CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous)
Kokapet (Village), Gandipet, Hyderabad, Telangana – 500075
www.cbit.ac.in

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 2021-22 from S. No. 5-121

5	Calculus	20MTC05
6	Chemistry	20CYC01
7	Engineering Mechanics-I	20CEC01
8	Programming for Problem Solving	20CSC01
9	Chemistry Lab	20CYC02
10	Programming for Problem Solving Lab	20CSC02
11	Workshop / Manufacturing Practice	20MEC02
12	Engineering Exploration	20MEC03
13	Vector Calculus and Differential Equations	20MTC06
14	English	20EGC01
15	Mechanics and Materials Science	20PYC05
16	Basic Electrical Engineering	20EEC01
17	English lab	20EGC02
18	Mechanics and Materials Science Lab	20PYC08
19	Basic Electrical Engineering Lab	20EEC02
20	CAD and Drafting	20MEC01
21	Community Engagement	20MBC02
22	Material Science And Metallurgy	20MEC04
23	Strength of Materials	20MEC05
24	Manufacturing Processes	20MEC06
25	Partial Differential Equations And Statistics	20MTC08
26	Basics Of Data Structures	20CSC06
27	Universal Human Values II- Understanding Harmony	20EGM03
28	Environmental Science	20CEM01
29	Material Science and Metallurgy Lab	20MEC07
30	Strength of Materials Lab	20MEC08
31	Manufacturing Processes Lab	20MEC09
32	Basic data structures Lab	20CSC07
33	Kinematics of Machines	20MEC10
34	Thermodynamics	20MEC11
35	Fluid Principles and Hydraulic Machines	20MEC12
36	Metal Cutting and Machine Tool Engineering	20MEC13

37	Indian Constitution and Fundamental Principles	20EGM01
38	Indian Traditional Knowledge	20EGM02
39	Power Plant Engineering	20MEE01
40	Production and Operations Management	20MEE02
41	Entrepreneurship	20MEE03
42	Mechatronics and Automation	20MEE04
43	Fluid Principles and Hydraulic Machines Lab	20MEC14
44	Metal Cutting and Machine Tool Engineering Lab	20MEC15
45	Dynamics of Machines	18ME C12
46	Applied Thermodynamics and Heat Transfer	18ME C13
47	Design of Machine Elements	18ME C14
48	Metal Cutting and Machine Tool Engineering	18PE C07
49	Refrigeration and Air Conditioning 1	18ME E01
50	Values, Ethics and Society	18ME E02
51	Plastics, Ceramics and Composite Materials	18PE E01
52	Product Design and Process Planning	18PE E02
53	Mechanical Vibrations	18ME E03
54	Automobile Engineering	18ME E04
55	Nano Science and Technology	18ME E05
56	Rights, Duties and Legislation	18ME E06
57	Non Destructive Testing and Evaluation	18PE E04
58	Fuels, Combustion and Environment	18ME E07
59	Dynamics and Vibrations Lab	18ME C15
60	Applied Thermodynamics and Heat Transfer Lab	18ME C16
61	Metal Cutting and Machine Tool Engineering Lab	18PE C08
62	CAD/CAM	18ME C17
63	Machine Design	18ME C18
64	Thermal Turbo Machines	18ME C19
65	Object Oriented Programming with C++	18ME E08
66	Mechanics of Composite Materials	18ME E09
67	Robotic Engineering	18ME E10
68	Production and Operations Management	18PE E06
69	Advanced IC Engines	18ME E11
70	Computational Fluid Dynamics	18ME E12
71	Principles of Entrepreneurship	18ME E13
72	Modern Machining and Forming Methods	18PE E08
73	Heat and Mass Transfer	18ME E14
74	Blockchain Technology	18ME E15
75	Renewable Energy Sources	18ME E17
76	Control Systems Theory	18ME E18
77	Artificial Intelligence	18ME E19
78	Industrial Administration and Financial Management	18ME E20
79	Principles and Applications of Additive Manufacturing	18PE E11
80	CAD/CAM LAB	18ME C20
81	Thermal Engineering Lab	18ME C21
82	Metrology and Instrumentation	18ME C22
83	Operations Research	18ME C23
84	Finite Element Analysis	18ME C24

85	Power Plant Engineering	18ME E21
86	Engineering Research Methodology	18ME E22
87	Data Analytics	18ME E23
88	Innovation and Intellectual Property Rights	18ME E24
89	Supply Chain Management	18PE E12
90	Object Oriented Programming using JAVA	18IT O01
91	History of Science & Technology	18PY O01
92	Gender Sensitization	18EG O02
93	Principles of Internet of Things	18IT O03
94	Basics of Artificial Intelligence	18CS O09
95	Metrology and Instrumentation Lab	18ME C25
96	Computer Aided Engineering Lab	18ME C26
97	Project: Part – 1	18ME C27
98	Remote Sensing and GIS	18EC O01
99	Decision Theory	18MT O01
100	Energy Auditing	18EE O03
101	Basics of Cyber Security	18CS O04
102	MEMS and its Applications	18EC O05
103	Technical Writing Skills	18EG O01
104	Basics of Biology	18BT O01
105	Disaster Mitigation and Management	18CE O02
106	Waste Management	18EE O05
107	Systems Automation & Control	18EC O07
108	Technical Seminar	18ME C28
109	Project Part - 2	18ME C29
110	Dynamics of Machines	18ME C12
111	Applied Thermodynamics and Heat Transfer	18ME C13
112	Design of Machine Elements	18ME C14
113	Metal Forming Technology	18PE C05
114	Refrigeration and Air Conditioning	18ME E01
115	Values, Ethics and Society	18ME E02
116	Plastics, Ceramics and Composite Materials	18PE E01
117	Product Design and Process Planning	18PE E02
118	Powder Processing	18PE E03
119	Automobile Engineering	18ME E04
120	Nano Science and Technology	18ME E05
121	Rights, Duties and Legislation	18ME E06

21-22

with effect from the Academic Year 2020-21

20MT C05

CALCULUS
(Common to ECE, EEE, MECH, CHEM, CIVIL)

Instruction	3 L+1T /2P Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	4

Course Objectives:

1. To explain the solutions of system of linear equations by Matrix Methods.
2. To discuss mean value theorems.
3. To explain the Partial Derivatives and the extreme values of functions of two variables.
4. To discuss the convergence and divergence of the series.
5. To explain the expansion of functions in sine and cosine series.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply the Matrix Methods to solve system of linear equations.
2. Analyse the geometrical interpretation of Mean value theorems.
3. Determine the extreme values of functions of two variables.
4. Examine the convergence and divergence of infinite Series.
5. Calculate the Euler's coefficients for Fourier series of a function.

UNIT-I

Matrices: Rank of a matrix, Echelon form, consistency of linear system of equations, Linear dependence and independence of vectors. Eigen values, Eigenvectors, Properties of Eigen values & Eigen vectors, Cayley-Hamilton theorem, Quadratic form, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

UNIT-II

Calculus: Rolle's Theorem, Lagrange's Mean value theorem, Cauchy's mean value theorem (without proofs). Curvature, Radius of curvature, Centre of curvature, Evolute and Involute.

UNIT-III

Multivariable Calculus (Differentiation): Functions of two variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions , Change of variables, Jacobians, Taylor's theorem for functions of two variables, Maxima and minima of functions of two variables.

UNIT-IV

Sequences and Series: Convergence of sequence and series, Tests for convergence of series: Comparison test, limit comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, alternating series, Leibnitz's series, absolute and conditional convergence.

UNIT-V

Fourier series: Periodic functions, Euler' formulae, Conditions for a Fourier expansion, functions having points of discontinuity, change of interval, even and odd functions, half range sine series, half range cosine series, and its applications in practical Harmonic analysis.

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. B.V.Ramana., 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.
3. David.Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/ Cole, 2005.

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20CY C01

CHEMISTRY

(Common to all branches)

Instruction:	3Hours per Week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

Course Objectives

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

Course Outcomes

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

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

UNIT-I Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method.Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2 , He_2^+ ,N_2 , O_2 , O_2^- , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II Use of free energy in chemical 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, electrode potentials, – Reference electrodes (NHE, SCE)-electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations.Numericals.

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

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

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Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)
Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides)
Cyclization (Diels - Alder reaction)

UNIT–IV Water Chemistry:
Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process),ion exchange method and Reverse Osmosis.Specifications of potable water & industrial water.Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V Engineering Materials and Drugs:
Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber).Conducting polymers- Definition, classification and applications.
Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.
Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation-Sol-gel method.Carbon nanotubes and their applications.Characterisation of nanomaterials by SEM and TEM (only Principle).
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. Malik, 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 (2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla, Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. 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., 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).

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20CE C01

ENGINEERING MECHANICS – I

Instruction:	3 L Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

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

1. Calculate the components and resultant of coplanar forces system.
2. Understand free body diagram and apply equilibrium equations to solve for unknown forces.
3. Apply concepts of friction for solving engineering problems.
4. Analyse simple trusses for forces in various members of a truss.
5. Determine centroid for elementary, composite figures and bodies.

UNIT- I:

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane. Resultant of coplanar concurrent force system. Moment of a force, couple and their applications. Resultant of coplanar non-concurrent force system.

UNIT - II:

Equilibrium of Force System: Free body diagram, equations of equilibrium. Lami's theorem, equilibrium of coplanar force systems.

UNIT - III:

Friction: Theory of static friction, Laws of friction, applications to single body, connected systems, wedge friction and belt friction.

UNIT - IV:

Analysis of Simple Trusses: Introduction to trusses, analysis of simple trusses using method of joints and method of sections.

UNIT - V:

Centroid and Centre of Gravity:

Centroid of lines and areas from first principles, centroid of composite figures, theorems of Pappus, centre of gravity of bodies and composite bodies.

Text Books:

1. K. Vijaya Kumar Reddy and J. Suresh Kumar, "*Singer's Engineering Mechanics: Statics and Dynamics*", B. S. Publications (SI Units), 3rd edn. Rpt., 2019.
2. A. Nelson., "*Engineering Mechanics*", Tata McGraw Hill, Delhi, 2010.

Suggested Reading:

1. Irving H. Shames, "*Engineering Mechanics*", 4th Edition, Prentice Hall, 2006.
2. R. C. Hibbeler, "*Engineering Mechanics: Principles of Statics and Dynamics*", Pearson Press, 2006.
3. Basudeb Bhattacharyya, "*Engineering Mechanics*", Oxford University Press, 2nd edn., 2016.

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20CS C01

PROGRAMMING FOR PROBLEM SOLVING
(Common to all Programs)

Instruction	3 Periods per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are

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 a means of implementing an algorithmic solution with appropriate control and data structures.
4. Develop in tuition to enable students to come up with creative approaches to problems.
5. Manipulation of text data using files.

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

1. Identify and understand the computing environments for scientific and mathematical problems.
2. Formulate solutions to problems with alternate approaches and represent them using algorithms / Flowcharts.
3. Choose data types and control structures to solve mathematical and scientific problem.
4. Decompose a problem into modules and use functions to implement the modules.
5. Apply arrays, pointers, structures, and unions to solve mathematical and scientific problems.
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 using functions and control statements.

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 Bubble) algorithms, 2-D arrays, matrix operations.

Strings: Introduction, strings representation, string operations with examples. Case study using arrays.

UNIT – IV

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

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Text Books:

1. M.T. Somashekar "Problem Solving with C", 2nd Edition, Prentice Hall India Learning Private Limited 2018
2. AK Sharma, "Computer Fundamentals and Programming", 2nd Edition, University Press, 2018
3. Pradeep Deyand Manas Ghosh, "Programming in C", Oxford Press, 2nd Edition, 2017

Suggested Reading:

1. Byron Gottfried, Schaum's Outline of Programming with C", Mc Graw-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, OXFORDPress,2015.

Online Resources:

1. https://www.tutorialspoint.com/cprogramming/index.htm.
2. https://onlinecourses.nptel.ac.in/noc18-cs10/preview

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with effect from the Academic Year 2020-21

20CY C02

CHEMISTRY LAB

(Common to all branches)

Instruction:	4 Hours per Week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	2

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes

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

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

Chemistry Lab

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2} & Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2}Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

Text Books:

1. J. Mendham and Thomas , "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg&A.Gulati,; R. Chand & Co. : New Delhi (2011).

