30	70	100	3
6.	Elective	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	18	11		390	360	750	26

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i)Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	100	--	100	6
	Total	100		100	6

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	100	100	200	12

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project
and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only. 50 marks awarded by the project guide
and 50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

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19MEC 201

THERMO DYNAMICS AND COMBUSTION

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to

1. Review the basic laws of thermodynamics and create awareness of the importance of thermodynamic principles in engineering applications
2. Understand the behavior of real gases vis-à-vis ideal gas
3. Create awareness about the importance of combustion reactions in real time applications
4. Understand the basic principles of power cycles and its relation with combustion processes
5. Understand various methods of direct energy conversion

Outcomes: At the end of the course, student will be able to

1. Apply various laws of thermodynamics to suit the engineering applications.
2. Apply the knowledge of thermodynamics for the behavior of real gases.
3. Understand the phenomenon of combustion
4. Understand the application of power cycles to engineering practice.
5. Understand various non-conventional energy conversion methods like fuel cells etc

UNIT–I

Thermodynamic Laws: Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamic properties of working substance. Third law of thermodynamics, Nerst heat theorem, Introduction to - Statistical thermodynamics, statistical interpretations of first and second law and Entropy

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UNIT – II

Real Gas Behaviour: P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal's equation - Generalized compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – Clapeyron Equation – Throttling – Joule – Thompson coefficient, Non-reactive Mixture of perfect Gases – Governing Laws, Real Gas Mixture

UNIT – III

Combustion: Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Heat of Reaction – Adiabatic flame Temperature, General product – Enthalpies – Equilibrium, Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions, The Van Hoff's Equation - The chemical potential and phase Equilibrium – The Gibbs phase Rule

UNIT – IV

Power Cycles: Power cycles, Review Binary vapour cycle, co-generation and combined cycles – Second law analysis of cycles – Refrigeration cycles. Thermo Dynamics of irreversible processes – Thermo electric circuits

UNIT – V

Direct Energy Conversion: Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation -Thermodynamic devices - Magneto Hydrodynamic Generations – Photo voltaic cells

Text Books:

1. Younus. A. Cengel & Michael. A. Boles, "Thermodynamics: An Engineering Approach", 7/e, TMH.
2. Y.V.C. Rao. "Postulates and Statistical Thermodynamics", Allied Publishers Inc., 1994.

Suggested Reading:

1. P.K. Nag, "Basic and Applied Thermodynamics", TMH, 2008.
2. J.P. Holman, "Thermo Dynamics", Mc Graw Hill, 2008
3. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.

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19MEC 202

ADVANCED FLUID DYNAMICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Understand different types of fluid flows and various functions related to fluids
2. Learn important equations related to fluids
3. Understand the concept of boundary layer
4. Understand the isentropic behavior of gas in nozzles
5. Learn about shocks of fluids

Outcomes: At the end of the course, student will be able to

1. Understand the concept of stream and velocity potential function
2. Apply of the knowledge of equations for analysis in cfd
3. Calculate thickness of boundary layer and shear stress
4. Design nozzles and diffusers
5. Estimate various parameters in fluids subjected to shocks

UNIT - I

Fluid Flows: Classification of fluids. Lagrangian and Eularian Methods of Study of fluid flow. Velocity and acceleration vectors. Circulation and Vorticity. Stream lines. Stream tube. Path lines. Streak lines and Time lines. Stream function and Potential function

UNIT - II

Laws of Fluid Flow: Continuity. Euler's and Bernoulli's equations. Incompressible and Compressible flows. Potential and viscous flows. Navier – Stoke's equation and applications

UNIT - III

Concept of Boundary Layer: Flow over an aerofoil – Lift and Drag coefficients. Boundary layer theory – laminar and turbulent boundary layers. Hydrodynamic and thermal boundary layer equations. Flow separation in boundary layers

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UNIT-IV

Gas Dynamics: Energy equation for flow and non flow processes. Application of Steady flow energy equation for turbines, turbo-compressors, nozzles and diffusers. Adiabatic energy equation. Acoustic velocity, Mach Number. Stagnation properties. Relationships between static and stagnation properties. Various regimes of flow – Steady flow ellipse

UNIT-V

Principles of Gas Dynamics Applicable to Shocks: Isentropic flow through variable area passages. Design of supersonic and subsonic nozzles and diffusers. Supersonic flows. Expansion and Shock waves. Normal and Oblique Shock waves. Prandtl-Meyer and Rankine-Hugoniot Relations. Simple problems on normal and oblique shock waves.

Text Books:

1. C. P. Kothandaraman, R. Rudramoorthy, "Basic Fluid Mechanics", New Age Intl. Publishers, 2014.
2. S. M. Yahya,"Fundamentals of Compressible flow", Wiley Eastern Ltd, 2014.
3. S. Radhakrishnan, 'Fundamentals of Compressible flow", TMH, 2014.

Suggested Reading:

1. Shapiro, "Compressible fluid flow", Ronold Press, New York, 1956.
2. Liepmen & Rosko, "Elements of Gas Dynamics", Wiley, New York, 1956.
3. Zoeb Hussain, "Gas Dynamics Though Problems", Wiley, New York, 1980.

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19MEC 103

RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives: To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Outcomes: At the end of the course, student will be able to

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report Writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing

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a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT - III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copy Right: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C. R. Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.
3. Y. P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004.

Suggested Reading:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India ltd, 2006
2. B. L.Wadehra, "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010.

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19MEE 201

THERMAL AND NUCLEAR POWER PLANTS (Programme Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Performance of steam power plant and to observe the importance of combustion of coal
2. Combined cycle effect in gas turbine power plants
3. Different nuclear reactors and estimate the economical benefits
4. Calculation of different energy tariffs under various load conditions
5. Pressure, temperature and flow parameters of a power plant

Outcomes: At the end of the course, student will be able to

1. Analyze on combustion of coal and find performance of different power plant cycles
2. Analyze the combined cycle power plants and waste heat recovery systems
3. Design various types of nuclear reactors taking safety precautions and making economically beneficial
4. Calculate the energy rates of power distribution considering the factors affecting the economy
5. Determine the pressure, temperature and flow measurements of steam and water to operate the power plant most efficiently and suggest various remedies to control pollutants

UNIT - I

Layout of Power Plants: Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, and Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, and Flue gas analysis. Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors

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UNIT - II

Combined Cycle Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages

UNIT - III

Nuclear Power Plant: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants. Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power

UNIT - IV

Economics of Power Plant: Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems

UNIT - V

Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control

Text Books:

1. E.I. Wakil, "Power Plant Technology", Mc Graw Hill, New York, 1985.
2. J. Weis Man and R Eckert, "Modern Power Plant Engineering", PHI, New Delhi, 1983.

Suggested Reading:

1. S.C. Arora and S. Domkundwar, "A course in Power Plant Engineering", Dhanpat Rai & Sons 2002.
2. P. K. Nag, "Power Plant Engineering", TMH, 2003.
3. P. C. Sharma, "Power Plant Engineering", Kataria Publications. 2007.

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19MEE 202

ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL

(Programme Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Harmful effects of pollutants and their control
2. Different techniques adopted in solid waste management
3. Causes and remedies for water pollution
4. Other types of pollution like oils, pesticides, noise etc
5. Controlling methods adopted to reduce pollution from their power plants

Outcomes: At the end of the course, student will be able to

1. Estimate air pollutants and suggest suitable remedial methods to control them
2. Suggest a suitable solid waste disposal system
3. Suggest suitable remedy to control water pollution
4. Suggest suitable remedy to control other pollutants like oils, pesticides, noise etc.
5. Suggest a suitable instrumentation for pollution control

UNIT-I

Air Pollution: Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues in Air Pollution control.

UNIT-II

Solid Waste Management: Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste

UNIT-III

Water Pollution: Sources and Classification of Water Pollutants - Characteristics - Waste Water Sampling Analysis - Waste Water Treatment - Monitoring compliance with Standards - Treatment, Utilization and Disposal of Sludge

1UNIT - IV

Other Types of Pollution: Noise Pollution and its impact - Oil Pollution - Pesticides - Radioactivity Pollution Prevention and Control

UNIT - V

Pollution from Thermal Power Plants and Control Methods: Instrumentation for pollution control - Water Pollution from Tanneries and other Industries and their control

Text Books:

1. G. Masters, "Introduction to Environmental Engineering and Science", Prentice –Hall, International Editions,1988..
2. S. Peavy, D. R. Rowe and G. Tchobanoglous, "Environmental Engineering", McGraw- Hill Book Company, NY, 1985.

Suggested Reading:

1. H. Ludwig and W. Evans, "Manual of Environmental Technology in Developing Countries", 1991.
2. "Environmental Considerations in Energy Development", Asian Development Bank (ADB), Manilla, 1991.

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19MEE 103

OPTIMIZATION TECHNIQUES (Programme Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The students will

1. Come to know the formulation of LPP models
2. Understand the Algorithms of Graphical and Simplex Methods
3. Understand the Transportation and Assignment techniques
4. Come to know the procedure of Project Management along with CPM and PERT techniques
5. Understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, student will be able to

1. Formulate a managerial decision problem into a mathematical model.
2. Apply Operations Research models to real time industry problems
3. Build and solve Transportation Models and Assignment Models.
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing and concepts in industry applications

UNIT - I

Basic Concepts: Operations Research definition, scope, Models, Linear programming problems, Formulation, Graphical Method, Simplex Method, and Duality in simplex.

UNIT - II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT - III

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times,

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Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT - IV

Queuing Theory: Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two Machines, processing 'n' jobs through three machines. Game Theory – definition saddle point Principle of Dominance.

Text Books:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008

Suggested Reading:

1. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
2. Pannerselvam, "Operations Research", Prentice Hall of India 2010
3. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

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19MEE 203

AIR CONDITIONING SYSTEM DESIGN (Programme Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. The difference between refrigeration and air conditioning
2. Working principles of simple vapour compression refrigeration cycle and absorption refrigeration
3. Necessity of psychrometry chart in air conditioning system design
4. Classification of air conditioning systems
5. How to calculate loads on air conditioning sysem

Outcomes: At the end of the course, student will be able to understand

1. Effect of refrigerants on environment and ozone depletion,
2. List out merits and demerits of absorption refrigeration system over simple vapour compression refrigeration system
3. List out factors effecting design of air conditioning system
4. Importance of air conditioning in engineering applications
5. Design components used in air conditioning circuits

UNIT-I

Refrigeration and Air Conditioning: Differentiation of refrigeration and air conditioning, COP, tone of refrigeration, classification of refrigerant, properties of refrigerants, eco-friendly refrigerants, green-house effect, ozone depletion, air refrigeration, Bell Coleman cycle, air craft refrigeration, classification of ari craft refrigeration

UNIT-II

Refrigeration Systems: Simple vapor compression refrigeration system, COP, pressure-enthalpy, temperature-entropy diagrams, theoretical and practical cycles, absorption refrigeration cycle, COP of absorption refrigeration cycle, simple and practical NH3 refrigeration cycle, Electrolux refrigeration cycle, lithium bromide refrigeration cycle

UNIT-III

Psychrometry : Introduction to psychrometry, psychrometric processes, comfort air conditioning, factors effecting comfort air conditioning, thermodynamics of human being, effective temperature, comfort chart, by-pass factor, indoor air quality, infiltration, problems on summer air conditioning and winter air conditioning

UNIT - IV

Air Conditioning Systems : Classification of air conditioning systems, window air conditioning system, split air conditioning system, year round air conditioning system, ERSH, GSHF, industrial air conditioning, transport air conditioning, food processing industries, photographic industries, food preserving industries, chillers

UNIT - V

Design of Air Conditioning System: Loads on air conditioning system, factors effecting design of air conditioning system, design of condensers, evaporators, fillers, humidifiers, de-humidifiers, fans, blowers and ducts, expansion devices, case studies of calculation of heat loads like auditorium, operation theatre, chilling centers, software used in design of air conditioning system.

Text Books:

1. C. P. Arora, "Refrigeration &Air Conditioning", Tata Mc Graw Hill, 1985.
2. Stoecker, "Refrigeration &Air Conditioning", Mc Graw Hill, 1992.
3. W. P. Jones, "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.

Suggested Reading:

1. Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill, 1974.
2. Manohar Prasad, "Refrigeration &Air Conditioning", New Age Publishers, 2014.
3. ASHRAE Hand book.

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19MEE 204

ENERGY CONSERVATION AND MANAGEMENT

(Programme Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Know the importance of energy sector in countries' development
2. Identify various auditing services
3. Prepare the organizational structure energy policy
4. Get the concept of management in process industries
5. Explain how to take tax considerations

Outcomes: At the end of the course, student will be able to

1. Know energy scenario both India and world
2. Review and asses the various audit tools
3. Understand energy policy planning and take energy management as a profession
4. Analyze energy security, codes, standards
5. Arrange the financial arrangements for industries

UNIT - I

Global & Indian Energy Scenario: Classification of Energy sources-Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns, Basics of Energy and its various forms.

UNIT - II

Energy Audit: Types of energy audit, Energy Auditing Services Basic Components of an Energy Audit Specialized Audit Tools Industrial Audits Commercial Audits Residential Audits Indoor Air Quality

UNIT - III

Energy Management: Program

Organizational Structure, Energy Policy Planning Audit Planning Educational Planning Strategic Planning, The Value of Energy Management The Energy Management Profession Some Suggested Principles of Energy Management, Energy Management Systems Justification of EMCSs Systems Integration

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UNIT - IV

Waste Heat Recovery: Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act. Economics of Waste-Heat Recovery, Energy management in water and waste water treatment – solid waste treatment- air pollution control systems . Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration -

UNIT - V

Capital Investments: Introduction General Characteristics of Capital Investments, Sources of Funds Tax Considerations Time Value of Money Concepts Project Measures of Worth Economic Analysis-Financing Energy Management Projects Introduction Financial Arrangements: A Simple Example Financial Arrangements: Details and Terminology Applying Financial Arrangements: A Case Study "Pros" & "Cons"

Text Books:

1. W. C. Turner, "Energy Management Handbook", 5/e, Marcel Dekker, Inc, New York, 2005.
2. W. R. Murphy and G. McKay, "Energy Management", Butterworth Heinemann, 2007.

Suggested Reading:

1. "General Aspects of Energy Management and Audit", National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management).
2. B. L. Capehart, W. C. Turner, W. J. Kennedy, "Guide to Energy Management", CRC Press, New York, 2005.

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19MEE 205

DESIGN OF SOLAR AND WIND SYSTEMS (Programme Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Need and importance of NCES and extent of Solar Energy as source.
2. Concepts of Solar collectors, applications and Storage.
3. Concepts of Solar Energy storage
4. Wind Energy Conversion Fuel cell and MHD principles
5. Biomass conversion principles and also about Geothermal energy

Outcomes: At the end of the course, student will be able to

1. Understand the implementation status of NCES in India along with basic concepts of Solar Energy
2. Analyze the performance of Solar Collectors
3. Understand PV Cell technology and storage methods
4. Conceptually design the wind turbine and understand fuel cells functioning.
5. Understand various Waste to Energy conversion technologies.

UNIT-I

Basics And Solar Energy: Definition-Concepts of Non Conventional Energy Sources (NCES), potential and limitations of NCES, their Classification and comparison, Solar Radiation, Basic definitions, Sun to Earth angles, Sun rise, Sunset and Day length

UNIT-II

Solar Energy Collectors: Flat plate and concentrating collectors along with their applications. Performance of flat plate and concentrating collectors. P-V Cell.

UNIT-III

Solar Energy Storage and Applications: Solar Satellite, Different Methods of storage, Sensible, Latent and Stratified, Solar engine Stirling and Brayton engines Solar Ponds, solar chimney, solar satellite, Stand alone grid connection

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UNIT - IV

Wind Energy: Wind energy conversion, General formula -Lift and Drag- Basics of wind energy conversion -Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors- Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle, Fuel Cells and MHD Working principles

UNIT - V

Bio-mass and Geothermal Energy: Availability of Biomass and various conversion process; Direct Combustion, Thermo chemical and Bio chemical conversion process, Factors effecting generation of Biogas and various types of biogas plants. Introduction to Geothermal Energy

Text Books:

1. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley.
2. Hasan Sayed, and D K Sharma, "Non Conventional Energy Sources", Katson Publishing.
3. G. D. Rai, "Non Conventional Energy Sources".

Suggested Reading:

1. S.P. Sukhatme, "Solar Energy", Tata Mcgraw Hill Publishing, 2014..
2. N.K. Bansal, "Non Conventional Energy Sources", Vikas Publishers, 2012.

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19CEA 101

DISASTER MITIGATION AND MANAGEMENT

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	—
Credits	0

Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Outcomes: At the end of the course the students are able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various

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participatory approaches/strategies and their application in disaster management

UNIT-I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT-IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects-gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh,"Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, "Government of India, "National disaster management plan, Part I and II"
2. K. K. Ghosh,"Disaster Management", APH Publishing Corporation, 2006.
3. "Hazards, Disasters and your community: A booklet for students and the community", Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

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19EEA 101

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

Outcomes: At the end of the course the students are able to

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).
The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar

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system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

Text Books:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. *M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015*

Suggested Reading:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN- 10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007
3. Shri Rama Verma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1, 2005

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19ECA 101

VALUE EDUCATION

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: This course aims to:

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Outcomes: After completion of the Course, students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive

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Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books : Self-management and Good health; internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

Text Books:

1. Chakroborty, S.K. "Values & Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998.

Suggested Reading:

1. Jaya Dayal Goyandaka, "Srimad Bhagavad Gita with Sanskrit Text, Word Meaning and Prose Meaning", Gita Press, Gorakhpur, 2017.

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19ITA 101

PEDAGOGY STUDIES

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	-------
Credits	0

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

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UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

Suggested Reading:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

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19MEC 203

THERMAL SYSTEMS LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: Student will understand to

1. Evaluate the performance of I.C Engine
2. Determine heat transfer coefficient in two phase heat transfer
3. Determine effectiveness of cross flow heat exchanger
4. Evaluate the thermal properties of fluids
5. Evaluate the COP of Refrigeration & Air conditioning Tutors

Outcomes: At the end of the course, student will be able to

1. Estimate the thermal efficiency of IC engine
2. Prove that value of convection heat transfer coefficient is very high with two phase heat transfer
3. Estimate the effectiveness of cross flow heat exchanger and prove that it is very high compared with other configurations
4. Find out properties of fluids such as coefficient of thermal expansion, enthalpy of fusion
5. Determine COP of Refrigeration and air conditioned tutors

List of Experiments:

1. Performance Evaluation on single/multi cylinder 4-stroke SI Engine.
2. Performance Evaluation on single/multi cylinder 4 stroke CI Engine.
3. Determination of heat transfer coefficient in Film wise and Drop wise condensation
4. To determine the effectiveness of Cross flow Heat Exchanger.
5. Heat Pipe Demonstration
6. Performance text on Axial flow compressor
7. Determination of coefficient of thermal expansion of Solids, Liquids and Gases
8. Determination of thermal capacity of Solids
9. Determination of isentropic coefficient of air by Clement-Desormes method
10. Measure of enthalpy of fusion and solidification
11. Determination of COP of Refrigeration tutor
12. Determination of COP of Air-conditioning tutor

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Note : Out of the above 12 experiments, any ten experiments have to be carried out.

Text Books:

1. Younus. A. Cengel & Michael A. Boles, "Thermodynamics An Engineering Approach", 7/e, TMH.
2. Y.V.C. Rao. "Postulates and Statistical Thermodynamics", Allied Publishers Inc., 1994.

Suggested Reading:

1. P.K. Nag, "Basic and Applied Thermodynamics", TMH, 2008.
2. J.P.Holman, "Thermo Dynamics", Mc Graw Hill, 2008.
3. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.

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19MEC 204

DESIGN OF SOLAR AND WIND SYSTEMS LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To make the students to understand

1. Concepts of solar energy collection and measurements
2. Wind and solar thermal applications
3. Direct conversion using solar PV cell
4. Wind turbine working and factors effecting its performance
5. Bio energy conversion principles

Outcomes: At the end of the course, student will be able to

1. Measure radiation using various instruments
2. Find the performance of solar water pump, water heater
3. Determine the effect of tilting angle on pv cell
4. Evaluate efficiency of wind turbine
5. Differentiate KVIC and JANATA bio energy conversion systems

List of Experiments:

1. Study of direct and diffused beam solar radiation (Solar Radiation Measurement)
2. Performance evaluation of solar flat plate collector (water heating, water pumping)
3. Performance evaluation of concentrating solar collector
4. Performance of PV panel in series and parallel combination: (Charging characteristics of a battery using PV panel, Effect of tilt angle on solar PV panel, Effect of shadow on solar PV panel , Effect of surrounding temperature on PV panel)
5. Study of direct and indirect solar dryer (how to dry various types of Agricultural products)
6. Analysis of KVIC Bio gas plant
7. Performance studies of Gasifier
8. Study of Janata Bio gas plant, Deenabandhu Biogas plant for demonstration
9. Small wind turbine of 500kw for the purpose of demonstration

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Text Books:

1. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley.
2. Hasan Sayed and D. K. Sharma, "Non Conventional Energy Sources", Katson Publishing.
3. G.D. Rai, "Non Conventional Energy Sources".

Suggested Reading:

1. P. Sukhatme "Solar Energy", Tata Mcgraw Hill Publishing, 2004
2. N.k. Bansal, "Non Conventional Energy Sources", Vikas Publishing, 2009.

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19MEC 106

FINITE ELEMENT TECHNIQUES

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	3	

Objectives: To make the students to

1. Understand finite element analysis fundamentals and formulations
2. Formulate the axial, truss, beam and 2D problems
3. Formulate the heat conduction and dynamics problems, understand the use of numerical integration and Gauss quadrature
4. Understand the convergence requirements and 3D problems
5. Perform engineering simulations using finite element analysis software (ANSYS)

Outcomes: At the end of the course, Student will be able to

1. Apply FE method for solving field problems using virtual work and potential energy formulations
2. Analyze linear problems like axial, truss and beam, torsional analysis of circular shaft
3. Analyze 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve the problems.
4. Evaluate the eigen values and eigen vectors for stepped bar, formulate 3 D elements, check for convergence requirements
5. Solve linear 1 D and 2 D heat conduction and convection heat transfer problems, Use of FEA software ANSYS for engineering solutions

UNIT-I

Introduction to Finite Element Method of Solving Field Problems: Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. **Potential Energy Approach:** Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

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UNIT - II

Analysis of Trusses: Analysis of plane truss with number of unknowns not exceeding two at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element

Analysis of Frames: Analysis of frames with two translations and a rotational degree of freedom at each node.

UNIT - III

Two Dimensional Stress Analysis: Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

UNIT - IV

Steady State Heat Transfer Analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.

Time Dependent Field Problems: Application to one dimensional heat flow in a rod.

Dynamic Analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.

Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT - V

Three Dimensional Problems in Stress Analysis: 3D elements: Introduction to tetrahedron and brick elements.

Introduction to thin and thick plates

Introduction to non-linear formulation through FE.

Text Books:

1. R. Tirupathi. Chandrupatla and D.B. Ashok, "Introduction of Finite Element in Engineering", Prentice Hall of India, 2004.
2. S.S. Rao. "The Finite Element Methods in Engineering", 2/e, Pergamon Press, 2001.
3. David. V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2003.

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Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley and sons, 2009.
2. K.J. Bathe, "Finite element procedures", 2/e, Prentice Hall of India, 2007.
3. D.L. Logan, "First course in finite element method", 5/e, Mason, OH: South Western, Cengage Learning, 2011.

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19MEC 205

ADVANCED HEAT AND MASS TRANSFER

Instruction	3	Hours per week
Duration of Semester End Examination	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	3	

Objectives: To make the students to

1. Understand the basic principles of fins and unsteady state heat transfer applied to industries.
2. Learn various equations and their application in engineering heat transfer
3. Understand boundary layer concept and their applications
4. Learn about principles of phase heat transfer and radiation heat transfer
5. Learn about mass transfer and its applications in process industries

Outcomes: At the end of the course, Student will be able to

1. Apply the equations pertaining to unsteady state heat transfer and knowledge in extended surfaces
2. Evaluate mass, momentum and energy equations with approximate and exact methods
3. Apply heat transfer knowledge in calculation of boundary layer thickness and various dimensionless numbers
4. Evaluate heat transfer coefficients under phase change phenomena and radiation heat transfer
5. Apply the knowledge of mass transfer in process industries

UNIT-I

Brief Introduction to Different Modes of Heat Transfer: Conduction: General heat conduction equation-Initial and Boundary conditions Steady State Heat Transfer: Simplified heat transfer in 1D and 2D – Fins. Transient heat conduction; Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – product solutions

UNIT-II

Finite Difference Methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems – implicit and explicit methods. Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum

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equations – Derivation of Energy equation - Methods to determine heat transfer coefficient: Analytical Methods - Dimensional Analysis and concept of exact solution. Approximate Method – Integral analysis

UNIT - III

External Flows: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometrics for Laminar and Turbulent flows. Internal flows: Fully developed flow: Integral analysis for laminar heat transfer coefficient – Types of flow – Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic & thermal entry lengths; use of empirical correlations

UNIT - IV

Free Convection & Radiation: Approximate analysis on laminar free convective heat transfer – Boussinesque Approximation - Different geometries – combined free and forced convection, Boiling and condensation: Boiling curve – Correlations- Nusselt's theory of film condensation on a vertical plate – Assumptions & correlations of film condensation for different geometrics

UNIT - V

Mass Transfer: Radiation Heat Transfer, Radiant heat exchange in grey, non-grey bodies, with transmitting, reflecting and absorbing media, specular surfaces, gas radiation – radiation from flames. Mass Transfer: Concepts of mass transfer – Diffusion & convective mass transfer Analogies – Significance of non-dimensional numbers.

Text Books:

1. Necati Ozisik, "Heat Transfer", TMH, 1998.
2. Incropera Dewitt, "Fundamentals of Heat & Mass Transfer", John Wiley, 2007.
3. Yunus A. Cengel, "Heat Transfer: A basic approach", TMH, 2008.

Suggested Reading:

1. R. C. Sachdeva, "Fundamentals of Engineering Heat & Mass Transfer", New Age International Publications, 2010.
2. J.P. Holman, "Heat Transfer", Mc Graw Hill, 2008.

19MEE 206

COMPUTATIONAL FLUID DYNAMICS (Programme Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Basic equations and concept of CFD
2. Concept of pdes and finite difference methods
3. Various types of grid generation and errors in numerical solution
4. Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods
5. Importance of FVM

Outcomes: At the end of the course, student will be able to

1. Derive CFD governing equations and turbulence models
2. Apply elliptical, parabolic and hyperbolic pdes and forward, backward and center difference methods
3. Understand errors, stability, consistency and develop O,H and C grid generated models
4. Evaluate the use of Crank-Nihcolson, Implicit and Explicit methods and analyze problem by Jacobi, Gauss Seidel and ADI methods
5. Solve conduction and convection problems using FVM.

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT - III

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference

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UNIT - IV

Finite Difference Solutions: Finite difference solutions - Crank Nicholson, Implicit and explicit, ADI - Jacobi, Gauss Seidel, solution for Viscous incompressible flow using Stream function – Vorticity method

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm

Text Books:

1. John D. Anderson, "Computational Fluid Dynamics", Mc Graw Hill Inc., 2015.
2. H. K. Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015.

Suggested Reading:

1. K. Muralidhar and T. Sundararajan T., "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.
2. S.V. Patankar, "Numerical Heat transfer and Fluid flow", Hemisphere Publishing Company, New York, 1980.

19MEE 207

REFRIGERATION AND CRYOGENICS (Programme Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the
1. Importance of selection of refrigerant,
2. Utility of simple vapour compression refrigeration cycle
3. Working principle of absorption refrigeration cycle,
4. The design principles of components of refrigeration system
5. Working principle of gas liquefaction

Outcomes: At the end of the course, student will be able to
1. Learn the applications of refrigeration and ODP, GWP and related environment issues
2. To design the refrigeration systems for domestic applications
3. Understand absorption refrigeration system and its advantages over vapor compression refrigeration
4. Design equipment needed for refrigeration system like evaporators, condensers.
5. To understand the applications in cryogenics and gas-liquefaction system

UNIT-I

Fundamentals of Refrigeration: Definition of refrigeration, applications of refrigeration, COP, tone of refrigeration, refrigerants and their classification, properties of refrigerants, designation of refrigerants, ozone depletion, eco-friendly refrigerants, Air Refrigeration, Bell Coleman cycle, air craft refrigeration, classification

UNIT-II

Vapor Compression Refrigeration System: Actual cycle, theoretical cycle, flash chamber, accumulator, sub-cooling, superheating, cascade refrigeration, wet compression, dry compression, improvements in the performance of cycle, multi-stage compression with Intercooling, multi-evaporator system

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UNIT - III

Vapor Absorption Refrigeration System: Absorption Refrigeration, Simple and Practical NH3 refrigeration, Electrolux refrigeration, LiBr refrigeration system, Efficiency of absorption refrigeration system, steam jet refrigeration, merits and demerits of steam jet refrigeration over simple vapour compression cycle

UNIT - IV

Refrigeration Applications and Psychrometry: Design, selection of evaporators, condensers, control systems, motor selection, Refrigeration applications, food preservation, transport, Introduction to psychrometry, psychrometric processes, humidifiers, de-humidifiers, filters, ducts

UNIT - V

Cryogenics: Application of cryogenics, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claudecycle, merits of one system over other system, Production of liquid air, Production of liquid nitrogen and production of liquid oxygen.

Text Books

1. C. P. Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2000.
2. Stoecker & Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, 1992.
3. Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.

Suggested Books.

1. Jordan & Priester, "Refrigeration and Air-conditioning", Prentice-Hall, 2/e, 1957.
2. G. G. Hasseldon, "Cryogenic Fundamentals", Academic Press,1992.

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19MEE 208

DESIGN OF HEAT EXCHANGERS (Programme Elective – III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Importance of heat exchanger in engineering application
2. Various co-relations for forced convection heat transfer coefficients for different geometries
3. Importance of pressure drop and its effect on heat transfer rate
4. Working principle of hair pin heat exchanger
5. Design concepts of condensers and heat pipe

Outcomes: At the end of the course, student will be able to

1. Explain different types of heat exchangers, LMTD method and NTU methods
2. List out co-relations for forced convection heat transfer coefficient for various geometries
3. Estimate the pressure drop in laminar and turbulent flow in heat exchangers
4. Determine pressure drop in hair pin and finned tube heat exchangers
5. Explain design and operational considerations in condensers and heat pipes

UNIT-I

Heat Exchanger Types and Design Methods: Tubular heat exchangers, plate heat exchangers, extended surface heat exchangers, flow arrangements, applications, overall heat transfer coefficient, multi-pass and cross flow heat exchangers, LMTD method, NTU method for heat exchanger analysis

UNIT – II

Forced Convection Heat Transfer Coefficient: Laminar forced convection in ducts and concentric annuli, turbulent forced convection in ducts and circular pipes, heat transfer in helical coils, and spirals and heat transfer in bends

UNIT – III

Pressure Drop and Fouling: Tube side pressure drop in laminar and turbulent flows, pressure drop in bends and fittings, Fouling of heat exchangers, basic considerations, effect of fouling on heat transfer and pressure drop.

UNIT - IV

Hair Pin and Finned Heat Exchangers: Pressure drop-hydraulic diameter, hair pin heat exchanger, parallel and series arrangements of hairpins, total pressure drop, compact heat exchangers, plate-fin heat exchangers, tube fin heat exchangers, pressure drop for fin tube heat exchanger

UNIT - V

Condensers: Horizontal shell and tube condensers, plate condensers, air cooled condensers, design and operational considerations, Heat pipe, working principle, heat pipe components and materials

Text Books:

1. Donald Q. Kern, "Process Heat Transfer", TMH Publications, 1963.
2. Sadik Kakac and Hongtan Liu, "Heat Exchangers-Selection, Rating and Thermal Design", 3/e, CRC Press, 2012.
3. David Reay and Peter Kew, "Heat Pipes, Theory, design and Applications", Butterworth-Heinemann (Elsevier), 5/e, 2006.

Suggested Reading:

1. S. Kakac, A. E. Bergles and F. Mayinger, "Heat Exchangers, Thermal, Hydraulic Fundamentals and Design", Hemisphere Publications, 1981.
2. "Standards of Tubular Exchangers Manual Association (TEMA)", 7/e, 1988.

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19MEE 209

TURBO MACHINES (Programme Elective – IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Principles and equations of turbo machinery
2. Velocity triangle and power developed by steam turbines
3. Working principles of Pelton, Francis and Kaplan turbines
4. Working principles of axial flow compressor and centrifugal compressor and their performance
5. Power required for rotary compressors and power developed by gas turbines

Outcomes: At the end of the course, student will be able to

1. Apply gas dynamics equations depending upon applications
2. Estimate the power developed by steam turbines
3. Calculate hydraulic efficiency of impulse and reaction turbines
4. Find the efficiency, pressure rise, degree of reaction, slip factor and performance of axial flow and centrifugal compressors
5. Understand cycles and improve the cycle efficiency in gas turbines

UNIT - I

Fundamentals of Turbo Machines: Classifications, Applications, Isentropic flow, Energy transfer. Efficiencies, Static and Stagnation conditions, Fluid equations - continuity, Euler's, Bernoulli's equation and its applications. Euler's flow through variable cross sectional areas.

UNIT - II

Steam Turbines: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure, Design of nozzles. Steam Turbines: Impulse turbines, Work done and Velocity triangle, Efficiencies Compounding

UNIT - III

Hydraulic Turbines: Introduction, Classification of turbines, Impulse and reaction turbines, construction, working and performance of Pelton, Francis and Kaplan Turbines, Selection of turbines: specific speed, unit quantities.

UNIT - IV

Axial Flow Compressors and Centrifugal Compressors: Work and velocity triangles, Efficiencies, Stage pressure rise, Degree of reaction, Performance of compressors, Velocity triangles and efficiencies; slip factor, performance of compressors.

UNIT - V

Gas Turbines: Principle of working – Classification – Joule's cycle – work done and efficiency – Brayton Cycle – Optimum Pressure ratio for maximum power and maximum efficiency – P_{max} and η_{max} – Improvement in cycle performance – Intercooling, Reheating and Regeneration (Heat exchanging) – Problems using these principles.

Text Books:

1. S. M. Yahya, "Turbines, Compreessors and Fans", 4/e, Tata McGraw-Hill Education Pvt. Ltd., 2010.
2. G Gopalakishnan and D. Prithvi Raj, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002.
3. Seppo. A. Korpela, "Principles of Turbomachinery", John Wiley & sons Inc. Publications, 2011.

Suggested Reading:

1. R. K. Turton, "Principles of Turbomachinery", E & F N Spon Publishers, London & New York,2004.
2. Dennis G Shepherd, "Principles of Turbomachines", Macmillan, 2007.

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19MEE 210

GAS TURBINES (Programme Elective – IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Adiabatic energy equation of nozzle.
2. Thermodynamic cycle of gas turbine
3. Working principle of rotary compressors.
4. Working principle of gas turbine power plant.
5. Working principle of jets and propulsions.

Outcomes: At the end of the course, student will be able to

1. Design nozzle with known inlet conditions
2. Evaluate thermal efficiency of gas turbines and its improvement
3. Determine overall efficiency of Axial flow compressor and Centrifugal compressors
4. Design combustion system for gas turbine plant
5. Determine thrust and propulsive force developed by jets and rockets.

UNIT-I

Gas Dynamics Fundamentals: Conservation Laws and governing equations for Mass, Momentum and Energy for Compressible flows; Basic definitions for Static and Stagnation Pressure, Mach Wave, Mach Angle and Over expanding Nozzle, Adiabatic Flow through Converging-Diverging Nozzle, Adiabatic Flow through a constant area duct, Phenomenon of Shock, Rayleigh Lines, Fanno Lines in duct flows

UNIT-II

Gas Turbines: Relative merits over conventional IC Engines, Introduction to Brayton and Atkinson cycle for Gas turbines, Pressure Ratio, Thermal Efficiency, Specific Output, optimum pressure ratio, Enhancement of Thermal Efficiency and/or specific power output using inter cooling, heat exchangers, reheat burners

UNIT-III

Compressors: Centrifugal Compressor-Major components – Inducer, Impeller, Vaneless Diffuser, Vaned Diffuser, Volute Casing, Velocity & Pressure variation in a stage, Degree of Reaction, Prewhirl and Surging. Axial Flow Compressor : Stage consisting of a Rotor and a Stator, Pressure Rise in a Stage, Polytropic Efficiency, Losses in a Compressor stage, Phenomenon of Blade Stall & Surging and Phenomenon of Chocking, Performance Curves

UNIT - IV

Gas Turbine Power Plants: Fuel and fuel feed systems; combustion systems-design considerations and flame stabilization; regenerator types and design; gas turbine power; plant performance. Application of airfoil theory to the study of flow through turbine blades; aerodynamic and thermodynamic design considerations; blade materials; blade attachments and blade cooling.

UNIT - V

Jets and Propulsion: Concept of Propulsion and Thrust, Variety of Propulsion systems for flying vehicles – Turboprop, Turbojet, Ram Jet, Pulse Jet, Analysis of propulsion cycle. Thrust Augmentation: Water Injection, Liquid Injection, Afterburning, Bleed Air system

Rocket Propulsion: Distinction between Turbojets and Rockets, Rocket Thrust, Specific Impulse, Total Impulse, Thermal Efficiency, Rocket Equation and applications.

Text Books:

1. H. I. H. Saravanamuttoo, G. F. C. Rogers, H. Cohen , Paul Straznicky, "Gas Turbine Theory", Pearson education. Ltd, 6/e, 2009.
2. V. Ganesan, "Gas Turbines", Tata McGraw-Hill Education, 3/e, 2010.

Suggested Reading:

1. S. M. Yahya, "Turbines, Compressors and Fans", Tata McGraw-Hill Education, 1992.
2. Vincent, "The Theory and design of Gas Turbines and Jet Engines", McGraw-Hill Education, 1950.

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19MEE 211

POWER PLANT CONTROL AND INSTRUMENTATION

(Programme Elective – IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Principles of static and dynamic characteristics of instruments
2. Working principles of feedback control concepts of electrical parameters
3. Create awareness of the importance of working principles of various measuring instruments, their applications in engineering industry and understand characteristics of instruments
4. Familiarize the principles of data acquisition along influence of electrical parameters on instrumentation
5. Understand the principles of modeling of power systems

Outcomes: At the end of the course, student will be able to

1. Estimate static and dynamic characteristics of instruments
2. Estimate the influence of electrical parameters on measurements
3. Understand theory on stability of instruments used for thermal systems and model power systems using various numerical methods
4. Estimate the role of computers for data acquisition
5. Represent various types of process control system

UNIT - I

Static & Dynamic Characteristics of Instruments: Static & dynamic characteristics of instruments, sensors, signal processing & data transmission elements, indicating & recording elements

UNIT - II

Data Acquisition: Use of computers for data acquisition & instrumentation for measuring temperature, pressure flow, speed, vibration & noise

UNIT - III

Electrical Parameters: On-line process instruments. Automatic process control systems Representation. Feedback control concepts. Transient & Frequency response. Types of controllers

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UNIT - IV

Stability Of Instruments: Stability, Digital Control System Modern Control theory. Boiler Control, Governing & Control of turbo-machines

UNIT – V

Computer Aided Power Systems Analysis: Modelling of power system, components, Formation of bus admittance and impedance matrices, Power flow solution Gauss-Seidel, Newton Raphson, and fast de-coupled load flow, Short Circuit studies, Static equivalents of power system, Basic concepts of security analysis and state estimation.

Text Books:

1. T.G.Beckwith and N. Lewis Buck, "Mechanical Measurements", Wesley Publishing, 1961.
2. K. Tayal, "Instruments and Mechanical Measurements", Galgotia Publications.
3. Mc Cloy and H.R. Martin, "The Control of Fluid Power", Longman Publication, 1973.
4. D.A. Williams and G. James, "Liquid Fuels", London Pergamon, 1963.

Suggested Reading:

1. David Lindsley, "Power-Plant Control and Instrumentation", IEE Control Engineering Series 585.
2. W. Bolton, "Instrumentation and Control Systems", 1/e, Elsevier, 2004.

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19EGA 101

ENGLISH FOR RESEARCH PAPER WRITING

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: The Course will introduce the students to

1. Understand the nuances of language and vocabulary in writing a Research Paper.
2. Develop the content, structure and format of writing a research paper.
3. Produce original research papers without plagiarism.

Outcomes: After successful completion of the course, the students will be able to

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT - I

Academic Writing : Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT - II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT - III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT - IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

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UNIT - V

Research Paper Publication: Reputed Journals - National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Books:

1. C. R Kothari, Gaurav, Garg, "Research Methodology Methods and Techniques", 4/e, New Age International Publishers.

Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. "MLA Hand book for writers of Research Papers", 7/e, East West Press Pvt. Ltd, New Delhi
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers", Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

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19EGA 102

INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	———
Credits	0

Objectives: The Course will introduce the students to

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement. to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Outcomes: After successful completion of the course, the students will be able to

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT - I

History of making of the Indian constitutions: History, Drafting Committee (Composition & Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT - II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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UNIT-III

Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions

Union Executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role. Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1/e, 2015.
2. M. P. Jain, "Indian Constitution Law", 7/e, Lexis Nexis, 2014

Suggested Reading:

1. "The Constitution of India", 1950 (Bare Act), Government Publication
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

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19EGA 103

STRESS MANAGEMENT BY YOGA

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	————
Credits	0

Objectives: The Course will introduce the students to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

Outcomes: After successful completion of the course, the students will be able to

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

UNIT-I

Meaning and Definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT-II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT-III

Concept of Stress According to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

UNIT-IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

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UNIT - V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.
Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. "Yogic Asanas for Group Training - Part-I": Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

Suggested Reading:

1. Nagendra H.R nad Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore,

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

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19EGA 104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	————
Credits	0

Objectives: The Course will introduce the students to

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awaken wisdom among them.

Outcomes: After successful completion of the course, the students will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT - I

Neetisatakam – Holistic Development of Personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT - II

Neetisatakam – Holistic Development of Personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV

Statements of Basic Knowledge - Shrimad Bhagavadgeetha: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

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UNIT - V

Role of Bhagavadgeetha in the Present Scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. "Srimad Bhagavad Gita" , Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Suggested Reading:

1. "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Online Resources:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

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19MEC 108

COMPUTER AIDED ENGINEERING LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To make the students

1. Model one and two-dimensional elements in ANSYS
2. Understand vibration, harmonic and transient analysis
3. Carry out buckling analysis
4. Analyze forming and sheet metal operations by FEA
5. Model crack element

Outcomes: At the end of the course, student will be able to

1. Understand the applications of one and two-dimensional elements
2. Solve engineering problems
3. Find buckling factors
4. Understand industrial applications of forming and sheet metal operations
5. Find fracture toughness

List of Exercises:

1. Introduction to Finite Element Analysis Software
2. Statically indeterminate reaction force analysis and determination of Beam stresses and Deflection
3. Static analysis of a corner bracket
4. Analysis of cylindrical shell under pressure
5. Bending of a circular plate using axisymmetric shell element.
6. Vibration analysis of a simply supported beam
7. Harmonic analysis of plates and shells
8. Transient analysis of vehicle crash
9. Buckling analysis of shells
10. Analysis of forming
11. Analysis of sheet metal operation
12. Stress intensity factor in cracked plates

<u>**Note:**</u> Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

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Text Books:

1. R. Tirupathi, Chandrupatla and B.D. Ashok, "Introduction of Finite Element in Engineering". Prentice Hall of India, 2004
2. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003

Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley and sons,2009
2. S.S. Rao, ,"The Finite Element Methods in Engineering", 2 /e, Pergamon Press, 2001.

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19MEC 206

COMPUTATIONAL FLUID DYNAMICS LAB

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Objectives: To acquaint the student with

1. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
2. Simulation of laminar, turbulent, internal flow, steady and unsteady problems
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of thermal related problems

Outcomes: At the end of the course, student will be able to

1. Analyze laminar flow problems in plates and pipes
2. Solve steady and unsteady flow past a cylinder
3. Perform analysis for free and forced convection
4. Evaluate the effect of angle of attack and velocity on NACA aerofiol
5. Simulate compressible flow in a nozzle, premixed combustion

List of Experiments:

1. Laminar Flow over Flat plate
2. Laminar Pipe Flow
3. Steady Flow past a Cylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Aerofoil.
9. Study of compressible flow through a nozzle
10. Partially premixed combustion analysis
11. Supersonic flow over a wedge
12. Study of flow over wind turbine blade/flow through bifurcation artery

<u>Note</u>: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

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Text Books:

1. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill, Inc., 2015.
2. H.K.Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015

Suggested Reading:

1. J.H. Ferziger and M. Peric, "Computational Methods for Fluid Dynamics", Springer.
2. K. Muralidhar and T. Sundararajan T, "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003

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19MEC 207

MINI PROJECT WITH SEMINAR

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Outcomes: Students are able to

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

- As part of the curriculum in the II- semester of the progarmme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter disciplinary/ industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
- All the investigations are clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

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Guidelines for awarding marks in CIE (Continuous Internal Evaluation):
Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (THERMAL ENGINEERING) – 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective-1	3	--	3	30	70	100	3
5.	Elective-2	3	--	3	30	70	100	3
6.	Elective-3	3	--	3	30	70	100	3
7.	Laboratory - I	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	18	09		340	360	700	25

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core-4	3	1		30	70	100	4
2.	Core-5	3	1		30	70	100	4
3.	Core-6	3	1		30	70	100	4
4.	Elective-4	3	--		30	70	100	3
5.	Elective-5	3	--		30	70	100	3
6.	Elective-6	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	18	11		390	360	750	26

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i) Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	100	--	100	6
	Total	100		100	6

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	100	100	200	12

Note : Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide and
50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
B.Tech (Bio-Tech)

SEMESTER – I

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
	THEORY								
1	18MT C02 / 18BT C01	Engg. Mathematics - I/ Basics of Biology-I	3	1	-	3	30	70	4
2	18PY C05	Physics	3	1	-	3	30	70	4
3	18CS C01	Programming for Problem Solving	3	-	-	3	30	70	3
4	18EG C01	English	2	-	-	2	20	50	2
	PRACTICALS								
5	18PY C08	Physics Lab	-	-	3	3	25	50	1.5
6	18CS C02	Programming for Problem Solving Lab	-	-	4	3	25	50	2
7	18ME C02	Workshop/ Manufacturing Practice	1	-	4	3	25	50	3
8	18EG C02	English Lab	-	-	2	2	15	35	1
Total			**12**	**02**	**13**	**-**	**200**	**445**	**20.5**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

Y. Rajani

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18MT C02

ENGINEERING MATHEMATICS– I
(for BiPC Stream of Bio-Tech)

Instruction:	3 L+1T Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. The purpose of E.T is to learn simple steps and its derivatives.
2. It is also essential to learn how to calculate steps, Evaluations and height of High tower buildings.
3. Limits, continuity and differentiability is very essential to function any system or organization.
4. To learn matrices is very important on day to day life in the form of Minimization or Maximization of price etc.
5. To assess the system of Thing for period of short time or long time the curve fitting is very useful.
6. These elementary operations are very important to grow further and achieve results in the form of Research and Development.

Course outcomes: On successful completion of this course the students shall be able to

1. Basics of elementary trigonometry is very essential to solve Engineering problems.
2. Very useful to find out Slopes, Heights and Distances.
3. Basics of limits, continuity and differentiability are must to develop the mathematical modelling.
4. Applications of matrices are abundantly used in Industry as well as Research and Development.
5. It is very useful to find constant co-efficient of straight line and curved equations by curve fitting methods and it uses are plenty at surveying agricultural fields.
6. It is for Research and Development.

UNIT-I :Trigonometry: Trigonometric ratios and compound angles, trigonometric ratios of multiple and sub multiple angles. Transformations-sum and product rules. Hyperbolic and Inverse Hyperbolic functions.

UNIT-II: Limits, Continuity: Intervals and neighbourhoods, limits and concept of a limit. Standard limits and related problems.

UNIT-III: Differentiation:Derivatives of a function, Elementary properties. Derivatives of Trigonometric, Inverse Trigonometric, Hyperbolic and inverse Hyperbolic functions. Methods of differentiation, second and higher order derivatives.

UNIT-IV: Matrices: Types of matrices, multiplication of matrices, scalar multiplication. Inverse of matrix-determinant, singular, non-singular, minor, cofactors, adjoint, Rank-Echelon form, consistency, inconsistency Solutions of simultaneous linear equations.

UNIT-V: Curve Fitting: Residues, Principle of Least squares and Curve fitting by the method of least squares, Fitting of a straight line, parabola, Fitting of the curves of the form $y = ab^x$, $y = ae^{bx}$.

Text Books:

1. Shanti Narayan and P.K. Mittal ," Differential Calculus" , 30th edition, S. Chand publishers, 2005.
2. A.R.Vasistha, "Matrices" , 43rd edition, Krishna Prakashan Media (P) Ltd. 2014.
3. B.S.Grewal , "Numerical Methods for scientists and engineers" , 43rd Edition, Khanna Publishers, 2015.

Suggested Reading:

1. N P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", 9th Edition, Laxmi publishers, 2016.
2. Joseph Edwards, "Differential Calculus For Beginners", Arihant publishers,2016.
3. KantiB.Datta, "Mathematical Methods of Science and Engineering", CENGAGE Learning publishers, 2014.
4. S.S.Shastry, "Introductory Methods of Numerical Analysis", 5thEdition, EEE publishers, 2014.

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18BT C01

BASICS OF BIOLOGY-I

(for MPC Stream of Bio-Tech)

Instruction:	3 L+1T Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. To provide knowledge on basic concepts of Biology to mathematic background students.
2. To give understanding fundamentals of origin of life onwards and various theories of evolution.
3. To provide an insight into classification of plants and their propagation mode.
4. To give the students an understanding of knowledge on microbes and their economic importance.
5. To impart theoretical knowledge on various physiological aspects of plants.

Course Outcomes: At the end of the course student will be able to

1. Explain the theories behind the origin of life and evolution studies.
2. Classify plants based on the habit and habitat of plants.
3. Compare the mechanism of reproduction and development of seed in plants.
4. Outline and identify the basic structure and function of various organelles of plant cell.
5. Identify and classify microbes and compile the their economic importance.
6. Analyse basic physiological processes in plants.

UNIT-I
HISTORY OF LIFE AND EVOLUTION

History of earth, evolutionary concepts of origin of life. Experimental verification of chemical origin of life - Miller's Experiment. Darwinism, Natural selection, Sexual selection, Artificial selection, Mendelism, Hugo de Vries mutation theory, neo-darwinism.

UNIT-II
PLANT SYSTEMATIC AND REPRODUCTION

Plant kingdom, salient features of classification. Alternation of generation of the plants. Type studies of Algae (Spirogyra), Fungi (Rhizopus), Bryophytes (Pteris), Gymnosperms (Cycas) and general characteristics and life cycle of Angiosperms. Overview of modes of reproduction-Asexual: vegetative propagation, budding, sporulation, binary fission; Sexual reproduction: pollination, fertilization, development of embryo, endosperm, fruit and seed formation. Apomixes, pathenocarpy, polyembrony type of reproduction.

UNIT-III

CELL STRUCTURE AND INTERNAL ORGANIZATION OF PLANTS

Cell as basic unit of life, overview of the plant cell, cell cycle, cell division, mitosis and meiosis. Concept of Growth, meristems (apical, intercalary and lateral) their functions. Simple tissue (parenchyma, collenchyma and sclerenchyma), complex tissues (xylem and phloem). Tissue systems (epidermal, ground and vascular)

UNIT-IV

MICROBIOLOGY

Introduction and importance of classification – five kingdoms. General account of prokaryotes. Concept of species and strains. Sterilization and media compositions. bacterial viruses - T4, plant viruses – TMV, animal viruses – HIV, Protista, Fungi, Plantae and Animalia. Reproduction in bacteria (asexual - binary fission and sexual - conjugation) and viruses (lytic and lysogenic). Economic importance of beneficial bacteria (agriculture, industry, medicine and biotechnology).

UNIT-V

PLANT PHYSIOLOGY AND CONCEPTS IN PLANT BIOTECHNOLOGY

Absorption of water – soil water, water potential, diffusion, imbibitions, osmosis, plasmolysis, absorption of water, ascent of sap, transportation. Crop improvement - Heterosis and mutation breeding. Plant tissue culture techniques and their applications. Plant growth regulators.

Text Books:

1. Biology. Raven, Johnson, Losos, Mason, Singer. Tata Mc Graw Hill Publishing Co. Pvt. Ltd 9th edition, (2010).
2. Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P.V.; Jackson, R. B. Biology: A global approach: Pearson Education Ltd (2014).

Suggested Reading:

1. Stent GS and Calender,RWH, Molecular Genetics (2nd Edition) Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher.
2. Prescott, LM . Harley JP and Klein CA, , Microbiology, 1995 2nd Edition , Wm, C Brown Publishers.
3. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1 st edition, 1983.

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18PY C05

PHYSICS
(for Chemical and Bio-Tech)

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:
The objectives of the course is to make the student
1. Learns the basic concepts of wave nature of light and acquires knowledge of lasers and fibre optics.
2. Understands the general concepts of electromagnetism.
3. Familiar with fundamental ideas of Quantum Mechanics.

Course Outcomes:
At the end of the course, the student will be able to
1. Demonstrate the wave nature of the light and describe the types of lasers. and optical fibres and their applications.
2. Develop the concepts related to electromagnetic behavior.
3. Demonstrate the important concepts of Quantum Mechanics.

UNIT-I: Optics
Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits;diffraction grating, characteristics of diffraction grating and its applications.
Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.

UNIT-II: Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with opticalfibres, step and graded index fibres, pulse dispersion, applications of optical fibres.

UNIT-III: Lasers: Introduction to interaction of radiation with matter, principles and working of laser: population inversion, pumping, various modes, threshold population inversion,types of laser: solid state, semiconductor and gas; applications of lasers.

UNIT-IV: Electromagnetism and Magnetic Properties of Materials:

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectricconstant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossottiequation, applications of dielectrics.Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

UNIT-V: Quantum Mechanics:

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box

TEXT BOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text BookEngineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGahill Education Publications, 2013.
3. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

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18CS C01

PROGRAMMING FOR PROBLEM SOLVING
(Common to All Programs)

Instruction	3 Periods per week
Duration of Semester-End Examination	3 Hours
Semester-End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives

1. Identification of computer components, Operating environments, IDEs.
2. Understanding the steps in problem solving and formulation of algorithms to problems.
3. Develop programming skills as an means of implementing an algorithmic solution with appropriate control anddata structures.
4. Develop intuition to enable students to come up with creative approaches to problems.
5. Manipulation of text data using files.

Course Outcomes: At the end of the course, students will be able to:

1. Identify the computing environments.
2. Formulate solutions to problems and represent them using algorithms/ Flowcharts.
3. Choose proper control statements and data structures to implement the algorithms.
4. Trace the programs with test the program solution.
5. Decompose a problem into modules and use functions to implement the modules.
6. Develop applications using file I/O.

UNIT -I

Introduction to computers and Problem Solving: Components of a computer, Operating system, compilers, Program Development Environments, steps to solve problems, Algorithm, Flowchart / Pseudocode with examples.

Introduction to programming: Programming languages and generations, categorization of high level languages.

Introduction to C: Introduction, structure of C program, keywords, identifiers, Variables, constants, I/O statements, operators, precedence and associativity.

UNIT – II

Introduction to decision control statements: Selective, looping and nested statements.

Functions: Introduction, uses of functions, Function definition, declaration, passing parameters to functions, recursion, scope of variables and storage classes.

Case study:

UNIT – III

Arrays: Introduction, declaration of arrays, accessing and storage of array elements, 1-dimensional array, Searching (linear and binary search algorithms) and sorting(selection and Buble) algorithms, 2-D arrays, matrix operations.

Strings: Introduction, stringsrepresentation, string operations with examples.

Case study:

UNIT – IV

Pointers: Understanding computer's memory, introduction to pointers, declaration pointer variables, pointer arithmetic, pointers and strings, array of pointers, function pointers, array of function pointers, dynamic memory allocation, advantages and drawbacks of pointers.

Structures: Structure definition, initialization and accessing the members of a structure, nested structures, structures and functions, self- referential structures, unions and enumerated data types.

UNIT-V

Files: Introduction to files, file operations, reading data from files, writing data to files, error handing during file operations.

Preprocessor Directives: Types of preprocessor directives, examples.

Suggested Reading:

1. A K Sharma "**Computer Fundamentals and Programming**", 2nd Edition, University Press, 2018.
2. PradeepDey and Manas Ghosh, "**Programming in C"**, Oxford Press, 2nd Edition, 2017.

References:

1. Byron Gottfried, Schaum's"**Outline of Programming with C**", McGraw-Hill.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
4. ReemaTharaja "**Introduction to C Programming**", Second Edition, OXFORD Press, 2015.
5. https://www.tutorialspoint.com/cprogramming/index.htm.
6. https://onlinecourses.nptel.ac.in/noc18-cs10/preview.

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18EG C01

ENGLISH

(Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
CIE	20 Marks
Credits	2

Course Objectives:

1. To enable the students to understand the role and importance of communication and to develop their basic communication skills in English.
2. To equip the students with basics of writing correct sentences to coherent paragraphs.
3. To equip the students with techniques of writing a précis and an essay by using accurate grammar and appropriate vocabulary.
4. To train the students to describe, define and classify processes and to draft formal reports by adhering to the proper structure.
5. To develop the reading skills and reading comprehension techniques of the students.
6. To develop the students reading, writing, grammatical, lexical and communicative competence

Course Outcomes:

1. The students will understand the nature, process and types of communication and will communicate effectively without barriers.
2. The students will write correct sentences and coherent paragraphs.
3. The students will know how to condense passages by writing précis and write essays by using accurate grammar and appropriate vocabulary.
4. The students will demonstrate advanced writing skills by drafting formal reports.
5. The students will apply their reading techniques and analyze reading comprehension passages.
6. The students will become effective communicators and will display their advanced skills of reading and writing and use correct grammar and appropriate vocabulary in all contexts.

UNIT-I Understanding Communication in English:
Introduction, nature and importance of communication.Process of communication.Basic types of communication - verbal and non-verbal.Barriers to communication.Intrapersonal and interpersonal communication.Johari Window.
Vocabulary &Grammar: The concept of Word Formation. Importance of proper punctuation.Articles.

UNIT-II Developing Writing Skills I:
Types of sentences. Use of phrases and clauses in sentences.Cohesion and coherence. Paragraph writing. Organizing principles of paragraphs in documents.
Vocabulary & Grammar: Cohesive devices. Root words from foreign languages and their use in English. Prepositions.

UNIT-III Developing Writing Skills II:
Techniques for writing precisely. Précis Writing. Essay Writing.
Vocabulary and Grammar: Subject-verb agreement, Noun-pronoun agreement Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.Redundancies, Clichés.

UNIT-IVDeveloping Writing Skills III:
Describing, Defining, Classifying, Providing examples or evidence.Writing introduction and conclusion.
Report writing – Importance, structure and elements of style of formal reports.
Vocabulary and Grammar: Misplaced modifiers. Synonyms, antonyms

UNIT-VDeveloping Reading Skills:
The reading process, purpose, different kinds of texts.Reading comprehension. Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.
Vocabulary and Grammar : Words often Confused. Standard abbreviations.

Text Books:

1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan, 2017.
2. Swan Michael,Practical English Usage.OUP. 1995.

Suggested Readings:

1. Wood F.T,Remedial English Grammar, Macmillan,2007.
2. Zinsser William,On Writing Well, Harper Resource Book, 2001.
3. Sanjay Kumar and PushpLata,Communication Skills.Oxford University Press, 2011.

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18PY C08

PHYSICS LABORATORY

(for Chemical and Bio-Tech)

Instruction:	3 Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits:	1.5

Course Objectives:

The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments.
2. Understand the behavior of the light experimentally.
3. Analyze the behavior of magnetic and dielectric materials.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the concept of errors and find the ways to minimize the errors.
2. Demonstrate interference and diffraction phenomena experimentally.
3. Understand the applications of magnetic and dielectric materials.
4. Know the working of lasers and optical fibres.
5. Distinguish between polarized and unpolarized light.

Experiments

1. Polarimeter – Determination of specific rotation of glucose.
2. Malus's law – Verification of Malus's law.
3. Double refraction – Determination of refractive indices of O-ray and E-ray of given calcite crystal.
4. Single slit diffraction – Determination of wavelength of given monochromatic source.
5. Diffraction Grating – Determination of wavelengths of two yellow lines of mercury light.
6. Double slit diffraction.
7. Fibre optics – Determination of NA and power losses of given optical fibre.
8. Newton's rings – Determination of wavelength of given monochromatic source.
9. Laser – Determination of wavelength of given semiconductor red laser.
10. Dielectric constant – Determination of dielectric constant of given PZT sample.

11. B-H curve – Determination of hysteresis loss of given specimen.
12. Planck's constant – Determination of Planck's Constant using photo cell.
13. M & H values.
14. Error analysis – Estimation of errors in the determination of time period of a torsional pendulum.

SUGGESTED READING:

1. *Engineering Physics Manual* by Department of Physics, CBIT, 2016.
2. S.K. Gupta, *Engineering Physics Practical*, Krishna's Educational Publishers, 2014.
3. O.P. Singh, V. Kumar and R.P. Singh, *Engineering Physics Practical Manual*, Ram Prasad & Sons Publications, 2009.
4. Indu Prakash, Ram Krishna and A.K. Jha, *A Text Book of Practical Physics*, Kitab Mahal Publications, 2012.

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18CS C02

Programming for Problem Solving
(Programming Lab – I)
(Common to All Programs)

Instruction	4 Periods per week
Duration of Semester-End Examination	3 Hours
Semester-End Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate C programming constructs to implement algorithms.
4. Identification and rectification of coding errors in program.
5. Develop applications in a modular fashion.
6. Manage data using files.

Course Outcomes:

At the end of the course students will be able to:

1. Identify and setup program development environment.
2. Implement the algorithms using C programming language constructs.
3. Identify and rectify the syntax errors and debug program for semantic errors.
4. Analyze the results to evaluate the solutionsof the problems.
5. Solve problems in amodular approach using functions.
6. Implement file operations with simple text data.

Lab experiments

1. Familiarization with programming environment.
2. Simple computational problems using arithmetic expressions.
3. Problems involving if-then-else structures.
4. Iterative problems e.g., sum of series.
5. 1D Array manipulation.
6. 2D arrays and strings.
7. Matrix problems, String operations.
8. Simple functions.
9. Recursive functions.
10. Pointers and structures.
11. Dynamic memory allocation and error handling.
12. File handling:

Design the experiments in such a way that the students will be able to end up the solution for a real world problem that uses most of the concepts of C programming language. For example: A banking application where it uses the concepts of operators, control structures, switch case for menu, structures, functions, error handling, files etc.

Suggested Reading:

1. Pradeep Dey and Manas Ghosh, "**Programming in C"**, Oxford Press, 2nd Edition, 2017.
2. ReemaTharaja "**Introduction to C Programming**", Second Edition, OXFORD Press, 2015.

References:

1. https://www.tutorialspoint.com/cprogramming/index.htm
2. https://www.w3resource.com/c-programming/programming-in-c.php
3. https://www.w3schools.in/c-tutorial/

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18ME C02

WORKSHOP/ MANUFACTURING PRACTICE

Instruction	1T+4P Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	3

Course Objectives:

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive & team work attitude to get things right the first time.
3. To provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. To advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.
6. Engineering Skill development with regard to making components, system integration and assembly to form a useful device.

Course Outcomes – (Laboratory): Student will be able to

1. Fabricate components with their own hands.
2. Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. Assembling different components, student will be able to produce small mechanisms/devices of their interest.
4. Gain practical skills of carpentry, tinsmithy, fitting, house wiring.
5. Gain knowledge of different Engineering Materials and Manufacturing Methods.
6. Understand trades and techniques used in Workshop and chooses the best material/ manufacturing process for the application.

18EG C02

ENGLISH LAB

(Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives:

1. To introduce students to phonetics and the different sounds in English.
2. To familiarize the students with the software and give them sufficient practice in correct pronunciation.
3. To enable students to speak English correctly with focus on stress and intonation.
4. The students will enhance their listening skills by practicing IELTS and TOEFL material.
5. To help students overcome their inhibitions while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
6. To help students to understand team work, role behavior and to develop their ability to discuss in groups and make oral presentations.

Course Outcomes:

1. The students will differentiate the speech sounds in English.
2. The students will interact with the software and understand the nuances of pronunciation in English.
3. The students will speak with the proper tone, intonation and rhythm and apply stress correctly.
4. The students will demonstrate their listening skills by analyzing the IELTS and TOEFL listening comprehension texts
5. The students will speak with clarity and confidence.
6. The students will work in teams and discuss various topics and demonstrate their presentation skills through posters.

Exercises

1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and

description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.

3. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm &Intonation** : Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – practice with IELTS and TOEFL material
6. **Situational dialogues and role play –** Dialogue writing, **–** Role behavior and role enactment.
7. **Group Discussions -** Dynamics of a group discussion, group discussion techniques, body language.
8. **Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
9. **Poster presentation –** Theme, poster preparation, team work and presentation.

Suggested Reading

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

B.Tech (Bio-Tech)

SEMESTER – II

S. No	Course Code	Title of the Course	Scheme of Instruction: Hours per week L	T	P/D	Scheme of Examination: Duration of SEE in Hours	Maximum Marks CIE	SEE	Credits
	THEORY								
1	18MT C04/ 18BT C02	Engg. Basics of Biology-II	3	1	-	3	30	70	4
2	18CY C01	Chemistry	3	1	-	3	30	70	4
3	18CE C01	Eng Mec	3	1	-	3	30	70	4
4	18ME C01	Engineering Graphics and	1	-	4	3	30	70	3
5	18EE C01	Basic Electrical Engineering	3	1	-	3	30	70	4
	PRACTICALS								
6	18EE C02	Basic Electrical Engineering Lab	-	-	2	2	15	35	1
7	18CY C02		-	-	3	3	25	50	1.5
		Total	**13**	**04**	**09**	**-**	**190**	**435**	**21.5**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

18MT C04

ENGINEERING MATHEMATICS– II
(forBiPC Stream of Bio-Tech)

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. The student is expected to know the behaviour of single valued functions of partial fractions and Rational functions.
2. Master the methods and techniques of integration and definite integrals.
3. Expected to know learn the basics of formation of First Order Differential equations and identifying the Nature of equations.
4. Expected to learn Higher Order Linear Differential Equations and its solutions by various methods.
5. Expected to learn system of Linear Equations and its solutions by various methods.
6. Students enable to learn formation of Differential Equations and modelling of Algebraic Equations and its solutions.

Course Outcomes: On successful completion of this course the students shall be able to

1. To find out Areas, Surface Areas, Volumes can be obtained by definite integrals.
2. Any complicated fraction can be decomposed by using partial fractions, then it makes integrable.
3. Model the First-Order Differential Equations and solve it for various Engineering Branches applications, etc.
4. Model the Higher Order Linear Differential Equations and solve it for various Engineering branches physical problems.
5. To learn how to find out approximate values of Multivariable Algebraic Equations by various methods.
6. It is very useful for Research and Development.

UNIT- I: Partial Fractions: Resolving f(x)/g(x) in to partial fractions, g(x) contains non repeated linear factors, g(x) contains repeated and non repeated linear factors, g(x) contains non repeated irreducible factors, g(x) contains repeated and not repeated irreducible factors.

UNIT - II :Integration: Integration considered as converse of differentiation, simple integrations of algebraic, trigonometric and exponential etc. Methods of integration, integration by parts, integration of rational, irrational and Trigonometric functions, definite integrals

UNIT- III :Differential Equations: Differential equations of First order and first degree, Variable separable, Homogeneous, linear, Bernoulli's equations, Exact differential Equations.

UNIT- IV :Differential Equations of Higher Order: Differential equations of higher order with constant coefficients, Complimentary functions and particular Integrals, Particular Integrals of $e^{ax}, \sin ax , \cos ax , x^{m}, e^{ax} \sin bx , e^{ax} \cos bx$ Differential equations of higher order with variable coefficients-Cauchy linear equations.

UNIT- V :Linear Algebra: Solution of system of Linear equations by Inverse, Gauss Jordan methods and Cramer's Rule. Cayley Hamilton Theorem (without proof)

Text Books:

1. Shanti Narayan and P.K. Mittal," Differential Calculus", 30th edition, S.Chand publishers, 2005.
2. A.R.Vasistha , "Matrices", 43rd edition, Krishna Prakashan Media (P) Ltd. 2014.
3. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publishers, 2014.

Suggested Reading:

1. William E.Boyce /Richard C.Dip, "Elementary differential equations", 9th Edition, wiley publishers, 2008.
2. N P Bali, "A Text Book of Engineering Mathematics", 9th Edition, laxmi publishers, 2016.
3. Joseph Edwards, "Differential Calculus For Beginners", arihant publishers, 2016.
4. KantiB.Datta, "Mathematical Methods of Science and Engineering",CENGAGE Learning publishers, 2014.

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18BT C02

BASICS OF BIOLOGY-II

(for MPC Stream of Bio-Tech)

Instruction:	3 L+1T Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. This course aims at providing knowledge on basic concepts of Biology to mathematic background students.
2. The course is designed to give understanding salient features of animal kingdom classification.
3. This course aims at providing an insight into animal tissues and their types.
4. To provide knowledge on various parasites, lifecycle and diseases caused by them.
5. The course aims at imparting theoretical knowledge on various biotic interactions in nature.

Course Outcomes: By the end of the course students be able to

1. Explain the criteria for classification of various organisms in animal kingdom.
2. Identify the basic structure and function of various organelles of animal cell.
3. Discuss the organization symmetry and tissue types in animal system.
4. Outline various biotic interactions in nature.
5. Demonstrate the basic information on gene, alleles and its inheritance.
6. Compare the gene regulation system in prokaryotes and eukaryotes.

UNIT- I

ANIMAL KINGDOM CLASSIFICATION

Classification of animal kingdom. Phylogeny of invertebrate and vertebrate phyla. Salient features of nonchordates up to phyla, and chordates up to class level. Binomial and trinomial nomenclature. Concept of species and genus.

UNIT- II

CELL AND TISSUES: STRUCTURE AND FUNCTIONS

Structure of animal cell and its organelles. Differences between plant and animal cell. Level of organization, multicellularity, diploblastic and triploblastic conditions. Asymmetry, symmetry: radial symmetry and bilateral symmetry. Acoelomates, pseudocoelomates and eucoelomates in brief. Animal tissues structure and functions. Different types of animal tissues and their functions. Epithelial, Connective, Muscular and Nervous tissues in brief

UNIT- III

PARASITOLOGY: PARASITISM AND PARASITIC ADAPTATION

Health and disease: introduction, life cycle, pathogenecity, treatment and prevention; *Entamoeba histolytica*, *Plasmodium vivax, Ascaris lumbricoides* and *Wuchereria bancrofti*. Brief account of pathogencity, treatment and prevention of typhoid, pneumonia, common cold and ring worm.

UNIT - IV

ECOLOGY AND ENVIRONMENT

Organism and environment, habitat and niche. Population and ecological adaptations, population interactions. Abiotic environmental factors – light, temperature, water and radiation. Biotic environmental factors –neutralism, competition, mutualism, commensalism, parasitism, predation. Attributes, growth, birth rate and death rate, age distributions.

UNIT – V

GENETICS

Structure and Functions of chromosome. Concept of gene and alleles, multiple alleles, ABO blood groups. Sex chromosomes, Sex determination, Sex linked inheritance, gene expression and regulation in prokaryotes and eukaryotes.

Text Books:

1. Biology. Raven, Johnson, Losos, Mason, Singer. Tata Mc Graw Hill Publishing Co. Pvt. Ltd 9th edition, 2010.
2. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1^{st} edition, 1983.

Suggested Reading

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis.III Edition, Blackwell Science.
2. K Vaidhyanath, K Pratap Reddy and K Sathya Prasad, Introduction to Applied biology and Biotechnology. BS Publications, India, 2004.

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18CY C01

CHEMISTRY

(Common to all branches)

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives

1. The aim of framing the syllabus is to impart intensive and extensive knowledge of the subject so that students can understand the role of chemistry in the field of engineering.
2. This syllabus helps at providing the necessary introduction of the inorganic chemistry principles and concepts of chemical bonding involved in a comprehensive manner understandable to the students aspiring to become practicing engineers.
3. Thermodynamic and Electrochemistry units give conceptual knowledge about spontaneous processes and how can they be harnessed for producing electrical energy and efficiency of systems.
4. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
5. New materials lead to discovering of technologies in strategic areas like defense and space research for which an insight into nano and composite materials of modern chemistry is essential.

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations & Ionic Equilibria.
3. List major chemical reactions that are used in the synthesis of molecules.
4. Apply the various methods used in treatment of water for domestic and industrial use.

5. Discuss the various Engineering materials & Drug synthesis & their applications.

UNIT- I Atomic and molecular structure:

Molecular Orbital theory - atomic and molecular orbitals.Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Energy level diagrams of diatomics (H_2, He_2^+,N_2, O_2, O_2^-, CO, NO). Pi- molecular orbitals of butadiene, benzene and their aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

UNIT-II Use of free energy in chemical equilibria and Ionic Equilibria:

Use of free energy in chemical equilibria : Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials –electrochemical series.Nernst equation and its applications. Potentiometric Acid base & Redox Titrations.Numericals.

Ionic Equilibria: Solubility product, Determination of solubility product, Applications of solubility product- Determination of solubilities of sparingly soluble salts; Predicting precipitation reactions; Precipitation of an insoluble salt; Precipitation of soluble salts ; Inorganic analysis .Numericals.

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures , Symmetry and chirality, Stereoisomers - Configurational isomers (Geometrical&Optical isomers), Conformational isomers - Newman and sawhorse representations of n-butane, enantiomers (lactic acid), diastereomers (Tartaric acid), optical activity, absolute configurations, Sequence rules for R&S notation.

Organic reactions

Types of Organic reactions:

Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution(S_N1& S_N2) ; Free Radical Substitution(Halogenation of Alkanes)

Addition Reactions:

Electrophilic Addition – Markonikoff's rule
Nucleophilic Addition – (Addition of HCN to carbonyl compounds)
Free radical Addition - Anti Markonikoff's rule (Peroxide effect)

Eliminations-E_1 and E_2 (dehydrohalogenation of alkyl halides)

Oxidation with $KMno_4$, $K_2 Cr_2O_7$; **Reduction** with $LiAlH_4$,$NaBH_4$
Cyclization (Diels - Alder reaction)

UNIT–IV Water Chemistry:
Hardness of water – Types, units of hardness, Disadvantages of hard water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination , Ozonisation & UV radiation.

UNIT-V Engineering Materials and Drugs:
Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol gel method. Carbon nanotubes and their applications.
Composite materials- Definition, types of composites, fibre reinforced, glass fibre reinforced and carbon fibre reinforced composites and applications.
Conducting polymers- Definition, classification and applications.
Drugs-Introduction,Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Mali, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi,reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7thedition(2011).
4. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C. Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd.,46thedition(2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8thedition (2006).

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18CE C01 **ENGINEERING MECHANICS**

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. The objective of this course is to understand the resolution of forces and to obtain resultant of all force systems, to understand moment of a force and equilibrium conditions of static loads for smooth and frictional surface
2. To obtain centroid, centre of gravity and moment of inertia for various regular and composite areas and bodies.
3. To understand the basic structural analysis, principles of virtual work and energy methods.
4. To know the basic concepts of dynamics and analysis as a particle and rigid bodies.
5. To understand the work energy principles, impulse momentum and their applications and to know the concept of simple harmonic motion and free vibration.

Course Outcomes: The students will be able to

1. Solve problems dealing with forces in plane and space force systems, draw free body diagrams to analyze various problems in equilibrium, for smooth and frictional surface.
2. Determine centroid and moment of inertia for elementary, composite areas and bodies.
3. Analyze simple trusses for forces in various members of a truss.
4. Solve problem in kinematics and kinetics of particles and rigid bodies.
5. Analyze body motion using work energy principles, impulse and momentum approach and able to apply the concepts of simple harmonic motion and free vibrations in dynamics.

Unit–I: Resolution, Resultant and Equilibrium of force system and Friction: Concepts of force, System of forces, components of forces in a plane and in space systems.Resultant of force systems.Moment of forces and its applications.Couples and its applications.Equilibrium of Force systems. Free body diagrams, equation of equilibrium of coplanar and spatial force systems. Static indeterminacy. Types of friction, Laws of friction, application of friction to a single body & connecting systems, wedge friction.

Unit–II: Centroid ,centre of gravity and moment of Inertia:

Centroid of simple figures from first principle, centroid of composite sections. Centre of gravity and its implications, Definition of Area moment of Inertia, Moment of inertia of plane section from first principles, Theorems of moment of inertia, moment of inertia of standard sections and composite sections, Mass moment of inertia of rectangular and circular plates, cylinder, cone & sphere.

Unit–III: Analysis of simple trusses, Virtual work and Energy methods:

Analysis of simple trusses using method of joints, methods of sections. Determine if a member is in tension or compression, zero force members. Virtual displacements, Principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom.Conservative forces and potential energy, energy equation for equilibrium.

Unit–IV: Particle Dynamics:

Rectilinear and curvilinear translation using rectangular, normal and tangential components.Relative and constrained motion. Newton's 2nd Law, rectangular and path coordinates. Basic terms, general principles in dynamics, D'Alembert's principle and its application in plane motion and connected bodies.Instantaneous centre of rotation in plane motion and simple problems.

Unit–V: Work- Energy, Impulse-momentum and Mechanical Vibrations:

Equation of work energy for translation and fixed axis rotation, work energy principles applied to particle motion, connected systems. Introduction to linear impulse momentum, principle of conservation of linear momentum, Impact, direct and oblique. Introduction to vibration, free and forced vibrations, simple harmonic motion, simple pendulum and compound pendulum.

Text Books:

1. Reddy Vijaykumar K. and J. Suresh Kumar," Singer's Engineering Mechanics Statics and Dynamics", B. S. Publications 2011.
2. A. Nelson, "Engineering Mechanics", Tata McGraw Hill, New Delhi, 2010.

Suggested Reading:

1. Irving H. Shames, "Engineering Mechanics", 4th Edition, Prentice Hall, 2006.
2. F. P. Beer and E. R .Johnson, "Vector Mechanics for engineers, Vol. I - Statics, Vol. II - Dynamics",
   9th edition, Tata McGraw Hill, 2011.
   R. C. Hibbeler, "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press, 2006.

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18ME C01

ENGINEERING GRAPHICS AND DESIGN

Instruction	1T+4D Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. to prepare to design a system, component, or process to meet desired needs within realistic constraints.
2. to prepare the student to communicate effectively.
3. to prepare the student to use the techniques, skills, and modern. engineering tools necessary for engineering practice.
4. to get exposure to a CAD package.

Course Outcomes:

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design.
3. To become familiar with engineering graphics standards.
4. Exposure to solid modelling.
5. Exposure to computer-aided geometric design.
6. Exposure to creating working drawings.
7. Exposure to engineering communication.

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Coordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

UNIT-1 Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute;

UNIT-2 Orthographic Projections:

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes (without traces) ; Projections of planes inclined Planes;

Introduction to CAD package:

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

UNIT-3 Projections of Regular Solids:

Projection of Prism, Cylinder, Pyramid and Cone : Simple position, axis inclined to one of the reference plane only. Customization & CAD Drawing: consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT-4 Sections and Sectional Views of Right Angular Solids:

Sections of solids in simple position Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.

Annotations, layering & other functions:

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques;

Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and twodimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

UNIT-5 Isometric Projections:
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Viceversa, Conventions;

Demonstration of a simple team design project:
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and ssembly levels; (Examples of specific components to the branch of study may be included)

Text Books:

1. N.D.Bhatt, Elementary Engineering Drawing, Charotar Publishers, 2012.
2. K.L.Narayana and P.K.Kannaiah, – Text Book of Engineering Drawing + Scitech Publications, 2011.
3. Basanth Agrawal and C M Agrawal –Engineering Drawing 2e –, McGraw-Hill Education(India) Pvt.Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., –Engineering drawing V+d H Pearson, 2nd edition, 2009.
2. K.Veenugopal, –Engineering Drawing and Graphics + Autocad V+d H New Age International Pvt.Ltd, 2011.
3. Bhattacharya. B, –Engineering Graphics I. K. International Pvt.Ltd, 2009.

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18EE C01

BASIC ELECTRICAL ENGINEERING

Instruction:	3L+1T Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	4

Course Objectives:

1. To understand the behavior of different circuit elements R,L & C, and the basic concepts of electrical circuit analysis.
2. To know the concepts of AC circuits, RMS value, Average value, Phasor analysis etc.,
3. To understand the basic principle of operation of Transformer and DC machines.
4. To understand the basic principle of operation of DC machines and AC machines.
5. To know about different types of electrical wires and cables, domestic and industrial wiring.
6. To understand safety rules and methods of earthing.

Course Outcomes: At the end of the course, the student will be able to

1. Acquire the concepts of Kirchhoff's laws and network theorems and able to get the solution of simple dc circuits.
2. Obtain the steady state response of RLC circuits and also determine the different powers in AC circuits.
3. Acquire the concepts of principle of operation of Transformers and DC machines.
4. Acquire the concepts of principle of operation of DC machines and AC machines.
5. Acquire the knowledge of electrical wiring and cables and electrical safety precautions.
6. Recognize importance of earthing and methods of earthing and electrical installations.

UNIT-I: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Time-domain analysis of firstorder RL and RC circuits.

UNIT-II: AC Circuits
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III: Transformers
Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation, Auto transformer.

UNIT-IV: DC and AC Machines
DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt, series and compound generators.
DC Motors: Classification, Torque equation, Characteristics, Efficiency, Speed Control of Series and Shunt Motors. Three - Phase Induction Motors: Construction, Principle of operation, Torque equation, torque-slip characteristics,
Power stages, speed control of induction motors.

UNIT-V: Electrical Installations
Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Earthing, Elementary calculations for energy consumption.

Text books:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, – Basic Electrical Engineering Tata McGraw Hill, 2010.
2. V. D. Toro, –Electrical Engineering Fundamentals Prentice Hall India, 1989.
3. D.C. Kulshreshtha, – Basic Electrical Engineering McGraw Hill, 2009.
4. P.V.Prasad, S.sivanagaraju, R.Prasad, “Basic Electrical and Electronics Engineering” Cengage Learning, 1st Edition, 2013.

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18EE C02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives:

1. To acquire the knowledge of different types of electrical elements.
2. To verify the basic electrical circuit laws and theorems.
3. To determine the parameters and power factor of a coil.
4. To calculate the time and frequency responses of RLC circuits.
5. To determine the characteristics of Transformers.
6. To determine the characteristics of dc and ac machines.

Course Outcomes: At the end of the course, the students are expected to

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the circuit analysis techniques.
4. Determine the parameters of the given coil.
5. Understand the basic characteristics of transformer.
6. Understand the basic characteristics of dc and ac machines.

List of Laboratory Experiments/Demonstrations:

1. Demonstration of Measuring Instruments and Electrical Lab components.
2. Verification of KCL and KVL.
3. Time response of RL and RC circuits.
4. Calculation of permittivity of a choke or coil by Wattmeter Method.
5. Verification of Thevenin's and Norton's theorems.
6. Turns ratio /voltage ratio verification of 1-Ph Transformers.
7. OC and SC tests on a given 1-Ph Transformer.
8. Observation of Excitation Phenomenon in Transformer.
9. Measurement of 3-Ph power in a balanced system (By 2- Wattmeter method).
10. Measurement of 3-Ph Energy by an Energy Meter (Demonstration of Principle).
11. Load test of DC Shunt motor.
12. Speed control of DC Shunt motor.
13. Load test of 3-Ph Induction motor.
14. Demonstration of LT Switchgear Equipment/Components.
15. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

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18CY C02

CHEMISTRY LAB

(Common to all branches)

Instruction:	3 Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	25 Marks
Credits:	1.5

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. The student should be conversant with the principles of volumetric analysis and identification of organic functional groups.
3. To apply various instrumental methods to analyze the chemical compounds and to improve understanding of theoretical concepts.

Course Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

Thestudents will learn to:

1. Estimate rate constants of reactions from concentration of reactants/ products as afunction of time.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. Synthesize a small drug molecule and Identify the organic compounds.
4. understand importance of analytical instrumentation for different chemical analysis.
5. Perform interdisciplinary research such that the findings benefit the common man.

Chemistry Lab

1. Estimation of temporary and permanent hardness of water using EDTA solution.
2. Estimation of amount of chloride in water.
3. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order).
4. Estimation of amount of HCl Conductometerically using NaOH solution.
5. Estimation of (a) amount of CH_3 COOH Conductometerically using NaOH [illegible]d CH_3 COOH present in the given mixture [illegible]using NaOH solution.

6. Estimation of amount of HCl Potentiometrically using NaOH solution.
7. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution.
8. Distribution of acetic acid between n-butanol and water.
9. Synthesis of drug - Aspirin.
10. Organic Chemistry- Identification of Functional groups - neutral group (carbonyl groups-acetaldehyde and acetone); acidic group (benzoic acid); basic group (aniline).
11. Determination of surface tension of organic solvents (ethanol, ethyl acetate)
12. Determination of Viscosity.

TEXT BOOKS

1. J. Mendham and Thomas ," Vogel' s text book of quantitative chemical analysis", Pearson Education Pvt.Ltd. New Delhi ,6th ed. 2002.

SUGGESTED READINGS

1. Dr. Subdharani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

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With effect from the Academic Year 2019-20

CHAITANYABHARATHIINSTITUTEOFTECHNOLOGY(A)
Department of Bio-Technology
Scheme of Instructions of III & IV Semesters of B.Tech Bio-Technology as per AICTE Model Curriculum 2019-20
B.Tech (Bio-Technology)

SEMESTERIII

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1	18MTC06	Engineering Mathematics-III	3	-	-	3	30	70	3
2	18BT C03	Cell and Molecular Biology	3	-	-	3	30	70	3
3	18BT C04	Biochemistry	3	-	-	3	30	70	3
4	18BT C05	Microbiology and Industrial Biotechnology	3	-	-	3	30	70	3
5	18BT C06	Process Principles and Reaction Engineering	3	-	-	3	30	70	3
6	18BT C07	Genetics	3	-	-	3	30	70	3
7	18EG M01	Indian Constitution	2	-	-	2	-	50	Non-Credit
8	18EE M01	Indian Traditional Knowledge	2	-	-	2	-	50	Non-Credit
	PRACTICALS								
9	18BT C08	Biochemistry Lab	-	-	2	2	15	35	1
10	18BT C09	Microbiology Lab	-	-	2	2	15	35	1
Total			22	-	4	-	210	590	20
Clock Hours Per Week -26									

L: Lecture T: Tutorial P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

with effect from academic year 2019-20

18MT C06

ENGINEERINGMATHEMATICS-III
(For Bio-Technology)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

To learn

1. To solve linear system of equations using Matrix Methods.
2. Understand the basic concept of continuity, differentiability and geometric interpretation of mean value theorems.
3. Concept of partial differentiation, maximum and minimum.
4. Identifying vector, scalar addition, multiplication, geometrical interpretation in 2D, 3D space.
5. Understand the concept of scalar and vector point functions of divergence and curl of vector functions and its physical interpretations.

Course Outcomes: At the end of the course students will be able to

1. Solve system of linear equations and identify the Eigen values and Eigen vectors in engineering problems.
2. Solve the problems based on Mean value theorems
3. Solve maxima and minima problems.
4. Solve vector and scalar triple product related problems.
5. Solve divergence and curl related problems.

UNIT-I

Matrices: Rank of the matrix, Echelon form, System of Homogeneous and Non-Homogeneous linear equations, Linearly dependence and independence of vectors, Eigen values and Eigenvectors. Quadratic forms, Reduction of quadratic form to canonical form by linear transformation.

UNIT-II

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Calculus: Rolle's Theorem, Lagranges Mean value theorem, Cauchy's mean value theorem (without proofs). Taylor's series and Maclaurin's series for single variable. Curvature, radius of curvature and Evolutes (Cartesian form only),

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UNIT-III

Partial differentiation: Homogeneous functions-Euler's theorem on homogeneous functions, higher order partial derivatives, Derivatives of composite and implicit functions, Taylor's series of two variables.

UNIT-IV

Vector Algebra: Addition of vectors, scalar multiplication, angle between two non zero vectors, linear combination of vectors, component of vectors in three dimensions, scalar product-geometrical interpretations- orthogonal projections, properties of dot product, angle between two vectors, vector product of two vectors and properties, scalar triple product, vectors triple products-results.

UNIT-V

Vector Calculus: Definitions- scalar and vector point functions, vector differential operator, Gradient, Divergence and Curl, Solenoidal and Irrational vectors, properties of gradient, divergence and curl (vector identities)

Text Books:

1. Grewal BS, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. Jain ARK, Iyenger SRK, "Advance Engineering Mathematics", 3rd edition, Narosa publications, 2007.
3. Narayan Shanti, Mittal PK, " Differential Calculus" , 30th edition, S Chand publishers, 2005.

Suggested Reading:

1. Vasistha AR, "Matrices", 43rd edition, Krishna Prakashan Media (P) Ltd. 2014.
2. Edwards J, "Differential Calculus For Beginners", Arihant publishers, 2016
3. Kreyszig E, "Advanced Engineering Mathematics", 10th edition, Wiley publishers, 2015

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4.
5.

18BT C03

CELL AND MOLECULAR BIOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of cell biology i.e. concept of cellular organelles and their functions.
2. Students are taught the structure of cytoskeleton, and how it maintains the cell structure integrity.
3. Student is made to understand the basics of molecular biology, and the central dogma of the genetic material

Course Outcomes: At the end of the course students will be able to

1. Recognize the structure and functions of cell organelles.
2. Interpret the knowledge of transport of metabolites and cell cycle checkpoints in their experimental work.
3. Distinguish the organization and Replication of DNA, damages and repairs
4. Identify the structure and function of transcripts and mechanism of transcription by RNA polymerases.
5. Illustrate the mechanism of translation and post translation mechanism

UNIT-I

Cell Structure, Organelles and their Functions: Cell structure and organization in bacteria, plants and animal cells; structure and functions of cell wall, lysosomes, ribosomes, golgi complex, peroxisomes, glyoxysomes, mitochondria, plastids, endoplasmic reticulum, vacuoles, centrioles; cytoskeleton - composition, structure and functions of microtubules, microfilaments and intermediate filaments; nucleus, its ultra structure, (nuclear envelope, nucleoplasm, chromatin fibers).