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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20CS C02

PROGRAMMING FOR PROBLEM SOLVING LAB
(Common to All Programs)

Instruction	4 Periods per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50 Marks
Credits	2

Course Objectives: The objectives of this course are

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

1. Identify and setup program development environment.
2. Design and test programs to solve mathematical and scientific problems.
3. Identify and rectify the syntax errors and debug program for semantic errors
4. Implement modular programs using functions.
5. Represent data in arrays, pointers, structures and manipulate them through a program.
6. Create, read, and write to and from simple text files.

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:

Text Books:

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

Online Resources:

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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20ME C02

WORKSHOP / MANUFACTURING PRACTICE

Instruction	5 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2.5

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.

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

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in fitting, carpentry, tin smithy, house wiring, welding, casting and machining processes.
3. Make a given model by using workshop trades including fitting, carpentry, tinsmithy and House wiring.
4. Perform various operations in welding, machining and casting processes.
5. Conceptualize and produce simple device/mechanism of their choice.

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

1. To make a rectangular box from the given sheet metal with base and top open. Solder the corners.
2. To make a scoop.
3. To make a pamphlet box.

Exercises in Fitting

1. To make a perfect rectangular MS flat and to do parallel cuts using Hacksaw
2. To make male and female fitting using MSflats-Assembly1
3. To make male and female fitting using MSflats-Assembly2

Exercises in House Wiring

1. 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 bellpush
2. 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
3. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.

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CYCLE 2

Exercises in Casting

1. Study of Sand casting process and 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

Exercises in Welding

1. Study of gas welding equipment and process. Identification of flames, making of Butt joint with gas welding.
2. Study of Arc welding process, making Butt joint with DCSP, DCRP
3. Study of Arc welding process, making Lap joint with A.C

Exercises in Machine shop

1. Study of Machine Tools like Lathe, Drilling, Milling and Shaper.
2. Facing, Plain turning and Step turning operations on Lathe machine.
3. 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.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury 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.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House,2017.

Suggested Reading:

1. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I", Pearson Education,2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India,1998.

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20ME C03

ENGINEERING EXPLORATION

Instruction	4 Hours per week
Duration of SEE	Nil
SEE	Nil
CIE	50 Marks
Credits	1.5

Prerequisites: Nil

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

1. Understand the role of an engineer as a problem solver.
2. Identify multi-disciplinary approaches in solving an engineering problem.
3. Build simple systems using engineering design process.
4. Analyze engineering solutions from ethical and sustainability perspectives.
5. Use basics of engineering project management skills in doing projects.

UNIT- I

Role of Engineers: Introduction, science, engineering, technology, engineer, scientist, role of engineer, various disciplines of engineering, misconception of engineering, expectations for the 21st century engineer and NBA graduate attributes.

Engineering problems and Design: Multidisciplinary facet of design, pair wise comparison chart, introduction to econometrics system, generation of multiple solution, Pugh chart, motor and battery sizing concepts, introduction to PCB design.

UNIT- II

Mechanisms: Basic components of a mechanism, degrees of freedom or mobility of a mechanism, 4-bar chain, crank rocker mechanism, slider crank mechanism, simple robotic arm building.

Platform-based development: Introduction to programming platforms (Arduino) and its essentials, sensors, transducers and actuators and their interfacing with Arduino.

UNIT- III

Data Acquisition and Analysis: Types of data, descriptive statistics techniques as applicable to different types of data, types of graphs and their applicability, usage of tools (MS-Office /Open Office/ Libre Office / Scilab) for descriptive statistics, data acquisition (temperature and humidity) using sensors interfaced with Arduino, exporting acquired data to spreadsheets, and analysis using representation.

UNIT- IV

Process Management: Introduction to Agile practice, significance of team work, importance of communication in engineering profession, project management tools, checklist, timeline, Gantt chart, significance of documentation.

UNIT -V

Engineering Ethics & Sustainability in Engineering: Identifying Engineering as a profession, significance of professional ethics, code of conduct for engineers, identifying ethical dimensions in different tasks of engineering, applying moral theories and codes of conduct for resolution of ethical dilemmas.

Sustainability in Engineering: Introduction, sustainability leadership, life cycle assessment, carbon foot print.

Text Books:

1. Clive L. Dym, Patric Little, Elizabeth J Orwin, "Engineering Design: A project-based introduction", 4th edition,Willey.
2. Matthew Python, "Arduino programming for beginners", Independently published,2020.
3. Patrick F. Dunn , "Measurement and data Analysis for engineering and science" , thirdedition,2014.
4. Andrew Stellman, Jennifer Greene, "Head First Agile: A brain-friendly guide to Agile principles, ideas, and real-world practices", Kindle Edition.

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Suggested Reading:

1. Charles B. Fleddermann, "Engineering ethics", fourth edition, Prentice Hall,2012.
2. Rob Lawlor, "Engineering in society", second edition, Royal academy of engineering.
3. Richard Dodds, Roger Venables, "Engineering for sustainable development: Guiding principles", The Royal Academy of engineering,2005.
4. Richard S. Paul, "Robot Manipulators: Mathematics, Programming, and Control", MIT Press.

ENGINEERING EXPLORATION ASSESSMENT SCHEME				
S. No	**Name of the module**	**Work Hours**	**Marks**	**Evaluation**
1	Role of Engineers	4	-	Evaluation - I
2	Engineering Design	16	5	
3	Mechanisms	6	3	
4	Engineering Ethics	2	2	
5	Platform-based Development	16	5	Evaluation - II
6	Data Acquisition and Analysis	6	4	Evaluation-III
7	Project Management	4	4	
8	Sustainability in Engineering	6	2	
9	Course Project Reviews	12	20	Final Evaluation
10	Code of conduct	-	5	
	Total	**72**	**50**	

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20MT C06

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS
(Common to ECE, EEE, MECH, CHEM, CIVIL)

Instruction	3 L+1T /2P Hours per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To explain double and triple integrals of various functions and their significance.
2. To explain Scalar and vector functions with its Physical interpretations.
3. To discuss vector line, surface and volume integrals.
4. To explain relevant methods to solve first order differential equations.
5. To discuss the solution of higher order differential equations.

Course Outcomes:

Upon completing this course, students will be able to:

1. Calculate the areas and volumes.
2. Apply the vector differential operators to Scalars and Vector functions.
3. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
4. Calculate the solutions of first order linear differential equations.
5. Solve higher order linear differential equations.

UNIT-I

Multivariable Calculus (Integration): Applications of definite integrals to evaluate surface areas and volumes of revolutions. Double integrals, Change of order of integration, Area enclosed by plane curves, Triple integrals, Volumes of solids.

UNIT-II

Vector Differential Calculus: Scalar and vector point functions, Gradient, Directional derivative, potential function. Divergence, Physical interpretation of Divergence, Curl, Physical interpretation of curl, vector identities.

UNIT-III

Vector Integral Calculus: Line integral, Surface integral and Volume integral, Green's theorem in a plane, Stoke's theorem and Gauss's divergence theorem (without proof).Fluid flow, Physical interpretation of the divergence.

UNIT-IV

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact equations, Linear equations, Bernoulli's equation, Clairaut's equation, Riccati's equation, Orthogonal trajectories, Chemical reactions and solutions, Rate of decay of Radio-active materials.

UNIT-V

Higher Orders Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of variation of parameters, solution of Euler-Cauchy equation. Ordinary point, singular point, regular singular point and Power Series solution. Applications: LR and LCR circuits.

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition,2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

Suggested Reading:

1. N.P.Bali and Dr.Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,9th edition, 2014.
2. R.K.Jain, S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publications,5thedition,2016.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint,2002

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20 EG C01

ENGLISH

(Common to all branches)

Instruction	2 Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	2

Course Objectives: This course will introduce the students:

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

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

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques

UNIT-I Understanding Communication in English:
Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.
Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II Developing Writing SkillsI:
Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.
Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT-III Developing Writing Skills II:
Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response
Vocabulary and Grammar: Subject-verb agreement.
Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV Developing Writing Skills III:
Report writing – Importance, structure, elements of style of formal reports ; Writing a formal report.
Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V Developing 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; Use of standard abbreviations.

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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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20PY C05

MECHANICS AND MATERIALS SCIENCE
(Common to Civil & Mechanical)

Instruction	3L/week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Course Objectives: The objectives of the course is to make the student

1. Acquire knowledge about physics of oscillations and rotational motion
2. Understand the physical properties of crystalline and magnetic materials
3. Aware of characteristic properties of dielectric materials and super conductors
4. Familiarize with coherent properties of light waves.

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

1. Compare the various types of oscillations
2. Demonstrate rotational motion of rigid body
3. Classify different types of crystals and their imperfections
4. Identify magnetic and dielectric materials for engineering applications
5. Make use of lasers and superconductors in technological applications

UNIT-I

Oscillations: Simple harmonic motion–Harmonic oscillator–Damped harmonic motion – over damped, critically damped and under damped oscillators–Forced oscillations and resonance.

UNIT-II

Rigid body Dynamics: Definition of rigid body–Rotational kinematic relations–Angular momentum and torque–Equation of motion for a rotating rigid body–Inertia tensor and its properties– Euler's equations and applications: law of energy conservation and law of conservation of angular momentum.

UNIT-III

Crystallography: Space lattice –Unit cell –Crystal systems –Bravais lattices –Number of atoms per unit cell – Coordination number –Atomic radius –Packing fraction (for *sc, bcc, fcc*) –Lattice planes – Miller indices – Bragg's law –Experimental determination of lattice constant of a cubic crystal by powder X-ray diffraction method–Structure of NaCl.

Crystal Imperfections: Classification of defects –Point defects –Concentration of Schottky and Frenkel defects.

UNIT-IV

Dielectric Materials: Introduction –Dielectric polarization –Types of dielectric polarization: electronic & ionic polarizations (quantitative); orientation & space-charge polarizations (qualitative) –Frequency and temperature dependence of dielectric polarization –Determination of dielectric constant (Schering bridge method) –Ferroelectricity–Barium titanate–Applications of ferroelectrics.

Magnetic Materials: Origin of magnetism – Magnetic moment - Bohr magneton–Classification of magnetic materials: dia, para, ferro, anti-ferro and ferrimagnetic materials – Weiss molecular field theory – Domain theory –Hysteresis curve, soft and hard magnetic materials –Applications.

UNIT-V

Lasers: Characteristics of lasers – Einstein's coefficients – Amplification of light by population inversion - Ruby, He-Ne, semiconductor laser – Applications of lasers in engineering and medicine.

Fiber Optics: Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers – Pulse dispersion – Fiber losses – Fiber optic communication system – Applications

Superconductors: General properties of superconductors – Meissner's effect – Type I and Type II superconductors – BCS theory (qualitative) – Applications.

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Text Books:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications,2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book of Engineering 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.

Suggested Reading:

1. R. Murugeshan and KiruthigaSivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications,2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill 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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20EEC01

BASIC ELECTRICALENGINEERING

Instruction	3 Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Course Objectives:

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To understand the basic principle of operation of AC and DC machines
3. To know about different types of electrical wires and cables, domestic and industrial wiring. safety rules and methods of earthing

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

1. Understand the concepts of Kirchhoff's laws and to apply them in superposition, Thevenin's and Norton's theorems to get the solution of simple dc circuits
2. Obtain the steady state response of RLC circuits with AC input and to acquire the basics, relationship between voltage and current in three phase circuits.
3. Understand the principle of operation, the EMF and torque equations and classification of AC and DC machines
4. Explain various tests and speed control methods to determine the characteristic of DC and AC machines.
5. Acquire the knowledge of electrical wiring, types of wires, cables used and Electrical safety precautions to be followed in electrical installations.
6. Recognize importance of earthing, methods of earthing and various low-tension switchgear used in electrical installations

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff 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.

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. 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

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: Principle of operation, Applications,

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, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

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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", McGrawHill,2009
4. P.V. Prasad, S. sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition,2013

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20EG C02

ENGLISH LAB

(Common to all branches)

Instruction	2 Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1

Course Objectives: This course will introduce the students:

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To IELTS and TOEFL material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behavior while developing their ability to discuss in groups and making oral presentations.

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

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze IELTS and TOEFL listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams ,and discuss and participate in Group discussions.

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. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary** – weaving an imaginative story around a given picture.
9. **Information Gap Activity** – Writing a brief report on a newspaper headline by building on the hints given
10. **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. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt. Ltd., 2011
4. Aruna Koneru, Professional Speaking Skills, Oxford University Press, 2016

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20PY C08

MECHANICS AND MATERIALS SCIENCELAB
(Common to Civil &Mechanical)

Instruction	4Periods/week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2

Course Objectives:

The objectives of the course is to make the student

1. Apply the concepts of physics while doing experiments
2. Learn the working of lasers and optical fibers
3. Understand the properties of magnetic and dielectric materials
4. Capable of measuring mechanical properties of solids and liquids
5. Understand the motion electrons in electric and magnetic fields

Course Outcomes:

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

1. Estimate the error in an experimental measurement
2. Make use of lasers and optical fibers in engineering applications
3. Recall the physical properties of dielectrics and magnetic materials
4. Find the mechanical properties of solids and viscosity of liquids
5. Demonstrate the motion of electrons in electric and magnetic fields

Experiments

1.	Error Analysis	:	Estimation of errors in the determination of time period of a torsional pendulum
2.	Flywheel	:	Determination of moment of inertia of given flywheel
3.	Compound Pendulum	:	Determination of acceleration due to gravity
4.	Young's Modulus	:	Determination of Young's modulus of the given steel bar/wooden scale by non-uniform bending method
5.	Helmholtz's Resonator	:	Determination of resonating volume of air and neck correction
6.	Melde's Experiment -	:	Determination of frequency of the electrically maintained vibrating bar/fork
7.	Viscosity of Liquid	:	Determination of viscosity of a given liquid by oscillating disc method
8.	Coupled Oscillator	:	To determine the coupling constant of a coupled oscillator performing parallel and antiparallel oscillation
9.	Dielectric Constant	:	Determination of dielectric constant of given PZT sample
10.	M & H Values	:	Determination of magnetic moment M of a bar magnet and absolute value H of horizontal component of earth's magnetic field
11.	B-H Curve	:	Determination of hysteresis loss of given specimen
12.	Thermoelectric Power	:	Determination of thermoelectric power of given sample
13.	Laser	:	Determination of wavelength of given semiconductor laser
14.	Optical Fiber	:	Determination of numerical aperture and power losses of given optical fiber
15.	e/m of an electron	:	Determination of specific charge of an electron by J.J. Thomson method

NOTE: A minimum of TWELVE experiments should be conducted.

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20EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To acquire the knowledge of different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switchgear components

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

1. Get an exposure to common electrical components, their ratings and basic electrical measuring equipment.
2. Make electrical connections by wires of appropriate ratings and able to measure electric power and energy.
3. Comprehend the circuit analysis techniques using various circuital laws and theorems.
4. Determine the parameters of the given coil and calculate the time response of RL & RC series circuits.
5. Recognize the basic characteristics of transformer and components of switchgear.
6. Understand the basic characteristics of dc and ac machine by conducting different types of tests on them.

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 series circuits.
4. Determination of parameters of a choke or coil by Wattmeter Method
5. Verification of Thevenin's and Norton's theorems
6. Turns ratio /voltage ratio verification of single phase Transformers
7. Open Circuit and Short Circuit tests on a given single phase Transformer
8. Observation of Excitation Phenomenon in Transformer
9. Measurement of three phase power in a balanced system using two Wattmeter method.
10. Measurement of 3-Ph Energy by an Energy Meter (Demonstration of Principle)
11. Load test on DC Shunt motor
12. Speed control of DC Shunt motor
13. Demonstration of Low Tension Switchgear Equipment/Components
14. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted from the above list.

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20ME C01

CAD AND DRAFTING

Instruction	1 T + 3 D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

Course Objectives:

1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

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

1. Become conversant with appropriate use of CAD software for drafting. (BL-3)
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting. (BL-2)
3. Construct the projections of points, lines, planes, solids (BL-3)
4. Analyse the internal details of solids through sectional views (BL-4)
5. Create an isometric projections and views (BL-6)

List of Exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice versa.

Text Books:

1. N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishers, 2012.
2. K.Venugopal, "Engineering Drawing and Graphics + AutoCAD", New Age International Pvt. Ltd,2011.
3. Basanth Agrawal and C M Agrawal, "Engineering Drawing", 2/e, McGraw-Hill Education (India) Pvt. Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., "Engineering Drawing", 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, "Text Book of Engineering Drawing", Scitech Publications, 2011.

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20MBC02

COMMUNITY ENGAGEMENT

Instruction	3 Hours per week (30 hours field work & 2 hours per week)
SEE	Nil
CIE	50 Marks
Credits	1.5 Credits

Course Objectives: The main Objectives of this Course are to:

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

Course Outcomes: After the completion of this Course, Student will be able to:

2. Gain an understanding of Rural life, Culture and Social realities.
3. Develop a sense of empathy and bonds of mutuality with Local Communities.
4. Appreciate significant contributions of Local communities to Indian Society and Economy.
5. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
6. Utilise the opportunities provided by Rural Development Programmes.

Module I Appreciation of Rural Society

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV Rural Development Programmes

History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, Beti Bhachao, Beti Padhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

Text Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

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20MEC04

MATERIAL SCIENCE AND METALLURGY

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 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 crystal structure and various imperfections of crystals.
2. Related material failure by fatigue and creep.
3. Interpret phase diagrams and TTT diagrams.
4. Understand the methods of improvement of mechanical properties by various heat treatment operations.
5. Differentiate the properties and applications of ceramics, polymers and composites.

UNIT - I

Plastic Deformation: Introduction to engineering materials, Imperfections in crystals, Dislocation in crystals, Types of dislocations, Effect of slip and twinning on plastic deformation, Strain hardening, Cold and hot working, Bauschinger effect, Recovery, Recrystallization, Grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, Ductile and brittle fracture, Griffith theory of brittle fracture, Crack propagation and ductile to brittle transition temperature.

UNIT - II

Diffusion: Fick's laws of diffusion, Application of diffusion theory in mechanical engineering.

Fatigue: S–N curve, Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Low and high cycle fatigue, Experimental determination of fatigue strength (RR–Moore Test).

Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep test.

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.

Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon, Tungsten and Titanium, Types of stainless steel, HSLA, TRIP, HSS, Brass, Bronze, Their

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composition and properties.

UNIT - IV

Heat Treatment: Purpose of heat treatment, Annealing, Normalizing, Hardening, Tempering, Construction and interpretation of T–T–T diagram, Austempering and Martempering, Case hardening, Carburizing, Nitriding, Carbo–nitriding, Flame hardening, Induction hardening, Laser and Electron beam hardening.

Introduction to Non-Destructive Testing: Importance of Non-Destructive Testing, Types: Liquid Penetrant Testing, Ultrasonic Testing, Radiography Testing, Applications of Non-Destructive Testing.

UNIT - V

Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, Cast iron by cupola furnace and method of production of steel by electric arc process.

Polymers and Ceramics: Polymerization, Thermoplastics and thermosetting plastics, Elastomers, Resins, Types, properties and applications of ceramics

Composites: Concept of composites, Matrix and reinforcement, Classification and Applications of composites.

Text Books:

1. V. Raghavan, Materials Science and Engineering, 4th edition, Prentice Hall of India Ltd., New Delhi, 2005.
2. S.H. Avner, Introduction to Physical Metallurgy, 2nd edition, Tata McGraw Hill Publishers, New Delhi, 2005.

Suggested Reading:

1. S.P. Nayak, Engineering Metallurgy and Material Science, 6th edition, Charotar Publishing House, Gujarat, 2005.
2. G. E. Dieter, Mechanical Metallurgy, 3rd edition, Tata McGraw Hill, New Delhi, 2005.
3. W.D. Callister (Adapted by R. Balasubramaniam), Materials Science and Engineering, 2nd edition, Wiley India, New Delhi, 2014.

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20MEC05

STRENGTH OF MATERIALS

Instruction	3 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 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 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, Strain energy for axial and torsional loads.

UNIT – II

Beams: Definition of shear force and bending moment, Relation between intensity of loading, Shear force and bending moment, Shear force and bending moment diagrams for cantilever, Simply supported and overhanging beams, Theory of simple bending, Moment of resistance and comparison of various cross-sections.

UNIT – III

Slopes and Deflections: Slope and deflection calculations of cantilever, Simply supported

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beams subjected to point loads and uniformly distributed loads with Macaulay's and double integration methods.

Torsion of Circular Cross-sections: Theory of pure torsion, Power transmission in solid and hollow circular shafts, 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.

Principal Stresses and Strains: Analysis of biaxial state of stress with and without shear, Mohr's Circle.

UNIT – V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures.

Columns and Struts: Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

Textbooks:

1. S.S. Rattan., Strength of Materials, 3rd edition, Tata Mc-Graw Hill, 2017.
2. Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf and David F. Mazurek., Mechanics of Materials, 8th edition, McGraw-Hill, New York, 2020.

Suggested Reading:

3. James M Gere, Mechanics of materials, 8th edition, Cengage Learning, 2013.
4. R.C. Hibbeler, Mechanics of Materials, 9th edition, Pearson, 2018.
5. S. Ramamrutham., Strength of Materials, 16th edition, Dhanpatrai and Sons, 2011.

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20MEC06

MANUFACTURING PROCESSES

Instruction	4 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

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. Define various terms related to manufacturing processes
2. Demonstrate the understanding of various manufacturing processes
3. Solve simple problems such as riser design and sheet metal calculations
4. Compare various manufacturing processes
5. Choose suitable manufacturing process for a given component

UNIT – I

Manufacturing Processes: Classification and importance.

Casting: Introduction, Classification of casting processes, Types of patterns, Pattern materials, Pattern allowances, Elements of gating system, Types of gates, Purpose and requirements of riser, Chvorinov's rule, Optimum shape and dimensions of riser, Riser design by Caine's method and Modulus method.

UNIT - II

Moulding and Melting: Moulding sand and its ingredients, Required properties of moulding sand, Core and 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 and CO_2 moulding.

UNIT- III

Arc Welding: Introduction to welding, Classification of welding processes, DCSP, DCRP, AC, shielded metal arc welding, Submerged arc welding, Gas Tungsten arc welding and gas metal arc welding,

Resistance Welding: Principle, Spot, Projection, Seam, Butt and percussion welding processes.

Solid State Welding: Friction welding, Ultrasonic welding and explosive welding

Other Welding Processes: Oxy-Acetylene welding, Laser beam welding, Electron beam welding, Soldering and brazing.

UNIT – IV

Bulk Deformation Processes: Open die, Closed die and isothermal forging processes, Rolling

process, Nomenclature of rolling , Geometric relationships in rolling, Direct, indirect, hydrostatic and impact extrusion processes , Wire drawing process

Sheet Metal Operations: Shearing process, Shearing load, Energy required, Types of shearing processes, Cup drawing process, Calculation of blank diameter for a given cup, Drawing load, Sheet bending process and bend allowance.

High Energy Rate Forming Processes: Explosive forming, Electro-hydraulic forming and electromagnetic forming.

UNIT – V

Additive Manufacturing: Introduction, Stereolithography, Fused deposition modeling, Selective laser sintering and applications of additive manufacturing

Powder Processing: Introduction, Production of powders, Mixing, Blending, Compacting and Sintering, Merits, Demerits and application of powder metallurgy products.

Processing of Plastics, Ceramics and Composites: Injection moulding, Blow moulding and thermoforming of plastics, Injection moulding and slip casting of ceramics, Roll bending and filament winding of composites.

Text Books:

1. G.K. Lal and S.K. Choudhury., Fundamentals of Manufacturing Processes, Alpha science International Ltd., 2005.
2. Mikell P.Grover., Principle of Modern Manufacturing, 5th edition, Wiley , 2014,

Suggested Reading:

3. P.N. Rao., Manufacturing Technology, Vol.1, 3rd edition, Tata McGraw Hill Publ., 2011.
4. John Schey., Introduction to Manufacturing Processes, 2nd edition, McGraw Hill Education, 1999
5. Amitabh Ghosh and Mallick., Manufacturing Science, 4th edition, Assoc. East West Press Pvt. Ltd., 2011.