UNIT-II

Membrane Transport and Cell Cycle: Biomembrane – lipid composition and structural organization, protein components and basic function, transport across membrane – passive diffusion, facilitated diffusion, osmosis, active transport (Na+ /K+ Pump), cotransport; uniport, antiport, symport. Cell cycle: Different phases of cell cycle; check points of cell cycle; Regulation of cell cycle - cyclins and cyclin dependent kinases

UNIT-III

Organization and Replication of DNA: Structure of DNA – Watson and Crick's model; role of histone and non histone proteins in structural organization of chromosomes; telomere and its importance; DNA Replication: Experimental evidences, enzymology of replication, complex replication apparatus; unidirectional, bi-directional and rolling circle replication; DNA damage and repair: Types of DNA damages- deamination, alkylation, pyrimidine dimmers; DNA Repair mechanisms- photo reactivation, Excision repair, mismatch repair.

UNIT-IV

Mechanism of Transcription: Structure of promoters- RNA polymerases of prokaryotic and eukaryotic organism; transcription- initiation, elongation and termination; post transcriptional processes of eukaryotic RNA: structure and functions of RNA- (rRNA, mRNA, tRNA, snRNA), prokaryotic and eukaryotic transcription. Processing of t-RNA, r-RNA, m-RNA splicing; concept of ribozyme, inhibitors of transcription.

UNIT-V

Mechanism of Translation: Ribosome- structural features; features of genetic code, wobble hypothesis; protein synthesis: translation in prokaryotes and eukaryotes- initiation of translation, elongation of polypeptide chain, termination of translation; Post translation modification, inhibitors of protein synthesis.

Text Books:

1. Geoffrey M. Cooper and Robert E. Hausman, "The cell: A molecular approach", 6th edition, Sinauer Associates, 2013.
2. Gerald Karp, "Cell and Molecular Biology": concepts and experiments, 6th edition, John Wiley & sons, 2009
3. David Freifelder, "Molecular Biology", 2nd edition, Narosa Publication, 2007.

Suggested Reading:

1. Rastogi S.C., "Cell and Molecular Biology", 2nd edition, New Age International, 2006.
2. Benjamin Lewin, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, "Lewin's Genes XI", Jones and Bartlett publishers, 2014.

18BT C04

BIOCHEMISTRY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course objectives:

1. Students will learn structure of carbohydrates, lipids, proteins and nucleic acids
2. Students will learn functions of carbohydrates, lipids, proteins and nucleic acids
3. Students will learn metabolism of different biomolecules.

Course outcomes: At the end of the course students will be able to

1. Recognize different biomolecules structure and describe the functions of various biomolecules.
2. Evaluate the energy yield from the catabolism of carbohydrates and explain the steps in anabolism.
3. Evaluate the energy yield from lipids and reconstruct lipids.
4. Outline steps involved in catabolism and anabolism of proteins.
5. Summarize steps involved in catabolism and anabolism of nucleic acids.

UNIT-I

Biomolecules: Carbohydrates- classification; Glycoproteins; glycolipid; Classification and nomenclature of lipids; Amino acid – Classification and its structure, peptide bond- structure; Proteins-classification and Biological functions; Forces stabilizing protein structure; Protein structure - primary structure, secondary structure (á-helical, â-pleated sheets), super secondary structures, Ramachandran Plot, tertiary and quaternary structure; Enzymes – properties.

UNIT-II

Metabolism of Carbohydrates: Carbohydrate Metabolism: Glycolysis – Preparatory phase and Payoff phase, substrate level Phosphorylation, regulation of glycolysis, HMP Shunt, Citric Acid Cycle, anaplerotic reactions, Electron Transport System and Oxidative Phosphorylation, Mitchell's chemiosmotic hypothesis; Gluconeogenesis; Glycogen metabolism – Glycogenolysis and Glycogenesis.

UNIT-III

Metabolism of Lipids: Lipid Metabolism: â - Oxidation of saturated, unsaturated fatty acid; Cholesterol Metabolism; Metabolic Pathways- Biosynthesis of Saturated and Unsaturated Fatty Acids, synthesis of Triglycerol; Metabolism of Phospholipids and Sphingolipids.

UNIT-IV

Metabolism of Proteins: Amino acids metabolism- Biosynthesis of aromatic amino acids, Peptides; Metabolic fate of Amino group; Nitrogen Excretion and Urea Cycle; Catabolism of aromatic and branched chain amino acids; Transamination, Oxidative Deamination and Oxidative Decarboxylation.

UNIT-V

Metabolism of Nucleic Acids: Structure of nucleotides, nucleosides and nitrogenous bases; chemical structure of DNA and RNA; Nucleic Acid Metabolism- De nova synthesis of Purine and Pyrimidine, salvage pathway, Ribonucleotides, synthesis of Deoxyribonucleiotides; Degradation of Purine and Pyrimidine Nucleotides.

Texts Books:

1. Eric E.Conn, Paul K Stumpf, George Bruening, Roy H Doi, "Outlines of Biochemistry", 5//E, John Wiely and Sons, 2006.
2. David Lee Nelson and Michael M. Cox, Lehninger "Principles of Biochemistry", 6^{th} edition, W. H. Freeman, 2013.

Suggested Reading:

1. Donald Voet and Judith G. Voet, "Biochemistry", 4^{th} edition, John Wiley & Sons, New York, 2011.
2. Reginald Garrett and Charles Grisham, "Biochemistry", 5^{th} edition, Cengage Learning, 2012.
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "Biochemistry", 6^{th} Edition. W. H. Freeman and Company, 2010.

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18BT C05

MICROBIOLOGY AND INDUSTRIAL BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Understand historical perspectives important in development of microbiology.
2. Describe prokaryotic cell structure with functions.
3. Classification of different groups of microorganisms.
4. Concepts of culture media preparation sterilization techniques and microbial growth.
5. Concepts of fermentation process and examples of industrially important products.

Course Outcomes: At the end of the course students will be able to:

1. Outline the historical aspects of microbiology and structure of prokaryotic cell.
2. Identify major characteristics and classification of microorganisms.
3. Describe importance of culture media and microbial growth.
4. Compare physical and chemical sterilization methods.
5. Apply theoretical knowledge for production of microbial metabolites.

UNIT-I

History and Introduction to Microbiology: History and scope of microbiology, contributions of Antony van Leuwenhoek, Louis Pasteur, Robert Koch, Iwanowskii, Edward Jenner; prokaryotic cell structure – plasma membranes, cytoplasmic matrix – inclusion bodies, ribosome, bacterial chromosome and plasmids, cell wall, components external to cell wall – capsule, slime layer, pili, fimbriae, flagella, bacterial endospores and their formation.

UNIT-II

Classification of Microorganisms: General and colony characters of major groups of microorganisms - algae, fungi, protozoa, bacteria and virus; Identification of microorganisms by major taxonomical characteristics (morphological, physiological, ecological, cultural, metabolic/biochemical, immunological and genetic); Classification of microorganisms - Haeckel's three kingdom concept, Whittaker's five kingdom concept, Three domain concept of Carl Woes.

UNIT-III

Microbiological Techniques and Growth: Methods of culturing of microorganisms - culture media, (liquid, semi-solid and solid media, synthetic media and complex media), Isolation of pure cultures (streak, spread and pour plate methods); Concept of sterilization - methods and their application- physical methods (heat, filtration and radiation), chemical methods (phenolics, alcohols, halogens, heavy metals, dyes, quaternary ammonium compounds, aldehydes, gaseous agents); Methods of preservation of microorganisms and their importance (Bacterial cultures); Microbial growth - growth curve, mathematical expression of growth, measurement of microbial growth (cell numbers and cell mass).

UNIT-IV

Production of Microbial Metabolites: Types of fermentation processes: aerobic and anaerobic processes, production of anaerobic fermentation products alcohols (ethanol and n-butanol), Production of beverages (beer and wine), Production of organic acid (citric acid); Production of aerobic fermentation products: classification of antibiotics, production of penicillin.

UNIT-V

Production Of Microbial Enzymes And Specialty Products: Production of commercially important industrial enzymes - proteases, amylases, lipases, cellulase, pectinase, and isomerase, bio-fertilizers and plant growth factors (Gibberellins); natural biopreservatives (Nisin); biopolymers (PHB); high fructose corn syrup.

Text Books:

1. Pelczar Michael J., Krieg Noel R., Chan, E.C., “Microbiology”, 5th edition, McGraw Hill higher education1993.
2. Crueger W and Crueger A, Biotechnology: Text Book of Industrial microbiology. 2nd edition, Panima Publisher, 2005.
3. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A-Stahl and Clark, “Brock Biology of Microorganisms”, 13th edition, Prentice Hall International Inc, 2010.

Suggested Reading:

1. Powar C.B. and Daginawala H.F., “General Microbiology – Vol I & II”, 2nd edition, Himalaya publishing house, 2005.
2. Arti Kapil, Ananthanarayan and Paniker’s “Text book of Microbiology”, 9th edition, Orient Blackswan, 2013.
3. Roger Y Stanier, “General Microbiology”, 5th edition, Palgrave Macmillan Limited, 1999.

18BT C06

PROCESS PRINCIPLES AND REACTION ENGINEERING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. The aim of the course is to impart knowledge of the basic chemical engineering principles and techniques used in analyzing a chemical process.
2. This course also aims to enable the students to evaluate material and energy balances in different units.
3. Through this course the students are given an understanding of application of principles of unit operations and unit processes in biotech Industries.
4. This course aims at analyzing the kinetics of chemical reactions.
5. The aim of the course is also to give the students an understanding of the theory of biochemical reactors and enhanced skill in formulation and analysis of different types of reactors used in biochemical engineering

Course Outcomes: At the end of the course student are able to

1. To analyze, interpret and solve the problems encountered in the preparation of material and energy balances of the process.
2. To predict the flue gas composition from fuel composition and vice versa.
3. To design and use the generalized flow sheets for different chemical processes.
4. To evaluate and assess the rate equations for any given chemical reaction
5. To compute and compare the basic design calculations of various reactors.

UNIT-I

Dimensions and System of Units: Fundamental quantities, derived quantities and conversions; SI and MKS system of Units; Basic Chemical Engineering calculations-Atomic, Molecular and Equivalent weights, molar concept, Concentration units for pure components, Vapor pressures, Moles, Mixers and solutions, Morality, Molality, Normality and Partial pressures; Laws of Chemical Combination; Definition of Stochiometry; Composition of mixers and solutions; Weight fraction; Mole fraction; Volumetric composition; Density and Specific gravity, Ideal gas law; Ideal mixtures and solution; Dalton's law of additive pressures; Amagats law of additive volumes.

UNIT-II

Operations in Bioprocesses: Application of principles of unit operations and unit processes in biotech Industries, Application of principles of transport phenomenon (momentum, mass and heat transfer) in bioprocessing. Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets. Laws of conservation of mass, meaning of material balance and its applications, Process flow sheet, Drawing material balance on non reacting steady system, Conversion, yield, Limiting reactants, Excess reactants, Recycling, By-passing, Material balances on steady state reacting systems with recycling and By-passing.

UNIT-III

Material Balances: Law of conservation of energy, Meaning of energy balance and its importance, Inputs of energy balance, Specific heat and sensible heat, Latent heat and heats of transition, Sublimation, Enthalpy of solutions, Standard heats of formation, Standard heats of combustion, Standard heats of reaction, Bess's law, Kirchoffs law, Determination of heat of reaction at temperature other than standard temperature using specific heat relationships, Combustion calculations, Combustion air requirements, determination of flue gas composition from fuel composition and vice versa.

UNIT-IV

Introduction to Reaction Kinetics: Concepts of Reaction Kinetics, Types of reaction, order of reaction, The effect of temperature and pH on reaction rate. Rate equations and Reaction mechanisms; Interpretation of batch reactor data, constant volume batch reactor, integral method of analysis of data for reversible and irreversible reactions. Searching for mechanism - Arrhenius equation - Growth Kinetics: Batch growth quantifying cell concentration, chemostat growth.

UNIT-V

Introduction To Bioreaction Engineering: Definitions, Differences and similarities between chemical and bioreactors; Classification of bioreactors; Reactor configurations; Description of a conventional bioreactor with all aspects; Design and construction criteria of a bioreactor; Residence time distributions, concentration, and temperature distributions; Models of non-ideal reactors. Animal and plant cell reactor technology- Environmental requirements for animal

cell cultivation, reactors for large-scale production using animal cells, plant cell cultivation.

Text Books:

1. Hougen and Watson. K.M., and Ragatz R A, "Chemical Process Principles", 2 nd Edition, Wiley, 1959.
2. Bhatt B I and S M Vora, "Stoichiometry", 4/ e, Tata McGraw Hill, 2006.

Suggested Reading:

1. David M. Himmelblau, James B. Riggs, "Basic Principles and Calculations in Chemical Engineering", 8/e, Prentice Hall, 2012.
2. Swamy AVN, "Fundamentals of Biochemical Engineering", BS Publications, 2007.

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18BT C07

GENETICS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of genetics, ie. Concept of how genes are responsible for inheritance of characteristics.
2. Students are taught the structure of chromosome, and how it stores genetic information.
3. Importance of chromosome taught by showing the effects of mutations on chromosomes.
4. Students are enlightened about crossing over being the basis of genetic diversity.
5. Students are made aware of chromosome related genetic disorders.

Course Outcomes: At the end of the course students will be able to

1. Apply to real life situations, the principles of human heredity.
2. Be able to describe the chromosomal basis of inheritance arised due to abberations in chromosomal structure and number.
3. Be able to map understand the organization of genes due to linkage and crossing over mechanism.
4. Be able to predict the chromosomal basis of mendelism, in sex linked genes and sex determination.
5. Able to analyze concept of non mendelian maternal inheritance and population level genetic processes.

UNIT-I:

Physical Basis Of Heredity: Mendel's laws of inheritance – segregation, independent assortment, modification of mendelian principles: Dominance and recessive genes, co-dominance, incomplete dominance, Gene and Alleles, multiple alleles, gene interactions, epistatic interactions, pleotropism.

UNIT-II

Chromosome Structure and Abberations: Prokaryotic and eukaryotic genome; karyotyping; specialized chromosomes: gaint chromosomes – polytene and lamp brush chromosomes; chromosomal aberrations- structural aberrations (deletions,

UNIT-III

duplication, inversion and translocation), numerical aberrations (aneuploidy, euploidy, auto polyploidy and allopolyploidy). Mutations – spontaneous, induced; physical and chemical mutagens; lethal mutation (characteristics and types), AMES test, applications of mutations.

Linkage And Crossing Over: Concept of linkage and crossing over, cytological basis of crossing over (in Drosophila and Maize), factors affecting recombination frequency, linkage maps; mechanism of recombination – model involving single strand breaks and double strand break in DNA duplex, significance of Crossing over. Two point and three point test cross. Interference. Tetrad analysis.

UNIT-IV

Sex Determination, Sex Linked And Genetic Disorders: Sex chromosomes, sex determination mechanism in animals (insects and humans) and plants, sex determination by genic balance and Y-linked genes. Dosage compensation, Maryleon's hypothesis; sex linkage and its disorders; autosomal disorders in human beings. Garrod's inborn errors of metabolism.

UNIT-V

Extra Chromosomal Inheritance and Quantitative Genetics: Extra chromosomal inheritance – inheritance of mitochondrial and chloroplast genes, maternal inheritance (CMS, nuclear petites in yeast, Mirabilus jalapa). Transgressive segregation, quantitative characters, Gene frequency, gene pool, Hardy- Weinberg Law, equilibrium, Fitness and selection Goodness of fit: Chi-square-test.

Text Books:

1. Snustad, D.Peter, Simmons Michael, "Principles of Genetics 6th edition", John Wiley& Sons publication, 2012.
2. Singh, B.D. "Genetics - 3rd edition", Kalyani Publications, 2004.
3. Gardner, E. J., Simmons, M. J., Snustad, D. P. and Snustad, "Principles of Genetics", John Wiley and Sons, Inc. 1985.

Suggested Reading:

1. Verma PS, Agrawal VK, "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology". S. Chand & Company Ltd., New Delhi, 2004.
2. Gupta PK, "Genetics", 4^{th} Rev Edition (2nd Reprint) Rastogi Publications, 2011.

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Code: 18EG M01

INDIAN CONSTITUTION

(BE/BTech III/IV Semester - Common to all branches)

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives

The course will introduce the students to :

1. The history of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes

After successful completion of the course the students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Have an insight into various Organs of Governance - composition and functions.
3. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
4. Be aware of the Emergency Provisions in India.
5. Understand the Right To equality, the Right To freedom and the Right to Liberty.

Unit-I

Constitution of India: Introduction and salient features. Constitutional history. Directive Principles of State Policy - Its importance and implementation.

Unit-II

Union Government and its Administration: Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States.

Parliamentary form of government in India. President: role, power and position.

Unit-III

Emergency Provisions in India: National emergency, President rule, Financial emergency

Unit IV

Local Self Government: District's Administration Head: Role and Importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Panchayati Raj: Introduction, Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and officials.

Unit V

Scheme Of The Fundamental Rights & Duties: Fundamental Duties - the legal status.

Scheme Of The Fundamental Rights - To Equality, to certain Freedom Under Article 19, to Life And Personal Liberty Under Article 21.

Suggested Reading:

1. **The Constitution of India**, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, **Framing of Indian Constitution**, 1st Edition, 2015.
3. M. P. Jain, **Indian Constitution Law**, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu**, Introduction to the Constitution of India**, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

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18EE M01

INDIAN TRADITIONAL KNOWELDGE

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Course Outcomes: After completion of this course, students will be able to:

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

UNIT-I

Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT-II

Indian Languages, Culture and Literature:

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India.

Indian Languages and Literature-II: Northern Indian languages & literature

UNIT-III

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT-IV

Fine arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India .

UNIT-V

Education system in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Text Books:

1. Kapil Kapoor, Text and Interpretation: The India Tradition,ISBN: 81246033375, 2005.
2. Science in Samskrit, Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007.
3. S. Narain, Examinations in ancient India, Arya Book Depot, 1993.
4. Satya Prakash, Founders of Sciences in Ancient India, Vijay Kumar Publisher, 1989.
5. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014.

Suggested Reading:

1. Kapil Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
2. Karan Singh, A Treasury of Indian Wisdom: An Anthology of Spiritual Learn,ISBN: 978-0143426158, 2016.

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18BT C08

BIOCHEMISTRY LAB

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Course objectives:

1. Students will learn the laboratory safety and standard operating procedures
2. Students will learn how to estimate and analyze different biomolecules

Course outcomes: At the end of the course students will be able to

1. Apply the laboratory safety and standard operating procedures and prepare the solutions and biological buffers
2. Estimate and analyze carbohydrate by different methods
3. Estimate and analyze amino acids and proteins by different methods
4. Estimate and analyze lipids and compare the acid value, Saponification value and iodine valve of various lipids.
5. Estimate and analyze nucleic acids

List of Experiments:

1. Introduction to Biochemistry Lab: Units, Volume / Weight measurements, concentration units
2. Preparation of Solutions – percentage solutions, molar solutions, normal solutions and dilution of stock solution
3. Measurement of pH
4. Preparation of buffers and reagents
5. Titration curve of amino acid and calculation of pK and pI values
6. Estimation of Carbohydrates by Anthrone method
7. Estimation of Amino acids by Ninhydrin method
8. Estimation of Proteins by Biuret method
9. Estimation of Proteins by Lowry method
10. Determination of Acid value, Saponification value and Iodine Number of Fat
11. Estimation of Cholesterol by Liebermann Burchard method
12. Estimation of DNA by Diphenyl amine method
13. Estimation of RNA by Orcinol method

Suggested Reading:

1. David, T. Plummer, "An introduction to Practical Biochemistry", 3rd edition, Tata McGraw Hill, 1988.
2. Beedu Sashidhar Rao, Vijay Deshpande, "Experimental Biochemistry – A student companion", Anshan Pub, 2006.

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18BT C09

MICROBIOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Course Objectives:

Students are made to understand the following experiments during their course of time:

1. Proper handling and focusing of Bright Field microscope
2. Physical and chemical sterilization methods for control of microorganisms
3. Preparation of culture media
4. Techniques for the isolation of pure cultures
5. Simple and Gram staining techniques

Course Outcomes: At the end of the course students will be able to

1. Outline of Magnification, Resolution, Refractive index of Microscope
2. Operate the physical sterilization equipments
3. Prepare the basic culture media for the growth of microorganisms
4. Perform streak plate, spread plate and pour plate techniques.
5. Identify type of bacteria (Gram positive or Gram negative)

List of Experiments:

1. Calibration of Microscope and Measurement of Microorganisms-Microtome.
2. Staining and Identification of microorganism: (a) Simple and Differential staining techniques.
3. Sterilization techniques (Autoclaving, Hot Air Oven, Radiation and Filtration).
4. Preparation of culture media (a) broth type of media (b) Agar.
5. Culturing of microorganism (a) broth (b) pure culture techniques-Streak plate, Pour plate.
6. Antibiotic tests- Disc diffusion method, minimum inhibitory concentration.
7. Biochemical tests- IMIVC test, Catalase, Coagulase test, Gelatinase test, Oxidase.
8. Factors affecting the bacterial growth and study of growth curve.

9. Measurement of Microbial Growth by Turbidometry and enumeration of bacterial numbers by serial dilution.
10. Measurement of Microbial Growth by Viable Count.
11. Production of Beer and Wine
12. Coliform test

Suggested Reading:

1. Gopal Reddy M, M.N. Reddy, D.V.R. Sai Gopal and K.V. Mallaiah , "Laboratory Experiments in Microbiology",3rd edition, Himalaya Publishing House Pvt Ltd, 2008,
2. Gunasekaran P., "Laboratory manual in Microbiology", 3rd edition, New Age International Publ., New Delhi, 2007.
3. Kannan N., "Laboratory manual in General Microbiology", 1st edition, Panima Publishing Corp., New Delhi, 2002.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
Department of Bio-Technology
B.Tech (Bio-Technology)

SEMESTER IV

S.No	Course Code	Title of the Course	Scheme of Instruction: Hours Per week L	T	P	Scheme of Examination: Duration of SEE in Hours	Maximum Marks CIE	SEE	Credits
	THEORY								
1	18CS C05	Basics of Data Structures	2	-	-	2	20	50	2
2	18BT C10	Immunology	4	-	-	3	30	70	4
3	18BT C11	Instrumental Methods in Biotechnology	4	-	-	3	30	70	4
4	18BT C12	Chemical and Biochemical Thermodynamics	3	-	-	3	30	70	3
5	18ME C09	Principles of Management	3	-	-	3	30	70	3
6	18CE M01	Environmental Science	2	-	-	2	-	50	Non-Credit
	PRACTICALS								
7	18CS C06	Basics of Data Structures	-	-	2	2	15	35	1
	18BT C13	Immunology Lab	-	-	2	2	15	35	1
8	18BT C14	Instrumentation Lab	-	-	2	2	15	35	1
9	18EG C03	Soft Skills Lab	-	-	2	2	15	35	1
Total			**18**	**-**	**8**	**-**	**200**	**520**	**20**
Clock Hours Per Week -26									

L: Lecture T: Tutorial P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

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18CS C05

BASICS OF DATA STRUCTURES
(Common for other Programmes)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	20 Marks
Credits	2

Pre-requisites: Basic knowledge of programming language such as C or C++ is preferred (but not mandatory) and some mathematical maturity also will be expected.

Course Objectives:
To introduce
1. Basic linear and non-linear data structures.
2. Analyzing the performance of operations on data structures.
3. Different sorting and searching techniques and their complexities.

Course Outcomes: At the end of the course students will be able to
1. Understand the basic concepts of data structures.
2. Understand the notations used to analyze the performance of algorithms.
3. Choose and apply an appropriate data structure for a specified application.
4. Understand the concepts of recursion and its applications in problem solving.
5. Demonstrate a thorough understanding of searching and sorting algorithms.

UNIT-I
Introduction: Data Types, Data structures, Types of Data Structures, Operations, ADTs, Algorithms, Comparison of Algorithms, Complexity, Time- space tradeoff.
Recursion: Introduction, format of recursive functions, recursion Vs. Iteration, examples.

UNIT-II
Linked Lists: Introduction, Linked lists and types, Representation of linked list, operations on linked list, Comparison of Linked Lists with Arrays and Dynamic Arrays.

UNIT-III

Stacks and Queues: Introduction to stacks, applications of stacks, implementation and comparison of stack implementations. Introduction to queues, applications of queues and implementations, Priority Queues and applications.

UNIT-IV

Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree, Conversion of General Trees to Binary Trees, Representations of Trees, Tree Traversals, Binary search Tree.

UNIT-V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees.
Searching and Sorting: Linear searching, binary Searching, sorting algorithms- bubble sort, selection sort, quick sort, heap sort.

Text Books:

1. Narasimhaarumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, 2017
2. S. Sahni and Susan Anderson-Freed, Fundamentals of Data structures in C,E.Horowitz, Universities Press, 2nd Edition.
3. ReemaThareja, Data Structures using C, Oxford University Press.

Suggested Reading:

1. D.S.Kushwaha and A.K.Misra, Data structures A Programming Approach with C, PHI.
2. Seymour Lipschutz, Data Structures with C, Schaums Outlines, Kindle Edition

Online Resources:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-1#DS

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18BT C10

IMMUNOLOGY

Instruction	4 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Course Objectives:

1. Students learn about the basic components and responses of Immune system
2. Knowledge of Antigen and antibody and the application of Antigen and antibody reaction
3. Importance of Antigen Processing and Presentation is emphasized.
4. Students understand significance of complement system and hypersensitivity
5. The immunological basics for diseases is taught to the students

Course Outcomes: At the end of the course students will be able to

1. Identify Immune system components and how they work in a coordinated way.
2. Apply the application of antigen-antibody interactions in development of medical diagnostic kits.
3. Analyze the Immune system related underlying causes in Allergies, Asthma and other hypersensitive reactions.
4. Acquainted with the diseases caused due to Immune system malfunctioning.
5. Explain the Immune system related medical complications in transplantation and Cancers.

UNIT-I

Immune System: Introduction to immunity, types of immunity – innate and adaptive immunity, humoral and cell mediated immune response, hematopoiesis, cells of the immune system, organs of immune system – primary (bone marrow and thymus) and secondary (lymph node, spleen, MALT, GALT), molecules of immune system (cytokines, interleukins, interferons, chemokines).

UNIT-II

Antigen, Antibody and its Interaction: Antigen – immunogenicity and antigenicity, factors influencing immunogenicity, haptens and adjuvants, epitopes; Immunoglobulin – structure, classes and function, antigenic determinants of immunoglobulin – isotype, allotype, idiotype, generation of antibody diversity, production of monoclonal antibodies by hybridoma technology and its applications. Strength of antigen antibody interaction, affinity, avidity, cross reactivity, precipitation, agglutination, immunoelectrophoresis, RIA, ELISA, western blotting, immunofluorescence, FACS.

UNIT-III

Antigen Processing and Presentation: Major histocompatibility complex (MHC) – organization, classes and function; Antigen processing and presentation – role of antigen presenting cells, endogenous antigens (cytosolic pathway), exogenous antigens (endocytic pathway), presentation of nonpeptide antigen.

UNIT-IV

The Complement System and Hypersensitivity: Complement system – components, function, activation (classical and alternative pathway); Hypersensitive reactions – Type I (IgE mediated hypersensitivity), type II (antibody mediated cytotoxic hypersensitivity), type III (Immune complex mediated hypersensitivity), type IV (delayed type hypersensitivity).

UNIT-V

Medical Applications Of Immunology: Autoimmunity – organ specific (insulin dependent diabetes mellitus, Graves' disease, myasthenia gravis) and systemic (systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis) autoimmune diseases, treatment of autoimmune diseases; Transplantation – immunological basis of graft rejection, immunosuppressive therapy (general and specific), immunoprophylaxis (attenuated, inactivated and DNA vaccines), immunology of cancer- tumour antigens, immune response to tumour, cancer immunotherapy

Text Books:

1. Judith A. Owen, Jenni Punt, Sharon A.Stranford, "Kuby Immunology", 7th edition, W.H. Freeman, 2013.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, "Roitt's Essential Immunology", 12th edition,John Wiley & Sons, 2011.

Suggested Reading:

1. Kenneth Murphy, "Janeway's Immunobiology", 8th edition, Garland Science, 2011.
2. Abdul K. Abbas, Andrew H. Lichtman, Shiv Pillai, "Cellular and Molecular Immunology 7th edition", Elsevier Health Sciences, 2011.
3. Sunil Kumar Mohanty and K. Sai Leela, "Text book of Immunology", 2nd edition, JP Medical Ltd, 2014.

18BT C11

INSTRUMENTAL METHODS IN BIOTECHNOLOGY

Instruction	4 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Course Objectives:

Students are made to understand the following concepts during their course of time:

1. Types of Analytical methods and Instruments used for Analysis, Importance of microscopy
2. Types of Instruments used for isolation of Biomolecules and Sub cellular organelles
3. Types of centrifuges like low speed, high speed, ultra centrifuges
4. Types of Chromatographic Techniques
5. Charge based separation Techniques

Course Outcomes: At the end of the course students will be able to

1. Solve the Analytical problems in instruments by Detection & sensitivity limits.
2. Assess the merits and demerits of instruments
3. Discuss Principle, procedure and applications of different types of centrifugation
4. Summarize Principle, Procedure and applications of chromatography's like TLC, paper
5. Explain Principle procedure and applications of different electrophoresis like SDS, Agarose

UNIT-I

Analytical Methods And Microscopy: Types of Analytical Methods - Instruments for Analysis (Types)- Uncertainties in Instrumental measurements - Sensitivity and detection limit for instruments; principle, procedure, and applications of Bright field. Dark field, fluorescent and electron microscopy.

UNIT-II

Instruments For Isolation Techniques: Cell disruption by French press, Sonification, freeze thaw technique; use of liquid N2 and chemical approaches involved in cell disruption; Isolation of Biomolecules and cell organelles: centrifugation; basic principles of sedimentation, sedimentation coefficient, Svedberg Unit; various types of centrifuges, their uses, rotors, fixed angle, vertical, swing out, zonal rotors; preparative centrifugation, differential density gradient centrifugation, analytical ultra centrifugation; Materials used in preparation of density gradient- sucrose & cesium chloride; Isolation of sub cellular organelles and Biomolecules. Determination of molecular weight and purity of Biomolecules by analytical ultra centrifugation.

UNIT-III

Separation Techniques: Partition coefficient, partition chromatography, counter current distribution, adsorption chromatography,Paper, TLC& GLC, adsorption media, solvent, continuous and gradient elution, fraction collection and detection of pure molecules. Methods based on size: Gel permeation chromatography, principle application- Molecular weight determination. Dialysis and its significance. Affinity chromatography, application & technique for purification of proteins and nucleic acids.

UNIT-IV

Charge Based Separation Techniques: Principle and application of Ion exchange chromatography, use of ion exchange- cation & anion exchangers, pH and salt gradients for elution of proteins, amino acids and nucleotides. Electrophoresis: Migration of charged molecules in electric field-moving boundary, paper, cellulose acetate, starch gel electrophoresis, SDS PAGE, Determination molecular weight, iso-electric focusing and its significance. Identification of specific proteins by western blotting. Agarose gel electrophoresis-separation of DNA & RNA, by agarose gel electrophoresis, recovery of DNA fragments from agarose gels, southern & northern blot techniques and their significance, pulse field gel electrophoresis.

UNIT-V

Spectrometric Identification Techniques: Basic concepts of spectroscopy, Visible & UV spectroscopy & Explain Beer lamberts law; Principles and application of Colorimetry & Flame photometry, Nephlometry; Principles and applications of Atomic absorption Spectrophotometry; Principles & applications of IR, ESR NMR & Mass spectroscopy; Explains the laws of photometry.

Text Books:

1. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th edition, Cambridge University Press, 2005.
2. Sivasankar, Instrumental Methods of Analysis, Oxford higher education, OUP, India, 2012.

Suggested Reading:

1. GW Ewing, Instrumental Methods of Chemical Analysis, 4th edition, Mc Graw Hill, 1985.
2. Hobert H Willard D.L.Merritt and J.R.J.A.Dean, Instrumental Methods of Analysis, CBS publishers & Distributors, 1992.
3. Skoog DA, Fundamentals of Analytical Chemistry, Thomson Brooks/ Cole, 2004.

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18BT C12

CHEMICAL AND BIOCHEMICAL THERMODYNAMICS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Course aims at developing to reason so that students can apply thermodynamic principles in the solution of practical problems.
2. The aim of the course is also to give students an understanding of equilibrium conditions of chemical and biochemical extractions.
3. The course aims to give students the concepts of the transfer of chemical species between phases.
4. The course aims to facilitate students to apply I and II law of thermodynamics to open and closed systems to turbines and heat engines.
5. The course aims to give students the knowledge to calculate oxygen consumption and heat evolution in aerobic cultures.

Course Outcomes: At the end of the course students will be able to

1. Measure heat and work increments for closed systems and cyclic processes.
2. Evaluate nozzle, turbine and compressors based on the principles of I-law of thermodynamics.
3. Calculate the coefficient of performance of heat engines and heat pump
4. Predict the extent of various reactions by Gibbs and Duhem equation.
5. Calculate separation processes like distillation based on vapour liquid equilibrium for binary systems and calculate equilibrium conversions.

UNIT-I

Introduction To Thermodynamics: System Definition and Classification of system – closed and open system based on number of components, exchange of mass and heat. State and Path Functions, equilibrium, Phase rule. Thermodynamic Properties of fluids. Forms of energy, classification of properties. I-Law of Thermodynamics, application of I-law to closed.

Volumetric Properties of Fluids: PVT behavior of pure fluids. Real and Ideal Gas. Equations of state – Ideal gas law, Virial equations of state (restricted to first two terms). Cubic equations of state – Vander Waals and Redlich kwong. Processes involving ideal gases (isochoric, isobaric, isothermal, adiabatic, polytropic – simple applications)

UNIT-II

The Second Law Of Thermodynamics: Limitations to I-law, qualitative statement of Kelvin Plank and Clausius versions of II-law, entropy – definition, entropy and heat calculations for ideal gases. Maxwell relations – problems not included, Residual properties – definition (VR, HR, SR , GR – basic property relations for ideal gases, problems not included)

UNIT-III

Solution Thermodynamics: Partial molar properties – definition and simple applications involving calculation of partial molar properties for binary systems using analytical methods (no graphical method). Concepts of Chemical potential and fugacity (for pure species and species in solution). Lewis Randall rule, Raoult's law, Henry's law – Definition and simple applications. Excess properties – definition and fundamental relation for excess Gibbs free energy, (problems not included). Activity and activity coefficients, correlations to calculate activity coefficients – Margules, Van Laar and applications involving binary systems.

UNIT-IV

Topics In Phase Equilibria And Chemical Reaction Equilibria: Vapor-liquid equilibrium calculations for binary systems – P-x-y ,T-x-y diagrams, using simple Raoult's law to binary mixture. Chemical Reaction Equilibria: Equilibrium criteria for homogenous chemical reactions. Standard Gibbs energy change of reaction, **Reaction co-ordinate** –definition. Evaluation of equilibrium constant – numerical problems not included. Effect of pressure and temperature on equilibrium constant – qualitative treatment, simple problems involving temperature dependence of equilibrium constant. Calculation of equilibrium conversions and yields for single reactions.

UNIT-V

Bioenergetics: Energetics of Metabolic Pathways, Energy coupling (ATP & NADH). Stoichiometry and energetic analysis of Cell Growth and Product Formation. Thermodynamics of microbial growth. Oxygen consumption and heat evolution in aerobic cultures. Energy balance equation for cell culture

Text Books:

1. J.M.Smith, H.C.Van Ness and M.M.Abbott, "Introduction to Chemical Engineering Thermodynamics", 6th ed, TMH, 2003.
2. J.A.Roels, "Energetics and kinetics in biotechnology" , Elsevier, 1983.
3. Y.V.C.Rao , Revised edition , "An introduction to thermodynamics", Universities Press, 2004.

Suggested Reading:

1. Robert A.Alberty, "Biochemical Thermodynamics: Applications of Mathematica", John Wiley and Sons, 2006.
2. Stanley I. Sandler, "Chemical and Engineering Thermodynamics", 3rd Edition, Wiley, 1999.
3. K.V.Narayanan, "A Textbook of Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd, 2004.

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18ME C09

PRINCIPLES OF MANAGEMENT

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
To make the students to

1. Understand basic fundamentals and insides of management
2. Understand the nature and purpose of planning
3. Gain the knowledge about the frame work organizing
4. Understand the essence and significance of directing
5. Recognize the importance of controlling and its outcomes

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Course Outcomes: At the end of the course students will be able to

1. Identify and evaluate the principles of management
2. Demonstrate the ability to have an effective and realistic planning
3. Identify the nature and the type of organization
4. Apply the tools and techniques of directing
5. Explain and evaluate the necessity for controlling and further refinement of an organization.

UNIT-I

Management: Definition of management, science or art, manager vs entrepreneur; managerial roles and skills; Evolution of management, Basic management theories by FW Taylor, Henry Fayol, Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management

UNIT-II

Planning: Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Planning plant location and layout, Decision making steps & processes.

UNIT-III

Organizing: Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management

UNIT-IV

Directing: Individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT-V

Controlling: system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:

1. S.P. Robins and M. Couiter, "Management", 10/e., Prentice Hall India, 2009.
2. JAF Stoner, RE Freeman and DR Gilbert, "Management", 6/e., Pearson Education, 2004.

Suggested Reading:

1. P.C. Tripathy & P.N. Reddy, "Principles of Management", Tata McGraw Hill, 1999
2. Harold Koontz and Cyril O'Donnell "Principles of Management'', Tata McGraw Hill, 2017.

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18CE M01

ENVIRONMENTAL SCIENCE
(MANDATORY COURSE)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives: To enable the student:

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Become aware about the importance of eco system and biodiversity for maintaining ecological balance
3. To identify the importance of interlinking of food chain
4. Learn about various attributes of pollution management and waste management practices.
5. To make the students contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes: At the end of the course, the student should have learnt

1. To define environment, identify the natural resources and ecosystems and contribute for the conservation of bio-diversity.
2. To suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
3. To relate the social issues and the environment and contribute for the sustainable development.
4. To follow the environmental ethics.
5. To contribute for the mitigation and management of environmental disasters.

UNIT – I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "*Introduction to Environmental Science*", B S Publications, **2004**.
2. Suresh K. Dhameja, "*Environmental Studies*", S. K. Kataria& Sons, **2009**.

Suggested Reading:

1. C. S. Rao," *Environmental Pollution Control Engineering*", Wiley, **1991**.
2. S. S. Dara, "*A Text Book of Environmental Chemistry &Pollution Control*", S. Chand Limited, 2006

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18CS C06

BASICS OF DATA STRUCTURES LAB
(Common for other Programmes)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Pre-requisites: Any Programming Language(C)

Course Objectives:

1. Design and construct simple programs by using the concepts of Data structures as abstract data type.
2. To have a broad idea about how efficiently pointers can be used in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To strengthen the practical ability to apply suitable data structure for real time applications.

Course Outcomes: At the end of the course students will be able to

1. Implement the abstract data type.
2. Implement linear data structures such as stacks, queues using array and linked list.
3. Understand and implement non-linear data structures such as trees, graphs and its traversal techniques.
4. Implement various kinds of searching, sorting techniques.
5. Develop the suitable data structure for real world problem.

List of Experiments

1. Implementation of operations on arrays.
2. Implementation of Stack.
3. Implementation of Queue.
4. Implementation of basic operations on Single Linked List.
5. Implementation of Searching techniques.
6. Implementation of Sorting techniques.
7. Case study like Banking System, Students Marks Management, Canteen Management etc.

Text Books:

1. Brian W Kernighan, Dennis Ritchie, C Programming Language, PH PTR, 2nd Edition.
2. Richard M Reese, Understanding and Using C Pointers, O'Reily , 2013.

WebLinks:

https://nptel.ac.in/courses/106102064/

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18BT C13

IMMUNOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Course Objectives:

Students identifies significance of blood grouping

1. The applications of Antigen antibody agglutination are demonstrated.
2. The applications of Antigen antibody Precipitation are demonstrated.
3. Students learn about diagnostic kits based on immunology
4. Students learn to interpret results

Course Outcomes: At the end of the course students will be able to

1. Demonstrate how Antigens and Antibody interact.
2. Identify agglutination and precipitation reactions.
3. Interprets the results based on the results of the antigen-antibody interaction.
4. Analyze the importance of different Immunological techniques developed.
5. Outline the importance of blood group matching in blood transfusions and other cases are practically demonstrated.

List of Experiments:

1. ABO Blood Grouping and Identification of Rh typing
2. Rocket immuno electrophoresis
3. Ouchterlony Double Diffusion for Antigen Antibody Patterns (ODD)
4. Immuno-electrophoresis (IEP)
5. Radial Immune Diffusion test (RID)
6. Widal test
7. VDRL tests
8. Total and Differential count of RBC & WBC by Micropipette method
9. Erythrocyte sedimentation rate
10. Enzyme Linked Immunosorbent Assay (ELISA) for Antigen capture and Antibody capture.
11. Estimation of Immunoglobullins by Precipitation with Saturated Ammonium Sulphate.

Suggested Reading:

1. Arti Nigam and Archana Ayyagari, Lab Manual in Biochemistry, "Immunology and Biotechnology", Tata McGraw Hill Education, 2007.
2. S. Ramakrishna and K.N. Sulochana, "Manual of Medical Laboratory Techniques", 1st edition, J.P. Medical Ltd, 2013.
3. Kanai L. Mukherjee and Swarajith Ghosh, "medical Laboratory Techniques, (Vol-I): Procedure Manual for Routine Diagnostic tests", 2nd edition, Tata McGraw Hill education.

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18BT C14

INSTRUMENTATION LAB

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Course Objectives:

With help of this course Students are expected to

1. Understand the basic concepts for the operation of Ph and spectrophotometer.
2. Estimate the micro and macro molecules by using chromatography techniques.
3. Separate the biomolecules with the application of different methods of electrophoresis.

Course Outcomes: At the end of the course students will be able to

1. Relate the instrumentation techniques to their real life applications.
2. Demonstrate their knowledge on different Spectrophotometers.
3. Identify and solve the problems associated with determination of molecular weights by chromatography and electrophoresis techniques.
4. Compare and analyze different biomolecules by using flame photometry and fluorometry.
5. Justify their results on separation of biomolecules by differential centrifugation methods.

List of Experiments:

1. The calibration of pH meter and measurement of pH for different solutions
2. Estimation of Ascorbic acid by colorimetric assay
3. Estimation of unknown samples by using conductivity meter
4. Estimation of different macromolecules by visible spectrophotometer
5. Verification of Lambert - Beers law by UV -VIS spectrophotometer
6. Estimation of proteins and nucleic acids by U.V method

7. Estimation of turbidity using Nephlometer
8. The separation of different macromolecules by Paper, Thin layer chromatography
9. The separation of different macromolecules by Paper, PAGE, SDS-PAGE
10. Estimation of minerals by Flame photometry
11. Estimation of Thiamine and Riboflavin by Fluorimetry
12. Preparation of Standard curve using UV-VIS & Flame Photometry
13. Fractionation of Plasma Proteins by Electrophoresis
14. Sub-cellular fractionation studies by differential centrifugation

Suggested Reading:

1. Sivasankar, Instrumental Methods of Analysis, Oxford higher education, OUP, India, 2012.

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18EG C03

SOFT SKILLS LAB

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Course Objectives: The course will introduce the students to:

1. Imbibe an impressive personality, etiquette, professional ethics & values, effective time management & goal setting.
2. Understand the elements of professional update & upgrade through industry exposure in a mini-live project. Understand confidence building strategies and thereby to make effective presentations through PPTs.
3. Learn what constitutes proper grooming and etiquette in a professional environment. Acquire the necessary skills to make a smooth transition from campus to corporate.

Course Outcomes: At the end of the course students will be able to

1. Be assertive and set short term and long term goals. Also learn to manage time effectively and deal with stress.
2. Win in professional communication situations and participate in group discussions with confidence. Write abstracts.
3. Write effective resumes. Plan, prepare and face interviews confidently.
4. Adapt to corporate culture by being sensitive - personally and sensible - professionally. Draft an SOP.
5. Apply the soft skills learnt in the mini-live project, by collecting and analyzing data and making oral and written presentations on the same.

Exercise-1

Main Topics: Thinking Skills, Personality Development – Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.

Flipped Sessions: Personal Sensitivity & Professional Sensibility (Reading & Discussion)

Writing Input: Writing to Express - Drafting & Delivering a Speech (Free Writing Exercise)

Exercise-2

Main Topics: Advanced Group Discussion with Case studies : Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.

Flipped Sessions: Importance of Professional Updating & Upgrading (Reading & Discussions)
Writing Input: Writing with Precision - Writing Abstracts

Exercise-3

Main Topics: Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews. Resume' writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skills.
Flipped Sessions: Mock Interviews (Video Sessions & Practice)
Writing Input: Writing to Reflect - Resume Writing

Exercise-4

Main Topic: Corporate Culture – Grooming and etiquette, communication media, academic ethics and integrity
Flipped Sessions: Corporate Culture, Etiquette & Grooming (Video Sessions & Practice through Role-play)
Writing Input: Writing to Define - Writing an effective SOP.