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20MTC08

PARTIAL DIFFERENTIAL EQUATIONS AND STATISTICS

Instruction	3 L + 1THours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Objectives:

1. To learn Numerical solution of ODE and Engineering problems.
2. To form PDE and to find its solution.
3. To know the model of wave and heat equations.
4. Able to fit the hypothetical data using probability distribution.
5. To learn fitting of distribution and predicting the future values.

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

1. Find solution of initial value problems of ODE by numerical method.
2. Solve Linear and non-linear PDE's.
3. Solve one-dimension wave and heat equations and two dimension Laplace equation.
4. Use the basic probability for fitting the Random phenomenon.
5. Analyze the random fluctuations of probability distribution and principles of least square approximations for the given data.

UNIT-I:

Numerical Methods: Solution of algebraic and transcendental equations by bisection method, Regula-Falsi method, Newton-Raphson method, Numerical solutions of first order ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

UNIT-II:

Partial Differential Equations: Formation of partial differential equations, Linear equations of first order (Lagrange's linear equations), Solution of first order non-linear partial differential equation (standard forms) and Charpits method.

UNIT-III:

Applications of Partial Differential Equations: Solution by method of separation of variables, Solution of one dimensional wave equation, Solution of one dimensional heat equation, Solution of two dimensional Laplace equation and its related problems.

UNIT-IV:

Basic Probability: Basic probability, Conditional probability, Baye's theorem, Random variable, Discrete probability distribution and continuous probability distribution, Expectation, Addition and multiplication theorem of expectation, Properties of variance, Moments (moments about the mean and moments about a point)

UNIT-V:

Probability Distributions and Curve Fitting: Poisson distribution, MGF and cumulants of the Poisson distribution, Normal distribution, Characteristics of normal distribution MGF and CGF of normal distribution, Areas under normal curve, Correlation, Coefficient of correlation and lines of regression, Curve fitting by the method of least squares, Fitting of straight lines, Second degree parabola, Exponential and growth curves.

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017.
2. S.C.Gupta and V.K. Kappoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2014.

Suggested Reading:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
3. Sheldon Ross, A First Course in Probability, 9th Edition, Pearson publications, 2014.

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20CSC06

BASICS OF DATA STRUCTURES

(Common for all Programmes except CSE & IT)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisites:
Basic knowledge of programming language such as C or C++ is preferred (but not mandatory) and some mathematical maturity also will be expected.

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 students will be able to
1. Identify various data structures, searching & sorting techniques and their applications.
2. Describe the linear and non-linear data structures, searching and sorting techniques.
3. Apply suitable data structures to solve problems.
4. Analyze various searching and sorting techniques.
5. Evaluate the linear and non-linear data structures.

UNIT – 1
Introduction: Data types, Data structures, Types of data structures, Operations, ADTs, Algorithms, Comparison of algorithms, Complexity, Time and space tradeoff.
Recursion: Introduction, Format of recursive functions, Recursion vs Iteration, Examples.

UNIT – 2
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 – 3
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
Searching and Sorting: Linear searching, Binary Searching, Sorting algorithms, Bubble sort, Selection sort, Quick sort, Heap sort

UNIT – 4
Trees: Definitions and concepts, Operations on binary trees, Representation of binary tree, Conversion of general trees to binary trees, Representations of trees, Tree traversals and Binary search tree.

UNIT –5
Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees

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Text Books:

1. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, 2017
2. E.Horowitz ,S. Sahni and Susan Anderson-Freed, Fundamentals of Data structures in C, 2nd Edition, Silicon Press, 2007)
3. ReemaThareja, Data Structures using C, Oxford, 2014

Suggested Reading:

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
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms
5. https://www.coursera.org/specializations/data-structures-algorithms

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20EGM03

UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY

(Common for all Programs)

Instruction	2 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Course Objectives:

This course aims to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in human being, family, society, and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

The course has 28 lectures and 14 practice sessions:

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation-as the process for self-exploration.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario.
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence)

rather than as arbitrariness in choice based on liking-disliking.

UNIT-II

Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
- Understanding the characteristics and activities of 'I' and harmony in 'I'.
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT-III

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
- Understanding the meaning of Trust; Difference between intention and competence.
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals.
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in the Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature.
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

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UNIT-V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values.
- Definitiveness of Ethical Human Conduct.
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.
- Strategy for transition from the present state to Universal Human Order:

  a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers.
  b. At the level of society: as mutually enriching institutions and organizations.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Mode of Conduct (L-T-P-C 2-1-0-3)

- Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.
- While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
- Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-

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assessment, peer assessment etc. will be used in evaluation.
Example:
Assessment by faculty mentor: 10 marks
Self-assessment/Assessment by peers: 10 M
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 The teacher's manual
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. A Nagaraj Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Cecile Andrews, Slow is Beautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small is Beautiful."
7. J. C. Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
10. 10.Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom -
12. Vivekananda - Romain Rolland (English)
13. The Story of Stuff (Book).

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20CEM01

ENVIRONMENTAL SCIENCE

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Objectives: To enable the student

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Outcomes: At the end of the course, student is able to

1. Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and affects of over utilization.
2. Understand the concept of ecosystems and realize the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to 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.

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UNIT – IV:

Environmental Pollution: Cause, Effects and control measures of air pollution, Water pollution, Marine pollution, Soil pollution, Noise pollution, 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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CBIT (A) With Effect from the Academic Year 2021-22

20MEC07

MATERIAL SCIENCE AND METALLURGY LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 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.
2. Observing the microstructure of low carbon steel, medium carbon steel and high carbon steel specimens.
3. Observing the microstructure of austenitic stainless steel, high speed steel and case carburized steel specimens.
4. Observing the microstructure of grey cast iron, white cast iron and spheroidal cast iron specimens.
5. Observing the microstructure of Al-Si alloy, and malleable cast iron specimens.
6. Preparation of α-β brass and normalized steel specimens for micro structural observation.
7. Preparation of medium carbon steel and mild steel specimens for micro structural observation.
8. Preparation of nodular cast iron and grey cast iron specimens for micro structural observation.
9. Determination of grain size using image analyzer.
10. Annealing and preparation of the given Steel specimen for microstructural observation.
11. Normalizing and preparation of the given Steel specimen for microstructural observation.
12. Hardening and preparation of the given Steel specimen for microstructural observation.
13. Comparative study on the influence of heat treatments (annealing, normalizing and hardening) on the microstructure and hardness of the given Steel specimen.

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

Suggested Reading:

1. V. Raghavan, Materials Science and Engineering, 4th edition, Prentice Hall of India Ltd., New Delhi, 2005.
2. S. H. Avner, Introduction to Physical Metallurgy, 2nd edition, Tata McGraw Hill Publishers, New Delhi, 2005.
3. Virtual labs – Physical Metallurgy Lab, NITK SURATHKAL.

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20MEC08

STRENGTH OF MATERIALS LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 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.
4. Demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

Outcomes: On successful completion of the course, students 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 and leaf spring by conducting load-deflection test.
3. Rigidity modulus of a given shaft specimen by torsion test and shear modulus of closely coiled helical spring.
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. Tension test on mild steel.
2. Compression test on mild steel.
3. Tension test on cast iron.
4. Compression test on cast iron.
5. Brinell's and Rockwell's hardness tests.
6. Izod Impact test.
7. Load-deflection test on a leaf spring to find out the Young's modulus of leaf material.
8. Deflection test on a helical spring to determine the rigidity modulus.
9. Torsion of shaft to determine the rigidity modulus of shaft material.
10. Defection test on a cantilever beam to determine the Young's modulus.
11. Deflection test on a simply supported beam to determine the Young's modulus.
12. Deflection test on propped cantilever to determine the Young's modulus.

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13. Deflection test on continuous beam to determine the Young's modulus.
14. Crushing and compression test on bricks and concrete cubes.

15. Look at each component (arm, leg, seat, back, etc.) of a chair in a classroom and decide what type of familiar structure it is and what type of loads act on it during normal use. List each component, state where and how the load acts and select the theory which you would have to consider when analyzing the stresses in the chair.

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

Suggested Reading:

1. S.S. Rattan., Strength of Materials, 3rd edition, Tata Mc-Graw Hill, 2017.
2. R. C. Hibbler, Mechanics of Mechanics of Materials, 9th Pearson, 2018.
3. Virtual labs – Strength of Materials Lab, NITK Surathkal.

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20MEC09

MANUFACTURING PROCESSES LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 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: On completion of the course, the 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.
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:

1. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
2. Study of resistance welding process and spot welding of MS Sheets.
3. Study of TIG welding process and plotting cooling curve in TIG welding process
4. Study of SAW Welding process and finding out deposition efficiency of the process.
5. Study of MIG welding process and testing of weld bead formed by MIG welding.

Metal Forming:

1. Evaluation of Formability of a given sheet material using Erichsen cupping test.
2. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity 6 Tons) and estimation of forces.
3. 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.
4. 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.
5. Study of extrusion dies and demonstration of extruding lead material
6. 3 D Printing of a simple component.

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

Suggested Reading:

1. P.N. Rao., Manufacturing Technology, Vol.1, 3rd edition, Tata McGraw Hill Publ., 2011.
2. Amitabh Ghosh and Mallick., Manufacturing Science, 4th edition, Assoc. East West Press Pvt. Ltd., 2011.
3. Metal Forming Virtual Simulation Lab, Dayalbagh Educational Institute, Agra

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20CSC07

Basics of Data Structures Lab
(Common for all Programmes except CSE & IT)

Instruction	2 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

Pre-requisites: Any Programming Language

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: The students will be able to

1. Implement the abstract data type.
2. Demonstrate the operations on stacks, queues using arrays and linked lists
3. Apply the suitable data structures including stacks, queues to solve problems
4. Analyze various searching and sortingtechniques.
5. Choose proper data structures, sorting and searching techniques to solve real world problems

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, Library Management etc
8. Open Ended questions

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/
https://www.udemy.com/algorithms-and-data-structures-in-python/

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20MEC10

KINEMATICS OF MACHINES

Instruction	3 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

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

1. Basic elements of mechanisms and their motion characteristics, DOF
2. Velocity and Acceleration analysis of various mechanisms.
3. Principles involved in functioning of pivots, collars, clutches, belts, brakes and dynamometers
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.

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

1. Understand basic elements of mechanisms and their motion characteristics, DOF.
2. Analyze Velocity and Acceleration of various mechanisms.
3. Understand and Evaluate Principles involved in functioning of pivots, collars, clutches, belts, brakes and dynamometers.
4. Design displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Select gear and gear train depending on application

UNIT - I

Basics of Mechanisms: Definition of kinematic link, Pair, Kinematic chain, Mechanism and machine, Degrees of freedom, Grubler's criterion, Inversions of four bar mechanism, 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

Velocity and Acceleration of Mechanisms: Velocities of mechanisms by instantaneous centre, Body centrode, Space centrode, Kennedy's theorem, Determination of velocity and acceleration of different mechanisms by relative velocity method including Coriolis component of acceleration, Freudenstein's method for synthesis of four bar linkage.

UNIT- III

Friction: Friction in pivots, Collars. Clutches - Single and Multi plate, Cone and centrifugal clutches.

Brakes and Dynamometers: Block or shoe, Band and block, Internal expanding shoe brake, Prony brake, Rope brake, Belt transmission torsion dynamometers.

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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.

Gear Trains: Gear trains, Simple, 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, 4th edition, Tata McGraw Hill Publishers, 2017.

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, 3rd edition, East West Publications, 2009.
3. J.E. Shigley, Theory of Machines, 3rd edition, Tata Mc.Graw Hill Publishers, New Delhi, 2014.

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20MEC11

THERMODYNAMICS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

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. Understand the concepts of system, thermodynamic properties, thermodynamic equilibrium and various methods of pressure and temperature measurements.
2. Apply the first law of thermodynamics to various thermodynamic processes along with the applications of steady flow energy equation.
3. Apply the Second law of thermodynamics to analyze heat pumps, refrigerators, heat engines and to evaluate entropy changes.
4. Evaluate the properties of pure substances and analyze the performance of steam power cycles.
5. Evaluate performance of air standard cycles and analyze the properties of gas mixtures.

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

Energy Interactions and 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, Diffuser, Throttling device, Turbine, Compressor and heat exchanger.

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

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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, Introduction to available and unavailable energy, Third law of thermodynamics, Helmholtz and Gibb's functions.

UNIT - IV

Pure Substances: 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, Clapeyron equation.

Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle, Representation on p-v, T-s and h-s diagrams, Evaluation of performance parameters, Efficiency, Work ratio, Specific steam consumption and heat rate.

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.

Non-reactive Ideal Gas Mixtures: Mole fraction, Mass fraction, Partial pressure, Dalton's law of partial pressures, Amagat-Leduc law of partial volumes, Relation between partial pressures, Mole fraction and volume fraction, Gas constant, Molecular mass, Specific heats of gas mixtures, Relation between volumetric and gravimetric analysis, Determination of theoretical air fuel ratio and equivalence ratio for various fuels,

Text Books:

1. P.K. Nag., Engineering Thermodynamics, 6th edition, Tata McGraw Hill Publishing, 2017
2. Yunus Cengel and Michael Boles., Thermodynamics: An Engineering Approach, 8th edition, McGraw Hill Education, 2017.

Suggested Reading:

1. R.K. Rajput., Engineering Thermodynamics, 4th Edition, Laxmi Publications, 2016.
2. Mahesh M Rathore., Thermal Engineering, Tata McGraw Hill Publishers, 2013.
3. D.S. Kumar., Engineering Thermodynamics, S.K. Kataria and Sons, 2014.

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20MEC12

FLUID PRINCIPLES AND HYDRAULIC MACHINES

Instruction	3 L + 1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 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. 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, Properties, Density, Specific weight, Specific gravity, Viscosity, Newton's law of viscosity, Pressure, Laws of fluid flow, Continuity theorem, Bernoulli's theorem, Pitot tube, Venturimeter, Notches, Darcy Weisbach equation, Hydraulic machines, Impulse-momentum equation and applications.

UNIT - II

Impact of Jet on Vanes: Layout of hydraulic power plant, Working principle, Velocity triangles, Impact force exerted, Power developed and efficiency of jet impinging on a fixed flat vertical vane, A single and series of flat moving vertical vanes, At the center and at one end of a fixed symmetrical and unsymmetrical curved vane, At the center and at one end of a single and series of symmetrical and unsymmetrical moving curved vanes.

UNIT- III

Reciprocating Pumps: Classification and working principle, Discharge, Slip, Coefficient of discharge, Power required to drive the pump and efficiency, Variation of pressure head due to acceleration of piston and pipe friction, Ideal and actual indicator diagrams, Separation, Safe speed to avoid separation, Air vessels, Work saved, Quantity of water entering into or coming out of air vessels and performance characteristic curves.

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UNIT - IV

Centrifugal Pumps: Classification and working principle, Comparison over reciprocating pumps, Velocity triangles, Head equivalent of workdone, Efficiencies, Pressure rise, Minimum starting speed, Specific speed, Physical significance, Model testing, Conditions of similarity, Priming, Performance characteristic curves, Common operational problems (troubles), reasons and remedies.

UNIT - V

Hydraulic Turbines: Classification and working, Velocity triangles, Power developed and efficiencies of Pelton wheel, Francis turbine and Kaplan turbines, Design of hydraulic turbines, Specific speed, Physical significance, Unit testing, Unit quantities, Model testing, Conditions for similarity and performance characteristic curves.

Text Books:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015.

Suggested Reading:

1. R.S. Khurmi and N. Khurmi., Hydraulics, Fluid Mechanics and Hydraulic Machines, 20th edition, S.Chand publishing, 2014
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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20MEC13

METAL CUTTING AND MACHINE TOOL ENGINEERING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Various cutting tool materials and tool geometry.
2. Factors effecting tool life and thermal aspects of metal cutting.
3. The working principles of various of types of lathes, drilling machine and milling machines ,
4. The working principles of boring machines, grinding machines and thread production
5. Working principles of non-conventional machines and jigs and fixtures

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

1. Describe tool geometry, select tool material for machining of various material and identify the types of chips.
2. Calculate cutting forces, MRR, power consumption under different cutting conditions.
3. Classify the mechanisms of tool wear, estimate tool life using Taylor's equation under various cutting conditions
4. Identify the basic parts, specifications, operations of various machine tools and understand jigs & fixtures
5. Classify methods of unconventional machining and identify suitable method for a given component.

Unit-I

Cutting Tool Materials: High carbon steel, HSS, Stellite, Carbides, Coated carbides and diamond.

Tool Geometry: Nomenclature of single point cutting tool by ASA and ORS, Geometry of drills, Milling cutters and broaches, Recommended Tool angles.

Chip Formation: Basic chip formation process, Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's 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, Tool Life & Machinability: Types of wear, Mechanism of tool wear, Tool life & machinability, Effects of process parameters on tool life, Taylor's tool life equation.

Economics of machining: Tool life for maximum production and minimum cost.

Unit-III

Constructional Features and Specifications of Machine Tools: Various operations on lathe, Types of lathes and special attachments on a centre lathe, Drilling, Milling operations, Indexing methods, Shaper, Planer, Slotter and their differences, Quick return mechanisms,

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Automatic feed devices. Jig boring machines, Differences between horizontal and vertical jig boring machines

Unit- IV

Grinding Machines: Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of wheels. Principles of broaching, Lapping, Honing, Polishing, Buffing, Super finishing and burnishing.

Screws and Gear Manufacturing: Screw making by tapping, Chasers, Thread rolling, Thread milling, Thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding.

Unit-V

Jigs and Fixtures: Design principles for location and clamping. Tool holding and work holding devices, Quick clamping devices, Types of Jigs and fixtures.

Unconventional Machining: Principles of working and applications of USM, AJM, WJM, EDM, ECM, LBM and EBM.

Text Books:

1. B.L. Juneja, G.S. Shekhon and Seth Nitin., Fundamentals of metal cutting & Machine tools, New Age Publishers, 2003.
2. P.N. Rao., Manufacturing Technology – Metal Cutting & Machine Tools, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.

Suggested Reading:

1. David A. Stephenson and John S. Agapiou., Metal Cutting Theory and Practice, 3rd edition, CRC Press, March 2016
2. Amitabha Ghosh and Ashok Kumar Mallik., Manufacturing Science, 2nd Edition, Affiliated East-West Press Pvt. Ltd, 2010.
3. M.C. Shaw., "Metal Cutting Principles", Clarendon Press, Oxford 1984.

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20EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0 Non Credit Course

Objectives: The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. 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. 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. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

UNIT - I

Constitution of India: Constitutional history, Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive principles of state policy, Its importance and implementation.

UNIT - II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights, Equality, Certain freedom under Article 19, Life and personal liberty under Article 21, Fundamental Duties and the legal status.

UNIT - III

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, Executive, President's role, Power and position.

UNIT - IV

Legislature and Judiciary: Central Legislature, Powers and functions of Lok Sabha and Rajya Sabha.

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Judiciary: Supreme court, Functions, Judicial review and judicial activism

UNIT - V

Local Self Government - District's administration head (Collector), 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.

Text Books:

1. Ed Prof V Ravindra Sastry, Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.
2. Indian Constitution at Work, NCERT, First edition 2006, Reprinted- January 2020.

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 Edition, 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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20EGM02 **INDIAN TRADITIONAL KNOWELDGE**

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	2 MID Sem assignments (Optional)
Credits	0 Non Credit 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

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

Culture and Civilization: Culture, Civilization and heritage, General characteristics of culture, Importance of culture in human literature, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: 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

UNIT-III

Linguistic Wealth: Indian Languages and Literature, The role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and handicrafts, Indian music, Dance drama and theatre, Introduction to mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

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Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction & Deduction, Ayurvedic biology, Definition of health

Essential Readings:

1. Kapil Kapoor, Text and Interpretation: The Indian Tradition, ISBN: 81246033375, 2005
2. Samskrita Bharati, Science in Samskrit, ISBN-13: 978-8187276333, 2007
4. Satya Prakash, Founders of sciences in Ancient India, Govindram Hasanand, ISBN-10: 8170770009, 1989
5. Brajendranath Seal, The Positive Sciences of the Ancient Hindus, Motilal Banarasidass, ISBN-10: 8120809254, 1915

Suggested Readings:

1. Swami Vivekananda, *Caste, Culture and Socialism*, Advaita Ashrama, Kolkata ISBN-9788175050280
2. Swami Lokeswarananda, *Religion and Culture*, Advaita Ashrama, Kolkata ISBN-9788185843384
3. Kapil Kapoor, *Language, Linguistics and Literature: The Indian Perspective*, ISBN-10: 8171880649, 1994.
4. Karan Singh, *A Treasury of Indian Wisdom: An Anthology of Spiritual Learn*,ISBN: 978-0143426158, 2016
5. Swami Vivekananda, *The East and the West*, Advaita Ashrama, Kolkata 9788185301860
6. Srivastava R.N., *Studies in Languages and Linguistics*, Kalinga Publications ISBN-13: 978-8185163475
7. Subhash Kak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
8. R.N Misra, *Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama,* IIAS, Shimla & Aryan Books International, ISBN 8173055149
9. S. Narain, *Examinations in ancient India*, Arya Book Depot, 1993
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020

SWAYAM/Nptel:

1. History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
2. Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
3. Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
4. Language and Society - https://nptel.ac.in/courses/109/106/109106091/
5. Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
6. Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
7. Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

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CBIT (A) With Effect from the Academic Year 2021-22

20MEE01

POWER PLANT ENGINEERING

(Professional Elective - I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

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. Identify different handling equipment used in steam plant.
2. Understand various coal combustion methods.
3. Recognize different types of dams, spill ways and hydro electric power plants.
4. Classify nuclear power plants based on moderator and coolant.
5. Analyze economics related to power plants and effect of pollutants.

UNIT - I

Introduction: Energy and power, Sources of energy, Classification of power plants, Power development in India.

Steam power plant: Plant Layout, Site selection factors, Types of coal, Requirements of good coal handling plant, Coal and ash handling systems, Removal of dust and dust collectors.

UNIT II

Coal Combustion and Firing Methods: Overfeed stoker, Chain grate and spreader stokers, Underfeed stoker, Multi-retort stoker, Unit system, Central bin system, Pulverized fuel burners, Cyclone burner, Fluidized bed combustion.

UNIT III

Hydro Electric Power Plant: Hydrological cycle, Recording and non recording rain gauges, Run-off flow measurement, Flow and mass duration curves, Site selection, Components and layout of hydro power plant, Types of dams and spillways, Classification of hydro electric plants.

UNIT - IV

Nuclear Power Plant: Breeding and fertile materials, Comparison of fission and fusion

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processes, Essential components of a nuclear reactor, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, Liquid metal cooled reactors, Breeder reactor, Radioactive waste disposal.

UNIT - V

Power Plant Economics: Terms and definitions, Types of loads, Load curve, Load duration curve, Fixed and operating costs, methods to find depreciation cost, Various types of tariffs.

Environmental considerations: Effluents from power plants and impact on environment.

Text Books:

1. R.K. Rajput, A Text Book of Power Plant Engineering, 5th edition, Laxmi Publications (P) Ltd, New Delhi, 2016.
2. P.K. Nag, Power Plant Engineering, 4th edition, McGra Hill Education (India) Private Limited, New Delhi, 2014.

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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20MEE02

PRODUCTION AND OPERATIONS MANAGEMENT

(Professional Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. 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 students are able to

1. Understand the role of production system and its design in production and operations management.
2. Apply forecasting techniques for predicting demand
3. Use aggregate planning, master scheduling and materials requirement planning in a production system
4. Compare various inventory control techniques used in production system.
5. Apply the quality control tools to improve performance of production system.

UNIT-I

Introduction: Production systems, Classification and characterisation

Plant Location and Layout: Factors affecting plant location, Objectives of plant layout, Types of layouts, Merits and demerits.

Work Study: Productivity, Introduction to method study and work measurement, Standard time calculations, Work sampling.

UNIT-II

Forecasting: Introduction, Forecasting objectives and uses, Demand patterns, Qualitative models, Market survey, Delphi method, Quantitative models, Moving average, Weighted

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moving average, Simple exponential smoothing, Trend adjusted exponential smoothing, Simple regression.

Forecast Errors: Mean absolute deviation, Mean square error, Mean forecast error, Mean absolute percentage error

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: Importance, MRP system, Inputs and outputs, Bill of materials.

UNIT-IV

Inventory Control: Importance, Inventory control systems, Types of Inventories, Inventory costs, Deterministic Inventory models, Basic purchase model, Purchase model with instantaneous replenishment and with shortages, Basic production model, Production model with shortages, Inventory model with price breaks, Just-in-time system eévolution and its characteristics.