Exercise-5

Main Topic: Mini Project – General/Technical. Research, developing a questionnaire, data collection, analysis, written report and project seminar. Elements & Structure of effective presentation. Presentation tools – Body language, Eye-contact, Props & PPT.
Flipped Sessions: Effective Presentations (Video & Writing Sessions, Practice through Emulation)
Writing Input: Writing to Record - Writing minutes of meeting.

Suggested Reading:

1. Madhavi Apte , "A Course in English communication", Prentice-Hall of India, 2007
2. Dr. Shalini Verma, "Body Language- Your Success Mantra", S Chand, 2006
3. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010
4. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004

* Flipped Class-room: Students explore the concept first and then trainer explains it, students work on their own.

Web Resources:

1. https://www.goskills.com/Soft-Skills
2. https://www.trainerbubble.com
3. https://www.skillsconverged.com

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CHAITANYA BHARATHI INSTITUTE OFTECHNOLOGY (A)

Choice Based Credit System (with effect from 2018-19)

B.Tech (Bio-Technology)

S.No	Course Code	Title of the Course	Scheme of Instruction Hours per week		Scheme of Examination			Credits
					Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16MT C08	Biostatistics	3	-	3	30	70	3
2	16BT C19	Fluid Mechanics and Heat Transfer	3	-	3	30	70	3
3	16BT C20	Protein Engineering and Enzyme Technology	4	-	4	30	70	4
4	16BT C21	Genetic Engineering and rDNA Technology	3	-	3	30	70	3
5	16BT E22 16BT E23 16MT E02	**Elective-I** 1. Environmentl Biotechnology 2. Food Biotechnology 3. Computational Numerical Methods	3	-	3	30	70	3
6	18CS E02 16BT E24 16BT E25	**Elective-II** 1. Python for Bioinformatics 2. Virology 3. Metabolic Engineering	3	-	3	30	70	3
PRACTICALS								
7	16BT C26	Fluid Mechanics and Heat Transfer Lab	-	3	3	25	50	2
8	16BT C27	Enzyme Technology Lab	-	3	3	25	50	2
9	16BT C28	Genetic Engineering Lab		3	3	25	50	2
		Total	19	9		255	570	25
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BIOSTATISTICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. Explain and apply principles of design, data collection and represent the data graphically.
2. Understand properties of the normal curve.
3. Infer properties of a population from a sample.
4. Compute simple probabilities of events.

Course Outcomes: At the end of the course the students are able to

1. Demonstrate the ability to apply fundamental concepts in exploratory data analysis.
2. Understand the concept of the sampling distribution of a statistic, and in particular describe the behavior of the sample mean.
3. Understand the foundations for classical inference involving. confidence intervals and hypothesis testing.
4. Apply inferential methods relating to the means of Normal distributions.
5. Demonstrate an appreciation of one-way analysis of variance (ANOVA).

UNIT – I DESCRIPTIVE STATISTICS

Types of data – Methods of collection of data-Graphical representation of data-Histogram-frequency polygon-Pie chart. Frequency distribution-Measures of central tendencies - Measures of dispersion (mean deviation and standard deviation) coefficient of variation and its significance Measures of dispersion-Skewness-Kurtosis-Boweyl's coefficient-Karl Pearson's coefficient of skewness- correlation-Lines of regression- applications of Biotechnology.

UNIT - II PROBABILITY

Classical approach- Axiomatic approach of probability. Basic theorems - addition and product theorem, conditional probability-Baye's theorem- applications to Biotechnology.

UNIT – III PROBABILITY DISTRIBUTIONS

Random variable- types of Random variable-probability mass function-probability density functions-Expectation, variance, co variance and their properties.

Probability function-Moment generating function (M.G.F), Cumulant generating function (C.G.F) and Characteristic function (CF). Discrete Distributions-Binomial distribution, Poison distribution-their expectation, M.G.F, C.G.F and

CF Continuous distributions: Normal Distribution- mean, variance, M.G.F and C.G.F. Properties of Normal distribution.

UNIT- IV INFERENCIAL STATISTICS I

Estimation-Hypothesis-Testing of Hypothesis-Types of Errors. Testing the single sample mean (αknown), Testing of single sample mean (σunknown).Testing the single sample proportion- single sample variance.

Testing the differences between two means, two proportions and two variances.

UNIT-V INFERENCIAL STATISTICS II

Testing of many proportions-χ^2 – test independent of attributes-r x c-tables. Analysis of variance-CRD.

Text Books:

1. Introduction to Bio-Statistics and Research Methods, by P.S.S Sunder Rao and J.Richard; fifth edition, PHI Learning Pvt. Ltd.2012.
2. Fundamentals of Applied Statistics by S.C.Gupta and Dr.V.K.Kapoor, Tenth edition, Publishers: Sultan Chand & Sons.

Suggested Reading:

1. Methods in Bio-Statistics by Mahajan, Japee Brothers Publishers, 2002
2. Text Book of Bio-Statistics; by A.K.Sharma Discovery Publishing House, 2005-Edition.
3. Fundamentals of Mathematical Statistics A Modern Approach, by S.C.Gupta and Dr.V.K.Kapoor, 10th edition, Publishers: Sultan Chand & Sons.

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16BT C19

FLUID MECHANICS AND HEAT TRANSFER

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in flow of fluids, flow field, flow past immersed bodies.
2. The course is designed to give an understanding on measurement of viscosity, flow measuring devices.
3. The course also deals with basic concepts in heat transfer, evaporation and condensation.

Course Outcomes: At the end of the course the students should

1. Be able to measure viscosity of different fluids.
2. Explain the functions of different flow measuring and monitoring devices.
3. Enable to calculate friction in flew process.
4. Enable to calculate pressure drop in flow process.
5. Calculate the heat transfer area, overall heat transfer co-efficient required for various processes.
6. Explain the operation of various, evaporators, condensers, heat exchange equipment.

UNIT-I BASIC CONCEPTS IN FLOW OF FLUIDS

Introduction, Nature of fluid, Rheology of fluids -Newton's law of viscosity. Concept of Newtonian and non-Newtonian fluids-Different types of non-Newtonian fluids with examples in bioprocessing. Measurement of viscosity using extrusion rheometer, plate and cone viscometer, coaxial cylinder viscometer etc.

UNIT-II FLOW FIELD

Friction losses in laminar flow through a circular tube (Hagen-Poiseuille equation), Friction losses in turbulent flow (Fanning equation), Pumping of fluids flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow -characterization by Reynold's number, pressure drop due to skin friction and form friction, friction factor chart, Hagen - Poiseuille equation.

UNIT-III FLOW PAST IMMERSED BODIES

Definition of drag and drag coefficient. Friction in flow through beds of solids, Brief introduction to flow of compressible fluids. Flow measuring and monitoring systems- valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box. Flow measuring devices-manometers, orifice-meter, venturimeter and rotameter. Brief description of Pumps and Blowers.

UNIT-IV BASIC CONCEPTS IN HEAT TRANSFER

Introduction and Mechanisms of heat transfer; Conduction heat transfer (through slab, cylinder & Sphere); Conduction through solids in series, Forced convection heat transfer inside pipes, Introduction to radiation heat transfer, Chilling and freezing of food and Biological materials. Heat transfer correlations, and calculations, basic heat exchange equipment.

UNIT-V BASIC CONCEPTS IN EVAPORATION AND CONDENSATION

Introduction, Types of evaporation equipment and operation methods; Overall heat transfer coefficients in evaporators; simple material balances. Calculation methods for single effect evaporators, Evaporation of biological materials. Types of condensation, numerical problems and condensation equipment.

Text books:

1. W L McCabe and JC Smith, "Unit operations in Chemical Engineering", 6th edition., McGraw Hill Intl. Ed, 2005.
2. Christie J. Geankoplis, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall India Pvt. Ltd.

Suggested Reading:

1. Kothandaraman CP and Rudramoorthy. R, "Basic Fluid Mechanics", New Age International Publishers, New Delhi, 1998.
2. Sachdeva RC, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 1996.

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16BT C20

PROTEIN ENGINEEERING AND ENZYME TECHNOLOGY

Instruction	4L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. The course aims at providing knowledge about structure and functions of proteins.
2. To understand the synthesis of proteins and analytical techniques for protein.
3. To learn the commercial applications of enzymes in diverse fields namely medicine, food industry, diagnostic industries.
4. To learn the role of enzyme kinetics and its action.
5. To understand the methods of enzyme immobilization and its mass transfer kinetics.

Course Outcomes: At the end of the course students will be able to

1. Explain structure properties and functions of proteins.
2. Outline protein isolation and analytical techniques.
3. Identify engineered proteins and its applications.
4. Discuss the applications of enzymes in different fields.
5. Explain the kinetics of enzyme action.
6. Compare various enzyme immobilization techniques and its mass transfer effects.

UNIT- I PROTEIN STRUCTURE AND FUNCTIONS

Peptide bond- Structure, functions; Proteins-classification and Biological functions; Physico-chemical properties, forces stabilizing protein structure - primary structure, secondary structure (á-helical, â-pleated sheets), super secondary structures, Ramachandran Plot, tertiary and quaternary structure; Myoglobin, Lysozyme, Ribonuclease A, Hemoglobin; Fibrous protein (Collagen).

UNIT- II PROTEIN SYNTHESIS AND PROTEIN DESIGN

Methods of protein isolation, purification and quantification; Chemical synthesis of peptides – Solid phase and liquid phase synthesis; Methods of detection (peptide mass fingerprinting, MALDI-TOF); Protein engineering strategies (Rational protein design & Directed evolution) and applications.

UNIT- III PRODUCTION AND APPLICATIONS OF ENZYMES

Enzyme nomenclature and classification of enzymes; Production and purification of crude enzyme extracts from plant, animal and microbial sources; Development of enzymatic assays; Applications of commercial enzymes; Proteases; Amylases; Lipases; Cellulases; Pectinases; Isomerases in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic purposes; Design of enzyme electrodes and their application as biosensors in industry, health care and environment.

UNIT- IV MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of enzyme action; Concept of active site and energetics of enzyme substrate complex formation; Specificity of enzyme action; Kinetics of single substrate reactions; Turn over number; Derivation of Michaelis -Menten equation; Multi substrate reaction mechanisms ; Types of Enzyme Inhibition; Allosteric enzymes.

UNIT - V ENZYME IMMOBILIZATION & MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS

Physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding; Advantages and disadvantages of different immobilization techniques; Overview of applications of immobilized enzyme systems; Analysis of Film and pore Diffusion Effects on kinetics of Immobilized Enzyme Reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors.

Text Books:

1. Trevor Palmer, Philip Bonner, "Enzymes", 2nd edition, Woodhead Publishing, 2007.
2. J.L. Jain, "Fundamentals of Biochemistry", revised edition, Chand (S.) & Co Ltd, India, 2016.

Suggested books:

1. Voet and Voet J.G, "Biochemistry", 4nd edition, John C.Wiley and Sons, 2010.
2. **Andreas S.** Bommarius and Bettina R. Riebel, "Biocatalysis - Fundamentals and Applications", Wiley-VCH, 2004.

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16BT C21

GENETIC ENGINEERING AND rDNA TECHNOLOGY

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

1. To provide theoretical concepts, basic principles and tools used in rDNA technology.
2. To learn essential features and various vectors used in gene cloning and rDNA technology.
3. To describe the principle, methodology and applications of PCR and molecular markers.
4. To outline the range of cloning strategies that are employed to clone a DNA sequence.
5. To describe how rDNA is used to produce proteins.
6. To illustrate the impact of rDNA technology on biotechnology applications.

Course Outcomes: At the end of the course students will be able to

1. Explain the basic principles and tools used in rDNA research starting from isolation of nucleic acid, enzymes etc.
2. Compare various types of cloning vectors and expression vectors and their use in rDNA technology.
3. Discuss about PCR, and its applications and molecular markers.
4. Predict various cloning strategies used in rDNA technology.
5. Identify high level expression of protein in different host systems
6. Apply gene cloning and rDNA technology in various fields.

UNIT-I: ISOLATION AND PURIFICATION OF DNA AND ENZYMES USED IN CLONING

Isolation and purification of DNA; Host controlled restriction and modifications; Enzymes used in cloning - **Restriction endonuclease, Polymerases, Ligase, Phosphatase, Kinase, Nuclease;** Restriction mapping; Blotting techniques – Southern, Northern and Western Blotting.

UNIT- II: CLONING VEHICLES

Essential features of cloning vectors; Cloning vectors - Plasmid vectors - pBR 322, pUC 18/19; Phage vectors – ëZAP, ëEMBL4; M13 derived vectors – M13mp18; Phagemid- Blue script vectors; Cosmid- pJB8; Artificial chromosomes - BAC, YAC; Expression vectors - pET vectors.

UNIT- III: POLYMERASE CHAIN REACTION AND MOLECULAR MARKERS

PCR – Principle, Designing of primers, PCR Methodology, RT-PCR, Multiplex PCR, PCR for site directed mutagenesis, Applications of PCR; Molecular marker – RFLP, RAPD, AFLP.

UNIT- IV: CLONING STRATEGIES

Construction of genomic and cDNA libraries; Basic concept of blunt end and cohesive end ligation, homopolymer tailing, use of linkers, adaptors. Introduction of cloned genes into hosts- Transformation, Transfection, packaging phage DNA *In vitro*; Detection of clones with desired gene; Methods of gene sequencing: - Maxam and Gilbert method, Sanger's dideoxy chain termination method, Pyrosequencing, automation of DNA sequencing.

UNIT- V: EXPRESSION OF RECOMBINANT PROTEINS AND APPLICATIONS OF rDNA TECHNOLOGY

High level expression of proteins in different host systems in *E. coli*, yeast, Insect and mammalian cells; Applications of Gene cloning and rDNA Technology - Recombinant Insulin, Recombinant Factor VIII, Golden rice. Introduction to Gene therapy (*Ex vivo* & *In vivo*), case study of ADA as an example. Safety guidelines for rDNA research.

Text books:

1. Brown TA, "Gene Cloning and DNA Analysis: An Introduction", 7th edition., Wiley Blackwell , A John Wiley & Son Ltd publications, UK, 2015.
2. Primrose SB and Twyman RM, "Principles of Gene manipulation and Genomics", 7th edition, John Wiley & Sons, 2013.

Suggested Reading:

1. Glick BR, Pasternak JJ and Patten CL, "Molecular Biotechnology: Principles and applications of Recombinant DNA", 4th edition, ASM Press, 2010.
2. Desmond S T Nicholl, "An Introduction to Genetic Engineering", 3rd edition, Cambridge End Press, 2008.
3. Richard J. Reece, "Analysis of Genes and Genomes", Wiley, 2004.

16BT E22

ENVIRNOMENTAL BIOTECHNOLOGY

(Elective –I)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

1. To provide theoretical concepts and a comprehensive knowledge on bioremediation methods.
2. To provide knowledge on metal leaching and non conventional fuels.
3. To impart theoretical basics on various methods used in treatment of waste water.
4. To provide knowledge on degradation of Xenobiotic compounds.
5. To update the students with the available information on biotechnological applications in hazardous waste management.

Course Outcomes: At the end of the course students will be able to

1. Discuss bioremediation in detail.
2. Use of Microorganisms for metal leaching and biofuels.
3. Out line the different methods for waste water treatment.
4. Explain the importance of Xenobiotics in nature.
5. Analyze hazardous waste disposal.
6. Demonstrate the role of biotechnology in dealing with environmental problems.

UNIT – I: BIOREMEDIATION

Introduction; Constraints and priorities of Bioremediation, Biostimulation of naturally occurring microbial activities Bio-augmentation; *In situ, Ex situ*, Intrinsic and Extrinsic Bioremediation; Solid phase bioremediation- Land farming, composting , Biopile. Phyto-remediation techniques, Liquid phase bioremediation.

UNIT – II: METAL BIOTECHNOLOGY AND BIOFUELS

Introduction to metal biotechnology; Microbial transformation; Biosorption, Metal leaching; Metal Extraction and future prospects. Microorganisms and their role in energy requirements of mankind. Role of carbon credits in Industries. Production of non-conventional fuels: Methane (Biogas), Hydrogen, Alcohols and Algal Hydrocarbons.

UNIT – III: BIOLOGICAL WASTE WATER TREATMENT

Biological processes for domestic and industrial waste water treatment. Aerobic systems – Activated sludge process, trickling filters, Biological filters, Rotating biological contractors (RBC), Fluidized bed reactor (FBR), Expanded bed reactor, Inverse fluidized bed bio-film reactor (IFBBR). Anaerobic biological treatment- Contact digesters, Packed column reactors, UASB.

UNIT- IV: DEGRADATION OF XENOBIOTIC COMPOUNDS

Introduction- Xenobiotic compounds; Recalcitrants; Biodegradation of Xenobiotics present in Environment. Degradative plasmids; Oil Pollution and Bioremediation of Contaminated soils. Biological Detoxification-Cyanide detoxification, Detoxification of Toxic Organics and Phenols.

UNIT- V: HAZARDOUS WASTE MANAGEMENT

Hazardous Waste, Biotechnological applications to hazardous waste management. Global Environmental problems and Biotechnological approaches for management. Nuclear waste generation and treatment.

Text books:

1. Alan Scragg "Environmental Biotechnology", 2nd edition , Oxford End Press, 2005.
2. Foster CF, John Ware DA, "Environmental Biotechnology", Ellis Horwood Ltd. 1987.

Suggested readings

1. Stanier RY Ingram JL., Wheelis ML & Painter RR "General Microbiology" Mcmillan Publications, 1989
2. Environmental Biotechnology By Priv.-Doz. Dr.Hans-Joachim Jördening, Prof. Dr. Josef Winter, Wiley-VCH Verlag GmbH & Co. KGaA. 2005.
3. John. T. Cookson "Bioremediation Engineering: Design And Application" by, Jr. Mc Graw Hill, Inc. 1995.

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16BT E23

FOOD BIOTECHNOLOGY

(Elective-I)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the importance of food biotechnology and its nutritive value.
2. Students are taught the types of food available in the nature and its consumption value.
3. Students made to understand the food spoilage.
4. Students are enlightened about the importance of food processing.
5. Students are made aware of chemical and physical methods of food processing.
6. Student is made to understand the methods of food preservation and its control in food spoilage.

Course Outcomes: At the end of the course the students are able to

1. Apply the fundamentals of food biotechnology to their real life situation.
2. Differentiate types of food and explain their consumption value.
3. Describe the types of pathogens and their effect on food.
4. Describe the physical and chemical methods of food processing.
5. Be in a position to preserve the food material to avoid food spoilage.
6. By understanding the principles of biotechnology able to work in a suitable food industry.

UNIT-I SCOPE AND IMPORTANCE OF FOOD BIOTECHNOLOGY

Introduction to Scope and importance of food biotechnology, Nutritive value of the food ; consumption and structure of foods and the importance of industrial processing of foods, various technologies and methods in food preservation, processing and packaging, food grade polymers.

UNIT- II FOOD PRODUCTS

Introduction to Probiotics, Nutraceuticals and GM foods ; Development of Industrial Food products: High Fructose Corn syrup, Single Cell Protein and Fermented foods, Bakery Products, Beverages, Milk Products and Mushroom Development; Food labeling.

UNIT- III FOOD SPOILAGE AND FOOD MICROBIOLOGY

Food spoilage, Bacterial agents of food borne illness; Clostridium, Salmonella, Vibrio and Shigella, non bacterial agents; Protozoa, Algae, Fungi and Viruses.

UNIT- IV FOOD PROCESSING

Bio-processing : Enzymes and chemicals used in food processing for flavor development; Processing of meat, fisheries, vegetables, dairy products; Thermal processing of foods; Microwave heating; Thermal inactivation of microorganisms; Freezing and thawing methods of food processing.

UNIT- V FOOD PRESERVATION

Food preservation using Irradiation: Characteristics of Radiations of Interest in food preservation, Principles underlying the destruction of microorganisms by irradiation, Processing of foods for Irradiation, Legal status of food irradiation, Effect of Irradiation of Food constituents and Storage Stability; Food Preservation with low and High Temperatures and Preservation of foods by Drying, equipment for Drying.

Text Books:

1. Roger Angold, Gordon Beech & Taggart, "Food Biotechnology" 1^{st} edition, Cambridge End Press, 1989.
2. Frazier, William, C.Westhoff, Dennisc, "Food Microbiology" 2^{nd} Edition TATA Mcgraw Hill Publishers, 1989.

Suggested Reading:

1. Ashok Pandey, "Biotechnology:Food Fermentation" Asia Tech Publishers Inc,New Delhi,1999.
2. J.M.Jay, M.J.Loessner and D.A.Golden, "Modern food microbiology", 7^{th} edition,Springer,2006.
3. Romeo T. Toledo, "Fundamentals of Food Process Engineering", 3rd edition, Springer, February, 2007.

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COMPUTATIONAL NUMERICAL METHODS

(Elective-I)

Instruction:	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessional:	30 Marks
Credits:	3

Course Objectives:

1. Learn interpolation and extrapolation techniques to fit the numerical tabulated data.
2. Solve numerical integration to get approximate solution of given date using Simpson's 1/3 rd, 3/8th Weddle's rules.
3. Solve numerical differentiation to get approximate solution of ODE using Taylor, Picard's , Euler's, modified Euler's , Runge kutta methods.
4. Solve algebraic and transcendental equations.
5. Solve simultaneous equations when the number of unknown increases by iterative methods and ill condition and well condition equations.

Course Outcomes: At the end of the course the students are able to

1. Learn interpolation and extrapolation techniques to fit the numerical tabulated date.
2. Solve numerical integration of given date using Simpson's 1/3 rd, 3/8th Weddle's rules.
3. Solve numerical differentiation to get approximate solution of ODE using Taylor, Picard's , Euler's, modified Euler's , Runga kutta methods.
4. Solve algebraic and transcendental equations.
5. Derive the solutions when system of equations has more than two unknowns and learn to reduce the instability of equations.

UNIT I: INTERPOLATION: Finite difference operators, Newton's forward and backward interpolation formulas, Newton's divided difference interpolation for unequal intervals,Lagrange's interpolation, inverse interpolation.

UNIT II: NUMERICAL DIFFERENTIATION & INTEGRATION: Numerical differentiation using Newton's forward & backward interpolation formulas, and Newton's divided difference interpolation formula. Numerical integration: Simpson's 1/3 rd, 3/8th rules. Weddle's rule.

UNIT III: NEMERICAL SOLUTIONS FOR DIFFENTIAL EQUATIONS: Solution of differential equation: Taylor's method, Picard's method, Euler's method, modified Euler's method, Runga kutta fourth order method.

UNIT-IV: Solutions of Algebraic and Transcendental Equations: Method of Bisection, Regulae Falsi Method (method of false position); Newton Raphson Method.

UNIT-V: Solutions of Simultaneous Equations: Gauss elimination method, Jacobi iteration Method, Gauss Serial Method of Iteration.

Text Books:

1. Numerical Methods by S. S. Shastry.
2. Numerical Analysis for Scientists and Engineers- by Mittal.
3. Numerical and statistical Methods in Computer by V.K.Singh.

Suggested Reading:

1. B.S.Grewal: Higher Engineering Mathematics, Hanna Publications.2 .Miller and Freund, Probability and Statistics for Engineers, PEARSON, 2005.
2. Erwyn Kreyszig: Advanced Engineering Mathematics.

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18CS E02

Python for Bioinformatics
(Elective-II)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

1. Introduce Python with reference to bioinformatics.
2. Study Object-Oriented programming in Python.
3. Explain Biological sequence analysis using Python.
4. Describe advanced analysis techniques.
5. Describe expression and gene analysis using Python.

Course Outcomes: At the end of the course students shall be able to:

1. Understand the basics of Python Programming.
2. Develop applications using Python to solve problems.
3. Identify and use Python modules related to Biology.
4. Analyze biological sequences using Python.
5. Understand advanced analysis techniques.
6. Analyze gene expressions using Python.

Unit-I

Introduction to Python: Basics of Python, Python IDEs,,running Python programs, types and operations, Functions, modules, classes, Exceptions.

Unit-II

Object-Oriented Programming, Modules: Object Oriented Programming, Threads, process, synchronization, databases and persistence, NumPy, SciPy, Image manipulation, Akando and Dancer modules

Unit-III

Biological Sequence Analysis: Biopython: Parsing DNA data files, Sequence Analysis, Dynamic Programming, Hidden Markov Model, Genetic Algorithms, Multiple Sequence Alignment, gapped alignment.

Unit-IV

Advanced Analysis Techniques: Trees, Text Mining, Clustering, Self-Organizing Map, Principal Component Analysis, Numerical Sequence Alignment.

Unit-V

Expression Analysis: Gene expression array analysis, Spot finding and Measurement, Spreadsheet Arrays and Data Displays, Applications with expression Alignment.

Text Books:

1. Jason Kinser, "**Python for Bioinformatics**", Jones & Bartlett Publishers, 2nd Edition, 2013.
2. ReemaThareja "**Python Programming**", Oxford Press, 2017.

Suggested Reading:

1. Mark Lutz, "**Learning Python**", 3rd edition, O'Reilly, 2007.
2. Alex Martelli, David Ascher, "**Python cookbook**", O'Reilly, 2002.
3. http://www.biopython.org

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16BT E24

VIROLOGY

(Elective–II)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course objectives:

1. Students are made to understand the morphology and genetics of viruses.
2. Students recognize the procedures for cultivation of plant & animal viruses.
3. Students are enlightened about the characterization of viruses.
4. Students are taught the ultra structure of bacteriophages.
5. Students are taught the replication of plant & animal viruses.
6. The concept of viral vaccines preparation is introduced to the students.

Course outcomes: At the end of the course the students are able to

1. Students understand the basic structure of viruses.
2. Students compare the techniques for cultivation of plant & animal viruses.
3. Students explain the pros & cons of characterization techniques of viruses.
4. Students illustrate the structure of different phages.
5. Student recognizes the differences between replication of plant & animal viruses.
6. Be able to understand the procedures in preparation of vaccines.

UNIT- I INTRODUCTION TO VIROLOGY

Brief outline of discovery of Viruses; Properties of Viruses; Morphology of Viruses- Structure, Capsid Architecture, Envelopes and peplomers; Chemistry of Viruses- Viral Proteins, Genome- Structure and Types; Study of sub viral agents- Brief account on Diseases caused by Viroids- PSTV, Cadang cadang; Prions- Scrape, Cruetzfeldy jakob. Satellite viruses.

UNIT- II CULTIVATION OF VIRUSES I

General methods of cultivation of viruses- in embryonated eggs, cultivation of animal and plant viruses; cultivation of bacteriophages, Isolation and purification of viruses- plant viruses, animal viruses; Criteria of purity, Maintenance and preservation of infectivity; Characterization of viruses- Electron microscopy, X-ray crystallography, sedimentation analysis;

UNIT- III CHARACTERIZATION OF VIRUSES II

Enumeration viruses- By electron microscopy, plaque assay, acid end point method, Haemagglutinin assay; Detection of viruses-By serological characterization, detection of viral antigen, detection of viral nucleic acid; chemical determination Ultra structure and life cycles of Bacteriophages- Ml3, T4 & lambda.

UNIT- IV PLANT VIRUSES

Taxonomy; Symptoms of diseases caused by plant viruses (Morphological, Physiological and Histological); Ultra structure and life cycles of TMV; transmission of plant viruses- Mechanical and biological (vector and non-vector); Basic control measures of plant diseases- vector and chemical control, biopesticides with examples.

UNIT- V ANIMAL VIRUSES

Taxonomy; Detailed structure and brief account on life cycles of RNA viruses-Polio, Influenza, Rota virus and HIV; Ultra structure and brief account on life cycles of DNA viruses- Vaccina, SV40 and Hepatitis Virus; Viral vaccines-types and preparation of conventional vaccines

Text Books

1. Dimmock NJ and Primrose SB, "Introduction to Modern Virology", 4th edition, Blackwell Scientific Publications, 1994.
2. Matthews REF "Fundamentals of Plant Virology". Academic Press, San Diego, 1992.

Suggested books

1. Carter J and Saunders V "Virology: Principles and Applications" John Wiley and Sons ltd, 2007.
2. Morag C, Timbury M, Chrchill Livingstone, "Medical Virology", London, 1994.

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16BT E25

Metabolic Engineering

(Elective–II)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. To identify the different metabolic regulations.
2. To outline various pathways of Biosynthesis of secondary metabolic and their applications.
3. To identify factors and criteria for bioconversions and their applications.
4. To learn the concept of metabolic flux and its application.
5. To compute metabolic pathways and algorithms.
6. To identify various applications of metabolic engineering in pharma chemical bioprocess, agriculture etc.

Course Outcomes: At the end of the course the students are able to

1. Revise the regulations & requirements of metabolic engineering.
2. Analyze and design various pathways of biosynthesis of secondary metabolies & their applications in various fields.
3. Assess the criteria & factors necessary for bio concessions- and out line their applications.
4. Discuss the analysis & applications of metabolic.
5. Design algorithms metabolic pathway modeling synthesis using bioinformatics tools.
6. Assess and compute various applications of metabolic engineering different fields.

UNIT- I INTRODUCTION

Identification of metabolic regulation: a key point in Metabolic Engineering. Basic concepts of Metabolic Engineering- Overview of cellular metabolism, Different models for cellular reaction, induction, Jacob monad model & its regulation, Different regulation by Isoenzymes,feed back regulation. Amino acid synthesis, pathways with regulation at enzyme & cell level.

UNIT- II BIOSYNTHESIS OF SECONDARY METABOLITES

Regulation of secondary metabolic path ways, precursor effect, prophase, Idiophase –relationships. Catabolite regulation bypassing control of secondary metabolism, producers of secondary metabolites and their applications.

UNIT- III BIOCONVERSIONS

Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances. Applications of Bioconversions. Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation. The modification of existing or the introduction of entirely new metabolic pathways.

UNIT- IV METABOLIC FLUX

Metabolic flux distribution analysis, Experiments determination method of flux distribution, Metabolic flux analysis and its applications.

UNIT- V METABOLOMICS & APPLICATIONS OF METABOLIC ENGINEERING

Metabolic pathway modeling, Analysis of metabolic control and the structure metabolic networks, Metabolic pathway synthesis algorithms. Application in pharmaceuticals, chemical bioprocess, food biotechnology, agriculture environmental bioremediation and biomass conversion.

Text Books:

1. Ste Phanopoulas.G.N "Metabolic Engineering Principles & Methodologies" , Academic Press-Elsevier,1998.
2. Wand.D.I.C Cooney C.L., Demain A.L., Dunnil.P.Humphrey A.E.Lilly M.D. " Fermentation and Enzyme Technology, John Wiley and sons, 1980.
3. Metabolic engineering Sangy Yuplee and E.T.Pa poutsakis Marcel Dekker Inc.

Suggested Reading:

1. Zubay G., Biochemistry, Macmillan Publishers, 1989.
2. Stanbury P.F., and Whitaker A., Principles of Fermentation Technology Pergamon Press, 1984.

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16BT E26

FLUID MECHANICS AND HEAT TRANSFER LAB

Instruction	3P Periods per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. This lab course is designed to understand the mechanics of fluid flow, analysis of various processes viz., Flow measuring devices Venturimeter, Mouth piece, and Triangular notch.), heat exchangers.

Course Outcomes: At the end of the course the students are able to

1. Course outcomes are based on a continuous evaluation basis, like viva voce, calculations etc., and a final exam.
2. Demonstrate various experimentation methods with skill and precision.
3. Determine Thermal conductivity of homogeneous wall.
4. Determine calculate heat transfer coefficient in unsteady state heat transfer.
5. Determine overall heat transfer coefficient in unsteady state heat transfer.
6. Determine friction losses in pipe fittings.

LIST OF EXPERIMENTS

1. Determination of discharge coefficient for orifice meter and venturi meter and their variation with Reynolds number.
2. Determination of weir meter constant K for v-notch and rectangular notch.
3. Calibration of rotameter and study of variation of flow rate with tube to float diameter.
4. Determination of viscosity of Glycerol - water solutions at different temperatures.
5. Determination of friction factor for flow of water through annulus using Farmings and Davos equations.
6. Determination of friction factor for flow through straight pipes of different diameters and study of variation of friction factor with Reynolds number.

7. Determination of friction losses in pipe fittings.
8. Determination of Thermal conductivity of homogeneous wall insulating powder under steady state conditions.
9. Determination of interface temperatures in composite wall under steady state conditions.
10. Determination of heat transfer coefficient in Natural convection.
11. Determination of overall heat transfer coefficient in unsteady state heat transfer.
12. Determination of inside heat transfer coefficient in coil heat exchangers.
13. Determination of overall heat transfer coefficient and effectiveness in a Double pipe heat exchange.
14. Determination of heat transfer area in a 1-2- shell and tube heat exchanges.
15. Determination of heat transfer coefficient on a single tube by film wise and drop wise condensation.

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16BT C27

ENZYME TECHNOLOGY LAB

Instruction	3P Periods per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. The course aims at providing knowledge about the preparation of buffers and chemicals.
2. Outline for isolation and purification of enzymes.
3. Compare the optimum ranges of physical parameters for enzyme activity.
4. Compute the Michelis-Menten kinetics.
5. The students understand the methods of immobilization of enzymes and their kinetics.

Course Outcomes: At the end of the course students will be able to

1. Preparation of buffers.
2. Demonstrate the isolation of enzymes.
3. Predict the optimum ranges of parameters on enzyme activity.
4. Analyze the effect of various physical parameters and Michelis-Menten kinetics (K_s, V_{max}) activity of enzyme.
5. Choose the suitable methods for immobilization of enzymes.

LIST OF EXPERIMENTS

1. Preparation of buffers.
2. Isolation and extraction of enzymes (Microbial, plant and animal source).
3. Effect of pH on enzyme activity.
4. Effect of temperature on enzyme activity.
5. Effect of substrate concentration on enzyme activity.
6. Effect of time interval on enzyme activity.
7. Development of Enzyme Assay.
8. Evaluation of Michelis Menten kinetic parameters.
9. Kinetic studies of enzyme inhibition.
10. Determination of growth curve of a supplied microorganism and to determine substrate degradation profile.
11. Studies on immobilization of enzyme/cell by gel entrapment method.
12. Comparative study of activities of free and immobilized enzyme systems.

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16BT C28

GENETIC ENGINEERING LAB

Instruction	3P Periods per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	3

Course objectives:

1. To provide an opportunity to experimentally verify the concepts of genetic engineering and rDNA technology already studied.
2. To provide hands on training to students to practically prove the theoretical concepts studied with respect to isolation, quantification, amplification, sequencing of DNA genome /fragments and analysis of recombinant protein from transformed bacterial cultures.

Course outcomes: At the end of the course the students are able to

1. Demonstrate isolation of nucleic acids.
2. Characterize the DNA by restriction digestion and restriction mapping.
3. Design polymerase chain reaction.
4. Plan different steps involved in cloning strategies.
5. Analyze and compute DNA Sequencing.
6. Analyze the recombinant protein by using SDS PAGE.

LIST OF EXPERIMENTS

1. Isolation of bacterial genomic DNA.
2. Isolation of plasmid DNA.
3. Visualization of Genomic and Plasmid DNA on Agarose gels.
4. Restriction digestion.
5. Restriction mapping of DNA fragments.
6. Gel elution.
7. DNA ligation.
8. Preparation of competent cells.
9. Genetic transformation and screening for recombinant bacterial cells.
10. Blotting techniques- southern blotting.
11. Amplification of DNA fragments by Polymerase Chain Reaction (PCR).
12. DNA sequencing- Sanger's Method.
13. Analysis of Recombinant Proteins using SDS-PAGE.

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Suggested Reading:. Green MR and Sambrook J, “Molecular Cloning-A laboratory manual”, Vol I, II and III, Cold spring Harbor Laboratory Press, 2012

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Choice Based Credit System (with effect from 2018-19)
B.Tech (Bio-Technology)

SEMESTER – VI

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16BT C29	Fermentation Technology	4	-	4	30	70	4
2	16BT C30	Mass Transfer Operations	4	-	4	30	70	4
3	16BT C31	Bioinformatics	4	-	4	30	70	4
4	18CS E02 16BT E32 16BT E33	**Elective – III** 1. JAVA Programming and Bio-Java 2. Medical Biotechnology 3. Phyto Chemicals and Herbal Products	3	-	3	30	70	3
5	16BT E34 16BT E35 16BT E36	**Elective – IV** 1. Developmental Biology 2. Pharamceutical Biotechnology 3. Bioprocess Economics & Plant Design	3	-	3	30	70	3
PRACTICALS								
7	16BT C37	Bioprocess Lab	-	3	3	25	50	2
8	16BT C38	Mass Transfer Operations Lab	-	3	3	25	50	2
9	16BT C39	Bioinformatics Lab	-	3	3	25	50	2
10	16BT C40	Mini Project	-	1	1	50	-	1
TOTAL			**18**	**10**	**28**	**225**	**500**	**25**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

16BT C29

FERMENTATION TECHNOLOGY

Instruction	4L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. The course aims at providing knowledge to students on scope and chronological development of fermentation technology.
2. To understand the types of fermentation process and design of fermentation.
3. To learn about the ancillaries of fermentor and its applications.
4. To gain in-depth knowledge about the working principles and operation of fermentors.

Course Outcomes: At the end of the course students will be able to

1. Interpret the Fermentation process.
2. Explain the types of fermentation media design and development of inocula.
3. Hypothesize the control of fermentation by various physical and chemical process parameters.
4. Summarize the scale up of fermentors and working principles.
5. To know the Differentiation between various fermentation systems.
6. Evaluate rheological properties of fermented broths.

UNIT-I INTRODUCTION TO FERMENTATION PROCESSES

The range of fermentation processes; Industrial applications; Future trends in fermentations; General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes.

UNIT- II MEDIA DESIGN AND DEVELOPMENT OF INOCULA

Typical media, Media formulation, energy resources, carbon and nitrogen components. Solid-substrate, Submerged fermentation and its applications. Development of Inocula – For yeast and Mycelial Process, The aseptic inoculation of plant fermenters.

UNIT- III AERATION AND AGITATION IN FERMENTATIONS

Oxygen transfer from gas bubble to cells; Oxygen transfer in fermentations; Oxygen transfer in large vessels: Bubble aeration and Mechanical agitation; Correlations for mass transfer coefficients; Gas Hold up; Measurement ofK_La- Oxygen-Balance method, Dynamic Method, Sulphite Oxidation

UNIT- IV SCALE UP AND RHEOLOGY IN FERMENTATIONS

Scale up of fermentation processes; Principles, theoretical considerations and techniques used; Scale down methods; The Rheology of fermentation broths; Rheological models; Measurement of rheological parameters; Rheological Control of fermentations; Mixing concepts, power requirement for mixing and improvement of mixing in fermentations.

UNIT - V FERMENTORS

Batch, Fed-batch and Continuous Fermentation systems; Dual and multiple fermentations; Comparison between batch and continuous fermentations; Steady state, unsteady state continuous fermentation theories; Examples of continuous fermentation; Practical problems with continuous operations. Behavior of microbes in different reactors (air lift, fluidized, batch, and continuous fed batch condition).

Text books:

1. Stanbury PF, Whitaker A and Hall S J, “Principles of Fermentation Technology” 2nd edition, Elsevier, 2013,
2. Pauline M. Doran, “Bioprocess Engineering Principles”, Academic press, 1995

Suggested Reading:

1. Brian McNeil and Linda Harvey, “ Practical Fermentation Technology” Wiley, 2008.
2. Crueger W and Crueger A, “Biotechnology: A Text Book of Industrial Microbiology”, 2nd Edition, Panima Publishing Corporation, New Delhi, 2000.

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16BT C30

MASS TRANSFER OPERATIONS

Instruction	4L Periods per week
Duration of End Examination	4 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. To provide the students with knowledge about various unit operations such as absorption, distillation, extraction, leaching.
2. To give insight about various membrane separation processes such as adsorption, Ion-exchange, dialysis and the application of these unit operations in commercial aspects of biotechnology.

Course Outcomes: At the end of the course the students are able to

1. Molecular diffusion in solids, liquids and gases
2. Determine the number of trays needed for the separation
3. Carry out material balances accurately.
4. Explain the principles of the various separation processes involved in the downstream processing of products, especially those of biological origin
5. Explain the principles and application of membrane separation processes.
6. Understand the types of adsorbents.

UNIT- I PRINCIPLES OF MASS TRANSFER

Introduction to Mass transfer and Diffusion, Molecular diffusion in Gases, Molecular diffusion in Liquids, Molecular diffusion in Biological solutions and gels, Molecular diffusion in Solids, Inter phase mass transfer and Mass transfer coefficients.

Gas - Liquid operations: Equilibrium relations between phases, Mass transfer between phases, Choice of solvent for absorption, Single stage and multi stage co current and counter current operations, Estimation of Mass transfer coefficient, Calculation of HTU, NTU concepts, equipments mechanically agitated vessels, packed columns and plate columns.

UNIT- II PRINCIPLES OF VLE FOR BINARY SYSTEM

Phase rule and Raoult's law, Boiling point diagrams and x-y plots, Relative volatility, Flash distillation, Differential distillation, Simple steam distillation. Distillation with reflux and McCabe - Thiele method. Special Cases for rectification using McCabe - Thiele; Stripping column distillation, Enriching Column distillation, Rectification with direct steam injection, Rectification with single side stream.

UNIT- III LIQUID - LIQUID EXTRACTION AND LEACHING

Introduction to Extraction process: Equilibrium relations in extraction, Analytical and graphical solutions for single and multi stage operations co-current and counter current operations without reflux. Equipments for liquid-liquid extraction: mixer-settlers for extraction, Plate and Agitated Tower Contactors for Extraction, Packed and spray Extraction towers.

Introduction to leaching process: Equilibrium diagrams for leaching, analytical and graphical solutions for single and multi stage counter current operations.

UNIT - IV BASIC CONCEPTS IN DRYING OF PROCESS MATERIALS

Methods of drying, Equipment for drying; Free moisture content of materials; Concept of bound and unbound moisture content of biological materials; Rate of drying curves; Calculation methods for constant-rate & falling rate drying methods; Freeze drying of biological materials.

UNIT- V ADSORPTION AND MEMBRANE SEPARATION PROCESS

Theory of adsorption, Industrial adsorbents, Adsorption equilibria, Frendlich equation-single and multiple operations- processing variables and adsorption cycles Introduction and Types of Membrane separation process: Principles of ion exchange. Dialysis, Gas permeation membrane processes, types of membranes and permeability's for separation of gases, Introduction to types of flow in gas permeation.

Text Books:

1. C J Geankopolis, "Transport Processes in chemical Operations", 4th edition, Prentice Hall India.
2. Robert ETreybal, "Mass Transfer operations", 3rd edition. McGraw-Hill.
3. Warren L, McCabe, Julian C. Smith, Peter Harriot, "Unit operations of Chemical Engineering", 5th Edition, McGraw- Hill.

Suggested Reading:

1. Jaime Benitez, "Principles and Modern Applications of Mass Transfer Operations", 2nd edition, 2009
2. J M Coulson and J F Richardson, "Chemical Engineering", Vol-II, 3rd edition, Pergamom Press.

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16BT C31

BIOINFORMATICS

Instruction	4L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives

1. To provide elementary knowledge in bioinformatics and biological information available to biologist on the web and learn how to use these resources on their own.
2. To learn fundamentals of biological databases and sequence alignment.
3. To understand evolutionary relationship among organisms.
4. To learn methods for determining the order of the nucleotide and to predict gene.
5. To aid in understanding structural bioinformatics and biochemical databases.

Course Outcomes: At the end of the course the students are able to

1. Explain the basics of bioinformatics and its scope.
2. Identify how biological databases are used for the retrieval of information.
3. Demonstrate the methods of sequence alignment and its use.
4. Create an evolutionary tree, evaluate and different software tools used for phylogenetic analysis.
5. Discuss about genome sequencing and genome sequencing projects.
6. Predict gene and protein structure and explain about biochemical databases.

UNIT-I INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES

Need of Computers in Biotechnology Research, Elementary commands and protocols, ftp, telnet, http; Bioinformatics- Introduction, Scope of Bioinformatics, Applications; Introduction to biological databases, types of biological database, file formats for biological sequence (NCBI, EMBL, SWISSPROT, FASTA); Information retrieval from biological Databases.

UNIT- II SEQUENCE ALIGNMENTS

Sequence Alignment-Local, Global alignment; Methods of pairwise sequence alignment; Multiple Sequence alignment methods; Comparison of pair wise and multiple alignment; Sequence database search- FASTA, BLAST, various versions of BLAST and FASTA; Amino acid substitution matrices- PAM and BLOSUM.

UNIT- III PHYLOGENETIC ANALYSIS

Understanding Evolutionary process; Origin of Molecular Phylogenetics; Relationship of phylogenetic Analysis to sequence alignment; Concept of evolutionary trees; Methods of Phylogenetic analysis, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis.