UNIT-V

Quality Control: Introduction, Quality gurus and their contributions, Quality tools, Process capability, Quality control by control charts, Sampling plans, Operating characteristic curve, Introduction to total quality management and six-sigma.

Text Books:

1. Joseph G. Monks., Operations Management: Theory and Problems, 3rd edition, McGraw Hill International Edition, 1987.
2. William J. Stevenson., Operations Management, 8th edition, Tata McGraw Hill Edition, 2005.

Suggested Reading:

1. Everrete E. Adam and Ronald J. Ebert., Production & Operations Management, 5th edition, Prentice Hall of India, 2005.
2. R. Panneerselvam., Production and Operations Management, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. Elwood S. Buffa., Modern Production/Operations Management, 5th edition, John Wiley Publishers, Singapore, 2002

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20MEE03

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ENTREPRENEURSHIP
(Professional Elective - I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and it s procedure.
4. Project management and its techniques.
5. Behavioural issues and Time management.

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

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

UNIT-I

Entrepreneurship: Definition, Functions of entrepreneurs, Qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, Women entrepreneurs, Innovation, Creativity, Intellectual property in entrepreneurial journey, Conception and evaluation of ideas and their sources, Need and importance of startups and incubation centers.

UNIT-II

Indian Industrial Environment: Competence, Opportunities and challenges, Entrepreneurship and economic growth, 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, Business model canvas, Elements of business plan and its salient features, Technical analysis, Profitability and financial analysis, Marketing analysis, Executive summary. Choice of technology and collaborative interactions, Sources of finance and Incentives for entrepreneurs. Busines firm registration procedures.

UNIT-IV

Project Management: Meaning and definition of project, Project organization, Project planning, Execution and control using CPM and PERT techniques, Human aspects of project management, Assessment of tax burden, Environmental issues.

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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, Strengths and weaknesses, Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai., Dynamics of Entrepreneurial Development and Management, 6th edition, Himalaya Publishing House, Mumbai, 1997.
2. Prasanna Chandra., Projects: Planning, Analysis, Selection, Implementation and Review, 8th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.

Suggested Reading:

1. Robert D. Hisrich and Michael P. Peters., Entrepreneurship, 5th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2005.
2. Stephen R. Covey., First Things First, 1st edition, Free press, New York, 2003.
3. S.S. Khanka., Entrepreneurial Development, 4th edition, S. Chand & Co. Pvt. Ltd., New Delhi, 2012.

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CBIT (A)
20MEE04

With Effect from the Academic Year 2021-22

MECHATRONICS AND AUTOMATION
(Professional Elective–I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. To understand the electrical and mechanical systems and their interconnection to perform a task.
2. Apply mechanical, electronics, control, and computer engineering in the design of mechatronics systems to specific applications.
3. Design of mechatronics systems to specific applications.
4. Interfacing and actuation of a microprocessor and compare the performance of various controllers
5. Design, development, and working of various automated systems.
6. Automation principles for various industrial applications

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

1. Apply the concept of mechatronics and analyze electrical and mechanical systems and their interconnection for a given application.
2. Apply mechanical, electronics, control, and computer engineering in the design of mechatronics systems to specific applications.
3. Analyze the design, interfacing, and actuation of a microprocessor and Compare the performance of various controllers (P, PD, PI and PID)
4. To design, develop automated systems for various applications.
5. To design and develop automated and autonomous robotic systems using AI and IOT for various industrial applications.

UNIT - I

Introduction to Mechatronics Systems: Need of interface of electrical & electronic devices with mechanical elements, Concept of mechatronics, Flow chart of mechatronics system, Elements of mechatronics system, Drive mechanisms, Actuators, Feedback devices and control system application in industries and systems development.

Sensors and Transducers: Sensors for displacement, Position and proximity, Velocity, Motion, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, (thermistor, thermocouple), Light sensors and selection of sensors.

UNIT – II

Pneumatic and Hydraulic Actuation Systems: Valves, Pumps and accessories, Hydraulic circuits, Mechanical servo control circuits, Electro-hydraulic servo control and hydro pneumatic circuits with examples.

Mechanical Actuation Systems: Cams, Gear trains, Ratchet and pawl.

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Electrical Actuation Systems: Mechanical switches, Solenoids, DC motors, AC motors, Stepper motors and servo motors.

UNIT - III

Microprocessor Technology: Introduction, Architecture, Configuration, Programming and using of 8051 controller with 'C' language, Interfacing input and output devices for various applications.

Process Controllers: Controllers, Uses of controllers, Open loop and closed loop control, Proportional, PD, PI, PID controllers, Analog and digital methods of control.

UNIT - IV

Introduction to Automation: Importance of automation, Use of mechatronics, Systems required, Purpose of automatic control, Implementation of industrial control system, Introduction to automatic control theory

Design of an Automated System: Building blocks of an automated system, Working principle, Selection of various components of an automated system, Specifications of various elements, Use of design data books and catalogues.

UNIT - V

Case Studies of Mechatronics Systems; Pick and place robot, Automatic car park systems, Automatic washing machine and engine management systems.

Introduction to robotic automation: Artificial Intelligence (AI) based systems, IOT in manufacturing industries.

Text Books:

1. William Bolton., Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education, 2015
2. Ronald P. Hunter., Automated process control systems – concepts and Hardware, 2nd edition, PHI, 1987.

Suggested Reading:

1. Devdas Shetty and Richard A. Kolk., Mechatronics System Design, Cengage Learning, 2010.
2. HMT Ltd., Mechatronics, Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.
3. A.K Sawhney., A course on Electrical and Electronic Measurements and Instrumentation, Dhanapatirai& co, 2015

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20MEC14

FLUID PRINCIPLES AND HYDRAULIC MACHINES LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 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 coefficient of discharge for venturimeter
4. Determination of coefficient of discharge for rectangular notch
5. Determination of coefficient of discharge for V- notch
6. Determination of impact force of jet on fixed flat and fixed curved vanes
7. Performance and characteristic curves of reciprocating pump
8. Performance and characteristic curves of centrifugal pump
9. Performance and characteristic curves of self priming pump.
10. Performance and characteristic curves of gear pump.
11. Performance and characteristic curves of Pelton wheel
12. Performance and characteristic curves of Francis Turbine under constant speed and variable speed conditions
13. Performance and characteristic curves of Kaplan turbine under constant speed and variable speed conditions

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

Suggested Reading:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015.
3. Virtual labs – Fluid Machinery Lab, NITK SURATHKAL

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20MEC15

METAL CUTTING AND MACHINE TOOL ENGINEERING LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

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. Work shop practice on lathe drilling and milling machines
4. Measure cutting forces during machining on Lathe machine, milling
5. Unconventional machining operations like EDM & ECM

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

1. Identify tool geometry and grind to a given tool signature
2. Perform various machining operations to produce components of different shapes and also using jigs &fixtures.
3. Determine the shear angle at various cutting conditions.
4. Evaluate cutting forces using dynamometer, estimate MRR & power consumption under different cutting conditions
5. Plan and create components of utility using various manufacturing facilities in the laboratory.

List of the experiments:

1. Facing and plain turning operations on lathe.
2. Step turning and knurling on lathe machine.
3. Taper turning on lathe.
4. Drilling and boring on lathe.
5. Thread cutting on lathe.
6. Influence of process parameters on MRR in turning operation.
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 during machining on lathe machine and milling machine.
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).
13. Design utility component, pre/pare process sheet for the manufacturing of the same and produce the component in the lab.

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

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Suggested Reading:

1. B.L. Juneja., G.S. Shekhon and Seth Nitin, Fundamentals of Metal Cutting & Machine tools, New Age Publishers, 2003.
2. P.N. Rao, Manufacturing Technology – Metal Cutting & Machine Tools, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Virtual labs – Machine Tools Lab, IITB MUMBAI

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18ME C12

DYNAMICS OF MACHINES

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

Objectives:

1. To understand force analysis of single slider crank mechanism and turning moment Diagrams for Flywheels
2. To understand the Gyroscopic effect and the performances of Governors
3. To know the Balancing of rotating and reciprocating masses.
4. To determine natural frequencies of undamped, damped and forced vibrating systems of single degree freedom systems.
5. To understand the modes of vibrations, Two degree of Freedom and Torsional Vibrations

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

1. Determine the fluctuation of energy and decide the cross section of flywheel. (BL-3)
2. Understand the gyroscopic effects in ships, aero planes and road vehicles. (BL-2)
3. Analyze the characteristics of various centrifugal governors. (BL-4)
4. Analyze balancing problems in rotating and reciprocating machinery. (BL-4)
5. Understand free and forced vibrations of single degree freedom systems and two-degree freedom linear systems. (BL-2)

UNIT- I

Force analysis: Dynamic force analysis of single slider crank mechanism, concept of dynamically equivalent link.

Flywheels: Working principle of flywheel, turning moment on the crank shaft, turning moment diagrams, maximum fluctuation of energy and its determination, coefficient of fluctuation of speed, design of flywheels, rim type flywheel versus solid type flywheel.

Gyroscope: Principle of gyroscope, roll, yaw and pitch motions, gyroscopic effect in a two-wheeler, car, ship and aeroplane, practical problems.

UNIT- II

Governors: Necessity of governor, different types of governors, working principle of centrifugal governors, characteristics of Watt governor, Porter governor, Proell governor, Hartnell governor, Hartung governor, hunting of governors, concept of control force, control force diagram, definition of stability of governor, condition for stability, concept of isochronism, sensitivity of governor, energy of governor.

UNIT- III

Balancing of Rotating masses: Balancing and its types, rotor balancing, single plane and two plane balancing, unbalanced forces and couples, static and dynamic balancing, balancing of rotors by analytical and graphical methods.

Balancing of reciprocating machines: Primary and secondary unbalanced forces, balancing of in line and radial engines.

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.

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UNIT –V

Two and three degree freedom systems: Natural frequencies of two degree freedom linear systems. Nodes in two and three rotor systems, modes of vibration, determining natural frequencies by Holzer's method for multi-rotor systems. Dunkerley's and Rayleigh's approximate methods.

Text Books:

1. S.S. Rattan, "Theory of Machines", Fourth edition ,Tata-Mc Graw Hill, ,2014
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, "Theory of Machines & Mechanisms", Oxford University press, 2003. .
3. William T.Thomson "Theory of Vibration with Application", 5th edition, Pearson education 2008

Suggested Reading:

1. A. Ghosh and Mallick, "Theory of mechanisms and machines", Affiliated to E-W Press, 1988.
2. J.S. Rao and Gupta, "Theory and Practice of Mechanical Vibrations", PHI, 1984

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18ME C13

APPLIED THERMODYNAMICS AND HEAT TRANSFER

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

Objectives:

1. The working principles of reciprocating air compressor and its applications in engineering
2. The working principle of diesel and petrol engine, their combustion phenomena and problems pertaining to abnormal combustion
3. Student will understand the features of IC engine like ignition system and injection system
4. The basic modes of heat transfer
5. The classification of heat exchanger, concepts of radiation heat transfer and phase heat transfer

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

1. Estimate the power required for reciprocating air compressor using the basic principles of thermodynamics for many engineering applications. (BL-4)
2. Evaluate the performance of C.I. and S.I. engines with appropriate consideration for public health and safety. (BL-5)
3. Understand the functioning of components of I.C. engines and the concept of abnormal combustion with remedial measures. (BL-2)
4. Derive the expressions for the heat transfer in conduction and convection with the basic principles of thermodynamics. (BL-3)
5. Understand the basic principles of heat exchangers, boiling and condensation. (BL-2)

UNIT – I

Reciprocating Air Compressors: Classification of compressors, advantages of reciprocating compressors over rotary compressors, applications of compressed air, working principle of reciprocating compressors - single stage and multi stage compressors with and without clearance, concept of optimum pressure ratio, minimum work input, various efficiencies of multi stage compressors, simple problems on reciprocating compressors.

UNIT - II

Internal Combustion Engines: Classification, working principles of 2 stroke, 4 stroke SI and CI engines, valve and port timing diagrams, performance of IC engines, Morse test, various methods of determining frictional power, various efficiencies, heat balance sheet.

UNIT - III

Combustion Phenomena: Stages of combustion in SI and CI engines, octane and cetane number, factors affecting, normal and abnormal combustion phenomenon in SI and CI engines, methods to control the abnormal combustion, types of combustion chambers, cooling systems, 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

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UNIT - V

Radiation: Various laws of radiation, concept of black-body.

Heat Exchangers: Classification, concept of LMTD and simple problems.

Condensation and boiling: Types of condensation, heat transfer coefficient for laminar parallel flow condensation, pool boiling curve, simple problems on condensation and boiling.

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,

Suggested Reading:

1 R.K. Rajput., "Thermal Engineering", Laxmi Publishers, New Delhi, 2014

2 D.S. Kumar, "Heat Transfer", S K Kataria Publishers, 2015

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18ME C14

DESIGN OF MACHINE ELEMENTS

(Use of data book is permitted)

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

Objectives:

1. To understand the principles of machine design and design considerations, types of loads, failure criteria.
2. To design machine members for static, fluctuating loads and impact loads
3. Learn the design principles of shafts, keys, couplings, belt drives and pulleys.
4. Understand the principles of design of permanent joints such as riveted and welded joints.
5. Understand the principles of design of bolted joints, power screws and gasket joints.

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

1. Understand the standards, codes, various design considerations and failure criteria of members (BL-2)
2. Analyze and evaluate machine members subjected to static and dynamic loads (BL-4)
3. Recommend suitable shafts, couplings and belt drives for a given application (BL-5)
4. Design permanent joints for a given application (BL-6)
5. Design bolted joints, power screws and screw jack (BL-6)

UNIT – I

Introduction: Materials used in machine design and their specifications to Indian standards, codes and standards used in design. Reliability, principles of Ergonomics and Manufacturing considerations. Preferred numbers, analysis of stress and strain: Types of loading and stresses. Cotter and knuckle joints. 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 shafts, Keys & Couplings: Solid, hollow and splined shafts under torsion and bending loads, types & design of Keys, muff , split muff , flange, marine type and flexible type of couplings.
Design of Belt Drive Systems: selection of belts and design of pulleys.

UNIT – IV

Design of Permanent Joints: Types of Riveted joints, efficiency of the joint. Design of riveted joints subjected to direct and eccentric loads. Types and design of welded joints subjected to direct and eccentric loading.

UNIT – V

Design of Bolted Joints, Power Screws: 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, "Design Machine Elements", Mc Graw Hill Publication, 2017.
2. J.E. Shigley, C.R. Mischne, "Mechanical Engineering Design", Tata Mc Graw Hill Publications, 2015.
3. R.S.Khurmi and J.K.Gupta, "Machine design", 34/e, S Chand publications, 2018.

Suggested Reading:

1. P. Kannaiah, "Machine Design", Sci-Tech Publications, 2010
2. M.F. Spotts, "Design of Machine Elements", Prentice Hall of India, 2013.

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Machine Design Data Books:

1. K. Mahadevan, K. Balaveera Reddy., "Design Data Hand book for Mechanical Engineers", 3/e, CBS Publisher, 2018
2. PSG College, "Design Data book", 2012

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18PE C07

METAL CUTTING AND MACHINE TOOL ENGINEERING

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

Objectives:

1. Various cutting tool materials and tool geometry.
2. Factors effecting tool life and thermal aspects of metal cutting.
3. The working principles of various of types of lathes, drilling machine and milling machines ,
4. The working principles of boring machines, grinding machines and thread production
5. Working principles of non-conventional machines and jigs and fixtures

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

1. Describe tool geometry, select tool material for machining of various materials and identify the types of chips. (BL-2)
2. Calculate cutting forces, MRR, power consumption under different cutting conditions. (BL-3)
3. Classify the mechanisms of tool wear, estimate tool life using Taylor's equation under various cutting conditions. (BL-4)
4. Identify the basic parts, specifications, operations of various machine tools and understand jigs & fixtures. (BL-2)
5. Classify methods of unconventional machining and identify suitable method for a given component. (BL-3)

UNIT - I

Cutting tool materials: High carbon steel, HSS, Stellite, Carbides, Coated carbides, Diamond.

Tool geometry: Nomenclature of single point cutting tool by ASA and ORS. Geometry of drills, Milling cutters and broaches. Recommended Tool angles. Chip formation: Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's 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 oftemperature, cutting fluids and applications.

Tool Wear and Tool Life: Criteria for tool wear, flank and crater wear theories, criteria for tool life in roughingand 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.

UNIT-III

Constructional features and specifications of machine tools: Various operations on Lathe, Types of Lathes and special attachments on a Centre Lathe. Drilling, Milling operations. Indexing methods. Shaper, planer and slotter and their differences. Quick return mechanisms, Automatic feed devices. Jig Boring machines-Differences between horizontal and vertical jig boring machines.

UNIT- IV

Grinding machines: Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of wheels. Principles of Broaching, Lapping, Honing, Polishing, Buffing, Super finishing and burnishing.

Screws and gear manufacturing: Screw making by tapping, chasers, thread rolling, thread milling, thread grinding, gear shaping, gear hobbing, gear shaving and grinding.

UNIT-V

Jigs and Fixtures: Design principles for location and clamping. Tool holding and work holding devices. Quick clamping devices. Types of Jigs and fixtures.

Unconventional machining: Principles of working and applications of USM, AJM, EDM, ECM, LBM andEBM.

Text Books:

1. P N Rao, "Manufacturing Technology – Metal Cutting & Machine Tools", 3/e Tata McGraw-Hill Publishing Company Limited, 2013.
2. B L Juneja and G S Sekhon, "Fundamentals of metal cutting and machine Tools", New Age International publishers, 2001.
3. Kalpakjian S. and Steven R. Schmid, "Manufacturing, Engineering & Technology", Pearson, 2007

Suggested Reading:

1. David A. Stephenson, Johs S. Agapiou, "Metal Cutting Theory and Practice", CRC Press, 3rd Edition, March 2016
2. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd. 2nd Edition, 2010

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18ME E01

REFRIGERATION AND AIR CONDITIONING

(Core Elective-I)

(Use of data book is permitted)

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

Objectives:

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 and comfort air conditioning.
5. Acquire knowledge in estimating air conditioning loads.

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

1. Evaluate COP of various air craft refrigeration systems using principles of thermodynamics along with necessity of eco-friendly refrigerants for public health and safety. (BL-4)
2. Analyze COP of vapor compression refrigeration system with the appropriate concern for environment. (BL-4)
3. Understand the Vapour absorption, steam jet refrigeration and non-conventional refrigeration in order to provide valid conclusions over simple vapor compression refrigeration system. (BL-2)
4. Understand the working principle of air conditioning system including human comfort and its importance over environment, society with balance of ecological system. (BL-2)
5. Apply the principles of engineering which are complex in nature, having lifelong learning to design air conditioning system for various environments. (BL-3)

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, Simplecooling 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 Refrigerationcycle. 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.

UNIT - III

Vapour Absorption Refrigeration System: Simple absorption systems, COP, Practical ammonia absorptionrefrigeration 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 andapplications.

Thermoelectric refrigeration systems: Seebeck effect, Peltier effect and Thompson effect, Analysis of the thermoelectric refrigeration systems using Peltier effect, Expression for COP, Vortex tube refrigeration principle and working.

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UNIT - IV

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation of variousPsychrometric processes on the chart.

Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics of humanbody, ASHRE comfort chart, Effective temperature.

UNIT - V

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, ApparatusDew Point, Various Heat Loads.

Design of air conditioning systems: Simple Problems on summer, winter and year Round Air conditioningsystems 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, 2017.
2. Stoecker, W.F., and Jones, J.W., Refrigeration and Air-Conditioning, Mc.Graw Hill, New Delhi, 2014.
3. R.K. Rajput, "Refrigeration and Air Conditioning", Laxmi Publications, New Delhi, 2013.

Suggested Reading:

1. V.K. Jain, "Refrigeration and Air Conditioning", S Chand & Company, New Delhi, 2019.
2. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, Allahabad, 2015.

Refrigeration and air conditioning data books:

1. Manohar Prasad, "Refrigeration and Airconditioning Data Book", New Age International Publishers, 2010.

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18ME E02

VALUES, ETHICS AND SOCIETY

(Core Elective - I)

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

Objectives:

1. Develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. Understand the values, the need for value adoption and prepare them meet the challenges
3. Develop the potential to adopt values, develop a good character and personality and lead a happy life
4. Practice the values in life and contribute for the society around them and for the development of the institutions/organization.
5. Understand the professional ethics and their applications to engineering profession

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

1. State basic values and the need for value education. (BL -2)
2. Differentiatebetween values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual. (BL-2)
3. Demonstrate the knowledge of ethics at their work place and apply different theoretical approaches to solve ethical dilemmas. (BL-3)
4. Apply risk and safety measures in the engineering practice. (BL-3)
5. Understand the role of a human being in ensuring harmony in society and nature. (BL-2)

UNIT- I

Concepts and Classification of Values –Need and Challenges for Value Adoption: Definition of Values, Concept of Values, Classification of Values, Hierarchy of Values, Types of Values, Espoused and Applied Values, Value judgement based on Culture, Value judgement based on Tradition, Interdependence of Values, Need for value education, Findings of Commissions and Committees, Corruption and illegal practices, Science and Technology without values, Exploitation of nature, Increasing use of violence and intoxicants, Lack of education in values, Implications of education in values, Vision for a better India, Challenges for Value adoption, Cultural, Social, Religious, Intellectual and Personal challenges.

UNIT -II

Process for Value Education: Right Understanding, Relationship and Physical Facilities,basicrequirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and prosperity correctly, a critical appraisal of the current scenario, Method to fulfill the above human aspirations; understanding and living in harmony at various levels.

UNIT-III

Basic Concepts of Professional Ethics: Ethics, Morals and Human life , Types of Ethics, Personal Ethics,Professional ethics, Ethical dilemmas, Indian and Global thoughts on ethics, Profession, Professional and Professionalism, Ethical role of a professional Basic ethical principles, Some basic ethical theories, use of ethical theories, Science, Religion Ethics, Genders and ethics, Media and ethics, Computer Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities.

UNIT- IV

Ethics in Engineering Profession: Engineering profession-Technology and Society-Engineering as SocialExperimentation-Engineering ethics-Ethical obligations of Engineering Professionals, Role of Engineers-Engineers as Managers, Professional responsibilities of Engineers, Engineers Responsibility for Safety, A few Case Studies on Risk management, Conflicts of Interest, Occupational Crimes- Plagiarism-Self plagiarism-Ethics Audit-Consideration for ethics audit-Ethics Standards and Bench Marking.

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UNIT - V

Understanding Harmony in the Family and Society: Understanding harmony in the family, the basic unit ofhuman interaction, Understanding values in human relationship; meaning of Nyaya and Program for its fulfillment to ensure Ubhay-tripti, Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.

Text Books:

1. Subramanian R., "Professional Ethics", Oxford University Press , 2017
2. Dinesh Babu S., "Professional Ethics and Human Values", Laxmi Publications , 2016
3. Nagarajan R.S., "A Text Book on Human Values and Professional Ethics", New Age Publications, 2007

Suggested Reading:

1. Santosh Ajmera and Nanda Kishore Reddy, "Ethics, Integrity and Aptitude", Mc Graw Hill Education Private Limited , 2014
2. Govinda Rajan M., Natarajan S., Senthil Kumar V.S., "Professional Ethics and Human Values", Prentice Hall India Private Limited, 2013.

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18PE E01

PLASTICS, CERAMICS AND COMPOSITE MATERIALS

(Core Elective-I)

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

Objectives:

1. Understand various types of plastics, their properties and uses.
2. Understand various methods of manufacturing plastic components.
3. Understand types of ceramics, refractoriness, and their uses.
4. Understand the manufacturing processes of ceramics.
5. Understand composites and their uses.

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

1. Recall the types of plastics, properties and applications. (BL-1)
2. Select the suitable method of manufacturing a plastic component. (BL-5)
3. Describe refractories, their manufacturing methods and applications. (BL-2)
4. Describe the properties, uses and Manufacturing methods of white wares, ceramic coatings and glass. (BL-2)
5. Understand the concept of composites, properties in engineering applications. (BL-2)

UNIT - I

Introduction to Polymers: Plastics and elastomers, polymerization, degree of polymerization, thermoplasticsand thermosetting plastics, properties and applications of various thermoplastic and thermosetting plastics, mechanical properties of plastics and their influencing parameters.