UNIT-IV GENOME MAPPING AND GENE PREDICTION

DNA sequencing- Map assembly, Genome Mapping; Genome sequencing, cDNA sequencing, Genome sequence assembly, Comparative Sequence Analysis; Gene Annotation; Human Genome Project (HGP); Basis of Gene Prediction, Gene predictions in Microbial genomes and eukaryotes, Gene Prediction Methods, Other Gene Prediction Tools.

UNIT -V STRUCTURAL BIOINFORMATICS AND BIOCHEMICAL DATA BASES

Protein structure basics, protein structure classification, visualization and comparison, protein secondary structure prediction and protein tertiary structure prediction; Introduction to Biochemical databases- KEGG, BRENDA. Molecular Modeling Databases (MMDB).

Text books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery", 3rd edition, PHI Learning Private Limited, New Delhi, 2010.

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001.
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi, 2009.
3. Ji Xiong, "Essential Bioinfomatics", Cambridge End Press, 2006.

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18CS E02

JAVA Programming and Bio-Java

(Elective-III)

Instruction	4L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	4

Course Objectives: The main objective of this course is:

1. To introduce the concepts of Object-Oriented programming.
2. Prepare the students to develop solutions using OOPs concepts.
3. Identify Java class libraries and Bio-Java class libraries.
4. Understand and develop GUI based solutions.
5. Develop Biotechnology related solutions using Java and Java class libraries.

Course Outcomes: At the end of the course students will be able to

1. Understand fundamental concepts in object-oriented programming.
2. Design and develop computer based solutions to solve real world problems.
3. Handle file I/O and exceptions.
4. Create Windows, Containers, GUI components in Java.
5. Create GUI-based applications.
6. Develop programs related to Biotechnology problems.

UNIT-I

Java Essentials: Features of Java, OOPs concepts in Java, Elements of java program, Variables, and Literals, Data Types, variables and arrays, Operators, arrays **Control structures**: if, if-else, nested if, if-else-if, switch, while, do-while, for, break and continue statements.

UNIT-II

Classes and Objects: Introduction to classes and methods, typecasting, access specifiers and modifiers, modifiers, passing arguments, Constructors.
Inheritance: Basics of inheritance, types of inheritance, polymorphism.

UNIT-III

Interfaces and Packages: Basics of interfaces, Packages, **Exception handling**: Types of exceptions and Errors, exception handling, Multithreading concepts.
Files and I/O Streams: File Class, Streams, Byte Streams.

UNIT-IV

AWT and Applets: Applets, GUI, Window class hierarchy, Dialog Boxes,, Layout managers, Swing Component Classes, Event-Handling, AWT Graphics classes and Swing Controls.

UNIT-V

StrBioLib: Molecular Biology Classes, Interfaces to Bioinformatics tools and Databases,General purpose tools, applications.
Writing simple Java programs for Biotechnology related problems.

Text Books:

1. Sagayaraj, Denis, KArthik and Gajalaxmi, "Java Programming", for Core and Adanced Learners", University Press, Pvt. Ltd, 2018.
2. Johan-Marc Chandonia, **StrBioLib**: a Java Library for Development of Custom Computations Structural Biology Applications", BIO-INFO ALPPLICATIONS NOTE, Vol. 23, No. 15,2007, PP2018-2020 (https://academic.oup.com/bioinformatics/article-abstract/23/15/2018/203542)

Suggested Reading:

1. https://www.tutorialspoint.com/java/index.htm
2. Herbert Schildt, " The complete reference Java 2", TMH
3. Internet World 60 minute Java by Ed Tittel

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16BT E32

MEDICAL BIOTECHNOLOGY

(Elective-III)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

1. To understand the scope and importance of tools used in medical biotechnology.
2. The course aims at providing knowledge about the working principles and types of advanced materials used in medical field.
3. To gain the in-depth knowledge about the clinical applications of stems cells &banking
4. To understand the differences between the normal cells and cancer cells and various diagnostic methods used in cancer detection.
5. To learn current molecular therapies and controversial issues..
6. To understand the bioethical issues.

Course Outcomes: At the end of the course the students are able to

1. Use the tools for the diagnosis of diseases.
2. Be in a position to design the prototype of medical instruments.
3. Explain the potentiality of stem cells and purpose of banking.
4. Explain about the uses of molecular therapies and how which led to controversy in society.
5. Explain about the advances in vaccines in production.
6. Analyze the socio ethical issues in medicine.

UNIT - I : INTRODUCTION TO MEDICAL BIOTECHNOLOGY

Introduction, scope and importance of medical biotechnology; The genetic basis of the disease; chromosomal disorders; single gene disorders-modes of inheritance, Thalassemia, sickle cell anaemia, cystic fibrosis, Tay sachs disease, Fragile –X-syndrome; polygenetic disorders; Alzheimers disease,Type-1diabetis and mitochondrial disorders (neurological disorders).

UNIT- II MEDICAL ONCOLOGY

Cancer types (case study: breast cancer and stomach cancer); Normal cells vs. cancer cells; cancer genetics; oncogenes and their proteins; tumor suppressor genes and their functions, diagnosis of cancer, Treatment of cancer; Radiation therapy, chemotherapy.

UNIT- III STEM CELL TREATEMENT

Cellular therapy, stem cells- definition, types, properties and uses of stem cells; sources of embryonic and adult stem cells; concept of tissue engineering; scaffolds and fabrication; clinical applications of stem cells; stem cell banking and ethical issues.

UNIT - IV MEDICAL INSTRUMENTATION AND DIAGNOSTICS

Concepts in Biomedical Engineering; principle, properties and applications of different types of biomedical devices; pacemakers, drug coated stents, dental implants, knee replacement implants, Molecular diagnosis by immunological approaches to detect protein biomarkers of the disease (types of ELISA), DNA approaches (Taq MAN approach, RT-PCR, epigenetic markers, detection of SNP by mass spectrometry; Applications of biosensors in medicine.

UNIT - V MOLECULAR THERAPEUTICS AND BIOETHICAL ISSUES

Types of molecular therapies; protein therapy by recombinant MAB, Enzymes (DNase-1, Alpha -1 antitrypsin), Lactic acid bacteria by Leptin, antisense therapy, immunotherapy by immunotoxins and recombinant vaccines.Bioethical issues in IVF, surrogacy and cloning technologies.

Text Books:

1. Judith Pongracz, Mary Keen, “Medical Biotechnology”, illustrated edition, Elseiver health sciences, 2009.
2. Bernard R Glick, Cheryl L.Patton, Terry L.Delovitch, “Medical biotechnology”, 1^{st} edition, ASM press,2013.
3. Cato T.Laurencin, MD.Ph.D, Lakshmi S-Nair, M.Phil.,Ph.D “Nano Technology and Regenerative Engineering The Scaffold”, Second Edition, CRC Press, Taylor & Francis Group, 2014.

Suggested Reading:

1. R.J.B.King, Robins, “Cancer biology”, 3^{rd} edition, Prentice Hall, 2006.
2. Subdery, “Human Molecular Genetics”, 2^{nd} edition, Prentice Hall, Pearson education.

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16BT E33

PHYTO CHEMICALS AND HERBAL PRODUCTS

(Elective-III)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course objectives:

1. To impart knowledge on medicinal plants and extraction of crude drugs.
2. To provide a comprehensive knowledge on analysis, types and detection of phytochemicals and adulterants.
3. To impart knowledge on the applications of various phytochemicals and herbal products.

Course outcomes: At the end of the course the students are able to

1. The undergraduates will know the sources of various crude drugs and their medicinal values.
2. The students will understand the procedures involved in the detection, extraction and analysis of crude drugs and adulterants.
3. The undergraduates will be able to implement their theoretical concepts and knowledge of extraction and their applications in herbal preparation for implementing the same practically.
4. Understand the preparation of adulterants.
5. Apply the different types of phyto chemicals in the real world.
6. Recognize the applications of herbal products.

UNIT I: CRUDE DRUGS, MEDICINAL AND AROMATIC PLANTS

Crude Drugs - Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Collection and processing of Crude Drugs. Utilization of Medicinal and Aromatic Plants in India. Genetics as applied to Medicinal herbs. Biogenesis of Phytopharmaceuticals.

UNIT II: ANALYSIS OF PHYTOCHEMICALS

Methods of Drug evaluation (Morphological, Microscopic, Physical and Chemical). Preliminary screening, Assay of Drugs - Biological evaluation / assays, Microbiological methods, Chemical Methods of Analysis and Detection of Adulterants: Chemical estimations. Drug adulteration - Types of adulterants.

UNIT III : TYPES OF PHYTOCHEMICALS

Carbohydrates and its derived products- Structures, types and extraction methods : Glycosides - Digitalis, Aloe, Dioscorea ; Volatile Oils - Clove, Mentha; Alkaloids - Taxus, Papaver, Cinchona; Flavonoids-and Resins. Tannins (Hydrolysable and Condensed types).

UNIT IV: APPLICATIONS OF PHYTOCHEMICALS

Application of phytochemicals in industry and healthcare; Biocides, Bio-fungicides, Biopesticides (Bacterial, fungal, viral with examples).

UNIT V: HERBAL PRODUCTS

History, Scope, and Current aspects of herbs and herbal medicines; Classification of active components of therapeutic plant and herbal products; Preparation of standardized extracts of Garcinea, Forskolin, Garlic, Turmeric and Capsicum, issues of licencing of herbal drugs.

Text books:

1. Kokate CK, Purohit AP and Gokhale SB, "Pharmacognosy", 4th edition, Nirali Prakashan, 1996.
2. Trease and Evans WC Evans, " Pharmacognosy" , 14th edition, Harcourt Brace & Company. 1989.
3. Hornok L, "Cultivation & Processing of Medicinal Plants" Chichister, U. K: J. Wiley & Sons.1992.

Suggested Reading:

1. Natural Products in medicine: A Biosynthetic approach Wiley. 1997
2. Chaudhri RD, "Herbal Drugs industry, A practical approach to Industrial Pharmacognosy" Eastern publishers, 2nd reprint, New Delhi. 1999.

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16BT E34

DEVELOPMENTAL BIOLOGY
(Elective-IV)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. Students are made to understand the basic concepts of developmental biology.
2. Students are taught the structure of gametes, and how they are generated.
3. Students are taught the influence of genes on body axis formation in Drosophila and Mammals.
4. Students are enlightened about the later embryonic developments i.e Organogenesis.
5. Students are made aware of sex determination in Drosophila and Mammals.
6. The concept of Ramifications of developmental biology is introduced to the students.

Course Outcomes: At the end of the course the students are able to

1. Students understand the basic concepts of Developmental Biology.
2. Students understand the Anatomy of gametes and Biochemistry in its recognition.
3. Analyze the role of genes in the body axis formation of Drosophila and Mammals.
4. Understand the importance and differentiation of germinal layers in to different organs.
5. Compare the role of genes in the sex determination of Drosophila and Mammals.
6. Explain the genetic anomalies leads to diseases.

UNIT-I: INTRODUCTION TO DEVELOPMENTAL BIOLOGY

The Anatomical approach to developmental biology: Mathematical modeling for development: The frog life cycle: Evidence for Genomic equivalence (Potency of cells), Specification (Autonomous, Conditional and Morphogenic Gradients: Commitment, Induction (Paracrine Factors) and Competence.

UNIT-II : EARLY EMBRYONIC DEVELOPMENT (Gametogenesis and Fertilization)

Structure of Gametes, Spermatogenesis and oogenesis in Mammals, Recognition of egg and sperm: Mammalian Fertilization (Fusion of Gametes and prevention of Polyspermy), External Fertilization in Sea urchin.

UNIT-III: LATER EMBRYONIC DEVELOPMENT (Morphogenesis)

Cleavage and gastrulation in Drosophila and Mammals: Early Drosophila developments: Genes that pattern the

Drosophila body axis: The generation of dorsal, ventral polarity: The origin of anterior, Posterior polarity: Segmentation genes (Gap Genes, pair rule genes and segment polarity genes), The homeotic selector genes: The anterior and posterior axis formation in Mammals.

UNIT-IV: ORGANOGENESIS AND SEX DETERMINATION

The emergence of Ectoderm-The Central nervous system and epidermis development: the function of mesoderm –osteogenesis and myogenesis: Lateral plate mesoderm and endoderm – the development of heart, blood cells, digestive and respiratory systems, Sex determination in Drosophila and Mammals: regeneration of liver in Mammals.

UNIT-V : RAMIFICATIONS OF DEVELOPMENTAL BIOLOGY

Medical Implications of Developmental biology, genetic errors of human development, infertility, *in vitro* fertilization (IVF) and teratogenesis (disruptors of teratogenesis): Developmental biology and future of medicine.

Text Books:

1. Manju Yadav, “Molecular Developmental Biology” Discovery Publishing, September, 2008.
2. Scott F Gilbert, Michael JF Barresi. “Developmental Biology”, 10th edition, Sinauer Associates, Inc, 2013.

Suggested Reading:

1. Snustad P, Simmons and Jenkins, “Principles of Genetics”, 2nd Edition, John Wiley Publications, 1999.
2. P.C.Jain , “Elements of Developmental Biology” International Publications, 2013.

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16BT E35

PHARMACEUTICAL BIOTECHNOLOGY

(Elective-IV)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

Students are made to analyze the following concepts during there course of time:

1. Origin, Scope and importance of pharmaceutical biotechnology.
2. ADME of Drugs. Pharmacokinetics and Pharmacodynamics of drugs.
3. Materials and Formulations of pharmaceuticals.
4. Collection, processing and storage of whole human blood.
5. Ideal requirements of Polyvinyl Pyrollidine and Dextran 40.
6. Steroidal and Nonsteroidal drugs, Antacids, Alkaloids and Biological extracts.

Course Outcomes: At the end of the course the students are able to

1. Identify different microorganisms for the production of secondary metabolites used as drugs.
2. Explain drug delivery systems like oral, parenteral, transdermal etc.
3. Outline the manufacture, Labeling, preservation and release of drugs in to the market.
4. Discuss fractionation of human RBC, dried human plasma, HPPF, from whole human blood.
5. Plan the procedures for the production of blood transfusion products to avoid infectious diseases.
6. Select the therapeutic activity and dosage of drugs to treat the diseases.

UNIT- I: FUNDAMENTALS OF BIOPHARMACEUTICALS

Pharmaceutical Biotechnology: An introduction, Origin, definition, Scope and Importance. Human protein replacements, Therapeutic agents for human diseases: Tissue Plasminogen activator, Interferon, Recombinant vaccines. Methods of Biotechnology and their applications of Gene transfer.

UNIT- II: DRUG METABOLISM AND PHARMACOKINETICS

ADME properties- Physiochemical properties of Drug Absorption, Distribution, metabolism (Biotransformation), bioavailability and Excretion. Pharmacokinetics and Pharmacodynamics. Basic considerations: Drug receptors, Drug interactions, Surgical supplies, Oral, Parenteral, Transdermal, Ophthalmic, Intravaginal and Intrauterine Drug Delivery systems.

UNIT- III: THE DRUG MANUFACTURING PRACTICES

Good manufacturing practices and facilities for drug production. Types of Tablets and capsules. Materials and Formulations for Manufacture of Tablets, Capsules. Excepients and its ideal properties, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols.

UNIT-IV: BLOOD AND PLASMA SUBSTITUTES

Collection, processing and storage of whole human blood, concentrated human RBC, dried human plasma, Human plasma protein fraction, Dried human serum, Human fibrinogen, Human thrombin, Human normal Immunoglobulin, Plasma substitutes- Ideal requirements, PVP, Dextran 40, control of Blood products, Transfusion products.

UNIT-V: PHARMACEUTICAL PRODUCTS

Fundamentals of Therapeutic categories such as Analgesics, Antipyretic, Anti-inflammatory drugs, Anesthetics, Antacids, Alkaloids, Glycosides, Anti-neoclassic drugs, Biologicals (Immunizing agents and allergenic extracts), Chemotherapy of Tuberculosis and Urinary tract infections.

Text books:

1. Purohit SS, Kakrani HN and Saluja AK., "Pharmaceutical Biotechnology", Student Edition Jodhpur, 2003.
2. Brahmankar, D.M., Sunil, B.Jaiswals - Biopharmaceutics & Pharmacokinetics a Treatise , 2nd edition, M.K.Jain Publication, Delhi, 2009.
3. Cooper and Guns, "Pharmaceutics", CBS publishers, 1989.

Suggested Reading:

1. David B Troy and Paul Beringer, "Remington's: The Science and practice of Pharmacy", Vol 1 and 2, Lippincott Williams & Wilkins Publications, 2006.
2. Tripathi, K.D. "Essentials of Medical pharmacology", Jaypee Brothers Medical Publishers 6th Edition , John Wiley, New Delhi, 2000.
3. Milo Gibaldi - Biopharmaceutics and Clinical Pharmocokinetics, First edition, Pharma Book Syndicate, 2006.

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16BT E36

BIOPROCESS ECONOMICS & PLANT DESIGN

(Elective-IV)

Instruction	3L Periods per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

1. To provide the students with knowledge about basic concepts in Interest, capital investment tax and depreciation;
2. Measures of economic performance.
3. This course aims at providing an insight into capital, overhead and manufacturing costs estimation
4. The course is designed to give an understanding of process design development and general design considerations.
5. This course aims at providing knowledge on design of batch and continuous sterilizers**,** Design calculations for immobilized enzyme kinetics.
6. To give insight about various types of valves, pumps, steam traps, spargers and impellers used in biotech industries.

Course Outcomes: At the end of the course the students are able to

1. Carry out interest calculations and prepare balance sheets for business transactions.
2. Determine the economic analysis of bioprocesses.
3. Carry out cost estimations for different industrial productions.
4. Develop process design, flow diagrams.
5. Carry out material and energy balances accurately
6. Design filters for air sterilization, batch and continuous sterilizers, valves etc.

UNIT-I: ECONOMIC EVALUATION

Capital cost of a project; Interest calculations, nominal and effective interest rates; basic concepts in tax and depreciation; Measures of economic performance, rate of return, payout time; Cash flow diagrams; Cost accounting-balance sheet and profit loss account; Break even and minimum cost analysis.

UNIT- II : BIOPROCESS ECONOMICS

Bio-Products regulations; Economic analysis of bioprocess; Capital, overhead and manufacturing costs estimation; Case studies of antibiotics (Penicillin and Streptomycin), recombinant products, single cell protein, anaerobic processes and other fine chemicals.

UNIT- III : INTRODUCTION TO PLANT DESIGN

Process design development: design procedures, design information and flow diagrams, material and energy balances, comparison of different process and design specifications; Optimization; General design considerations: Health and safety hazards, Environment protection, plant location and plant layout, plant operation and control.

UNIT- IV : BASIC DESIGN PROBLEMS

Design examples on continuous fermentation, aeration, and agitation; Design calculation of filter for air sterilization; Design of batch and continuous sterilizers; Design calculations for immobilized enzyme kinetics; Practical considerations in designing of Bioreactor/Fermentor construction.

UNIT- V :

Introduction to different types of valves, pumps, steam traps, spargers and impellers used in fermentation industries; Design exercise on trickle flow fermentor; Problems associated with design equations.

Text Books:

1. Plant Design and Economics for Chemical Engineers, 5/e Max S. Peters, Ronald E. West, (2003) McGraw-Hill Higher.
2. Biochemical Engineering -Humphrey, A. E.; Millis, JSTOR 1966.
3. Biochemical Engineering, by Harvey W. Blanch, Douglas S. Clark CRC; 1st edition (1997).

Suggested Reading:

1. Biochemical Engineering and Biotechnology Handbook by Bernard Atkinson, Ferda MavitunaGrove's Dictionaries; 2 edition (1992).
2. Bioprocess Engineering:Basic Concepts. Michael L. Shuler / Fikret Kargi, Reihe:Prentice ,(2001) Hall.

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16BT C37

BIOPROCESS LAB

Instruction	3P Periods per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. The course aims at providing knowledge about the methods of sterilization of cells and Thermal death kinetics of spores.
2. The course aims at demonstrating the design of the bioreactor.
3. The students understand the types of reactors and its instrumentation.
4. To analyze and compare fermentation kinetics.
5. To demonstrate the immobilized enzyme stability.

Course Outcomes: At the end of the course the students are able to

1. Out line the sterilization techniques.
2. Discuss about bioreactor instrumentation and control.
3. Compare the parameters to find optimum value where the microbial activity is higher.
4. To predict the K_La value.
5. Analyze the stability of immobilized enzyme.
6. Evaluate the flow characteristics of fluids.

LIST OF EXPERIMENTS

1. Sterilization techniques (chemical, physical and filter methods) and thermal death kinetics.
2. Media optimization (placket- Burman design)
3. Bioreactor instrumentation and its control.
4. Microbial production of fine chemicals (Eg: citric acid and alcohol).
5. Study of growth substrate utilization.
6. Product formation kinetics in shake flask cultures.
7. Batch fermentation kinetics.
8. Fed batch fermentation kinetics.

9. Measurement of K_La by sodium sulphite (Na_2SO_3) oxidation method.
10. Studies on immobilized enzyme/cells in packed bed reactor.
11. Estimation of rheological parameters in fermentation broths.

Suggested Reading:

1. Gunasekharan P, Laboratory manual in Microbiology, 2009
   Chellapandi P, Laboratory manual in Industrial Biotechnology, Pointer publishers, 2007

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16BT C38

MASS TRANSFER OPERATIONS LAB

Instruction	3P Periods per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. This lab course is designed to understand and study the behavior of different reactors. Eg: Batch, CSTR, PFR, analysis of various processes viz., Diffusion, Distillation VLE.

Course Outcomes: At the end of the course the students are able to

1. Determine the diffusion coefficient of liquids in air.
2. Verify the Rayleigh equation.
3. Calculate the theoretical and actual steam consumption.
4. Construct T-x-y diagram using VLE.
5. Determine equilibrium constant using Batch, CSTR and PFR reactors.
6. Calculate activation energy.

LIST OF EXPERIMENTS

1. Diffusion of CCL_4 organic vapor in air estimation.
2. Determine Liquid - liquid diffusivity.
3. Estimate Surface evaporation.
4. Wetted wall column.
5. To verify Rayleigh equation using Simple distillation.
6. Calculate the theoretical and actual steam consumption by Steam distillation.
7. To determine Packed bed distillation.
8. To determine Liquid - liquid equilibrium
9. To determine Liquid - liquid extraction.
10. To construct T-x-y diagram using Vapor liquid equilibrium
11. To determine equilibrium constant using Batch reactor.
12. To determine equilibrium constant using Continuous stirred tank reactor

13. To determine equilibrium constant using Saponification in a tubular reactor.
14. Mixed flow reactors in series.
15. To calculate the activation energy by Temperature dependency.

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16BT C39

BIOINFORMATICS LAB

Instruction	3P Periods per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. To provide practical instructions to the students on using the specific databases and learn how to use these resources on their own and analysis the output.

Course Outcomes:

1. Retrieve the information from biological databases.
2. Utilize BLAST, FASTA and some online tools.
3. Use and compare the online sequence alignment tools.
4. Construction evolutionary tree by phylogenetic analysis.
5. Predict gene and protein structure.
6. Design primers and construct restriction map.

LIST OF EXPERIMENTS

1. Searching Bibliographic databases for relevant information.
2. Sequence retrieval from DNA and Protein databases.
3. BLAST services.
4. FASTA services.
5. Pair wise comparison of sequences (Local and global alignment).
6. Multiple Sequence Alignment.
7. Evolutionary studies/Phylogenetic Analysis.
8. Protein Databank retrieval and visualization.
9. Structure Exploration of Proteins.
10. Restriction Mapping.

11. Identification of Genes in Genomes.
12. NCBI ORF Finder.
13. Primer Design.

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Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001.

16BT C40

MINI PROJECT

Instruction	1 P Periods per week
Duration of End Examination	1 Hours
CIE	50 Marks
Credits	1

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 50 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 50 Marks in the end examination:

1. Power point presentation 20 Marks
2. Thesis/Report preparation 30 Marks

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

Choice Based Credit System (with effect from 2019-20)

B.Tech (Biotechnology)

SEMESTER – VII

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16BT C41	Down Stream Processing	3	-	3	30	70	3
2	16BT C42	Plant Biotechnology	3	-	3	30	70	3
3	16BT C43	Animal Biotechnology	3	-	3	30	70	3
4	16BT C44	Bioprocess Dynamics & Control	3	-	3	30	70	3
5	16BT C45	Computer Applications in Bioprocess Industries	3	-	3	30	70	3
6	16BT E46 16BT E47 16BT E48	**Elective-V (Core)** Genomics & Proteomics Cancer Biology Intellectual Property Rights Regulatory Affairs & Clinical Trials	3	-	3	30	70	3
PRACTICALS								
7	16BT C49	Down Stream Processing Lab	-	3	3	25	50	2
8	16BT C50	Tissue Culture Lab	-	3	3	25	50	2
9	16BT C51	Project Seminar	-	3	-	50	-	2
TOTAL			**18**	**9**	**24**	**280**	**520**	**24**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

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16BT C41

DOWN STREAM PROCESSING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role and, importance of downstream processing.
2. Students are taught the various techniques of cell disruption and the principles of solid liquid separation processes, filtration and centrifugation
3. Students are made to understand the principles of membrane based separations and their applications.
4. Students are enlightened about chromatographic separations, types and their importance in product purification.
5. Students are made to study the principle of crystallization, drying and lyophilisation.

Course Outcomes:

At the end of the course the students are able to

1. Explain the key aspects of Downstream Processing from both a technical and economic perspective.
2. Learn the various techniques of cell disruption and unit operations for separation of insolubles
3. Design mineral water plant
4. Design and select chromatographic separation process for different bioproducts and scale up
5. Learn various techniques of product polishing and formulation.

UNIT-I

Role Of Downstream Processing In Biotechnology: Role and Importance of Downstream Processing in Biotechnological Processes; Characterization of Biomolecules and fermentation broths; Physico-Chemical basis of Bio-separations; Characteristics of Bio-separations; Process design criteria for bioproducts; Downstream process economics.

UNIT-II

Primary Separation And Recovery Processes: Cell Disruption methods for intracellular products- Mechanical, Chemical and Enzymatic Methods; Removal of Insolubles, Biomass separation techniques; Flocculation; Sedimentation; Centrifugation; Filtration: Theory, Equipment-Depth filters, Plate and frame filters, Pressure leaf filters, Continuous rotary drum filters, filter media and filter aids, Problems on specific resistance of the cake, time taken for filtration and, compressibility of cake.

UNIT-III

Product Enrichment Operations: Membrane-based separations-Types of membranes, solution diffusion model, capillary flow model; Types of flow-Cross flow, Tangential flow and mixed flow; Types of membrane based separations: Micro-filtration, Ultra-filtration, Dialysis, Electro dialysis, Reverse Osmosis; Theory, design and configuration of membrane separation equipment, Applications; Aqueous Two-phase extraction of proteins; Precipitation of proteins with salts and organic solvents; Adsorption processes.

UNIT-IV

Product Purification And Polishing: Chromatographic separations- Principles, Classification, General description of column chromatography; IMAC, Bio-affinity Chromatography; Design and selection of chromatographic matrices; Design of large-scale chromatographic separation processes

UNIT-V

New and Emerging Technologies: Pervaporation, super critical fluid extraction; Electrophoretic Separations; Final Product Polishing- Crystallization: nucleation, crystal growth, Industrial crystallizers, Drying: drying terminologies, drying curve, Industrial dryers Lyophilization: principles and applications; Formulation Strategies; Case studies (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Text Books:

1. Sivasankar B, J M Asenjo, Separation processes in Biotechnology, Marcel-Dekker, 1993.
2. Keith Wilson, John Walker, John M. Walker, Principles and Techniques of Practical Biochemistry 5th edition Cambridge University Press, 2000.

Suggested Reading:

1. Nooralabettu Krishna Prasad, Downstream Process Technology by PHI publications.

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16BT C42

PLANT BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. The students should be able to understand explicitly the basic concepts of Plant Tissue culture.
2. To understand the developmental pathways of callus induction and plant regeneration.
3. To understand the techniques for production of secondary metabolites in *in vitro* using plant cell and tissue culture.
4. To understand the methods of gene transfer in plants for production of transgenics.
5. To understand the various strategies and sources of trangenes for crop improvement.

Course Outcomes:
At the end of the course the students are able to

1. Describe the theoretical concepts behind establishment of in vitro techniques.
2. Explain the importance and applications of various in vitro techniques
3. Exploit plant tissues for production of biologics at commercial scale.
4. Interpret the knowledge of how the transgenes are utilized in the production of trangenics resistant to biotic, abiotic stress resistant and improved quality etc.
5. Analyse and use the appropriate vectors for production of transgenics

UNIT-I
Introduction To Plant Tissue Culture: Introduction to cell and tissue culture: History, Totipotency, Cell Theory, Tissue culture media (composition, preparation);Sterilization techniques; Callus and cell suspension culture; Organogenesis and Embryogenesis and their applications.

UNIT-II
Tissue Culture In Crop Improvement: Micropropagation of virus-free plants; Somaclonal variation; Haploids in plant breeding; Germplasm conservation (Cryopreservation). Protoplast isolation, culture and fusion: Somatic hybridization.

UNIT-III
Molecular Farming & Industrial Products: in vitro production of short chain and long chain fatty acids; Industrial enzymes; Edible vaccines. Production of secondary metabolites from plant cell cultures using Cell suspension cultures, Immobilized cell systems, Precursor feeding (elicitation) and hairy roots. Bioreactor systems and models for mass cultivation of plant cells.

UNIT-IV
Plant Genetic Engineering –I Techniques: Agrobacterium mediated gene transfer; Plant vectors and their use in genetic manipulation; Direct gene transfer methods; electroporation, microinjection, particle bombardment and chemical methods.

UNIT-V
Plant Genetic Engineering –Ii Productivity And Safety Regulations: Transgenics in crop improvement: Biotic Stress resistance: Herbicide,Insect, Disease, virus etc., Abiotic stress tolerance: Drought, Temperature, Salt. Transgenics for improved nutrional quality, storage, longer shelf life. Environmental impact and gene flow.

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Text Books:

1. Bhojwani SS and Razdan, Plant Tissue Culture Theory and Practice, Elsevier Science, 2004
2. Chawla HS, Introduction to Plant Biotechnology, 4th edition, Oxford and IBH publishers, 2002

Suggested Reading:

1. Nigel G Halford, Plant Biotechnology: Current and future applications of genetically modified crops , edited John Wiley & Sons Ld. 2006.
2. Surabh Bhatia, Kiran Sharma, Randhir Dahiya and, Tanmoy Bera, Modern applications of Plant Biotechnology in Pharmaceutical Sciences, Elsevier publication, Academic press, 2015

16BT C43

ANIMAL BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Students are expected to understand the technical procedure involved to culture animal cells.
2. Students will learn various steps involved in the establishment of primary culture and their maintenance.
3. Students will know about cell viability and cytotoxicity, cell death.
4. Students are expected to know about stem cells and their applications.
5. Students will describe IVF and embryo transfer, cloning and gene transfer methods for generation of transgenic animals and its applications.

Course Outcomes:

At the end of the course the students are able to

1. Explain the animal cell culture requirements and procedure.
2. Outline the establishment and maintenance of animal cell culture.
3. Discuss about Stem cells and their applications and describe the procedure for measurement of cell viability and cytotoxicity, cell death.
4. Explain various methods for IVF and embryo transfer, cloning and generation of transgenic animals and their applications.
5. Outline various applications of animal biotechnology.

UNIT-I

Animal Cell Tissue Culture: History and scope of animal cell tissue culture, advantages and disadvantages of tissue culture; Laboratory facilities for animal tissue culture; Aseptic techniques; The substrate on which cells grow; Treatment of substrate surfaces; Culture media for cells and tissues.

UNIT-II

Primary Culture and Cell Lines: Disaggregation (Enzymatic and Mechanical) of tissue and Primary culture. Culture cells and evolution of cell lines. Maintenance of cultures- Cell lines, Cell separation, Cell synchronization; Cloning of cell lines; Cell transformation; Bioreactors for animal cell culture; Scaling-up of animal cell culture.

UNIT-III

Stem Cells, Cell Viability and Toxicity: Stem cells, types of stem cells, embryonic stem cells and their applications; Measurement of cell viability and cytotoxicity, Measurement of cell death; Senescence, Apoptosis, Necrosis.

UNIT-IV

Embryo Transfer, Cloning and Transgenic Animals: Artificial insemination, *in vitro* fertilization and embryo transfer; Cloning of animals - Reproductive cloning, Therapeutic cloning; Gene transfer or Transfection methods; Transgenic animals- Mice, Sheep, Pig, Rabbit, Goat, Cow and fish.

UNIT -V

Applications of Animal Biotechnology: Application of animal cell culture; Mammalian cell products; Viral vaccines produced from animal cell cultures. Three dimensional culture; Tissue engineering.

Text Books:

1. Ian Freshney, R., “Culture of Animal Cells: A manual of basic technique and specialized applications” Seventh edition, John Wiley and Sons, 2016.
2. John Masters, “Animal Cell culture: A practical approach” OUP Oxford, 2000.
3. Gupta P.K., “Biotechnology and Genomics” Rastogi Publications, 1st edition, 6th reprint, 2013

Suggested Reading:

1. Srivastava, A.K., Singh, R.K., Yadav, M.P., “Animal Biotechnology” Oxford & IBH Publishing Co. Pvt. Ltd., 2005.
2. Ranga, M.M., “Animal Biotechnology”, 3 reprint, Agrobios, India, 201

16BT C44

BIOPROCESS DYNAMICS & CONTROL

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. The course aims at providing dynamics of system process, flow, level and temperature etc.
2. The course aims at incorporating with concepts of response of first order system for non interacting and interacting systems.
3. The course aims at providing knowledge the design of control system for open and close loop control.
4. The course aims at inculcating concepts of the control of pH of process and biochemical reactions.

Course Outcomes:

At the end of the course the students are able to

1. Use the knowledge of Process dynamics to control level, temperature, flow variable etc in bioprocess industries.
2. Devise simple feedback control strategy for a bioprocess
3. Incorporate the knowledge of closed loop and open loop tuning methods to fine tune the control parameters.
4. Use the knowledge of control valve sizing in the design of control valve system in bioprocess units.
5. Apply the knowledge of process control to regulate the pH of bioreactors and apply the knowledge of process control to regulate the pH of bioreactors.

UNIT-I

Process Dynamics: Laplace transform of simple functions, transforms of derivatives, solutions of differential equations, inversion by partial fractions, Partial fractions. Process variables, Dynamics of simple processes – Flow, level, Temperature, Pressure and Concentration; Transfer function – Properties, response of simple processes for Step, Impulse and Sinusoidal Forcing functions. Concept of Time Constant, Linearization, Response of first order systems in series - Non-interacting and Interacting systems. Physical examples of secondorder system

UNIT-II

Control Actions And Controllers: Controller and Control system – measuring device and final control elements, Open and Closed loop control, Negative and Positive feedback control, Servo and Regulatory problems. Ideal transfer functions –Control valve, Controllers, Proportional, Integral and derivative actions – PI. PD and PID controls. Block diagram- Development of block diagram, Over all Transfer function for single loop system, overall transfer function for change in set point and load, transportation lag.

UNIT-III

Optimum Controller settings: Controller Tuning – Evaluation criteria with l/4th decay ratio, Criteria for good control- IAE. ISE, ITAE. Controller Tuning – Ziegler –Nicholas and Cohen Coon methods .Continuous cycling method, Control of processes with a time delay.

UNIT-IV

Final Control Element: I/P Converter– pneumatic, electric and hydraulic actuators. Control valves – Construction, valve sizing, valve characteristics, valve positioner. Control of Globe, Butterfly and Diaphragm valves.

UNIT-V

Advanced Control Strategies: Brief description of Cascade control. Feed forward control, Ratio control, with a simple example. Dynamics and Control of pH of a process and Biochemical reactor.

Text Books:

1. Donald R.Coughanowr , Process Systems Analysis and Control, 2nd ed., McGraw Hill Inc., 1991.
2. George Stephanpoulos,"Chemical process control", Pearson Prentice Hall, 1984.
3. Seborg, Edgar, Mellichamp, Doyle, "Process Dynamics and Control", 3rd edition John Weily and Sons, 2010.
4. Harriott P, "Process control", Tata McGraw-Hill publishing Co., New Delhi, Reprint 1991.

Suggested Reading:

1. Patranabis D, Principles of Process Control by 2nd ed., Tata McGraw-Hill publishing Co., New Delhi, Reprint 1997.
2. Eckman D.P., Automatic process control, Wiley Eastern Ltd., New Delhi, 1993.

16BT C45

COMPUTER APPLICATIONS IN BIOPROCESS INDUSTRIES

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in software development processes, Algorithm design and Process Models.
2. The course is designed to give an understanding on obtaining. solutions of differential equations by Euler`s, Modified Euler`s, Runge-Kutta methods
3. This course aims at providing an insight into the solution of set of simultaneous equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods.
4. The aim of the course is also to give the students an understanding of obtaining solutions of numerical methods.

Course Outcomes:
At the end of the course the students are able to
1. Distinguish between different process models
2. Formulate process models leading to set of ordinary differential equations and solution procedures numerical methods.
3. Formulate process models leading to set of linear simultaneous equations and solution procedures.
4. Formulate process models leading to transcendental and polynomial equations and solution procedures.
5. Understand the steps involved in optimization that are a prerequisite for the development of process flow sheets and optimize biochemical process.

The Programs are to be written in "C" only
UNIT-I
Computers and Software: Computing environments, the software development processes, Algorithm design, Program composition, Quality Control, Documentation, Storage and •Maintenance, Software strategy. Process Models: Uses, Distributed & Lumped parameter models, Linear and Nonlinear models, Steady state andDynamic models, Continuous and Discrete models, Empirical models. Formulation of Process Models: Momentum, mass and energy balances, constitutive rate equations, transport rate equations, biochemical kinetic rate expressions, thermodynamic relations. Review on "C" Language Fundamentals.

UNIT-II
Function Approximation: Function Approximations by Linear and nonlinear least square analysis, Formulation Process Models leading to set of ordinary differential equations and solution procedures by Eulers, Modified Eulers and Runge Kutta methods.

UNIT-III
Formulation of Process Models : Formulation of Process Models leading to set of linear simultaneousequations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss-Seidel methods.

UNIT-IV
Process Models Leading to Transcendental and Polynomial Equations:
Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bisection, Reguli-falsi, Newton Raphson, Richmond, Muller's and Bairstow methods

UNIT-V

Process Optimization : Nature and organization, basic concepts and elements of Optimization, Scope and hierarchy of optimization, Essential features and general procedure of optimization problems and applications of optimization , single variable functions, direct, indirect and random search methods – with and without acceleration Elimination methods for unrestricted and exhaustive search, Fibonacci search, Dichotomous search, Golden-section (gradient) search methods.

Text Books:

1. DR. B.S. Grewal, Higher engineering mathematics Khanna publishers, 1998.
2. Steven C. Chapra and Raymond P Canale, Numerical methods for Engineers 2nd edition, MCGraw Hill International edition, 1988.

Suggested books:

1. Henry R. Bungay Computer Applications in Bioprocessing Volume 70 Springer, 2000.
2. Edger T.E., and Himmelbau D.M., “Optimization of chemical processes”, McGraw Hill international edition, 1988 3. Bioprocess engineering Enrique Galindo and Octavio T. Ramírez Volume 16, Issue 7, 1998.

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16BT E46

GENOMICS & PROTEOMICS

Elective-V (Core)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the fundamentals of genome
2. Students are made to understand DNA sequencing and various DNA sequencing methods.
3. Students are enlightened about construction and screening of cDNA libraries.
4. Students are enlightened about the current methods existing in the field of genomics.
5. Students are made to understand the basics of proteomics, tools for proteomics and protein modifications

Course Outcomes:

At the end of the course the students are able to

1. Be able to know about genomes, types of genomes and the advanced techniques used for analysing genome.
2. Be able to construct cDNA libraries and explain the importance of cDNA libraries in the identification of functional genes in the genome.
3. Understanding the advancements in the field of modern genomics from classical genomics.
4. To have basics of how proteins are determined and about the function of proteins
5. Be able to design personalized medicines and explain their uptake, action and metabolism.

UNIT-I

Structural Genomics: Overview of genome-Types, analysis of genomes; comparative homologies; evolutionary changes; Genetic analysis:Linkage mapping and analysis, High resolution chromosome maps, Physical mapping, YAC, BAC, Hybrid mapping strategies, microarrays, Sequence specific tags(SST),Sequence tagged sites(STS), FISH, RFLP and RAPD.

UNIT-II

Functional Genomics: Construction and screening of cDNA libraries; cDNA microarrays(DNA micro array, protein micro array), Gene disruptions, Serial analysis of gene expression (SAGE), SAGE Adaptation for Downsized Extracts (SADE); Applications of DNA arrays.

UNIT-III

Next Generation Sequencing: Next generation sequencing- importance; Different sequencer platforms available; Methods of Sequencing; File formats; Data generation tools; Preprocessing of data; Genome wide association studies; Chip-Seq; RNA-Seq; Metagenomics.

UNIT-IV

Proteomics And Tools Used For Proteomics: Protein structure, Protein databases, data mining, Sequence alignment, Algorithms in proteomics, Applications of proteomics: proteome mining, protein expression profiling, protein-protein interactions, protein modifications; Protein digestion techniques; Mass spectrometry: MALDI-TOF, Mass analyzers, peptide Mass Fingerprinting, Protein arrays.

UNIT-V

Metabolomics And Pharmacogenomics: Metabolomis-Basics; Pharmacogenomics-Basics, Diseased genes and their identification; Drug uptake an metabolism; Drug targets; Designer medicine; Genomics perspective of bioterrorism; Ethical and legal implications.

Text Books:

1. Sahai S, “Genomics and Proteomics-Functional and Computational Aspects”, Plenum Publications, 1999.
2. Rastogi SC, Mendiratta N, Rastogi P, “Bioinformatics-Methods and Application, Genomics, Proteomics,and drug discovery”, 2nd edition, Prentice Hall of India, New Delhi, 2003.
3. Hunt SP, Levessy FJ, “Functional genomics” Oxford University Press, UK, 2000.

Suggested Reading:

1. Lieber DC, “Introduction to Proteomics, Tools for the new biology”, Humana Press, UK, 2000.
2. Cendric Gondro, “Primer to Analysis of Genomic Data Using R”, Springer, 2015.

16BT E47

CANCER BIOLOGY
Elective-V (Core)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
1. Student is made to understand the role of cell cycle and diet in cancer.
2. Students are taught the Molecular aspects of cell cycle control.
3. Importance of physical and chemical carcinogens taught by showing effects of mutagens on cell cycle.
4. Students are enlightened about discovery of proto-oncogenes and their activation.
5. Students are made to understand the diagnosis and treatment of cancer.

Course Outcomes:
At the end of the course the students are able to
1. Apply to real life situations, the concept of diet and cell cycle.
2. Incorporate the fundamentals of cell biology and Molecular biology to understand how they are responsible for cancer.
3. Explain the types of carcinogens and the effect of mutagens on cell cycle.
4. Describe the structure of retrovirus and how they led to discover the oncogens.
5. Outline the No. of stages of cancer, detection of cancer and treatment of cancer and explain the ADME properties of anti cancer drugs.

UNIT-I
Fundamentals Of Cancer Biology: Definition and hall marks of cancer, Cell cycle control, regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitors, Mutations that cause changes in signal molecules, Effects on receptor, Signal switches, Tumor suppressor genes, Different forms of cancer(Case studies for carcinoma ex: breast cancer and stomach cancer), Diet and cancer.

UNIT-II
Principles Of Carcinogenesis: Natural History of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, Ionizing radiation and UV radiation mechanism of Carcinogenesis.

UNIT-III
Principles Of Molecular Cell Biology Of Cancer: Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes, Activation of protooncogens to oncogens. Growth factors related to transformations.

UNIT-IV
Cancer Metastasis And Treatement: What is Metastasis, Classic theory of tumor Metastasis, Clinical significance of invasion, Heterogeneity of metastatic phenotype, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion).Diagnosis of cancers, Advances in Cancer detection(Biomarkers technology and nanotechnology), Different forms of therapy-Chemotherapy, Radiation therapy and immunotherapy.

UNIT-V
Principles Of Cancer Pharmacology: Pharmacokinetics and pharmacodynamics of antineoplastic drugs. Metabolism of anticancer drugs, inter individual differences in response to anticancer drugs, mechanisms of anticancer drug resistance. Molecular targets for drug development, mechanism of gene silencing (antisense, ribozymes, RNAi) and chemoprevention studies.

Text Books:

1. Franks LM and N.M.Teich , "Introduction to Cellular and Molecular Biology of Cancer", 2^{nd} edition, Oxford Medical Publications, 1991.
2. Raymond W. Ruddon "Cancer Biology", 3^{rd} edition, Oxford University Press, USA 1995.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3^{rd} edition, Prentice Hall, USA.2003.

Suggested Reading:

1. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2^{nd} Edition, Taylor & Francis, 2004.
2. Robert A. Weinberg, "The Biology of Cancer", 5^{th} edition, Garland Science.2006.
3. Robin Hesketh, "Introduction to Cancer Biology" Cambridge University Publishers, Jan, 2013.

16BT E48

INTELLECTUAL PROPERTY RIGHTS REGULATORY AFFAIRS AND CLINICAL TRIALS
Elective-V (Core)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To make the students to under stand about Intellectual property rights and their importance, National and international regulatory affairs, GCP &ICH guidelines.
2. To introduce and provide a comprehensive introduction to Regulatory Affairs as typically practiced by Regulatory Affairs professionals in medical device and biopharma companies.
3. To enable to students to follow the Current trends in Clinical research and regulations.

Course Outcomes:

The students at the end of the course will

1. The Students will apply the knowledge gained about IPR and to demonstrate the process of patent filing.
2. To create awareness to the Students about the ICH, GCP, FDA guidelines.
3. To discuss and explain the role of regulatory affairs and their significance.
4. Evaluate the criteria for drug approval related documentation.
5. To evaluate, assess, compare and interpret various phases of clinical trials and the basis of approval of new drugs, their outcome in new drug discovery.

UNIT-I

Intellectual Property Rights: Intellectual property rights, and intellectual property protection, patents and methods of application of patents, trade secret, copy rights, trade marks, legal implication, trade related aspects (TRIPS), farmers rights, plant breeder's rights.

UNIT-II

Regulatory Affairs- India: Indian contest- requirements and guidelines of GMP, understanding of Drugs and Cosmetic Act 1940 and rules 1945 with reference schedule M, U & Y. The Narcotics Drugs and Psychotropic Substances Act Medicinal and Toilet Preparations (Excise Duties) Act, 1955. The Pharmacy Act, 1948 Types of ANDA filing (Para I, II, III, IV filing) Clinical trial approval by Drug Controller General of India (DCGI) Exclusivities (NCE, NS, NP, NDF, PED, ODE, PC).

UNIT-III

Regulatory Affairs- Global: Introduction to FDA, WHO, Code of federal Regulations, ICH Guidelines,Related quality systems- objectives and guidelines of USFDA, WHO & ICH, European Medicines Agency and its responsibility, EU clinical trial directive. Requirement of GLP: Guidance and recommendation on Dissolution and Bio-equivalence requirement. Hatch Waxmann Act.

UNIT-IV

Documentation And Protocols: Documentation: Types related to pharmaceuticals industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, IND, BLA, CTD, DMF, Dealing with post approval changes- SUPAC, handling and maintenance including electronic documentation, 510K device application.

UNIT-V

Introduction To Clinical Research: History, Importance and Scope, stake holders in clinical research, Framework of clinical research, Declaration of Helenski, 2000 amendment, medical and clinical research terminology, Principles of GCP, Roles and responsibilities in clinical research according to ICH GCP, Sponsor, Investigator, IRB/IEC, Essential documentation, Confidentiality issues. Clinical data management system, Double data entry.

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Text Books:

1. Fleming DA, Hunt DL, "Biological Safety Principles and Practices", 3rd edition, ASM Press, Washington, 2000.
2. Dominique PB and Gerhardt Nahler, International Clinical Trial, Volume 1&2,, Interpharm Press, Denver, Colorado.

Suggested Reading:

1. Good Clinical Practices, Central Drugs Standard Control Organization, Govt. of India Drugs and Cosmetics Act, 1940.
2. Code of Federal Regulations by USFDA-Download

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16BT C49

DOWN STREAM PROCESSING LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Course Objectives:

1. To provide an opportunity to experimentally verify the theoretical concepts studied.
2. To give extensive exposure to various unit operations of downstream processing.
3. Students are explained how to design protocol for separation of bioproduct based on characteristics

Course Outcomes:

At the end of the course the students are able to

1. Understand the fundamentals of downstream processing for biochemical product recovery.
2. Calculate operating parameters for a given downstream processing unit operation.
3. Develop their skills in the purification of bioproducts from fermentation broths.
4. Design chromatographic separation process for a given compound.
5. Arrange unit operations into an appropriate sequence for the purification of a given type of biological product.

List of Experiments:

1. Cell Disruption of microorganism using sonicator.
2. Cell Disruption of plant cells / animal cells.
3. Homogenization of microbes / plant material using pestle and mortar.
4. Liquid-liquid extraction.
5. Separation of solids from liquid by Sedimentation
6. Separation of micro organisms from fermentation broth by Microfiltration.
7. Separation of solute particles by Dialysis.
8. Separation of alpha amylase by Ammonium Sulphate Precipitation.
9. Isolation and quantification of casein from milk by Isoelectric Precipitation.
10. Separation of biomolecules by Gel Exclusion Chromatography.
11. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
12. Purification of proteins by Affinity Chromatography.
13. Determination of purity and molecular weight of proteins by SDS-PAGE.
14. Simple distillation- vapor liquid equilibrium.
15. Solid liquid extraction.

Text books:

1. David Plummer, "An introduction to Practical Biochemistry" 3rd edition, John Wiley & Sons, 1998.

2. Keith John Walker John Walker Principles and Techniques of Biochemistry and Molecular Biology by,Cambridge University Press; 6 edition ,2005.

16BT C50

TISSUE CULTURE LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant Tissue culture and Animal tissue culture.
2. Develop their skills in plant tissues culture techniques.
3. Get extensive exposure to various techniques of plant cell and tissue culture.
4. To develop a protocol for genetic transformation using Agrobacterium strains.
5. The students will handle animal cell culture.

Course Outcomes:

At the end of the course the students are able to

1. Provides an opportunity to experimentally verify the theoretical concepts studied.
2. Gain hands on training in developing protocols for various in *in vitro* techniques: callus cultures, cell and suspension cultures etc.
3. Establish *in vitro* techniques of micropropagation of crop/horticulture and medicinal plants.
4. Establish a system of genetic transformation using Agrobacterium strains.
5. Handle and experience the Protoplast isolation and culture that helps them to produce somatic hybrids.

List of Experiments

1. Preparation of Plant tissue Culture Media
   i) Preparation of MS stock solutions
   ii)Preparation of MS callus induction media
2. Surface sterilization
3. Callus induction: Embryo Culture.
4. Meristem tip culture
5. Micro propagation of horticultural/medicinally important plants
6. Cell suspension cultures initiation and establishment.
7. Organogenesis and Embryogenesis.
8. Production of synthetic seeds.
9. Protoplast isolation (demo)
10. Agrobacterium mediated gene transfer: induction of Hairy roots
11. Preparation of Animal cell culture media
12. Preparation of cheek epithelium cells
13. Preparation of Primary cell lines
14. Cell counting and viability
15. Staining of animal cells

Text Books:

1. H. Jones and John M. Walker, Plant Gene Transfer and Expression Protocols: Methods in Molecular Biology, 49, Humana Press, 1996.
2. J. G. Chirikjian, Biotechnology: Theory and Techniques (Plant Biotechnology, Animal Cell Culture and Immunobiotechnology), Jones & Bartlett Publishers, U.K., 1996.

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16BT C51

PROJECT SEMINAR

Instruction	3 Hours per week
CIE	50 Marks
Credits	2

The objective of 'Project Seminar' is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks:

Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation
		HEAD Dept. of Bio-Technology Chaitanya Bharathi Institute of Technolo Gandipet, Hyderabad-500 075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Choice Based Credit System (with effect from 2019-20)

B.Tech (Biotechnology)

SEMESTER – VIII

S.No	Course Code	Title of the Course	Scheme of Instruction: Hours per week L/T	P/D	Scheme of Examination: Duration of SEE in Hours	Maximum Marks CIE	SEE	Credits
THEORY								
1	16BT E52 16BT E53 16BT E54	**Elective-VII (Core)** Tissue Engineering Immunodiagnostics Molecular Modeling & Drug Design	3	-	3	30	70	3
2	16ME O06 16EC O02 16EG O01	**Elective-VIII (Open)** Research Methodologies Biomedical Instrumentation Technical Writing Skills	3	-	3	30	70	3
3	16CS O03 16CS O04 16ME O01	**Elective- IX (Open)** IOT and Applications Basics of Data Science Using R Entrepreneurship	3	-	3	30	70	3
4	16BT C55	Seminar	3	-	3	50	-	2
5	16BT C56	Project	6	-	3	50	100	6
TOTAL			**18**		**15**	**190**	**310**	**17**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

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16BT E52

TISSUE ENGINEERING
Elective-VII (Core)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. To provide fundamental principles and elements of tissue engineering.
2. To get insight into the roles of cells, tissue organization and matrix in tissue engineering.
3. To learn the practical approach of carrying out tissue culture.
4. To learn about the Stem cells and different materials to use as biomaterials.
5. To gain knowledge about the medical applications of tissue engineering

Course Outcomes:

At the end of the course students will be able to

1. Recognize the upcoming concepts of tissue engineering, ethical issues, and future prospects
2. Illustrate the molecular mechanisms at tissue level and in cell matrix in tissue engineering.
3. Identify *in vitro* culturing techniques and scale up designs.
4. Classify and identifies the need of compatible biomaterials as scaffolds for Tissue engineering.
5. Identify and interpret the knowledge, of tissue engineering in producing organs for therapeutic applications.

UNIT-I

Introduction To Tissue Engineering: Basic definition of Tissue engineering ; origin and history of Tissue Engineering, overview of its basic steps and its applications; General scientific issues, Ethical issues; current challenges and future prospectives.

UNIT-II

Cells And Tissue Organization: Cells- cell growth and death; cell differentiation; Cells in tissues and organs. Cell to cell interactions; cell adhesion molecules (CAM) Organization of cells into higher ordered structures- Mesenchymal cells; EMT, Molecular mechanisms and control of EMT process. Tissues- Vascularity; angiogenesis; wound healing. Extra cellular matrix (ECM) –components.

UNIT-III

Functional Tissue Engineering: Cell and tissue culture- media; culture initiation; transformation and immortalization; validation; differentiation; maintenance of cells in vitro; cryopreservation. Stem cells in tissue engineering Bioreactors for tissue engineering- Bioreactor design requirements; Spinner flask bioreactors. Rotating-wall bioreactors, Compression bioreactors, Strain bioreactors, Hydrostatic pressure bioreactors, Flow perfusion bioreactors, combined bioreactors

UNIT-IV

Biomaterials of Tissue Engineering: Scaffolds- fabrication; 3D scaffolds Biodegradable polymers; synthetic polymers; hybrid of synthetic and biological polymers; prosthetic devices. Engineering biomaterials for tissue engineering.

UNIT-V

Applications of Tissue Engineering: Tissue replacement –crucial factors Skin grafting Bone tissue engineering; Cardiac tissue engineering; Neural tissue engineering; Vascular tissue engineering;

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Text Books:

1. Robert.P.Lanza, Robert Langer & Vacanti, Principles of tissue engineering.. Academic Press. 2nd edition 2000.
2. B. Palsson, J.A. Hubbell, R. Plonsey & J.D. Bronzino. Tissue engineering. CRC Taylor & Francis 2000.

Suggested Reading:

1. Bernard prish, Tissue engineering- Design, practice & reporting, Woodhead Publishing Ltd. Cambridge. UK 2009.
2. Atala O.P & Lanza.L , Methods of tissue engineering.. Woodhead Publishing Ltd. Cambridge. UK. 2009.

16BT E53

IMMUNODIAGNOSTICS
Elective-VII (Core)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. The students will learn the basic principles, procedures and applications of immunodiagnostic tests.
2. The students are introduced to engineer antibody by using rDNA technology
3. The students are illustrated to the steps involved in the develop, production and applications of monoclonal antibody technology
4. The students will learn the development of preventive agents such as vaccines
5. The students also learn the novel methods used for immunodiagnostics

Course Outcomes:

At the end of the course students will be able to

1. Outline the principle, importance, scope, and classification of immunodiagnostic tests.
2. Demonstrate the antigen antibody reaction and its application in immunodiagnostics for diagnosing various diseases by using different types of immunodiagnostic tests
3. Discuss about the development of monoclonal antibodies for diagnosis, treatment and prevention of disease.
4. Explain the new methods of treating various diseases are being explored by vaccine development.
5. Describe the novel techniques used in immunodiagnostics.

UNIT-I

Introduction to Immunodiagnostics: Principles of immunodiagnostic tests and their development; classification of immunodiagnostic tests; Immunodiagnostics importance and scope; the antigen antibody reaction; Selection and preparation of reagents; Assay design; Antibody engineering; Catalytic antibodies.

UNIT-II

Immunodiagnostics Techniques: Immunodiagnostics techniques – Precipitation, Immunoelctrophoresis, Agglutination, RIA, ELISA, Fluoroimmunoassay, Luminescent immunoassay, Immunofluorescence, Cell separation techniques, Western blotting.

UNIT-III

Hybridoma Technology: Hybridoma technique - choice of host for immunization and myeloma cells, choice of immunogen, preparation of antigen for immunization, growth of myeloma cell lines, preparation of cells for fusion, cell fusion, selection and screening of hybridoma, purification and application (biochemical research, clinical diagnosis and treatment) of monoclonal antibodies.

UNIT-IV

Vaccines: Whole organism Vaccines; Subunit vaccines - Herpes Simplex virus, Foot and Mouth disease; Peptide vaccines - Foot and Mouth disease, Malaria; Live recombinant vaccines- Cholera, Salmonella; Vector vaccines - directed against viruses and bacteria; Purified vaccines, Conjugate polysaccharide vaccines; DNA vaccines; Antifertility vaccines.

UNIT-V

Novel Techniques in Immunodiagnostics: Imaging as an Immunodiagnostic Tool; Multicolor Flow Cytometry; Immunoglobulin and Free-light Chain Detection; Methods for Autoantibody Detection; Immunodiagnostic of Allergy; Multiplex Analysis of Cytokines; Immunomonitoring of Clinical Trials; Immunological Assays Used in Vaccine Clinical Trials.

Text books:

1. Edwards R, “Immunodiagnostics: A practical approach” Oxford University Press, 1999.
2. Rastogi SC, “Immunodiagnostics Principles and Practice” New Age Publishers, 1996.

Suggested Reading:

1. Shepherd, P., Dean C., “Monoclonal Antibodies: A Practical Approach” Oxford University Press, 2000.
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen., “Kuby Immunology” 8th edition, Macillan learning, 2018.
3. Ralph M Aloisi Lea, Principles of Immunology and Immunodiagnostics, Lea & Febiger, 1988.

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16BT E54

MOLECULAR MODELING & DRUG DESIGN
Elective-VII (Core)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
1. Empirical force fields and Hydrogen bonding in different molecules.
2. Simulation methods to calculate Thermodynamic properties of molecules.
3. Molecular dynamics simulation of molecules by simple and continuous potential.
4. Practical aspects in setting and running the molecular dynamics simulation.
5. Montecarlo simulation method for rigid and flexible molecules.

Course Outcomes:
At the end of the course students will be able to
1. Calculate Total energy of molecule by using force field potentials.
2. Calculate Internal energy, Heat capacity, Temperature, pressure.
3. Hard sphere potential, Continuous potential by Finite differential method.
4. Choosing the initial configuration and analyzing the results of computer simulation.
5. Simulation of polymers by Random walk method, Self avoiding walk method and classify the CADD to treat Alzheimers and TB diseases.

UNIT-I
Empirical Force Fields And Molecular Mechanics: Introduction to Molecular Mechanics, Coordinate system, Molecular graphics, Force fields, Bond stretching, Angle bending, Torsions, polarizable force fields Out of plane bending motions, Electrostatic interactions, Vanderwalis interactions, Effective pair potentials, Hydrogen bonding.

UNIT-II
Computer Simulation Methods: Calculation of Thermodynamic properties, Phase space, Practical aspects of computer simulation, Periodic boundary condition, Boundaries monitoring Equilibrium, Truncating the potential and minimum image convention, Long range process, Analyzing results of simulation and estimating errors**.**

UNIT-III
Molecular Dynamics Simulation Methods: Molecular Dynamics using simple modules, Molecular Dynamics with continuous potentials: Finite difference methods and Predictor corrector integration method, Constraint Dynamics, Transport properties, Time dependent properties, Molecular Dynamics at constant Temperature and Pressure, QMM simulations.

UNIT-IV
Montecarlo Simulation Methods: Metropolis methods, Importance of Hamiltonian equation, Montecarlo simulation of Rigid and Flexible molecules, Montecarlo simulation of Polymers: Lattice model & continuous polymer model, calculating chemical potential, Differences between Molecular dynamics & Montecarlo simulation method.

UNIT-V
Applications of Molecular Modeling and Drug Design: Production of Drugs in Pharmaceutical companies, CADD: Strucure Based Drug Design and Ligand Based Drug Design, Quantiative Structural Activity Relationship (QSAR) studies in Protein- Ligand interactions, Case studies of Alzheimers disease, Tuberculosis and Cancer etc.

Text books:

1. AR Leach, Molecular modeling principles and Applications Longman Publications, 1996.
2. Molecular Dynamics simulation -Elementary Methods- John Wiley and Sons, 1997.

Suggested Reading:

1. C. Brandon and J. Tooze, Introduction to protein structure by Garland, 2nd edition, 1998.
2. V. Kothakar, Essentials of Drug Designing Dhruv publications, 1998.

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18ME O06

RESEARCH METHODOLOGIES
(Open Elective- I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
1. To make the students to formulate the research problem
2. To identify various sources for literature review and data collection.
3. To prepare the research design
4. To equip the students with good methods to analyze the collected data
5. To explain how to interpret the results and report writing

Course Outcomes:
At the end of the course, the students are able to
1. Define research problem
2. Review and asses the quality of literature from various sources.
3. Understand and develop various research designs.
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Improve the style and format of writing a report for technical paper/ Journal report

UNIT-I
Research Methodology: Objectives and Motivation of Research, Types of Research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research Approaches, Significance of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II
Literature Survey: Importance of Literature Survey, Sources of Information-primary, secondary, tertiary, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT –III
Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Steps in sample design

UNIT–IV
Data Collection: Collection of primary data, Secondary data, Measures of central tendency-mean, mode, median, Measures of dispersion- Range, Mean deviation, Standard deviation, Measures of asymmetry (skewness), Important parametric tests -z, t, F, Chi-Square, ANOVA significance

UNIT–V
Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation- Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Books:

1. C.R Kothari, “Research Methodology, Methods & Technique”, New Age International Publishers, 2004.
2. R. Ganesan, “Research Methodology for Engineers”, MJP Publishers, 2011

Suggested Reading:

1. Vijay Upagade and Aravind Shende, “Research Methodology”, S. Chand & Company Ltd., New Delhi, 2009
2. G. Nageswara Rao, “Research Methodology and Quantitative methods”, BS Publications, Hyderabad, 2012.
3. Naval Bajjai, “Business Research Methods”, Pearson 2011.
4. Ratan Khananabis and Suvasis Saha, “Research Methodology”, Universities Press, Hyderabad, 2015.

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16EC O02

BIOMEDICAL INSTRUMENTATION
(Open Elective- I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To understand the physiological systems present in the human body.
2. To understand the application of electronic systems used in modern health care.
3. To acquire, process and analyse Bio medical signals.

Course Outcomes:

At the end of the course students will be able to

1. Know the functionality of the human body.
2. Know the practical limitations of electronic gadgets used for human systems.
3. Measure various physiological parameters.
4. Know the functionality of Bio medical recorders.
5. Learn the concepts of Brain- computer interface.

UNIT-I

Introduction to Bio Medical Instrumentation: Components of the Man-Instrument system, Physiological systems of the body, Problems encountered in measuring a living system.Sources of Bio electric potentials: Resting and action potentials, propagation of action potentials, Bio electric potentials.

UNIT-II

Basic Transducer Principles: Transducer principles, active and passive transducers, their bio medical applications.

Electrodes: Electrode theory, bio potential electrodes, bio chemical transducers.

UNIT-III

Cardiovascular System: The heart and cardiovascular system, the heart, blood pressure, blood flow, heart sounds, ECG, Measurement of blood pressure, blood flow, cardiac output, and heart sounds and PCG. Patient care and monitoring systems: Elements of Intensive care systems, patient monitoring systems, other instruments, organisation of the hospital for patient care monitoring, pace makers, defibrillators.

UNIT-IV

Bio Medical Amplifiers: Basic requirements, differential amplifier, carrier amplifier, chopper amplifier, phase sensitive detector. EEG: Signal sources, EEG recording, applications of EEG. EMG: Surface and needle electrodes, EMG, measurement of conduction velocity, ERG, EOG. Respiration: mechanism, spirometer, and pneumotachograph.

UNIT-V

Bio telemetry: Introduction, physiological parameters adaptable to biotelemetry, components of telemetry system, implantable units, applications of telemetry in patient care. Computer in Biomedical instrumentation: digital computer, micro processor, Interfacing computer with other medical equipment, Biomedical computer applications, Introduction to CAT scanner. X-Ray: X-ray unit, radiation therapy, Introduction to MRI and nuclear imaging.

Suggested Reading:

1. Leslie Cromwell, Fred J Weibell and Erich A Pfeiffer, BioMedical Instrumentation and Measurements, PHI, 2nd edition, 2003.
2. C Raja Rao and SK Guha, "Principles of Medical Electronics and BioMedical Instrumentation", Universities press, 2013.

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16EG O01

TECHNICAL WRITING
(Open Elective-1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
The course will introduce the students to:
1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes:
At the end of the course students will be able to
1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

Unit-I
Communication – Nature and process.
Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.
Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit-II
Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit-III
Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.
Technical Articles: Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

Unit- IV
Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.
Technical Proposals: Definition, types, characteristics, structure and significance.

Unit-V
Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.
Technical Presentations: Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

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Text Book :

1. Meenakshi Raman & Sangeeta Sharma, “Technical Communications-Principles and Practice”, Oxford University Press, Second Edition, 2012.
2. 1.M Ashraf Rizvi, “Effective Technical Communication”, Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading :

1. Kavita Tyagi & Padma Misra, “Basic Technical Communication”, PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, “Business Correspondence and Report Writing”, Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

16CS O03

IOT AND APPLICATIONS
(Open Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre-requisites: Programming Basics.

Course Objectives:
1. Impart necessary and practical knowledge of components of Internet of Things.
2. Develop skills required to build IoT based systems in the field of biotechnology.

Course Outcomes:
At the end of the course students will be able to
1. Understand Internet of Things and its hardware and software components.
2. Interface I/O devices, sensors & communication module.
3. Remotely monitor data and control devices.
4. Develop real time IoT based projects.
5. Advance towards research based IoT in the field of biotechnology.

Unit- I
Introduction to IoT: Sensors, Types of sensors and Transducers, Actuators and Types of Actuators.

UNIT-II
Basics of Networking : Functional Components of IoT, IoT interdependencies, IoT Service oriented architecture, IoT categories, IoT gateways, IoT and associated technologies, Key technologies for IoT, IoT challenges.

Unit- III
IoT **Hardware Components:** Computing (Arduino/Raspberry Pi), Communication, Sensors, Actuators, I/0 interfaces, Programming API's (for Arduino/ Raspberry Pi).

Unit- IV
Generic IoT Systems: Home Automation: Smart Lighting, Environment: Weather Monitoring System, Weather Reporting Bot, Forest Fire Detection.

UNIT- V

IoT for Biotechnology: Agriculture: Drip-irrigation, Seed quality detection system, Biological water treatment system, Alcohol Detection System, Bio fuel cell for low power IoT devices

Text Books:

1. Raj and Anupama C. Raman,"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2018.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested Reading:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.

3. Raj Kamal, “Internet of Things:Architecture and Design”, McGraw Hill, 2017.
4. Cuno Pfister, "Getting Started with the Internet of Things", 0 Reilly Media, 2011.
5. O. Vermesan, P. Fries**s, “**Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, Series in Communications, 2013.

Online Resources / Weblinks / NPTEL Courses:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey “, IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. Gotovtsev, Pavel M., and Andrey V. Dyakov. "Biotechnology and Internet of Things for green smart city application." 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT). IEEE, 2016.
3. Yanjing, Sun, et al. "Research and design of agriculture informatization system based on IOT." Journal of Computer Research and Development 48 (2011): 316-331.
4. Somov, Andrey, et al. "Bacteria to power the smart sensor applications: Biofuel cell for low-power IoT devices." 2018 IEEE 4th World Forum on Internet of Things (WF-IoT). IEEE, 2018.
5. Han, Shuqing, et al. "Analysis of the frontier technology of agricultural IoT and its predicationresearch." IOP Conference Series: Materials Science and Engineering. Vol. 231. No. 1. IOP Publishing,2017.

16CS O04

BASICS OF DATA SCIENCE USING R
(Open Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre-requisites: Probability and Statistics, basics of programming languages.

Course Objectives:
1. Understand R programming language.
2. Explore the programming skills needed to use R tool for statistical analysis of Biological data.
3. Analyze biological data.

Course Outcomes:
At the end of the course students will be able to
1. Understanding the basics of R, various statistical measures, algorithms useful for data analysis.
2. Explore the programming skills needed to use R tool for biological data.
3. Analyze biological data using R tool.
4. Apply classification and clustering algorithms to bilogical data.
5. Identify and work with the technologies and resources related to bioinformatics.

UNIT-I
Basics of R: Introduction, R features, setting up and exploring R environment, loading packages, types of data objects in R, working with R data objects, Controlling work space, importing files.
Programming with R: Variables and assignment, operators, control structures, Functions-built-in, writing own functions, package creation.

UNIT-II
Data Analysis and Graphics: Data summary functions in R, Graphics technology in R, saving graphics, additional graphics packages.
Bayesian Data Analysis: Need of Bayesian approach, Application of Bayes rule, Priors, Likelyhood functions, evaluating the posterior, Applications of Bayesial Statistics in Bioinformatics.
Stochastic Modeling: Stochastic process and Markov Processes, Classification of Stochastic processes, modeling a DNA sequence with Markov Chain, Characteristics of Markov Chain.

UNIT-III
MCMC using Brugs: ABO blood type example. Gibbs sampling.
Statistical Inference: Sampling distributions, Parameter estimation, interval estimation, bootstrapping, R packages for bootstrapping.
Hypothesis Testing: Package ctest, Binomial test, comparing variances, Wilcoxon tests, Chi-Square test, Fisher's Exact tests, Likelyhood Ratio tests.

UNIT-IV
ANOVA and Regression: ANOVA table, performaning ANOVA using R, graphical analysis of ANOVA comparison, Regression: Correlations, linear regression model, fitting and testing of regression mdoel, generalization of the model.
Working with Multivariate Data: Multivariate data, sample statistics, display of multivariate data, outliers and principal components. Classification of disriminant analysis- classification with two population and more than two populations, cross validation classification trees.

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UNIT-V
Clustering methods: measures of dissimilarities, K-means clustering, K-Medoid clustering, Hierarchical clustering-Agglomeratve and divisive
R Packages: Bioconductor and SeqinR.
Data Technologies: R for Data manipulation, example, Database technologies, Bioinformatics resources on the WWW.

Text Books:

1. Kim Seefeld, Ernest Linder, "Statistics using R with Biological examples", 2007 (https://cran.r-project.org/doc/contrib/Seefeld_StatsRBio.pdf).
2. Robert Gentleman, "R Programming for Bioinformatics", 1st Edition, CRC Press, 2008.

Suggested Reading / Online Resources:

1. Arvil Cohhlan "A Little Book of R for Bioinformatics", Release 1.0, CC ver 3.0
2. https://epdf.tips/r-programming-for-bioinformatics.html
3. https://epdf.tips/r-programming-for-bioinformatics.htmlhttps://www.cyclismo.org/tutorial/R/objectOriented.html
4. https://www.w3schools.in/r/object-oriented/

16ME O01

ENTREPRENEURSHIP
(Open Elective-III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Student will understand
1. The environment of industry and related opportunities and challenges
2. Concept a procedure of idea generation
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Course Outcomes:
At the end of the course students will be able to
1. Identify opportunities and deciding nature of industry
2. Brainstorm ideas for new and innovative products or services
3. Analyze the feasibility of a new business plan and preparation of Business plan
4. Use project management techniques like PERT and CPM
5. Analyze behavioural aspects and use time management matrix

UNIT-I
Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II
Identification and characteristics of Entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III
Business Plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV
Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V
Behavioral Aspects of Entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior
Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Y. Rajani

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication, 1994.
3. G.S. Sudha, “Organizational Behavior”, National Publishing House, 1996.

Y. Rajani

16BT C55

SEMINAR

Instruction	3Hours per week
CIE	50 Marks
Credits	2

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summaryand Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall preferably be from any peer reviewed recent journal publications.

Y. Rajasri

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

16BT C56

PROJECT

Instruction	6 Hours per week
CIE	50 Marks
SEE	100 Marks
Credits	6

The object of Project is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 50)
CIE (Continuous Internal Evaluation) Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Department Review Committee	05	Review 1
	08	Review 2
	12	Submission
Supervisor	05	Regularity and Punctuality
	05	Work Progress
	05	Quality of the work which may lead to publications
	05	Report Preparation
	05	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in SEE: (Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

Y. Rajasri

16MCC101 **DISCRETE MATHEMATICS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Gain Logical and Mathematical ability to introduce most of the basic terminologies used in computer science with particular reference to the relationships among the discrete structures.
2. Learn about Boolean algebra.
3. Apply the concepts of Relations, Functions, properties of Integers and Set Theory.
4. Learn about principle of Inclusion, Exclusion and Generating Functions.
5. Understand the concept of Recurrence Relations, Groups and Algebraic Structures
6. Model and analyze the computational processing using combinatorial methods.

Course Outcomes:
After completion of the course the students would be able to:
1. Apply knowledge of the concepts needed to test the logic of a program.
2. Apply knowledge of Boolean algebra and Set Theory.
3. Apply knowledge of Properties of Integers, Relations and Functions.
4. Expose principles of Inclusion and Exclusion, Generating Functions, Recurrence Relations, Groups and Algebraic Structures.
5. Synthesize the indirection of hypothesis and simple indirection methods.
6. Prove elementary properties of modular arithmetic and explain their applications in Computer Science.

UNIT – I
Fundamentals of Logic: Basic Connectives and Truth Tables, Logical Equivalence, Logical Implication, Use of Quantifiers, Definitions and the Proof of Theorems. **Boolean algebra**: Switching Functions, Logic gates, Don't Care Condition **Set Theory**: Sets and Subsets, Set operations and the Laws of Set theory Counting and Venn Diagrams.

UNIT – II
Properties of Integers: The well-ordering principle, Recursive definitions, The Division Algorithm, Euclidean Algorithm, Fundamental theorem of arithmetic. **Functions:** Cartesian product, Functions, Onto Functions, Special Functions, Pigeonhole Principle, Composition and Inverse Functions, Computational Complexity. **Relations**: Partial Order Relations, Lattices, Equivalence Relations and Partitions.

UNIT – III
Principle of Inclusion and Exclusion: Principles of Inclusion and Exclusion, Generalization of principle, Derangements, Rooks Polynomial, Arrangements with Forbidden Positions.
Generating Functions: Introductory examples, Definitions and examples, Partition of Integers, Exponential generating function, Summation operator.

UNIT – IV
Recurrence Relations: First-order linear recurrence relation, Second-order linear homogeneous recurrence relations with constant coefficients, Non- homogeneous recurrence relations, Divide-and-conquer algorithms. **Algebraic Structures**: Definition, Examples and properties. **Groups**: Definition, Examples and elementary properties, Homomorphism, Isomorphism and Cyclic groups.

UNIT – V
Graph Theory: Definitions and examples, Sub graphs, Complements and graph isomorphism, Vertex degree, Planar graphs: Hamiltonian paths and Cycles, Graph coloring.
Trees: Definitions, Properties and examples, Rooted Trees, Spanning Trees and Minimum Spanning Trees.

Text Books:

1. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics”, Pearson Education, 4th Edition, 2003.

Suggested Reading:

1. Kenneth H Rosen, “Discrete Mathematics and its Applications” Tata McGraw Hill, 6^{th} Edition, 2007.
2. J.P Tremblay & R. Manohar, “Discrete mathematical Structures with Applications to computer science” McGraw Hill. 1987.
3. Joe L. Mott, A.kandal & T.P. Baker, “Discrete mathematics for compute scientists, & mathematicians", Prentice Hall N.J., 1986
4. Kevin Ferland, “Discrete Mathematics”, Houghton Mifflin Company, 2009.

HEAD OF DEPARTMENT
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16MCC102 COMPUTER PROGRAMMING AND PROBLEM SOLVING

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Understand algorithms, flow charts and pseudo codes.
2. Learn programming environment.
3. Gain the basic terminology used in computer programming.
4. Understand different data types in C programming.
5. Understand the decision structure, loops, functions, arrays, pointers, strings, structures and files.

Course Outcomes:
After completion of the course, the students would be able to:

1. Design Algorithms and Flowcharts to solve the various problems.
2. Execute the programs.
3. Apply different data types in various programs.
4. Apply the built-in functions, customized functions and preprocessor directives in various programs.
5. Apply the Arrays and Pointers for solving the problems.
6. Apply the Strings and Structures, dynamic memory allocation techniques and files for solving the various problems.

UNIT – I
Algorithm, flowchart, pseudo code, Structured Programming, program development steps, creating and running programs, structure of a C program, character set, keywords, identifiers, constants, basic data types and sizes, variables, operators, operator precedence and associativity, expressions, evaluating expressions, type conversions, basic formatted Input/output statements, decision control structures: if and switch statements, loop control structures: while, do-while and for, continue, break.

UNIT – II
Functions: Basic concepts, user defined functions, parameter passing, local variables, global variables, recursive functions, comparison of iteration and recursion, standard library functions, header files, storage classes, preprocessor.

UNIT – III
Arrays: Basic concepts, one-dimensional array, passing arrays to functions, searching and sorting: linear search, binary search and bubble sort, two-dimensional array, multi-dimensional array.
Pointers: Basic concepts, pointers as function arguments, pointer arithmetic, pointers to pointers, pointers and one-dimensional arrays, pointers and two-dimensional arrays, array of pointers.

UNIT – IV
Strings: Basic concepts, string I/O operations, pointers and strings, string manipulation functions. **Structures**: Declaration, definition and initialization of structures, accessing structures, nested structures, array of structures, structures and functions, pointers to structures, unions, enumerated types, typedef.

UNIT – V
Dynamic memory management functions, command line arguments. **Files**: Basic concepts, text files, binary files, basic file I/O operations, sequential-access files, random-access files.

Text Books:

1. Pradip D &Manas G, “Programming in C”, 2nd edition, Oxford University Press, 2007.
2. B.A. Forouzan and R.F.Gilberg,”Computer science, A structured programming approach using C”, 3rd edition, Cengage learning, 2007.

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Suggested Reading:

1. BW Kernighan DM Ritchie, "The C programming Language", 2nd edition, Prentice Hall India, 1998.
2. P.J Deitel and H.M Deitel , "C How to program" , 6th edition, PHI, 2010.
3. Yashwant Kanetkar, "Let us C", 13th edition, BPB Publications, 2013.
4. E Balaguruswamy, "Programming in ANSI C", 5th edition, Tata McGraw-Hill, 2007.
5. K R Venugopal& S R Prasad, "Mastering C", McGraw-Hill, 2007.

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16MCC103 ELEMENTS OF INFORMATION TECHNOLOGY

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

Students will:

1. Understand concepts of Information Technology and its applications.
2. Understand the physical and logical structure of the computer.
3. Have knowledge of the concepts of Networks and Communication Technology.
4. Obtain Knowledge of Files and Databases.
5. Understand the flow of information and the various levels of management within an organization.
6. Identifying security issues of computers and communication systems.

Course Outcomes:

After completion of the course, the students would be able to:

1. Get concepts of Information Technology and its Applications.
2. Identify the physical and logical structure of the computer.
3. Gain the knowledge of Network and Communication Technology.
4. Become familiar with the use of Files and Databases.
5. Gain the knowledge of flow of information in an organization and the various levels of management with in an organization.
6. Handle security issues of computers and communication systems.

UNIT -I

Introduction to Information Technology: Data, Information, Basic operations of Computers, Hardware: Input, Output, Memory, Communication, **Software**: **System software**: Operating System, Device drivers, Utility programs, GUI, **Application software**: Ways to obtain application software, Types of application software, Five sizes of computers, **Common operating systems**: DOS, MAC OS, Windows: XP, VISTA, Windows 7.0, Network OS, Hand held devices OS.

UNIT -II

Hardware: Generations of Computers, Measuring Capacity, Binary Coding Schemes, Number System, Block diagram of Computer, **Micro Computer System Unit**: Computer case, Power supply, Mother Board, Chips, CPU, Memory, Ports and Cables, **Input Devices**: Keyboard, Pointing devices, Source data entry devices, Audio and Video devices, Digital cameras, Speech recognition systems, RFID, Sensors, human biology input device, **Output Devices**: Soft copy output, Hard copy output, Mixed output devices, **Secondary Storage Device**: Floppy disks, hard disks, optical disks, flash memory, magnetic tape, online secondary storage, smart cards.

UNIT -III

Network communications: Digital basics of computers, **Networks**: Benefits of networks, Client – Server and Peer to Peer Networks, Types of Networks, Components of Networks, Intranet, Extranet and VPNS, Network Topologies. **Communications**: Wired and Wireless Communication Media, Cyber threats, Hackers and Safe Guards, **Internet and World Wide Web**.

UNIT- IV

Files & Databases: Data Storage Hierarchy, Types of Files, Key Field, Compression and Decompression, File Management Systems, **Database Management Systems**: Benefits of DBMS, DBA, Database Models, Data Mining, E-Commerce, Ethics of Using Databases.

UNIT -V

Information Systems: Qualities of good information, Information flows within an Organization, Computer Based Information Systems: OIS, TPS, MIS, DSS, ESS and ES. **System Development**: Six phases of system analysis and design. **Software Development**: Programming as a five step procedures. Five Generations of Programming Languages, **Security Issues**: Threats to Computers & Communication Systems. Safe guarding computers and communications.

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Text Book:

1. Williams B.K. Sawyer et.al. "Using information Technology", 9^{th} Edition, Tata McGraw Hill, 2011.

Suggested Reading:

1. Aksoy & DeNardis" Introduction to Information technology", Cengage Learning, 2006.
2. Dennis P. Curtin, Kim Folley, et.al. "Information Technology, The breaking Wave", Tata McGraw Hill, 1998.
3. ITL Edn Solutions Ltd. "Introduction to Information Technology", Education, 2005.

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16MBC128 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Introduce managerial economics and demonstrate its importance in managerial decision making.
2. Develop an understanding of demand and relevance of it's forecasting in the business.
3. Examine the economic analysis of production process in relationship with inputs.
4. Explain different costs and their relationship with the output.
5. Explain the concept of Accountancy and provide knowledge on preparation and analysis of Final accounts.
6. Understand the importance of project evaluation in achieving a firm's objective.

Course Outcomes:
After completion of the course, students will be able to:
1. Apply fundamental knowledge of Managerial economics' concepts and tools.
2. Understand various aspects of demand analysis and forecasting.
3. Analyze production function in terms of best combination of inputs.
4. Decision the best cost and benefits to achieve the objectives.
5. Analyze different opportunities and come out with best feasible capital investment decisions.
6. Understand accountancy concepts and conventions, final accounts and financial analysis.

UNIT - I:
Introduction to Managerial Economics : Definition, Nature and Scope of Managerial Economics, Micro Economics vs Macro Economics. Relationship of Managerial economics with other disciplines- Mathematics, Statistics, Accounting, and Operations Research. Role and responsibilities of Managerial economist in Business decisions. Fundamental concepts of Managerial economics - Opportunity cost concept, Principle of Time perspective, Incremental principle, discounting principle, and Equi-marginalism.

UNIT- II:
Demand Analysis : Meaning of Demand, Determinants of demand, types of demand, Individual vs Market Demand, Demand schedule, Demand curve and Demand function. Law of Demand and its exceptions. Elasticity of Demand- Definition, Types, and Measurement of Elasticity of Demand. Demand Forecasting- Factors governing demand forecasting, Methods of demand forecasting (Survey method, Statistical method, Expert opinion method, Test marketing, and judgmental approach).

UNIT - III:
Production and Cost Analysis : Production Analysis: Concept and Meaning of production-Factors of production, Production Function, law of variable proportions (with one variable and two variable inputs), Iso-quants and Iso-costs, Laws of returns, Economies and dis Economies of scale - internal and external economies. Cost analysis: Cost concepts - Actual vs opportunity cost, Incremental and sunk cost, Short run and long run cost, Fixed and variable cost. Cost output relationship in short -run and long-run.
Break Even analysis (BEA) – Break even chart, Determination of Break Even Point (simple numerical problems) Margin of safety. Managerial applications, and limitations of BEA.

UNIT - IV:
Introduction to Financial Accounting : Definition, Concepts and conventions of Accounting, Principles of double entry book keeping, Preparation of journal, ledger and Trial balance. Preparation of Financial statements- Trading and profit and loss account, and Balance sheet with simple adjustments.

UNIT –V:
Capital Management and Capital Budgeting: Significance of capital, Types of capital and sources of capital. Meaning of capital budgeting, Importance of capital budgeting. Methods of capital budgeting- Payback period

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method, Average rate of Return (ARR), Net present value method (NPV) Internal rate of return method (IRR) Profitability Index. (Simple Numerical Problems).

Text Books:

1. P.L. Mehta,"Managerial Economics – Analysis, Problems and Cases" , Sultan Chand &Sons Educational, 2011.
2. Grawal T.S, Introduction to Accountancy", S.Chand Publishers, 2009.
3. Pandey, I.M, Financial management, 10th Ed.Vikas Publishing House, 2010.

Suggested Reading:

1. Varshney R.L. K.L. Maheswari Managerial economic, Sultan Chand.
2. J.C.Pappas and E.F.Brigham, Managerial Economics.
3. Maheswari, S.N, Introduction to Accountancy, Vikas Publishing House, 2005.
4. M. Kasi Reddy & S.Saraswathi, Managerial economics & Financial Accounting, PHI 2007.

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16EGC101 PROFESSIONAL COMMUNICATION IN ENGLISH

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Understand the role and importance of communication and to develop their basic communication skills in English.
2. Improve the students' listening skills and introduce them to different reading strategies.
3. Train students to use language appropriately for interviews, presentations and public speaking
4. Encourage the all-round development of students by focusing on soft skills.
5. Develop the students writing skills, career skills and make them industry ready.

Course Outcomes:
After completion of the course, students would be able to:
1. Apply critical and creative thinking abilities necessary for effective communication in today's business world.
2. Demonstrate competency in writing effective paragraphs, letters and reports.
3. Become effective, confident speakers and deliver persuasive presentations.
4. Understand the nuances of listening comprehend texts and draw inferences and conclusions.
5. Understand the significance of soft skills in the working environment.

UNIT – I:
Understanding Communication in English: Meaning, definition, Nature and Scope of Communication, Importance of Communication, Process of Communication, Intrapersonal and interpersonal communication, One way vs. Two way communication. Barriers to Effective Communication, Overcoming the Barriers. Communication in a business organization: Internal (Upward, Downward, Horizontal, Grapevine, Problems, Solutions) and External Communication. Strategies for conducting successful business meetings.

UNIT-II
Developing Listening & Reading Skills: Process and Types of listening. Problems in comprehension and retention. Barriers to listening, effective listening strategies. Note – taking. Process and purpose of reading. Reading Techniques-Skimming, Scanning, inferences and conclusion. Reading comprehension-known and unknown passages.

UNIT – III
Soft Skills: Introduction to Soft skills, Hard skills vs Soft skills, Public Speaking, Presentation Skills and techniques, Body Language, Leadership skills, Team Building, Decision Making, Business Etiquette - Email & Telephone Etiquette.

UNIT – IV
Written Communication: Sentence Structures & Paragraph Writing. Letter Writing-form, structure, layout. Sales Letters. Basics of Official Correspondence: Handling Correspondence, Receipt and Dispatch of Mails, Filing system, Classification of Mails; Quotations, Orders, Tenders. Information Transfer.

UNIT-V
Career Skills: Resume Writing, Elements of an Effective Resume, Application Letters, Job Interview –Purpose, Types, Interview Skills & Techniques. Grammar & Vocabulary.

Text Books:
1. **Vibrant English**, Orient Blackswan Ltd.

Suggested Reading:

1. M .Ashraf Rizvi, **Effective Technical Communication**, Tata Mc Graw- Hill, New Delhi
2. Meenakshi Raman and Sangeetha Sharma, **Technical Communication - Principles and Practice**, Oxford Univ. Press, New Delhi.
3. Alok Jain, P.S. Bhatia and A.M. Shiekh, **Professional Communication Skills** S. Chand & Company Ltd., 2005
4. R.C.Sharma & Krishna Mohan, **Developing Communication Skills, Business correspondence and report writing** Tata McGraw Hill
5. Evans, D, **Decision maker**, Cambridge University Press, 1997.
6. Shiv Khera, **You Can Win,** Macmillan Books – Revised Edition, 2003
7. Stephen Covey **7 Habits of Highly effective people,** Free Press

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16MCC104 COMPUTER PROGRAMMING LAB USING 'C'

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Learn programming environment.
2. Gain the basic terminology used in computer programming.
3. Understand different data types in C programming.
4. Understand the decision structure, loops, functions, arrays, pointers, strings, structures and files.

Course Outcomes:
After completion of the course, the students would be able to:
1. Write, compile, debug and execute the programs.
2. Apply various data types in various programs.
3. Apply the built-in functions and customized functions for solving the programs.
4. Use the decision structures, loop structures, functions, and arrays in various programs.
5. Apply pointers, strings and structures in various programs.
6. Write programs using files.

C-Programs:
1. Write a program to calculate the area of a circle, rectangle, square and triangle.
2. Write a program to find the Roots of a Quadratic Equation $ax^2+bx+c=0$, where $a>0$.
3. Write a program to find the biggest of three different numbers by using nested if – else statement.
4. Write a program to find the division of the student using percentage of marks.
5. Write a program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement).
6. Write a program to find max, min and sum of given set of numbers.
7. Write a program to find the sum of individual digits of a positive integer.
8. Write a program to find the factorial of a given positive number.
9. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
10. Write a program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
11. Write a program to find the reverse of the given positive integer and check reverse number is palindrome or not.
12. Write a program to find the sin(x) value using series expansion. (Hint: $\sin(x) = x - x^3/3! + x^5/5! - \ldots..$)
13. Write a program to find the cos(x) value using series expansion. (Hint: $\cos(x) = 1 - x^2/2! + x^4/4! - \ldots..$)
14. Write program for the following using non-recursive functions.
    i) To find the factorial of a given integer.
    ii) To find the GCD (greatest common divisor) of two given integers.
15. Write program for the following using recursive functions.
    iii) To find the factorial of a given integer.
    iv) To find the GCD (greatest common divisor) of two given integers.
16. Write programs using functions to perform the following search techniques
    i) Linear search ii) Binary search
17. Write a program to implement bubble sort technique.
18. Write program using function to perform the Additions of Two Matrices
19. Write program using function to perform the Multiplication of Two Matrices
20. Write program using function to perform the Transpose of a given Matrix
21. Write a program to display the array elements from last index to first index and display the even and odd elements sum.
22. Write a program to demonstrate call by reference mechanism by swapping two integers.
23. Write a program to find the number of characters, words and sentences in the given string.

24. Write a program to copy the contents of one string into another string using pointers.
25. Write a program to concatenate two strings without using strcat library function.

26. Write a program that uses functions to perform the following operations using Structure complex.
    i) Reading a complex number
    ii) Displaying a complex number
    iii) Addition of two complex numbers
27. Write a program that uses functions to perform the following operations using Structure complex.
    i) Reading a complex number
    ii) Displaying a complex number
    iii) Multiplication of two complex numbers
28. Write a program which counts number of characters, words and sentences in the file.
29. Write a program which copies contents of one file into another file.
30. Write programs to demonstrate sequential access files.
31. Write programs to demonstrate random access files.

Suggested Reading:

1. E Balaguruswamy, "Programming in ANSI C", 5th edition, Tata McGraw-Hill, 2007.
2. K R Venugopal & S R Prasad, "Mastering C", McGraw-Hill, 2007.
3. Yashwant Kanetkar, "Let us C", 13th edition, BPB Publications, 2013..

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16MC C105 ELEMENTS OF INFORMATION TECHNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:

Students will:

1. Have knowledge of physical and logical structure of compute system.
2. Have hands on learning of MS-Word features such as section breaks, formatting, Mail Merge, Macros.
3. Gain knowledge of MS-Excel features such as Formulas and Functions and Different type of charts.
4. Acquire knowledge of MS-PowerPoint features.
5. In-depth learning of MS-Access features such as Creation of databases, Queries, Forms and Reports.
6. Learn basic dollar prompt commands in Linux.

Course Outcomes:

After completion of the course, students would be able to:

1. Assemble System and Load Software in the system
2. Create professional MS-Word documents
3. Efficiently generate Excel documents.
4. Give efficient presentations.
5. Handle various database applications.
6. Use basic dollar prompt commands in Linux.

Lab Experiments:

1. Identify and describe the relationships and role of the components of the "Logical' Diagram of the computer. (e.g. processor, RAM, ROM, BIOS, input, output, storage.)
2. Relate the "logical" diagram of a computer system to the "physical" system by Identifying physical components of a computer and describing their purpose. (e.g. the Processor, memory chips, motherboard, disk drives, and controller cards such as AGP Board, network cards, sound card, as well as parallel and serial ports etc.)
3. Assemble the computer which they will use and load the OS with partitions for Windows and Linux, configure for network connection
4. Troubleshoot his/her PC
5. Install/Uninstall SW/HW on his/her PC from time to time
6. Identify and distinguish between various types of application software. by describing and using them. (e.g. word processor, spreadsheet, database, browser, mailers etc.)
7. Distinguish between various commercially available systems by relating the cost to Features available on each system
8. **MS Word:** Create documents with standard formatting commands, single/multi Column, breaks, insert pictures/objects, drawings, hyperlinks, header/footer, and tables, Mail Merge, Macros.
9. **MS Power Point:** Create presentations with preset animations, using different layouts, Backgrounds, slide master, insert pictures/objects, drawings, hyperlinks, header/footer, Tables
10. **MS Excel:** Creating worksheets with various kinds of data, making charts, conditional Formatting, awareness of the various functions- statistical, date/time, math/trig etc, ability to explore (help) and use these functions if need be, demonstration through some Common functions like sum, average, standard deviation, logical and information.
11. **MS-Access:** Creation of database, queries, forms, Reports using student information system.
12. Learning of basic Dollar prompt commands in Linux.

Suggested Reading:

1. Williams B.K. Sawyer et.al. "Using information Technology", 9^{th} Edn. Tata Mc-Graw Hill, 2011.
2. Srivastava S.S. "MS OFFICE", Laxmi Publications, New Delhi.
3. Behrous A Fourzan, Richard F Gilberg "Unix and Shell Programming: A Text Book", Thompson Learning 2003.

16EGC102 PROFESSIONAL COMMUNICATION LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:

Students will:

1. Introduce to phonetics and the different sounds in English.
2. Familiarize with the software and give them sufficient practice in correct pronunciation.
3. Speak English correctly with focus on stress and intonation.
4. Participate in group discussions with confidence and to make effective presentations.
5. Plan and prepare for an interview, process of interview and interview techniques.

Course Outcomes:

After completion of the course, students would be able to:

1. Understand the speech sounds in English and the nuances of pronunciation.
2. Understand tone, intonation and rhythm and apply stress correctly.
3. Participate in group discussions with clarity and confidence.
4. Speak confidently on stage with appropriate body language.
5. Plan, prepare and face interviews with confidence.

Syllabus:

1. Introduction to English Phonetics: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. Sound system of English: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters
3. Word stress: Primary stress, secondary stress, functional stress, rules of word stress.
4. Listening skills – practice with IELTS and TOEFL material
5. Situational dialogues and role play.
6. Group Discussions – dynamics of group, intervention, summarizing, modulation of voice and body language.
7. Presentation Skills – Elements of effective presentation – Structure of presentation – Presentation tools – Body language. Creating an effective PPT
8. Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews.

Suggested Reading:

1. E. Suresh Kumar et al, **English for Success** (with CD), Cambridge University Press India Pvt, Ltd. 2010.
2. T Balasubramanian, **A Textbook of English Phonetics for Indian Students**, Macmillan, 2008.
3. J Sethi et al. **A Practical Course in English Pronunciation** (with CD), Prentice Hall India, 2005.
4. Edgar Thorpe. **Winning at Interviews**, Pearson Education, 2006
5. Priyadarshi Patnaik**. Group Discussions and Interviews,** Cambridge University Press Pvt Ltd 2011

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16MCC106 **OBJECT ORIENTED PROGRAMMING**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Learn java basics & object oriented programming principles.
2. Know the concepts of interfaces, packages.
3. Get the concepts of exception handling in java.
4. Acquire the concept of multithreading
5. Interpret the concepts on I/O package.
6. Understand the basic concepts of Applets and AWT.

Course Outcomes:
After completion of the course, the students would be able to:

1. Gain the knowledge on object oriented programming concepts.
2. Create classes and objects.
3. Acquire knowledge on multithreading and exception handling.
4. Understand the role of Strings and I/O Streams.
5. Design and Develop the GUI Components.
6. Perform event driven programming.

UNIT -I
Object Oriented Programming: History of java, and evolution of java, java Buzzwords, Object Oriented Programming, Data types, Variables and Arrays, Operators, Control Statements,

UNIT -II
Introduction To Classes: Classes, Methods, Constructors, This keyword, finalize method, Garbage Collection, Overloading, Overriding, Recursion, nested classes,

Inheritance: Inheritance and its types, super, overriding, Abstract Classes, Using final.
Packages And Interfaces: packages, Access protection, Importing packages, Implementing Interfaces

UNIT -III
Exceptional Handling: Exception–handling fundamentals, Exception types, Using try and Catch, throw, throws and finally clauses.

Multithreaded Programming: java Thread Model, Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter thread communication.

UNIT - IV
String Handling: String class, String buffer class, String length, Special String operations, string comparison, Primitive type wrappers

Java I/0 classes and Interfaces, Files, Stream and Byte Classes, Character Streams, Serialization. Deserialization.

UNIT –V
GUI and Event Driven Programming: Applet Class, Event Handling, Delegation event model, event classes, event listener Interfaces.

Using AWT Controls, Layout Managers and Menus: AWT classes, Window fundamentals**,** labels, Buttons, Checkboxes, lists etc, layout managers, Handling Events by extending AWT components.

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Text Books:

1. Patrick Naughton "JAVA, The Complete Reference" Tata McGraw Hill, 4th Edition 2005. (For Unit : I,II,III and IV)
2. Richard A.Johnson, "Java Programming and Object-Oriented Application Development" Cengage Learning, India edition 2009. (For Unit : V)

Suggested Reading:

1. John Dean and Raymond "Introduction Programming with Java A problem solving approach", McGraw Hill 2008.
2. Joe Wigglesworth and Paula McMillan, "Java Programming: Advanced Topics" Cengage Learning. 3rd Edition 2009.

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16MCC107 **COMPUTER ORGANIZATION**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Understand the basics of Boolean algebra.
2. Learn the concepts of digital circuits.
3. Understand the various computer micro operations.
4. Acquire the knowledge of computer organization and design.
5. Learn various topics pertaining to the operations of Central Processing Unit.
6. Understand the basic principles of concurrent and parallel processing.

Course Outcomes:
After completion of the course, the students would be able to:

1. Acquainted with the representations of number systems.
2. Understand the concepts of Boolean algebra and KMaps.
3. Learn the basic computer organization and its design.
4. Understand the components of CPU and their functionality.
5. Learn the input–output and memory organization.
6. Understands Parallel processing and its applicability.

UNIT -I
Data Representation: Data types, Complements, Fixed and Floating Point Representation, Other binary codes and error Detection codes.

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean algebra, Map Simplification, Combinational Circuits, Flip Flops, Sequential Circuits.

Digital Components: Integrated Circuits, Decoder, Multiplexers, 'Registers, Shift Registers, Binary counter, Memory unit.

UNIT -II
Register Transfer And Micro Operations: Register Transfer language, Register transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations and Arithmetic logic shift unit.

Basic Computer Organization And Design: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycles, Memory Reference Instructions, Input, Output and Interrupts, Design of Accumulator logic.

UNIT -III
Central Processing Unit: Micro programmed Control, Control Memory, Address Sequencing, Micro program Example, Design of Control Unit. General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control.

UNIT -IV
Input–Output And Memory Organization: Peripheral Devices, I/O output interface, Asynchronous data transfer, Modes of transfer, Priority Interrupt, DMA, Input output Processor, Serial Communication. : Memory Hierarchy, Main Memory, Cache Memory.

UNIT -V
Parallel Processing: Trends of Parallel Processing, UniProcessor Architecture, Parallel Processing Mechanism, Multi Programming and Time Sharing, Pipeline Computers, Array Computers, Multi-Processor Systems, Serial Vs Parallel Processing, Parallelism Vs Pipelining.

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Text Books:

1. M. Morris Mano, "Computer System Architecture", Pearson Asia/Prentice Hall, 3^{rd} edn.2007. (For Units I,II,III and IV)
2. Kai Hwang and Faye A.Briggs, “Computer Architecture and Parallel Processing” International edn., 1984 (For Unit : V),

Suggested Reading:

1. William Stallings "Computer Organization & Architecture", Pearson Education, Sixth Edition, 2003.

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16MCC108 **SOFTWARE ENGINEERING**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Provide the basic definition and understanding of software engineering.
2. Acquaint the software engineering paradigms.
3. Familiarize with the concepts of software requirement specifications.
4. Understand the software design concepts.
5. Learn the concepts of software testing.

Course Outcomes:
After completion of the course, the students will be able to:
1. Understand the basics of software engineering principles
2. Acquire the knowledge on software development models.
3. Translate the problems into software design models.
4. Acquaint with the basics of software design principles.
5. Understand the basics software testing approaches and strategies.
6. Learn the concepts of software reengineering, reverse engineering and software maintenance activities.

UNIT-I
Introduction to Software Engineering: Software Engineering Challenges, Software Engineering approach, Software Process, Waterfall, Iterative, Prototype, Incremental, Spiral, Models.

UNIT- II
Software Requirement Analysis and specification: Software Requirements, Need for SRS, Problem analysis, Requirements specification, IEEE format of SRS, Function Oriented Design: Design Principles, Module-level concepts, Design notations and specifications

UNIT-III
Structured design methodology, Software Architecture: Role of Software Architecture, Architecture views, Component and Connector view. Risk Engineering - Risk Analysis and Management. RMMI Techniques.

UNIT-IV
Effort & Schedule Estimation, Software Project Estimation, COCOMO, Function Point Analysis. Testing Techniques & Strategies: white box, black box, basis path testing, Unit testing, Integration testing, Validation testing & System Testing

UNIT-V
Software Maintenance, Maintenance activities, Software Reengineering, Reverse Engineering, Forward Engineering, Software configuration management.

Text Books:
1. Roger S, Pressman, "**Software Engineering: A Practitioner's Approach**", 6^{th}ddition, Tata Mc Graw Hill, 2010.

Suggested Reading:
1. Pankaj Jalote "**An Integrated Approach to Software Engineering**", 3^{rd} edition, Narosa Publishing House, 2010.

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16MCC109 **DATA STRUCTURES USING C ++**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Know the basic concepts of C++.
2. Acquire the knowledge on classes and Inheritance concepts.
3. Aware of different linear data structures concepts.
4. Get the knowledge on different sorting techniques.
5. Understand the concept of hashing and collision resolution techniques.
6. Aware of different non-linear data structures.

Course Outcomes:
After completion of the course, students would be able to:
1. Gain knowledge on basic concepts of C++.
2. Get the knowledge on classes and inheritance concepts.
3. Learn various linear data structures concepts.
4. Distinguish between different sorting techniques.
5. Implements different collision resolution techniques on hashing.
6. Acquire knowledge on various non-linear data structures.

UNIT- I
C++ Introduction: Overview, Program Structure, namespace, identifiers, variables, constants, data types, enum, operators, Overloading of functions, default arguments, this pointer, inline functions, dynamic memory allocation and De allocation (new and delete), operator overloading.

UNIT- II
C++ Class Overview: Class Definition, Objects, Class Members, Access Control, Class Scope, Constructors and destructors, friend functions. Function and class templates, Inheritance basics, base and derived classes, inheritance types, base class access control, overriding, runtime Polymorphism using virtual functions.

UNIT- III
Sparse Matrix: Representation and its efficiency in storage.
Stacks: Definition and Operations and Applications, Array and Linked Representation of Stacks.
Queues: Definition and Operations. Array and Linked Representation of Queues and their Applications.
Linked Lists: Definition and Operations, Double linked list representation, Circular linked lists.

UNIT- IV
Sorting: Bubble sort, Merge Sort, Selection Sort, heap sort, Quick sort, Insertion sort , Posterior Analysis, Sequential Search, binary search.
Hashing : Hash table, its implementation, Hash table representation, types of hashing,collision resolution techniques.

UNIT- V
Trees: Definitions and Properties, Representation of Binary Trees, Operations. Binary Tree Traversal, Binary search trees, operations- insertion, deletion and searching, heap trees. AVL Tress and Operations on AVL Trees.B-Trees and its operations.
Graphs: Definition and representation of graphs, data structures for representing graphs- edge list structures, adjacency list structures, adjacency matrix,Graph traversals – BFS and DFS. Spanning trees, minimum spanning trees, prim's and kruskal's algorithms.

Text Books:
1. Object Oriented Programming with C++, E. Balaguru Swamy, Tata McGraw Hill,4th Edition, 2008.
2. Data structures, Algorithms and Applications in C++, S. Sahani, Universities Press. 2nd Edition, 2006.

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Suggested Reading:

1. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI. 2^{nd} Edition, 2002.
2. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and D.Mount, Wiley student edition, seventh edition, John Wiley and Sons, 2011.
3. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, 3^{rd}Edition, Pearson Education. Ltd., 2007.

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16MCC110 **OPERATIONS RESEARCH**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
The students will:
1. Understand and analyze managerial problems in industry to utilize resources effectively.
2. Formulating the mathematical models for real world managerial problems in industry.
3. Minimizing loss and maximizing profit of an organization.
4. Find the shortest paths to the transportation problems.
5. Provide networks and queuing models which are applicable to manage organizational functionalities.
6. Learn techniques to solve linear programming problems using different methods.
7. Solve problems using dynamic programming.

Course Outcomes:
After completion of the course, the students would be able to:
1. Apply the methods to utilize organizational resources effectively.
2. Formulate mathematical models for real world problems.
3. Apply the methods of maximization and minimization to get more profits and reduced losses.
4. Solve linear programming problems.
5. Model and solve the managerial problems using dynamic programming.
6. Apply networks and queuing models to solve organizational problems.

UNIT - I
Linear Programming: Introduction, Concepts of Linear Programming Model, Development of LP models, Graphical Method, Linear Programming Methods, Special cases of Linear Programming, Duality.

UNIT - II
Transportation Problem: Introduction, Mathematical Model for Transportation Problem, Types of Transportation problem, Methods to solve Transportation Problem, Transshipment Model.

UNIT - III
Assignment Problem: Introduction, Zero-One Programming Model for Assignment Problem, Types of Assignment Problem, Hungerian Method, Branch-and-Bound Technique for Assignment Problem.
Network Techniques: Introduction, Shortest path models – Systematic Algorithm, Dijkastras Algorithm, Floyd Algorithm, Minimum Spanning Tree Problems – PRISM, Kruskal's Algorithms.

UNIT - IV
Dynamic Programming: Introduction, Applications of Dynamic Programming, Solution of Linear Programming Problem through Dynamic Programming.

UNIT - V
Game Theory: Introduction, Game with Pure Strategies, Game with Mixed Strategies, Dominance Property, Graphical Method for 2 X n or m x 2 Games, Linear Programming Approach for Game Theory.

Text Books:

1. Panneerselvam "Operations Research", Second Edition, PHI, 2006.

Suggested Reading:

1. Prem Kumar Gupta and DS Hira, "Operations Research", S. Chand, 2011.
2. JK Sharma, "Operations Research Theory and Applications", Fourth Edition, MacMillan, 2010.
3. Rathindra P sen, "Operations Research- Algorithm and Application", PHI, 2010.
4. K.Swarup, P.K. Gupta and Man Mohan "Operations Research" Sultan Chand & Sons, 2012.

16MTC102 **PROBABILITY AND STATISTICS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

The students will:

1. Extend and formalize knowledge of the theory of probability and random variables.
2. Introduce new techniques for carrying out probability calculations and identifying probability distributions.
3. Motivate the use of statistical inference in practical data analysis.
4. Study the elementary concepts and techniques in statistical methodology.
5. Provide the introduction to subsequent statistics courses.

Course Outcomes:

After completion of the course, the students would be able to:

1. Describe discrete data graphically and compute measures of centrality and dispersion.
2. Compute probabilities by modeling sample spaces and applying rules of permutations and combinations, additive and multiplicative laws and conditional probability
3. Construct the probability distribution of a random variable, based on a real-world situation, and use it to compute expectation and variance.
4. Compute probabilities based on practical situations using the binomial and normal distributions.
5. Use of statistical inference in practical data analysis.

UNIT –I:

Introduction to Statistics: Over view, origin and development of Statistics, Managerial applications of statistics. Methods for collection of data, constructing a graphical methods (Histogram, Ogive curve, Pie-Chart, Stem and Leaf diagram) Measures of Central Tendency, Measures of Dispersion: Skewnes and Kurtosis.

UNIT-II:

Probability and Random Variables - Introduction to Probability: Concepts and Definitions of probability-classical and axiomatic approach. Sampling theorems- Addition theorem, multiplication theorem and conditional probability and Bayes Theorem.

Random variables: Expectation and variance of a random variable, Probability distribution function, properties of discrete and continuous probability distribution functions.

UNIT-III:

Probability distributions- Discrete probability distributions: Binomial distribution, Properties and applications - Poisson distribution, Properties and applications.

Continuous probability distributions: Normal distribution, Standard normal random variable, Properties and applications, Exponential distribution Properties and applications.

UNIT-IV:

Sampling Estimation-Statistical estimation: Point and interval estimation, confidence interval.

Testing of Hypothesis: Steps for statistical testing, Type I and Type II errors. Large sample tests-Test for one and two proportions, Test for one and two means, Test for equality of variances.

UNIT-V:

Hypothesis testing for Small samples and Curve Fitting-Small sample tests: t- distribution- Properties and applications, Testing for one and two means.

Chi-square distribution: Test for goodness of fit, Test for independence of attributes

Curve fitting: Correlation-Properties, Regression-Lines of Regression-Properties. Fitting of Straight Line and Growth Curves.

Text Books:

1. S.C.Guptha & V.K.Kapoor “Fundamentals of Mathematical Statistics” , Sultan Chand Pub.,2014.
2. S.C.Guptha “Fundamentals of Statistics”, Himalaya Publishing, 7th Edition , 2014.

Suggested Reading:

1. A.K. Md. Ehsanes Saleh Vijay K. Rohatgi, “An Introduction to Probability and Statistics”, Wiley, 2008.
2. Anthony J. Hayter “Probability and Statistics for Engineers and Scientists”, Brooks/Cole; International edition, 4^{th} Revised edition, 2012

16MCC111 **OBJECT ORIENTED PROGRAMMING LAB UISNG JAVA**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will be able to:
1. Memorize the object oriented programming concepts.
2. Create classes, objects and constructors.
3. Know the difference of overloading and overriding.
4. Learn the concepts of exception handling and multithreading.
5. Acquire the knowledge on I/O package.
6. Learn the Applets and AWT components.

Course Outcomes:
After completion of the course, students would be able to:
1. Write programs using object oriented programming.
2. Develop classes, objects and constructors.
3. Implement multithreading and exception handling concepts.
4. Create programs on strings and I/O streams.
5. Develop Applets and AWT Components
6. Apply event handling and arrange layout managers.

List of Sample Problems/Experiments:

1. Write programs to perform basic operations (Operators, Control Structures, Arrays etc..)
2. Write a program to create classes, objects
3. Write Programs using constructor
4. Write programs using method overloading
5. Write programs using method overriding, dynamic method dispatch
6. Write Programs using inheritance
7. Write programs on interfaces
8. Write programs on packages
9. Write programs on Exception handling
10. Write programs on Multithreading
11. Write programs using wrapper classes
12. Write Programs using I/O streams and files
13. Write programs on applets
14. Write Programs using AWT
15. Write programs using Event handling, Layout managers

Suggested Reading:

1. Patrick Naughton "Java, the Complete Reference" Tata McGraw Hill 2005.
2. Richard A.Johnson, "Java Programming and Object-Oriented Application Development" Cengage Learning, India edition 2009.

16MCC112 **DATA STRUCTURES LAB USING C++**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Know the concepts of classes, constructors and destructors.
2. Acquire the knowledge on inheritance concepts.
3. Aware of different linear data structures concepts.
4. Get the knowledge on different sorting techniques.
5. Understand the concept of hashing and collision resolution techniques.
6. Aware of different non-linear data structures.

Course Outcomes:
After completion of the course, students would be able to:
1. Design classes, constructors and destructors.
2. Implement programs on various inheritance types.
3. Develop programs on various linear data structures.
4. Implement the programs on different sorting techniques.
5. Implements different collision resolution techniques on hashing.
6. Develop programs on various non-linear data structures.

List of Sample Problems/Experiments:
1. Write a C++ program to illustrate the concept of Class with Constructors, Methods.
2. Write a C ++ program to illustrate the concept of Inheritance.
3. Write a C++ programs for implementing Stack using following:
   a) Arrays
   b) Linked Lists
4. Write a C++ programs for implementing Queues using following:
   a) Arrays
   b) Linked Lists
5. Write a C++ programs for implementing Linked Lists:
   a) Single Linked Lists
   b) Double Linked Lists
   c) Circular Linked Lists
6. Write a program for infix to postfix conversion.
7. Write a C++ program for implementing Binary Search Trees.
8. Write a C++ program for implementing Hashing.
9. Write a C++ program for implementing Quick Sort.
10. Write a C++ program for implementing Insertion Sort.
11. Write a C++ program for implementing Selection Sort.
12. Write a C++ program for implementing Merge Sort.
13. Write a C++ program for implementing Graph Traversals DFS and BFS.

Suggested Reading:

1. Complete reference to C++, 4th Edition, Herbert Schildt., 2003.
2. Object Oriented Programming with C++, E. BalaguruSwamy, Tata McGraw Hill, 4th Edition, 2008.
3. Advanced Data structures & Algorithms in C++,V.V.Muniswamy,Jaico Publishing House.
4. Data structures via C++, A.M. Berman, Oxford University Press.

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16MCC113 **DATABASE MANAGEMENT SYSTEM**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Learn the basic fundamentals of database.
2. Understand the data models.
3. Make a study of SQL and relational database design.
4. Know about data storage techniques and query processing.
5. Impart knowledge in transaction processing, concurrency control techniques.
6. Study the concepts of system crash and recovery management.

Course Outcomes:
After completion of the course the students would be able to:
1. Acquire the knowledge of the basic concepts of the database.
2. Create the data models.
3. Map ER models into Relations and normalize the relations
4. Acquire the knowledge of query evaluation.
5. Gain the knowledge of concurrent execution and transaction management.
6. Understand the issues in system crash and recovery measures.

UNIT-I
Introduction to DBMS and DB Models: File system Vs. DBMS, Advantages of DBMS, Data Abstraction, Database Design, and ER diagrams, Entities, Attributes and Entity Sets, Relationship Sets, Additional features of ER model, Conceptual Design with the ER model. The Relational Model: Introduction to the Relational Model, Integrity Constraints over relations, Logical Database design(ER to Relational), creating tables, views, Destroying / Altering Tables and Views.

UNIT-II
Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies, Normal Forms, Decompositions, Normalizations. **Structured Query Language**: Overviews, Basic Structure of SQL, Queries, Set Operations, Null Values, Additional Basic Operations, Aggregate Functions, Nested Sub queries, Join Expression. **Advanced SQL**: SQL Data Types, Integrity Constraints, Authorization, Functions and Procedural Constructs, Cursors, Triggers.

UNIT-III
Indexing and Hashing: Basic Concepts, File Organization Indexing, Index Data Structures, Tree-Structured indexing: Indexed sequential Access Method (ISAM) B+ Trees: A dynamic index structure, format of a node, search, Insert, Delete, Duplicates+ Trees in Practice.
Hash-Based Indexing: Static Hashing, Extendable Hashing, Linear Hashing, Extendable Hashing versus Linear Hashing. Comparison of Ordered Indexing and Hashing.

UNIT-IV
Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control. **Concurrency Control**: 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlock, Specialized Locking Techniques, Concurrency Control without Locking.

UNIT-V
Crash Recovery: Introduction to ARIES, The Log, Other Recovery Related Structures, The WAL, Check pointing, recovering from a system Crash, Media recovery. Security and Authorization: Introduction to database security, Access Control Discretionary Access control, Mandatory access control. Additional Issues related to Security.

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Text Books:

1. Silberschataz, Korth, Sudarshan “Database System Concepts”, 5th Edition McGraw Hill 2011.

Suggested Reading:

1. Raghu Ramakrishna, Johannes, Gehrke “Database Management Systems”, 3rd Edition, Mc-Graw Hill 2003
2. Ramez Elmasri, Shamkant B. Navathe, Somayajulu, Gupta “Fundamentals of Database systems”, Pearson Education 2006.

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16MCC114 **WEB TECHNOLOGIES**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Acquire knowledge on XHTML and CSS.
2. Learn basics of JavaScript.
3. Know how to create interactive web pages.
4. Acquire knowledge on XML.
5. Learn basics of PHP and MYSQL databases.
6. Acquire knowledge on client side and server side programming.

Course Outcomes:
After completion of the course, the students would be able to:
1. Develop the web pages using XHTML and CSS.
2. Perform client side validations.
3. Create interactive web pages.
4. Store and transport data using XML.
5. Access MYSQL database using PHP.
6. Design and Develop simple websites.

UNIT – I
Introduction to XHTML: origins and evolution of HTML and XHTML, basic syntax, standard XHTML document structure, basic text markup, images, hypertext links, lists, tables, forms, frames, syntactic differences between HTML and XHTML.
Cascading Style Sheets (CSS): Introduction, levels of style sheets, style specification formats, selector forms, property value forms, font properties, list properties, color, alignment of text, box model, background images, positioning.

UNIT – II
Basics of JavaScript: overview of JavaScript, object orientation and JavaScript, general syntactic characteristics, primitives, operations, expressions, screen output and keyboard input, control statements, object creation and modification, arrays, functions, constructors, pattern matching using regular expressions, errors in scripts.

UNIT- III
JavaScript and XHTML Documents: JavaScript execution environment, document object model, element access in JavaScript, events and event handling, handling events from body elements, handling events from button elements, Handling events from text box and password elements.
Dynamic Documents with JavaScript: Introduction, positioning elements, moving elements, element visibility, changing colors and fonts, dynamic content, stacking elements, locating the mouse cursor, reacting to a mouse click, slow movement of elements, dragging and dropping elements.

UNIT – IV
Introduction to XML: Introduction, syntax of XML, XML document structure, document type definitions, namespaces, XML schemas, displaying raw XML documents, displaying XML documents with CSS, XSLT style sheets, XML processors.

UNIT – V
Introduction to PHP: origins and uses of PHP, overview of PHP, general syntactic characteristics, primitives, operations, expressions, output, control statements, arrays, functions, pattern matching, form handling, cookies, session tracking.
Database Access through the web: MYSQL database system, database access with PHP and MYSQL.

Text Book:

1. Robert W.Sebesta, "**Programming the World Wide Web**", 4th Edition, Pearson Education, 2008.

Suggested Reading:

1. Thomas Powell "HTML & XHTML: The Complete Reference", 4th Edition, Tata McGraw-Hill, 2003.
2. Thomas A Powell, Fritz Schneider "JavaScript: The Complete Reference", 3rd edition, Tata McGraw Hill, 2013.
3. Steven Holzner "PHP: The Complete Reference", McGraw Hill Education, 2008.

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16MCC115 DESIGN AND ANALYSIS OF ALGORITMS

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Learn the various asymptotic notations and amortized analysis.
2. Acquire knowledge on divide and conquer and Greedy designing techniques.
3. Learn the concepts of dynamic programming techniques.
4. Acquire knowledge on backtracking and branch and bound designing techniques.
5. Learn the concepts of NP-Hard and NP-completeness.
6. Learn important algorithmic design paradigms and methods of analysis.

Course Outcomes:
After completion of the course, the students would be able to:
1. Analyze the time and space complexities of algorithms.
2. Solve various problems using divide and conquer and greedy method.
3. Solve various problems using dynamic programming, backtracking and branch and bound techniques.
4. Identify the complexity classes such as P, NP, NP-Complete and NP-Hard to which an algorithm belongs and design a feasible solution.
5. Determine the amortized running time of the problem.

UNIT-I
Introduction: Algorithm Definition, Algorithm Specification, Performance Analysis.
Review of Elementary Data Structures: Stacks, Queues, Trees, Dictionaries, Priority Queues, Sets and Disjoint Set Union.

UNIT-II
Divide and Conquer: General Method, Finding the Maximum and Minimum, Merge Sort, Quick Sort, Stassen's Matrix Multiplication.
Greedy Method: General method**,** Knapsack problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Optimal Storage on Tapes, Optimal Merge Patterns.

UNIT-III
Dynamic Programming: General Method, Multistage Graphs, All-Pairs Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack, Reliability Design, Traveling Salesmen Problem.
Basic Traversal and Search Techniques: Breadth First Search (DFS) and Traversal, Depth First Search (DFS) and Traversal, Connected Components and Spanning Trees, Bi-connected Components and DFS.

UNIT-IV
Backtracking: General Method, 8-Queen's Problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycles, Knapsack Problem.
Branch and Bound: The Method, 0/1 Knapsack Problem, Traveling Salesperson Problem.

UNIT -V
NP-Hard and NP-Complete Problems: Basic Concepts, Cook's Theorem, NP-Hard Graph Problems and NP-Hard Scheduling Problems.

Text Book:
1. Ellis Horowitz, Sartaj Shani, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press, 2007.

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Suggested Reading:

1. R. Pannerselvam “Design and Analysis of Algorithms”, PHI, 2007.
2. Hari Mohan Pandey "Design and Analysis of Algorithms", University Science Press, 2009.
3. Aho, Hopcroft, Ullman “The Design and Analysis of Computer Algorithms”, Pearson Education, 2000.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein “Introduction to Algorithms”, 2nd Edition, Prentice Hall of India Private Limited, 2006.
5. Anany Levitin “Introduction to the Design & Analysis of Algorithms”, Pearson Education, 2003.
6. Parag H.Dave, Himanshu B. Dave “Design and Analysis of Algorithms”, Pearson Education, 2nd Edition, 2014.

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16MCC116 **OPERATING SYSTEMS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

Students will:

1. Aware of the evolution and fundamental principles of operating system, processes and their communication.
2. Aware of the process execution in terms of threads and they came to know about different thread libraries.
3. Aware of the various process synchronization tools and they came to know about dead lock and its issues.
4. Aware of the various operating system components like process management, memory management.
5. Know about file management and I/O subsystems concepts in operating systems.
6. Aware of components of operating system in LINUX with relevant case study.

Course Outcomes:

After completion of the course the students would be able to:

1. Get the knowledge of operating system components and its services.
2. Understand the basic process execution in terms of threads and they came to know about different thread libraries.
3. Learn the various process synchronization tools and they came to know about dead lock and its issues.
4. Distinguish the mapping between the physical memory and virtual memory.
5. Apply file handling concepts in OS perspective.
6. Acquire the knowledge of components and services of LINUX Operating System.

UNIT-I

Operating System Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems.

System structures: Operating System Services, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, Operating System Structure, Virtual Machines, Operating System debugging.

Process Concept: Process Concept, Process Scheduling, Operations on process, Inter process Communication.

Multithreaded Programming: Multithreading Models, Thread Libraries, Threading Issues.

UNIT–II

Process Scheduling: Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple Processor Scheduling.

Process Synchronization: Critical Section Problem, Peterson's Solution, Semaphores, Classic Problems of Synchronization, Monitors.

Deadlocks: System Model, Deadlock Characterization, Methods in Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT- III

Memory Management Strategies: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation.

Virtual Memory Management: Demand Paging, Copy on Write, Page Replacement Algorithms, Allocation of Frames, Thrashing.

System Protection: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix.

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UNIT- IV

File System: File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection.

Implementing File System: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery.

Secondary Storage Structure: Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap Space Management, RAID Structure.

UNIT- V

I/O Systems: I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Request to Hardware Operations, STREAMS.

Case Study: **The Linux System**: Linux History, Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output, Inter process Communication.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 7^{th} Edition, John Wiley and Sons, 2011.
2.

Suggested Reading:

1. Gary Nutt, “Operating Systems”, 3^{rd} Edition, Pearson Education, 2004.
2. Harvey M. Deital, “Operating Systems”, 3^{rd} Edition, Pearson Education, 2004.

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16MCC117 DATABASE MANAGEMENT SYSTEMS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Present SQL and procedural interfaces to SQL comprehensively.
2. Give an introduction integrity constraints on a database using a state-of-the-art RDBMS
3. Understand the concepts of Views and their usability.
4. Impart the knowledge PL/ SQL including stored procedures, stored functions, cursors, packages
5. Understand the Data Control Language (DCL) privileges and roles.
6. Present the concepts of Forms and Reports

Course Outcomes:
After completion of the course, the students would be able to:
1. Populate and query a database using SQL DML/DDL commands.
2. Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS
3. Implement the views with multiple options.
4. Programming PL/SQL including stored procedures, stored functions, cursors, packages.
5. Access and control authorization.
6. Design and build a Forms and Reports

List of Programs:

I. SQL
1. Creating tables using commands in DDL
2. Manipulating the data using DML
3. Using Aggregate functions Set operators
4. Simple condition query creation using SQL Plus
5. Complex condition query creation using SQL Plus
6. Exercising all types of Joins, views
7. Exercising Data Control Language and Transaction Control Language

II. PL/SQL

8. Demonstration of Blocks, Cursors,
9. Procedures, Functions and Packages.
10. Creation of Triggers

III. FORMS

11. Designing forms for various databases.(Creating, Inserting, Updating, Deleting)

IV. REPORTS

12. Generation using SQL Reports
13. Creation of Reports based on different queries.

Note:-The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

Suggested Reading:

1. Nilesh Shah "**Database Systems Using Oracle**", PHI, 2007.
2. Rick F Van der Lans "**Introduction to SQL**", 4th Edition, Pearson Education, 2007.
3. Benjamin Rosenzweig, Elena Silvestrova "**Oracle PL/SQL by Example**", 3rd Edition, Pearson Education, 2004.
4. Albert Lulushi "**Oracle Forms Developer's Handbook**", Pearson Education, 2006.

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16MCC118 **WEB TECHNOLOGIES LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Practice various tags in XHTML and CSS.
2. Practice programs using JavaScript control statements, arrays, functions etc.
3. Practice programs using events on the XHTML elements.
4. Practice programs using XML.
5. Practice programs using PHP control statements, arrays, functions etc.
6. Practice programs using MYSQL database.

Course Outcomes:
After completion of the course, the students would be able to:
1. Create static web pages using XHTML and CSS.
2. Create dynamic web pages and perform client side validations using JavaScript.
3. Store and Transport data using XML.
4. Write programs using PHP.
5. Access MYSQL database through PHP.
6. Design and Develop websites.

List of programs:

XHTML: Create programs using the following concepts

1. Text Markup Tags.
2. Images.
3. Hyperlinks.
4. Ordered and Unordered Lists.
5. Tables and Nested Tables.
6. Forms.
7. Frames.

CSS: Create programs using the following concepts

8. Inline Styles.
9. Internal Stylesheet.
10. External Stylesheet.
11. Pseudo Classes.
12. Font properties. Borders, Margins, Paddings and Background Images.

JAVASCRIPT: Create programs using the following concepts

13. Pre-defined objects (Date, String, Math etc.,).
14. Selection statements switch statements and loop statements.
15. Demonstrate user defined objects.
16. Array object.
17. Functions.
18. Illustrate pattern matching using regular expressions.
19. Handle various events occurred in the HTML document.
20. Validate the form data.
21. Illustrate positioning of the HTML elements in the web page.
22. Demonstrate moving elements, elements visibility, stacking elements and dragging and dropping elements.

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XML: Create programs using the following concepts

24. XML Documents.
25. XML Schema for the XML documents.
26. CSS style sheets for the XML documents.
27. XSLT style sheet for the XML documents.
28. Design an XML document to store information about patients in a hospital.

PHP: Create programs using the following concepts

29. Selection statements and loop statements.
30. Arrays.
31. Functions.
32. Pattern matching.
33. Handling forms.
34. Access MYSQL database through PHP.

Suggested Reading:

1. Robert W.Sebesta "**Programming the World Wide Web**", 4th Edition, Pearson Education, 2008.
2. Thomas Powell "**HTML & XHTML: The Complete Reference**", 4th Edition, Tata McGraw-Hill, 2003.
3. Thomas A Powell, Fritz Schneider "**JavaScript: The Complete Reference**", 3rd Edition, Tata McGraw Hill, 2013.
4. Steven Holzner "**PHP: The Complete Reference**", McGraw Hill Education, 2008.

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16MCC119 **OPERATING SYSTEMS LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Learn programs on system calls, threads and signals
2. Learn programs on process scheduling algorithms
3. Learn programs on Inter process Communication.
4. Learn programs on synchronization problems
5. Learn programs on files
6. Learn about the basic Linux commands.
7. Learn basic shell programs.

Course Outcomes:
After completion of the course, the students would be able to:
1. Write programs on system calls, threads and signals.
2. Write programs on process scheduling algorithms
3. Write programs on Inter process Communication.
4. Write programs on synchronization problems
5. Write programs on files
6. Use basic Linux commands
7. Write basic shell programs

List of Programs:

1. Programs using process related systems calls.
2. Print type of file for each command line arguments.
3. Programs to create threads.
4. Program using Signals.
5. Programs on process scheduling algorithms
6. Echo server-using pipes.
7. Echo server-using message Queues.
8. Producer & Consumer Problem using Semaphores and Shared memory
9. Producer & Consumer Problem using message passing.
10. Readers & Writers Problem using Semaphores and Shared memory
11. Dining philosopher's problem using semaphores.
12. Programs related to files
13. Program using File Locking.
14. Basic Linux Commands
15. Basic shell scripts

Suggested Reading:

1. W. Richard Stevens, "**Unix Network Programming**", Pearson Education Inc, PHI Learning 1990.
2. Behrouz A. Forouzan, Richard F. Gilberg, "**UNIX and Shell Programming: A Textbook**", Books/Cole-Thomson Learning, 2003.

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16MBC04 ORGANIZATIONAL BEHAVIOUR (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Familiarize the students with the basic understanding of individual behavior and explore issues of motivation, communication, leadership, power, politics and organizational change.
2. Provide a comprehensive, up-to-date, practical knowledge base that provides an engaging introduction and concepts of organizational behavior.
3. Orient the students with real life examples that correlate the theory to actual practice from the industry.
4. Enable the students to practically implement the Organizational Behavior principles and practice in real time situations in their careers and life.

Course Outcomes:
After completion of this course students would be able to:
1. Analyze the behavior, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.
2. Assess the potential effects of organizational-level factors on organizational behavior.
3. Critically evaluate the potential effects of motivating and leading the individuals in the Organization.
4. Analyze organizational behavioral issues in the context of groups, power, politics and conflict issues.

UNIT – I
Organizational behavior – Nature and levels of organizational behavior – Individuals in organization – Individual differences – Personality and Ability – The Big 5 Model of personality – Organizationally relevant personality traits. The nature of perception – characteristics of the perceiver, target and situation – perceptual problems.

UNIT – II
Organizational Designs and Structures – Traditional and Contemporary organizational designs. Organizational culture and ethical behavior – factors shaping organizational culture– creating an ethical culture.

UNIT – III
Motivation–early and contemporary theories of motivation. Leadership – early and contemporary approaches to leadership.

UNIT – IV
Groups and group development – turning groups into effective teams. Managing change – process, types and challenges. Communicating effectively in organizations – communication process–barriers to communication–overcoming barriers to communication–persuasive communication–communication in crisis situations.

UNIT – V
Power, Politics, Conflict and Negotiations–Sources of individual, functional and divisional Power. Organizational politics. Conflict – causes and consequences – Pondy’s model of organizational conflict– conflict resolution strategies.

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Text Books:

1. Jennifer George and Gareth Jones "Understanding and Managing Organizational Behavior", Pearson Education Inc., 2012
2. Jon L Pierce and Donald G. Gardner, "Management and Organizational behavior", Cengage Learning India (P) Ltd., 2001.
3. Richard Pettinger "Organizational Behaviour", Routledge, 2010

Suggested Reading:

1. Stephen P. Robbins, Jennifer George and Gareth Jones "Management and Organizational Behavior", Pearson Education. Inc., 2009.
2. K. Aswathappa "Organizational Behavior", Himalaya Publishing House., 2013.
3. John Schermerhorn, Jr. James G. Hunt and Richard N. Osborn "Organizational Behavior", 10th Edition, Wiley India, Edition. 2009.

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16CEE21 DISASTER MITIGATION AND MANAGEMENT (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:

1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. Impart knowledge in students about the nature, mechanism causes, consequences and mitigation measures of the various natural disasters including hydro metrological and geological based disasters.
3. Enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters including chemical, biological and nuclear warfare agents.
4. Equip the students with the knowledge of various chronological phases in the disaster management cycle.
5. Create awareness about the disaster management framework and legislations in the context of national and global conventions.
6. Enable students to understand the applications of geospatial technologies like remote sensing and geographical information systems in disaster management.

Course Outcomes:
After completion of the course, students would be able to:

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at local level
2. Choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Understand various mechanisms and consequences of natural and human induced disasters for the participatory role of engineers in disaster management.
4. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans
5. Understand various participatory approaches/strategies and their application in disaster management
6. Understand the concepts of remote sensing and geographical information systems for their effective application in disaster management.

UNIT-I

Introduction to Natural, human induced and human made disasters – Meaning, nature, types and effects; International decade of natural disaster reduction (IDNDR); International strategy of natural disaster reduction (ISDR)

UNIT-II

Natural Disasters– Hydro meteorological disasters: Causes, impacts, Early warning systems, structural and non-structural measures for floods, drought and cyclones; Tropical cyclones: Overview, cyclogenesis, drought monitoring and management.; Geographical based disasters: Earthquakes and Tsunami- Overview, causes, impacts, zoning, structural and non-structural mitigation measures; Tsunami generation; Landslides and avalanches: Overview, causes, impacts, zoning and mitigation measures. Case studies related to various hydro meteorological and geographical based disasters.

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UNIT - III

Human induced hazards: Risks and control measures in a chemical industry, Causes, impacts and mitigation measures for chemical accidents, chemical disaster management, current status and perspectives; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents and traffic accidents.

UNIT – IV

Use of remote sensing and GIS in disaster mitigation and management; Scope of application of ICST (Information, communication and space technologies in disaster management, Critical applications& Infrastructure; Potential application of Remote sensing and GIS in disaster management and in various disastrous conditions like earthquakes, drought, Floods, landslides etc.

UNIT - V

Concept of disaster management: Introduction to disaster management, Relationship between Risk, vulnerability and a disaster, Disaster management cycle, Principles of disaster mitigation: Hazard identification and vulnerability analysis, Early warning systems and forecasting; Infrastructure and development in disaster management; Disaster management in India: National disaster management framework at central, state, district and local levels. Community based disaster management.

Text Books:

1. Rajib, S and Krishna Murthy "Disaster Management Global Challenges and Local Solutions", Universities Press Hyderabad, R.R ,2012.
2. Notes / Reading material published by National Disaster Management Institute, Ministry of Home Affairs, Govt. of India.

Suggested Reading:

1. Navele, P & Raja, C.K. "Earth and Atmospheric Disasters Management, Natural and Manmade", B.S. Publications, Hyderabad.
2. Fearn-Banks "Crises computations approach: A case book approach", Route ledge Publishers, Special Indian Education, New York & London, 2011.
3. Battacharya. T "Disaster Science and Management", Tata McGraw Hill Company, New Delhi.

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16MCC120 **COMPUTER NETWORKS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Learn the basics of data communication and networks.
2. Get the idea of different layers of OSI model.
3. Learn the concepts of Data Link layer such as Flow and Error control.
4. Study various Routing Algorithms and concepts of Network layers.
5. Learn Transport layer protocols and concepts of Application layer.
6. Obtain the concepts of Socket programming.

Course Outcomes:
After completion of the course, the students would be able to:
1. Gain good knowledge of the basics of data communication and networks.
2. Get an overview of the different layers of OSI model.
3. Gain knowledge of Flow and Error control mechanisms of Data Link layer.
4. Design various Routing Algorithms of Network layer.
5. Formulate Transport layer protocols and concepts of Application layer.
6. Acquire the knowledge of Socket programming.

UNIT - I
Data Communications: Components – Data Representation - Data Flow, Networks- Network Criteria – Physical Structure- Network Models – Categories of Networks – Internetwork, Internet, Protocols and Standards, Network models - ISO/OSI model and its layers, TCP/IP model, Addressing, Physical layer and Media – Digital to Digital conversion, Line coding, Transmission modes, Transmission Media- Guided media – Unguided media, Modem, RS232 Interfacing.

UNIT-II
Data link Layer: Error detection and Correction – Block coding, Hamming code, CRC, Flow and Error control, Noiseless channels - Simple and Stop and Wait protocols, Noisy channels-Stop and Wait ARQ – Go back-N ARQ – Selective repeat ARQ – Piggybacking, HDLC.
Multiple Access: LAN-Pure and Slotted ALOHA, Ethernet IEE 802.3, IEEE 802.4,IEEE 802.5, Bridges.

UNIT-III
Network Layer- Internetworks - Switching– Virtual Circuit and Datagram Network concepts, Logical Addressing, Internet Protocol. Routing – Unicast Routing Protocols - Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP.

UNIT-IV
Transport Layer: Services of Transport Layer, Multiplexing.
Transmission Control Protocol (TCP) – Congestion control and Quality of Services - User Datagram Protocol (UDP).
Application Layer: Domain Name Space (DNS), SMTP and FTP, WWW and HTTP, Fire Walls.

UNIT-V
Socket Programming: Socket address, elementary socket system calls, advanced socket system calls, reserved ports, socket option, asynchronous I/O input/output Multiplexing out-of-band data, sockets and signals, Internet super server.

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Text Books:

1. Behroz A Forouzan, “Data Communications and Networking”, 4^{th} Edition, Tata McGraw – Hill, 2009.
2. W. Richard Stevens, “Unix Network Programming”, Pearson Education Inc, PHI Learning 1990.

Suggested Reading:

1. Andrew S. Tanenbaum, “Computer Networks”, 5^{th} Edition, Pearson Education, 2011.

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16MCC121 **DATA WAREHOUSING AND DATA MINING**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Identify the scope and necessity of Data Mining & Warehousing for the society.
2. Describe and designing of Data Warehousing to integrate the Data Mining system
3. Understand Data Mining functionalities to solve the real world problems.
4. Develop ability to design various algorithms based on data mining techniques.
5. Understand various interesting patterns and presentation techniques for decision making
6. Gain the interest in research and design of new Data Mining Techniques.

Course Outcomes:
After completion of the course, the students would be able to:
1. Identify the scope of Data Mining & Warehousing for the society.
2. Design of Data Warehouses and integrate the Data Mining system for various organizations.
3. Apply Data Mining functionalities to solve the real world problems
4. Design and implement the various data mining algorithms based on various requirements
5. Identify interesting patterns and presentation techniques in making decisions
6. Make base for further research on advanced Data Mining Techniques

UNIT-I:
Introduction: What Motivated Data Mining? Why Is It Important, What Is Data Mining, Data Mining—On What Kind of Data, Data Mining Functionalities—What Kinds of Patterns Can Be Mined?, Are All of the Patterns Interesting? Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or Data Warehouse System, Major Issues in Data Mining,. Data Preprocessing: Why Preprocess the Data, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

UNIT-II:
DataWarehouse and OLAP Technology: What Is a DataWarehouse, A Multidimensional Data Model, DataWarehouse Architecture, DataWarehouse Implementation, From DataWarehousing to Data Mining, Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction—An Alternative Method for Data Generalization and Concept Description.

UNIT-III:
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining Various Kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining,

UNIT-IV:
Classification and Prediction: What Is Classification? What Is Prediction, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Classification by Association Rule Analysis, Lazy Learners, Other Classification Methods, Prediction Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor, Ensemble Methods—Increasing the Accuracy, Model Selection.

UNIT-V
Cluster Analysis: What Is Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based

Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

Text Books:

1. Jaiwei Han and Micheline Kamber “Data Mining- Concepts and Techniques”, Morgan and Kaufmann, 2^{nd} Edition, 2006.

Suggested Reading:

1. Pang-Ning Tan,Micheal Steinbach, Vipin Kumar, “Introduction to data Mining”, Pearson Education, 2008.
2. Ian. H. Witten, Eibe Frank and Mark.A.Hall “Data Mining:Practical Machine Learning Tools and Techniques”, 3^{rd} Edition(Then Morgan Kufmann series in Data Management systems), 2011
3. “Statistical and Machine learning –Learning Data Mining, Techniques for Better Predictive Modeling and Analysis to Big Data”.
4. Arun K Pujari “Data Mining Techniques”, University Press, 2^{nd} Edition, 2009
5. MH Dunham “Data Mining” Pearson Education, 2009.

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16MCC122 ADVANCED JAVA PROGRAMMING

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Servlets, session management and usage of JDBC in servlets.
2. Java beans, Application builder tool and java beans API.
3. EJB Architecture, EJB requirements and EJB entity beans.
4. EJB clients, deployment tips and perl control structures and operators.
5. JSP scripting elements & directives and java messaging services.
6. JDBC driver connection to database, Row set object and Result set.

Course Outcomes:
After completion of the course, the students would be able to:
1. Get the knowledge of servlets, session management and usage of JDBC in servlets.
2. Employ the java beans, Application builder tool and java beans API.
3. Demonstrate the EJB Architecture, EJB requirements and EJB entity beans.
4. Demonstrate the EJB clients, deployment tips and perl control structures and operators.
5. Identify the JSP scripting elements & directives and java messaging services.
6. Examine the JDBC driver connection to database, Row set object and Result set

UNIT - I
J2EE Platform: Enterprise Architecture Styles, Containers and Technologies.
Servlet overview: The Java web server – your first servlet – servlet chaining – server side includes- Session management – security – HTML forms – using JDBC in servlets – applet to servlet communication.

UNIT - II
Java Beans: The software component assembly model- The java beans development kit- developing beans – notable beans – using infobus - Glasgow developments - Application Builder tool- JAR files-Introspection-Bound Properties-Persistence-customizers - java beans API.

UNIT - III
EJB: EJB architecture- EJB requirements – design and implementation – EJB session beans- EJB entity beans-EJB Clients – deployment tips, tricks and traps for building distributed and other systems – implementation and future directions of EJB-Variable in perl- perl control structures and operators – functions and scope.

UNIT - IV
JSP: Introduction JSP-Examining MVC and JSP -JSP scripting elements & directives-Working with variables scopes-Error Pages - using Java Beans in JSP Working with Java Mail-Understanding Protocols in Javamail-Components-Javamail API-Integrating into J2EE-Understanding Java Messaging Services-Transactions.

UNIT – V
JDBC : Introduction to JDBC, JDBC Drivers, Packages related to JDBC, JDBC Data Sources, Retrieving Meta Information from database and Result set, Distributed Transactions and Row Set objects, Accessing a Database through Servlets and JDBC**.**

Text Books:
1. H. Schildt, 2002 “Java 2 Complete Reference”, 5th Edition, Tata McGraw Hill, New Delhi.
2. Subramanyan AllamRaju “Professional Java Server Programming”, J2EE 1.3 Edition, A Press Publications.

Suggested Reading:

1. K. Moss "Java Servlets", 2nd Edition, Tata McGraw Hill, New Delhi, 1999.
2. Joseph O'Neil "Java Beans from the Ground Up", Tata McGraw Hill, New Delhi, 1998.
3. J. McGovern,R. Adatia,Y. Fain, "J2EE 1.4 Bible", Wiley-Dreamtech India Pvt. Ltd, New Delhi, 2003.

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16MCC123 **COMPUTER NETWORKS LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Learn Networking commands.
2. Understand connection oriented and connection less iterative programs
3. Learn connection oriented and connection less concurrent programs.
4. Acquire the knowledge of Pre fork Server program.
5. Obtain the concept of Remote command execution.
6. Gain the knowledge of Advanced Socket System Calls.

Course Outcomes:
After completion of the course, the students would be able to:
1. Use Networking commands.
2. Implement connection oriented and connection less iterative programs.
3. Execute connection oriented and connection less concurrent programs.
4. Implement the Pre fork Server program.
5. Run the program on Remote command execution.
6. Execute programs on Advanced Socket System Calls.

List of Programs:

1. Using and understanding following Commands. Ifconfig, net stat, ping, arp, telnet, ftp, finger.
2. a) Connection oriented Iterative Echo Server
   b) Connectionless Iterative Echo server
3. a) Connection oriented Concurrent Echo Server
   b) Connectionless Concurrent Echo server
4. a) Connection oriented Iterative Time Server
   b) Connectionless Iterative Time Server
5. a) Connection oriented Concurrent Time Server
   b) Connectionless Concurrent Time Server
6. Remote command execution.
7. Program to pass file descriptors.
8. To demonstrate the usage of Advanced Socket System Calls like
   Getsockopt(), Setsockopt(), Select(), Readv(), getpeernamet(), Getsockname().
9. To demonstrate the Non-Blocking (Asynchronous) Input-Output.
10. To demonstrate the implementation of Pre forked Server.

Suggested Reading:

1. W. Richard Stevens, "Unix Network Programming", Pearson Education Inc, PHI Learning 1990.
2. Behroz A Forouzan, "Data Communications and Networking", 4th Edition, Tata McGraw – Hill, 2009.

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16MCC124 DATA WAREHOUSING AND DATA MINING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:

Students will:

1. Understand the need of Data Warehouses over Databases, and the difference between usage of operational and historical data repositories.
2. Understand loading the data from different sources and preprocessing of different types of the data.
3. Build different types of data models from various datasets which are useful to model the data
4. Experience row and column operations of different datasets.
5. Get a clear idea of various classes of Data Mining techniques, their need, scenarios (situations) and scope of their applicability.
6. Learn the algorithms used for various types of Data Mining Problems.

Course Outcomes:

After completion of the course, the students would be able to:

1. Understand the need of Data Warehouses over Databases.
2. Load the data from different sources and preprocess of different types of the data.
3. Build variety of data models useful in modeling data.
4. Use data mining functionalities in different Scenarios.
5. Prepare graphs using data mining tools for patterns presentation.
6. Execute variety of algorithms.

List of Programs:

1. Connect and load data from Databases, User input, Excel files
2. Select the records from data sets using “Select” operation.
3. Extract samples from different data sets using “Selection” operation.
4. Demonstrate of record operation “balance” on different datasets.
5. Aggregate the records using Aggregate operation on different datasets
6. Manage the records of different datasets using “Sort” operation.
7. Merge the records from different datasets.
8. Separate the top most records using “Distinct” operation.
9. Demonstration of record operation “Distinct” on different datasets
10. Filter the fields from different datasets.
11. Derive a new field using existing fields from different datasets using “Derive” operation.
12. Demonstration of field operation “Derive” on different data sets
13. Group the data into different bins using binning.
14. Partition the data using field operation portioning.
15. Interchange the rows and columns of dataset using transpose operation.
16. Draw the graph of “Plot” Graph building on variety of data
17. Draw the graph of “Distribution” Graph building on variety of data
18. Construct histogram on variety of data.
19. Construct collection graph on variety of data.
20. Draw the graph of “Multi plot” Graph building on variety of data
21. Create “Web” Graph on variety of dat.
22. Build Apiori association model on transactional data.
23. Build C4.5 classifier.
24. Train and Test CRT classifier on categorical data.
25. Train and Test CHAID classifier.
26. Construct and Test QUEST classifier.
27. Design, Model and test Neural Network classifier.
28. Construct Binary classifier for binary class data.
29. Construct and Test K-Means clustering model.
30. Model COHENON unsupervised data.

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31. Construct GRI classifier.
32. Construct different REGRESSION equations.
33. Design and Test Logistic modeling.
34. Demonstration of output operations
    a) Stats b) Analysis, c) Matrix, d) Table, e) Transform

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16MCC125 **MINI PROJECTS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:

1. Handle small scale projects in the lab.
2. Learn the basic concepts of Front End, Middleware and Back End technologies.
3. Learn the implementation of Mini Project which shall lead into the implementation of Major Project.

Course Outcomes:
After completion of the Mini Project, the students would be able to:

1. Implement the basic level technologies pertaining to Front End, Middleware and Back End.
2. Implement the Major Project successfully.

Fourth Semester of the MCA course contains the Mini Project has to be carried out by each student individually in a period of 15 weeks of duration. Students should submit a synopsis at the end of 2^{nd} week in consultation with the Project Guide. The synopsis should consist of definition of the problem, scope of the problem and plan of action. Before completion of the fourth semester the students are required to present their work before the internal committee of the MCA department, in which each student will be awarded with marks.

At the end of the semester the students are required to present their project work before the External Committee for Vive-Voce examination, in which each student will be awarded with marks.

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16MCE102 **SOFTWARE TESTING (Elective-I)**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Learn the basic concepts of Testing.
2. Follow the methodology of White Box Testing.
3. Learn the concepts of Functional Testing.
4. Obtain knowledge of Integration and System Tastings.
5. Understand the concepts of Object Oriented Testing.
6. Obtain the concepts Millennium Testing.

Course Outcomes:
After completion of the course, the students would be able to:
1. Gain the basic knowledge of Testing.
2. Acquire the knowledge of White Box Testing methods.
3. Test an application using Functional Testing.
4. Gain knowledge about Integration and System Testing.
5. Use Object Oriented Testing and Millennium Testing methods.
6. Explore on testing types which are to be applied for various applications.

UNIT-I
Introduction to Software Testing Concepts, White Box Approach, Basis Path Testing, Cyclomatic Complexity, Independent paths, D-D Graphs, Dataflow Testing,

UNIT-II
Functional Testing: Boundary Value Testing, Equivalence Class Testing, Decision Table-Based Testing, Retrospective on Functional Testing.

UNIT-III
Integration and System Testing: Levels of Testing, Unit testing, Integration Testing, System Testing, Interaction Testing.

UNIT-IV
Object-Oriented Testing: Issues in Object-Oriented Testing, Class Testing, GUI Testing, Object-Oriented System Testing.

UNIT-V
Millennium Testing: Exploratory Testing, Model-Based Testing, Test-Driven Development, All Pairs Testing, Software Testing Excellence.

Text Books:
1. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", 3rd Edition, CRC Press, 2007.
2. Roger S. Pressman "Software Engineering", 7th Edition, Pearson Education.

Suggested Reading:
1. Boris Beizer "Software Testing Techniques", 2nd Edition, Dreamtech, 2013.
2. M.G. Limaye "Software Testing: Principles – Techniques and Tools", 1st Edition, Tata Mc. Hill, 2009
3. Mauro Pezze, Michal Young "Software Testing and Analysis: Process, Principles and Techniques", Wiley India Pvt. Ltd.

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16MCE103 ARTIFICIAL NEURAL NETWORKS (Elective-I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Basics of Biological Neural Networks.
2. Basics of Artificial Neural Networks.
3. Applications of Artificial Neural Networks.
4. Different pattern recognition tasks using Artificial Neural Networks.
5. Competitive learning neural networks.
6. ART networks.

Course Outcomes: After completion of the course, the students would be able to:
1. Gain the knowledge of ANN techniques and their applications.
2. Understand the various algorithms for ANN.
3. Apply various algorithms for ANN.
4. Understand the clustering concepts and algorithms
5. Bring out structural ART networks and feature extraction techniques.
6. Identify, Analyze, Formulate and solve different application oriented problems.

UNIT – I
Introduction to ANN - Features, structure and working of Biological Neural Network Trends in Computing Comparison of BNN and ANN.
Basics of Artificial Neural Networks - History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture

UNIT – II
Backpropagation networks (BPN) - Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.
Activation & Synaptic Dynamics - Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks.

UNIT – III
Basic functional units of ANN for pattern recognition tasks - Basic feedforward, Basic feed back and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks. Feedforward neural networks – Linear responsibility X-OR problem and solution.
- Analysis of pattern mapping networks summary of basic gradient search methods.
Feedback neural networks Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning.

UNIT – IV
Competitive learning neural networks - Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

UNIT – V
Applications of ANN - Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters.
NET Talk - to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.

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Text Books:

1. B. Yegnanarayana “Artificial Neural Networks”, PHI, 2010.
2. S. Raj Sekaran , Vijayalakshmi Pari “Neural networks, Fuzzy logic and Genetic Algorithms”, 2015.

Suggested Reading:

1. Simon Hhaykin “Neural Networks A comprehensive Foundations”, Pearson Education, 2nd Edition 2004.
2. Li Min Fu “Neural Networks in Computer Intelligence”, TMH 2003.
3. James A Feeman David M S Kapura “Neural Networks”, Pearson Education 2004.

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16MCE106 **CLOUD COMPUTING (ELECTIVE-II)**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:

1. Analyze the components of cloud computing and its business perspective.
2. Evaluate the various cloud development tools.
3. Collaborate with real time cloud services.
4. Analyze the case studies to derive the best practice model to apply when developing and deploying cloud based applications.
5. Understand large data processing in the cloud.
6. Utilize the resource management in the cloud.

Course Outcomes:
After completion of the course, the student would be able to:

1. Identify the components of cloud computing for service perspective.
2. Apply the Cloud Computing developing tools.
3. Imply the Cloud Computing models for developing best applications.
4. Give services in Real time requirements.
5. Apply large data processing methods in Clouds.
6. Use the maximum Cloud Computing resources properly.

UNIT-I
Fundamental Cloud Computing-Understanding Cloud Computing, Origins influences, Basic Concepts and Terminology, Goals, Benefits, risks, Challenges, Rolls and boundaries, Cloud characteristics, Cloud Delivery models, Cloud deployment models.

UNIT-II
Cloud enabling technology-Broadband Networks and Internet architecture, Data center technology, Visualization technology, Cloud Security-basic terms and concepts, Threat agents, Cloud security threats,

UNIT-III
Cloud Infrastructure Mechanisms-Logical network perimeter, Virtual server, Cloud Storage device, cloud usage monitor, Resource replication, special cloud mechanisms, cloud management mechanisms, cloud security mechanisms,

UNIT-IV
Cloud Computing Architecture-Fundamental Architecture, Work load distribution architecture, Resource pooling architecture, Dynamic scalability architecture, service load balancing architecture, Cloud bursting architecture, redundant storage architecture, Hyper clustering architecture, load balanced virtual server instances architecture, non-disruptive service architecture, zero down time architecture, cloud balancing architecture, Resource reservation architecture, rapid provision architecture.

UNIT-V
Working with clouds-(Cloud Provider Perspective) Building IaaS Environments, Equipping PaaS Environment, optimizing SaaS Environments. (Cloud consumer perspective)- Working with IaaS Environments, working with PaaS Environment, working with SaaS Environments.

Text Book:

1. Thomas Erl, Ricardo Puttini "Cloud Computing: Concepts, Technology & Architecture", Prentice, Hall, 1st Edn. 2015

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Suggested Reading:

1. Rajkumar Buyya, James Broberge and Anddrzej, M Gosciniski "Cloud Computing Principles and Paradims". Wiley publishing 2011.
2. John W Rittinghouse,james F.Ransome. "Cloud Computing Implementation, Management and Security" CRC Press 2009.
3. Kai Hwang. Geoffrey C.Fox,Jack J. Dongarra, "Distributed and Cloud Computing from parallel Processing to the Internet of things".

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16MCE107 SOFTWARE PROJECT MANAGEMENT (ELECTIVE-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:

1. Introduce software project management and to describe its distinctive characteristics.
2. Discuss project planning and the planning process.
3. Show how graphical schedule representations are used by project management.
4. Discuss the notion of risks and the risk management process.
5. Managing the people in software industry.
6. Understand the quality of a project.

Course Outcomes: After completion of the course, the students would be able to:

1. Gain basic knowledge of software project management principles
2. Come up with a project schedule and assign resources
3. Choose an appropriate project development model.
4. Identify project risks, monitor and track project deadlines.
5. Work in a team environment and be aware of different modes of communications.
6. Understand the various levels of quality metrics and measurements.

UNIT-I

Software Project Management: Introduction, Importance, Software Projects Vs Other types of Projects, Contract Management, Technical Project Management, Activities covered by SPM, Plans, Methods and Methodologies. Setting Objectives, Project Success and Failures, Management and Control.
Project Evaluation and Programme Management: Project port polio management, Evaluation of Individual projects, Cost Benefit Evaluation Techniques, Risk Evaluation, Program Management, Managing the Resource with in the Program, Strategic Program Management, Aids to Program Management, **Overview of Project Planning.**

UNIT-II

Selection of an Appropriate Project Approach: Choosing the methodologies and technologies, Software process and process models.
Software Effort Estimation: Problems with Over and Underestimates, Software Effort Estimation Techniques. Function Point Analysis. A Parametric Productive Model – COCOMO-2
Activity Planning: Objectives of Activity Planning, Schedules, Activities, Sequencing, Network Planning Models.

UNIT-III

Risk Management : Categories of Risk, A Frame work with Dealing with Risk, Evaluating Risk with the Schedule.
Resource Allocation: Nature of Resource, Identify Resource Requirements, Scheduling, Creating Critical path, Cost Schedules, Scheduling Sequence.
Monitoring & Control: Creating Framework, Collecting Data, Project Termination Review, Visualizing Progress, Cost Monitoring, Prioritizing Monitoring, Change Control, Software Configuration Management.

UNIT-IV

Managing Contracts: Types of Contracts, Stages in Contract Placement, Typical Terms of Contracts, Contract Management Acceptance.
Managing People in Software Environments: Organizational behavior, selecting the Right person for the Job, Instruction in the best methods, Motivations, the Oldham-hackman Job characteristics model, Stress, Health and Safety, Some Ethical and Professional concerns.
Working in Teams: Becoming a Team, Decision making, Organization and Team Structures, Coordination of dependencies, Communication genres, Communication plans, Leadership.

UNIT –V

Software Quality : The Place of Software Quality in Project planning, Quality Management Systems, Process Capability models, Software Reliability Quality plans,
ISO : ISO – 9126, Product and Process Metrics
An Overview of PRINCE 2 : Components of Prince 2.

Text Book:

1. Bob Hughes and Mike Cotterell "Software Project Management", 5th Edition, Tata McGraw Hill, 2010.

Suggested Reading:

1. Walker Rayce "Software Project Management: A Unified Framework", Addison Wesley, 1998.
2. Watts S. Humphrey "Managing Software Process", Addison – Wesley Pearson Education, 1998.

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16MC C126

OBJECT ORIENTED SYSTEM DEVELOPMENT

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Objectives:

Students will:

1. Learn the concepts of nine UML diagrams.
2. Use the concepts of things and relationships in UML.
3. Learn about the structural and dynamic modeling.
4. Apply the concepts of Architectural modeling.
5. Acquire the concept and structure of RUP and USDP.
6. Study about the various models of USDP and core workflows.

Outcomes:

After completion of the course the students would be able to:

1. Understand the basic building blocks of UML.
2. Use the knowledge and applications of nine UML diagrams.
3. Learn the knowledge of how to model the object oriented applications through UML.
4. Acquire the knowledge of Structural and Behavioral modeling.
5. Apply the knowledge of dynamic and architectural modeling.
6. Study the concepts of RUP, USDP and models.

Unit – I:

UML Introduction, Why we model, introducing the UML, Building blocks of UML.Basic Behavioral Modeling, Use Cases, Use Case Diagrams, Structural Modeling, Object diagrams, Class Diagrams, Relationships, Advanced Relationships in Class diagrams.

Unit – II:

Dynamic modeling, Interactions, Interaction Diagrams, Events and signals, State Machines, Processes and Threads, State Chart Diagrams, Activity Diagrams.

Unit – III:

Architectural Modeling, Interfaces, Packages, Components, Component Diagrams, Design Patterns and Frame works, Deployment diagrams, Systems and models.

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Unit – IV:

Unified Software Development Process, The Unified Process, The Four Ps, Use-Case- Driven Process, Architecture – Centric Process, Iterative and Incremental Process.

Unit – V:

Core Workflows, Capturing Requirements as Use Cases, Analysis Model, Design Model, Implementation Model and Test Model.

Text Books:

1. Grady Booch, James Rumbaugh, Ivor Jacbson, "The Unified ModelingLanguage – User Guide", 2nd Edition, Pearson Education, India, 2007.
2. Ivor Jacbson, Grady Booch, James Rumbaugh, "The Unified Software Development Process", Pearson Education, India, 2008.

Suggested Reading:

1. Grady Booch, Rabert A. Maksimehuc and Three more, " Object Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 1991.
2. Craig Larman, "Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education, 2008.
3. Ali Bahrami, "Object Oriented System Development", Irwin/Mc Graw Hill, 1999.

16MC C127

MACHINE LEARNING

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Objectives:
Student will:
1. Learn the concepts of Classification and Prediction.
2. Understand the mathematical concepts related to Multilayer perception.
3. Apply clustering techniques for unsupervised data.
4. Train classifiers and predictors on supervised data.
5. Find optimal models for decision making.
6. Design ensemble models for Classification.

Outcomes:
After completion of the course the students would be able to:
1. Acquire the basic knowledge of Machine Learning; identify algorithms, machine learning problems.
2. Classify data sets using classifiers.
3. Use prediction Techniques.
4. Recognize patterns using Machine Learning models.
5. Apply dimensionality reduction techniques on different datasets.
6. Design ensemble methods.

Unit-I
Introduction: Learning, Types of Machine Learning.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Constructing Decision Trees, CART, Classification Example.

Unit-II
Linear Discriminants: The Perceptron, Linear Separability.
Linear Regression Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Derivingback.
Propagation SUPPORT Vector Machines: Optimal Separation, Kernels.

Unit-III
Some Basic Statistics: Averages, Variance and Covariance, The Gaussian.
The Bias-Variance Tradeoff Bayesian learning: Introduction, Bayes theorem, Bayes Optimal Classifier, Naive Bayes Classifier.

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Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

Unit-IV

Evolutionary Learning: Genetic Algorithms, Genetic Operators.

Genetic Programming Ensemble learning: Boosting, Bagging.

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis.

Unit-V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison.

Text Books:

1. Tom M. Mitchell, "Machine Leaming ",MacGraw Hill, 1997
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 2009.

Suggested Reading:

1. J F Khamber, Data Mning Concepts, Elsevier, 2007
2. Margaret H Dunham, "Data Mining", Pearson Edition, 2003.
3. GalitShmueli, Nitin R Patel, Peter C Bruce, "Data Mining for Business Intelligence", Wiley India Edition, 2007.
4. RajjallShinghal, "Pattern Recognition ", Oxford University Press, 2006.

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16MC C128

CRYPTOGRAPHY & NETWORK SECURITY

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Objectives:

Students will:

1. Learn OSI Security architecture and classical Encryption techniques.
2. Acquire fundamental knowledge on the concepts of finite fields and number theory.
3. Understand various block cipher and stream cipher models.
4. Describe the principles of public key cryptosystems, hash functions and digital signatures.
5. Acquire the knowledge of Security practices and system security.
6. Gain the knowledge of e-mail, IP and Web security.

Outcomes:

After completion of the course the students would be able to:

1. Compare various cryptographic techniques.
2. Design secure applications.
3. Inject secure coding in developed applications.
4. Develop secure cipher models.
5. Generate secure e-mail, IP and Web security algorithms.
6. Build secure system.

Unit-I

Introduction & Number Theory : Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid salgorithm-Finite fields- Polynomial Arithmetic –Prime numbers-FermatsandEulers theorem-Testing for primality The Chinese remainder theorem- Discrete logarithms.

Unit-II

Block Ciphers & Public Key Cryptography: Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

Unit-III

Hash Functions And Digital Signatures: Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS – EI Gamal – Schnorr.

Unit-IV

Security Practice & System Security: Authentication applications – Kerberos – X.509 Authentication services - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs- SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security.

Unit-V

E-Mail, IP& Web Security: E-mail Security: Security Services for E-mail-attacks possible through E-mail - establishing keys privacy-authentication of the source- Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME. IPSecurity: Overview of IPSec - IP and IPv6-Authentication Header-Encapsulation Security Payload (ESP)-Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding). Web Security: SSL/TLS Basic Protocol-computing the keys- client authentication- PKI as deployed by SSLAttacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET).

Text Books:

1. William Stallings, "Cryptography and Network Security", 6th Edition, Pearson Education, 2013.
2. Charle Kaufman, Radha Perlman and Mike Speciner "Network Security", Prentice Hall of India, 2002.

Suggested Reading:

1. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw Hill, 2007.

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OBJECT ORIENTED SYSTEM DEVELOPMENT LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Objectives:

Students will:

1. Learn basic operations of Rational Rose case tool .
2. View and browse the four sections of Rational Rose case tool.
3. Depict and model the diagrams of UML in Rational Rose case tool.
4. Know about the representation of Structural and Dynamic modeling.
5. Understanding the concepts of Architectural modeling and its representation.
6. Submit a technical report of the case study in IEEE format.

Outcomes:

After completion of the course the students would be able to:

1. Understood the browsing and viewing sections of Rational Rose case tool.
2. Gained the knowledge of selecting a case study and converting it to be suitable to model in UML.
3. Gained the knowledge to draw and model the UML diagrams.
4. Gained the practical knowledge of **st**ructural modeling of Object Oriented Applications through UML.
5. Gained the practical knowledge of dynamic modeling of Object Oriented Applications through UML.
6. Gained the knowledge of technical writing and documentation of the case study in IEEE format.

List of Experiments:

1. Use case Diagram
2. Class Diagram
3. Object Diagram
4. Sequence Diagram
5. Collaboration Diagram
6. State chart Diagram
7. Activity Diagram
8. Component Diagram
9. Deployment Diagram

The students should finally submit a technical report on their case study in IEEE format.

Text Book:

1. Ivor Jacbson, Grady Booch, James Rumbaugh, "The Unified Software Development Process", Pearson Education, India, 2008.

16MC C130

MACHINE LEARNING LAB USING PYTHON

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Objectives:

Students will:

1. Learn the basic concepts and techniques of Machine Learning.
2. Develop the skills in using recent machine learning software for solving practical problems.
3. Be familiar with a set of well-known supervised semi-supervised and unsupervised learning algorithms.
4. Do experiments on real-time data for decision making.

Outcomes:

After completion of "**Machine Learning Lab**", the student is expected to:

1. Understand complexity of Machine Learning algorithms and their limitations;
2. Understand modern notions in data analysis oriented computing;
3. Be capable of confidently applying common Machine Learning algorithms in practice and implementing their own.
4. Be capable of performing experiments in Machine Learning using real-world data.

Experiments:

1. Python Datatypes, Variables, Recursive Functions.
2. Strings, Lists, User defined functions, Tuples, Dictionaries.
3. Packages, Libraries of Python.
4. Demonstrating the Data preprocessing techniques.
5. Demonstration on How to get different datasets
6. Write a simple program on Simple Linear Regression
7. Multiple Linear Regression Backward Elimination – Preparation & Automatic Backward Elimination.

Use Decision Tree functions on real time data for

8. C4.5,
9. CART,
10. CHAID
11. Logistic Regression
12. K-Nearest Neighbors
13. Support Vector Machine with different kernals
14. Random Forest Classification

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Use clustering functions on real time data for

15. K-Means.
16. Hierarchical Clustering.

Use Association mining functions for

17. Apriori.

Apply Data compression techniques for real time data

18. Linear Discriminant Analysis (LDA).
19. Principal Component Analysis (PCA).

Text Book:

1. **Andreas C. Müller, Sarah Guido,** "ntroduction to Machine Learning with Python: A Guide for Data Scientists**"** O'Reilly Media, edition 1, 2016.

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16MC C131

SEMINAR

Instruction	3 Hours per week
Continuous Internal Evaluation	50 Marks
Credits	2

Objectives:

Students will:

1. Prepare a systematic and independent study of the state of the art technological topic in the broad area of his/her specialization.
2. Prepare PPT slides with the write-up and block diagrams of the selected area of study.
3. Present the selected topic and deliver a speech in front of the class and evaluating faculties.

Outcomes:

After completion of the course the students would be able to:

1. Conduct a independent technical study and survey on the selected topic.
2. Prepare a PPT slides presentation.
3. Deliver a speech and presentation of the study topic in front of the class and evaluating faculties.

Oral presentation is an important aspect of technical education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in a broad area of his/her specialization.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects of the seminar presentation.

- Literature Survey.
- Organization of the material.
- Presentation of PPTs.
- Technical writing.

Each student is required to submit one page of synopsis of the seminar talk two days before for display on the notice board. Give a 15 minutes presentation followed by 5 minutes discussions. Submit a report on the seminar topic with a list of references and slides used within a week. Seminars are to be scheduled in the 5th week of the semester. The sessional marks will be awarded to the students by at least two faculty members on the basis of an oral and written presentation as well as their involvement in the discussion.

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16MC E110

INTERNET OF THINGS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Objectives:

Students will:

1. Gain vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Acquire IoT standards and Business processes.
4. Learn data and knowledge Management and use of Devices in IoT Technology.
5. Understand State of the Art – IoT Architecture.
6. Have knowledge of Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Outcomes:

After completion of the course the students would be able to:

1. Gain vision of IoT from a global context.
2. Determine the Market perspective of IoT.
3. Use Devices, Gateways and Data Management in IoT.
4. Implement IoT standards and Business processes.
5. Build state of the art architecture in IoT.
6. Develop Applications of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

Unit-I

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

Unit-II

M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data Management.

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Unit-III

M2M and IoT Technology Fundamentals - Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management. IoT Architecture-State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and Architecture, IoT Reference Model.

Unit-IV

IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

Unit-V

Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation-Introduction, Case Study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Text Book:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

Suggested Reading:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
   HakimaChachi "Internet of Things (Connecting Objects)" Wiley – 2010.

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16MC E111

BUSINESS INTELLIGENCE AND ANALYTICS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Objectives:

Students will:

1. Learn data mining techniques and understand relationships between the underlying business process of an organization.
2. Understand the role of business analytics within an organization.
3. Acquire the knowledge on data warehousing concepts.
4. Provide in-depth knowledge of handling data and business analytics tools that is used for decision-making.
5. Acquire knowledge on prescriptive analytics.
6. Understand the various applications of business analytics on different domains.

Outcomes:

After completion of the course the students would be able to:

1. Get clear idea about the basic concepts of business analytics in an organization.
2. Demonstrate detailed knowledge about the role of business analytics in decision making.
3. Distinguish between descriptive, predictive and prescriptive analytics.
4. Gaining knowledge on data warehousing and data mining concepts.
5. Understand the usefulness of business analytics in various functional areas of an organization.
6. Understand the future directions for business analytics.

Unit- I:

Introduction: Introduction to Analytics, data science, Big data. Business analytics-challenges from outside and within, BASP (Business analytics success pillars) framework, Applications of Analytics to different domains, Data, Information, and Knowledge, Analyst's Role in the BA Model - Three Requirements the Analyst Must Meet , Required Competencies for the Analyst , Hypothesis-Driven Methods, Data Mining with Target Variables , Explorative Methods.

Unit- II:

Descriptive analytics : Descriptive analytics-Data warehousing-concepts, characteristics, Data marts, Meta data and process of data warehousing, Business

Reporting, Visual Analytics and Business performance measurement, Why a Data Warehouse, Architecture and Processes in a Data Warehouse, Tips and Techniques in Data Warehousing.

Unit- III:

Predictive analytics: Introduction, Data mining concepts and Applications, Data mining process, methods, classification techniques. Text mining-introduction, text analytics and sentiment analytics.Web mining-introduction, Web analytics and social analytics.

Unit- IV:

Prescriptive analytics : Introduction- categories of models- optimization, simulation, heuristics, predictive models, other models. Automated decision systems and Expert systems, Knowledge Management and collaborative systems.

Unit-V:

GIS : Nature of Geographic data, Spatial Objects and Data Models, Getting map on Computers, GIS standards and Standardization Process of GIS development, Implementation and Deployment phases, Big Data, Defining Big Data, Big Data Landscape, Business Implications of Big Data, Technology Implications of Big Data, Big Data Technologies, Management of Big Data.

Text Books:

1. Ramesh sharada, DursunDelen, Efraim Turban, “Business intelligence and analytics” Pearson, 2013.
2. Jean paulisson,jesse s.harriot,”Win with advanced Business analytics” wiley and sas, 2012.

Suggested Readings:

1. Gert H.N. Laursen, JesperThorlund “Business Analytics for Managers” JohnWiley& Sons, Inc.2010.

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16MC E113

BIG DATA ANALYTICS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Objectives:
Students will:

1. Introduce the concepts and challenges of big data, role of HDFS in handling big data and MapReduce Architecture.
2. Explore mapper and reducer to solve real world problems.
3. Introduce the features of NoSQL and study the working mechanisms of MongoDB.
4. Impart knowledge to work with semi structured and unstructured data using Pig.
5. Familiarize with features of Hive to process and query big data.
6. Process and query the big data in HDFS environment.

Outcomes:
After completion of the course the students would be able to:

1. Develop framework for handling Big Data using Hadoop
2. Acquire, Store and analyse big data in business environments using HDFS
3. Develop programs in MapReduce to solve real world problems
4. Model data using MongoDB
5. Handle semi structured and unstructured big data using Pig
6. Process and query big data in HDFS environment using Hive

Unit - I:
Introduction to Big data and its importance, Considering a Big data solution, Big Data use cases: IT for IT Log Analytics, The Fraud Detection Pattern, Social Media Pattern. The Hadoop Distributed Files system: The Design of HDFS, HDFS Concepts, Blocks, Name nodes and Data nodes, Block Caching, HDFS Federation, HDFS High Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems, Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow, Anatomy of a File Read, Anatomy of a File Write, Coherency Model, Parallel Copying with distcp, Keeping an HDFS Cluster Balanced.

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Unit - II:

MapReduce: A Weather Dataset, Data Format, Analyzing the Data with Hadoop, Map and Reduce, Java MapReduce, Scaling Out, Data Flow, Combiner Functions, Running a Distributed MapReduce Job Developing a MapReduce Application: Writing a Unit Test with MRUnit, Mapper,Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web.

Unit – III:

How MapReduce Works: Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures, Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, The Map Side, The Reduce Side, MapReduce Types and Formats: MapReduce Types, The Default MapReduce Job, Input Formats, Input Splits and Records, Text Input, Output Formats, Text Output.

Unit – IV:

No SQL Databases: Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, Working mechanisms of Mongo DB: Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation.

Unit – V:

Pig: Installing and Running Pig, an Example, Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice. Hive: Installing Hive, The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Paul C. Zikopoulos, Chris Eaton, Dirk DeRoos, Thomas Deutsch, George Lapis, "Understanding Big Data - Analytics for Enterprise class Hadoop and Streaming Data", McGrawHill, 2012.
3. Kristina Chodorow, "MongoDB: The Definitive Guide-Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Media, 2013.

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Suggested Reading:

1. Chuck Lam, Mark Davis, AjitGaddam, “Hadoop in Action”, Manning Publications Company, 2016.
2. Alex Holmes,” Hadoop in Practice”, Manning Publications Company, 2012.
3. Alan Gates, “Programming Pig”, O’Reilly Media Inc, 2011.
4. Edward Capriolo, Dean Wampler, and Jason Rutherglen, “Programming Hive”, O’Reilly Media Inc, October 2012.

   VigneshPrajapati, “Big data Analytics with R and Hadoop”, Packt Publishing, November 2013.

16MC E114

E-COMMERCE

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Objectives:

Students will:

1. Learn basics of E-Commerce.
2. Design the E-Commerce Network Infrastructure.
3. Study and the E-Commerce Security Issues and its solutions.
4. Learn the Various electronic Payment options.
5. Apply the various Electronic Advertisements.
6. Use the basics of M Commerce.

Outcomes:

After completion of the course the students would be able to:

1. Apply knowledge of Basics on E-Commerce and its Applications.
2. Obtain knowledge on E-Commerce Network Infrastructure.
3. Get Knowledge on E-Commerce Security Issues and its solutions.
4. Apply exposure on various electronic Payment systems.
5. Use the obtain knowledge on various Electronic Advertisements.
6. Gets Exposure on the basics of M Commerce.

Unit-I

Electronic Commerce: Introduction, definition, benefits, impact, classifications, Applications, Business models.

Electronic Data Interchange: Building blocks of EDI, Value added networks, Benefits of EDI, Applications of EDI.

Unit-II

Architecture: Introduction to Architecture and Frameworks. **Network Infrastructure**: LAN, Ethernet, WAN, Internet, TCP/IP Reference Models, Domain Name Servers (DNS), Internet and Industry Structure.

Information Distribution and Messaging: FTP and its Applications, e-mail, WWW Server, HTTP, Web Server Implementation.

Unit-III

Information Publishing Technology: Publishing, Web Browsing, HTML, CGI, Multimedia and its Objects, Virtual Reality Modelling Language (VRML). **Securing Business on Internet**: Vulnerable, Security policy and Procedures. Site Security, Protecting the Network, Firewalls, Securing the Web (HTTP) Service.

Securing the Network Transactions : Transaction Security, Cryptology, Cryptographic Algorithm, Public-Key Algorithm, Authentication Protocols, Digital Signature.

Unit-IV

Electronic Payment Systems: Introduction, Online-Payment Systems, Pre-Paid, Post Paid, Requirements Metrics of a Payment System. Search Engine and Directory services.

Internet Advertising: Introduction, Competitive advertising media, Models of Internet Advertising, Banner, Sponsoring, Screen saver, Push Broadcasting, Corporate Web Sites.

Unit-V

Mobile Commerce : Introduction, Benefits, Frameworks, Agents in Electronic Commerce, Types, Agent Technologies, Agent Standards and Protocols, Agent Applications.

Text Book:

1. Bharat Bhasker "Electronic Commerce: Framework, Technologies and Applications", Tata McGraw-Hill Education, 2006.

Suggested Reading:

1. Ravi Kalakota& AB.B. Whinston – "Frontiers of Electronic Commerce ", Pearson Education, India 1999.
2. Daniel Minoli, Emma Minoli : "Web Commence Technology Handbook", Tata McGraw Hill, 2007.

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16MC C132

MAJOR PROJECT WORK

Instruction	6 Hours per week
Semester End Examination	Viva Voce
Continuous Internal Evaluation	100 Marks
Semester End Examination	100 Marks
Credits	12

Objectives:

Students will:

1. Understand the client /user project requirements.
2. Develop a software life cycle mechanism for the given problem scenario
3. Convert the project requirements in a implementable format.
4. Develop test cases and testing scenario to the code generated.
5. Document the entire project work in a IEEE format.

Outcomes:

After completion of the course the students would be able to:

1. Understand to capture project requirements from the client/end users.
2. Understand and implement software life cycle for the given requirements.
3. Design a real time solution for the given software requirement specifications
4. Understand how to develop test cases and design test case scenarios.
5. Document the entire project work in IEEE standards and format.

Sixth (Final) Semester of the MCA course is exclusively meant for Major Project work. Major Project Work has to be carried out by each student individually in a period of 15 weeks of duration. Students should submit a synopsis at the end of 2nd week in consultation with the Project Guide. The synopsis should consist of definition of the problem, scope of the problem and plan of action. After completion of eight weeks students are required to present a Project Seminar on the topic covering the aspects of analysis, design and implementation of the project work to the committee consisting of two faculty members of MCA department in the college along with a guide will evaluate the project and award internal marks.

At the end of the semester the students are required to present their project work before the External Committee for Vive-Voce examination, in which each student will be awarded with marks.

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