UNIT - II

Processing of Plastics and Elastomers: Constructional features, working principles, advantages, disadvantages and applications of Injection moulding, Extrusion, calendaring, thermoforming, Blowmoulding, 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 technologyincluding 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, Fiber reinforced composites, Applications of various types of composites, Production techniques for glass fiber, carbon fiber and ceramic fiber, manufacturing methods of composites.

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Text Books:

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

Suggested Reading:

1 R.K.Rajput, "A text book of Manufacturing Technology", Vol-I, Laxmi Pub., 2007.

2 P.C. Sharma, "A Text book of Production Technology", 8/e, S. Chand & Co., Pvt. Ltd., 2014.

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18PE E02

PRODUCT DESIGN AND PROCESS PLANNING

(Core Elective-I)

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

Objectives:

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

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

1. Define the needs of the customer while designing a new product or modifying existing product in the competitive environment. (BL-1)
2. Understand creativity, brainstorming and ergonomic concepts. (BL-2)
3. Apply the concept of design for manufacture, assembly, maintenance, reliability and product life cycle in developing a product. (BL-3)
4. Implement the Intellectual Property Rights to a new product or a process. (BL-3)
5. Evaluate and recommend an effective Process Plan and principles of value engineering to new product development. (BL-5)

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 brainstorming 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, andmarketing, 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 and Copy Rights.

Process Planning: Need and significance of process planning, Process capability studies, Process sheets, Benefits and Types of Computer Aided process planning.

UNIT - V

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

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Text Books:

1. B.W. Niebel & A.B.Draper, "Production Design & Process Engg", McGraw Hill, 1974.
2. K. G. Swift & J. D. Booker, "Process Selection: From Design to Manufacture", Butterworth-Heinemann Ltd; Revised 2/e, 2003.
3. BhaskaranGopalakrishnan, "Product Design and Process Planning in CE (Design & Manufacturing", Chapman and Hall publishers, 1994.

Suggested Reading:

1. A.K. Chitale& R.C. Gupta, "Product Design & Manufacturing", PHI, 1997.
2. Karl T. Ulrich, Stephen Eppinger, "Product Design and Development", McGrawHill Publication, 2012.

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18ME E03

MECHANICAL VIBRATIONS

(Core Elective-I)

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

Objectives:

1. To analyze free vibration, damped and un-damped vibrations.
2. The principles of harmonically excited vibrations
3. The principle of damped and un-damped vibrations of two degrees of freedom system
4. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.
5. The working principles of vibration measurements

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

1. Apply Newton's law of motion and energy method to get governing differential equations of vibrating systems. (BL-3)
2. Analyze response of machine members in forced vibration with different excitation frequencies. (BL-4)
3. Recommend suitable Vibration parameters for isolation and compute critical speeds. (BL-5)
4. Predict natural frequency and mode shape for all continuous systems. (BL-3)
5. Understand working principles of vibration measuring instruments. (BL-2)

UNIT - I

Single Degree of Freedom Systems: Undamped, Damped Translational and Torsional Systems, Different methods for equation of motion- Energy method, Rayleigh method, principle of virtual work, principal of conservation energy. 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.

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 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 equations of motion, characteristic equations, identification of nodes and mode shapes.

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.

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Text Books:

1. J.J. Thomson, "Theory of vibration with Application", 5/e, 2014.
2. S.S. Rao, "Mechanical vibration", 5/e, Pearson, 2011
3. G.S. Grover & Nigam, "Mechanical vibrations", 8/e, New Chand & Bros, 2018

Suggested Reading:

1. V.P. Singh, "Mechanical vibration", 3/e, Dhanpath Rai &Co., 2014.
2. S. Graham Kelley, "Mechanical vibration", Schaums Outline Series, TMH, 2011.

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18ME E04

AUTOMOBILE ENGINEERING

(Core Elective-II)

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

Objectives:

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

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

1. Understand the basic layout of automobiles. (BL-2)
2. Understand the various systems in an automobile like engine cooling, lubrication, ignition, electrical and air conditioning systems with the principles of thermodynamics. (BL-2)
3. Describe the principles of suspension and steering system using modern tool usage. (BL-2)
4. Explore therecent systems in Braking and Transmission. (BL-3)
5. Evaluate the effect of automobile pollution on environment and necessity of pollution norms along with trouble shooting (BL-5)

UNIT - I

Types of Automobiles: Normal, Hybrid and Hydrogen Fuel vehicles.

Engine: Engine location and its components, chassis layout - parts of the automobile body, terminology, automobile frames ; crank shaft, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion – Zenith carburettor, Fuel injection system, Mechanical Fuel Injection system- MPFI, Electronic Fuel Injection system.

UNIT - II

Lubricating Systems: Wet sump, dry sump and petroil systems

Cooling systems: Water pumps, radiators, thermostat control, anti-freezing compounds

Ignition Systems: Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems- Batteries used in Electric and Hybrid Vehicles, starting motors,

Electrical Systems : Main electrical circuits, generating & starting circuit, lighting system, indicating devices, warning lights, speedometer, automobile air-conditioning.

UNIT - III

Steering Systems: Linkage arrangements and its components, steering gear box types,recent trends, Davis Steering , Modified Ackerman linkage, Steering geometry: caster, camber, King Pin Inclination, Toe in, toe out.

Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, wheel alignment

Suspension systems: 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: Disc and drum types, leading and trailing shoe layout, Description and operation of hydraulic brake, hand brake linkage, Pneumatic, air and vacuum brakes

UNIT – V

Maintenance: Trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment

Pollution control: Pollution control techniques used for petrol and diesel engines, PCVS, EGR, SCRT, Thermal Reactors, Catalytic converters; Euro norms and Bharat Norms.

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Text Books:

1. Crouse & Anglin, "Automotive Mechanics", 10/e, TMH. Publishing Co. Ltd., New Delhi, 2006.
2. Kirpalsingh., "Automobile Engineering", Vol. I & II Standard Publishers, Delhi, 2017.
3. Joseph Heitner, "Automotive Mechanics", 2/e, Affiliated East West Pvt. Ltd. 2013.

Suggested Reading:

1. R.K. Rajput, "A Textbook of Automobile Engineering", Laxmi Publications, New Delhi, 2012.
2. D S Kumar, "Automobile engineering", S K Kataria Publications, New Delhi, 2015.

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18ME E05

NANO SCIENCE AND TECHNOLOGY

(Core Elective –II)

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

Objectives:

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, the students are able to

1. Understand the basic concepts, developments and challenges in Nano technology. (BL-2)
2. Describe the methods of evaluating magnetic and electronic properties, microstructure by SPM, atomic force microscopy, friction force microscopy. (BL-2)
3. Apply homogenous & heterogeneous methods and characterization techniques of Zero & One dimensional Nano structures. (BL-3)
4. Evaluate various Nano Material Fabrication Techniques. (BL-5)
5. Analyze Nano materials and Nano bio materials for obtaining solutions to societal problems. (BL-4)

UNIT - I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance ofNanotechnology, 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 (HI-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
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 polymerceramic, Characterization procedures, applications
Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, applications

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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, 2004
3. Carl C Koch, "Nano materials Synthesis, Properties and applications", Jaico Publishing House, 2008

Suggested Reading:

1. Willia Tllsey Atkinson, "Nano Technology", Jaico Publishing House, 2009
2. George W. Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009

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18ME E06

RIGHTS, DUTIES AND LEGISLATION

(Core Elective - II)

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

Objectives:

1. Understand the value of human rights
2. Understand the Lawful rights available to him and others
3. Create understanding the rights of under privileged and respect them
4. Understand role of an individual in the Civil Society
5. Understand the safety aspects while using technology and to understand the role of NGO's in protecting human rights and environment.

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

1. Recall the human rights in the global and national context. (BL-1)
2. Understand the overall view on working of Indian constitution. (BL-2)
3. Analyse the societal problems in the context of human rights. (BL-4)
4. Evaluate implementation of right to development and right to information. (BL-5)
5. Application of human rights for human safety and clean environment. (BL-3)

UNIT-I

Conceptual Background Of Human Rights And Duties: Rights, inherent, inalienable,universal, indivisible, Values, Dignity, liberty, equality, justice, unity in diversity, Need for balance between Rights and Duties, Freedom and Responsibility, Theories of human rights, History of human rights civilization, Human rights movements, Universal declaration of human rights 1948, classification and three generations of human rights and sarvodaya.

UNIT-II

Human Rights And Duties In India: Evolution, Independence movement, making of theConstitution, Indian Constitution, Fundamental Rights, Directive Principles, Fundamental duties, Their Interrelationship, Enforcement and protection mechanism of human rights in India, Judiciary, Article 32 and 226 of Indian Constitution, National Human Rights Commission and other Commissions and Committees, Non-governmental organizations, Information Media, Education.

UNIT-III

Societal Problems: Core Problems, Poverty, underdevelopment and illiteracy, Women, children andthe disadvantaged groups, National and state commissions of Women/children/minority/SC/ST.

UNIT-IV

Right to Development: Socio-Economic and Cultural Effects of Globalization, Right to Education,Transparency in Governance and Right to Information, Consumer Protection act.

UNIT-V

Environment Rights Such as Right to Clean Environment and Public Safety: Issues of Industrial Pollution,Prevention, and Rehabilitation, Safety aspects of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment.

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Text Books:

1. Mr. Ishay, "The history of Human rights", Orient Longman, New Delhi, 2004.
2. S.N. Chaudhary, "Human Rights and Poverty in India: Theoretical Issues", Delhi: Concepts, 2005.
3. Anuradha Kumar, "Encyclopedia of Human Rights Development of under Privilege", New Delhi: Sarup, 2002.

Suggested Readings:

1. K.P. Saksena, "Human Rights and the Constitution: Vision and the Reality", New Delhi: Gyan Pub., 2003.
2. Dr.J.N.Pandey, "Constitutional Law of India", Central Law Agency; Central Law Agency; 37th Edition, 2001.

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18PE E04

NON DESTRUCTIVE TESTING AND EVALUATION

(Core Elective-II)

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

Objectives:

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. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography.
4. Merits and demerits of the different NDT Technologies.
5. Latest research and developments in NDT.

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

1. Understand Non Destructive Testing techniques of Dye penetrant inspection andMagnetic particle inspection. (BL-2)
2. Compareeddy current testing with other NDT methods. (BL-2)
3. Identify different types of defects using ultra sonic testing. (BL-2)
4. Analyze the radiograph to detect the defects by using principles of radiography. (BL-4)
5. Interpretlatest techniques of NDT with other methods. (BL-3)

UNIT - I

Dye Penetrant Inspection: Principles of penetrate inspection, characteristics of a penetrate, water washablesystem, post emulsification system, solvent removable system, surface preparation and cleaning, penetrate application, development, advantages limitations, and applications.

Magnetic Particle Inspection: 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, coilarrangements, 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. Don.E. Bray, Roderic K. Stanley: Nondestructive Evaluation- A Tool in Design, Manufacturing, and Service, Revised Ed, CRC Press, 1997.

Suggested Reading:

1. Paul E. Mix, "Introduction to Nondestructive Testing- A Training Guide", John Wiley & Sons, 2005.
2. J. Prasad and C. G. K. Nair, "Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Education, 2nd edition, 2011.

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18ME E07

FUELS AND COMBUSTION

(Core Elective-II)

(Use of combustion tables is permitted)

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

Objectives:

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

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

1. Analyse quality of fuels based on its properties with a special emphasis on environment with merits and demerits. (BL-4)
2. Understand the refining methods of various liquid fuels using the principles of engineering with a special focus on public health and safety and environmental considerations. (BL-2)
3. Estimate the theoretical air fuel ratio for different types of combustion processes using basic laws of thermodynamics in the context of environment. (BL-5)
4. Identify various techniques of utilizing fuels with different combustion appliances for cleaner environment and safety. (BL-3)
5. Understand the impact of pollutants on environment and to demonstrate the knowledge for sustainable development. (BL-2)

UNIT-I

Solid fuels: Origin of coal; analysis of coal-proximate analysis and ultimate analysis; tests on coal-calorific values, caking, fusibility, grindability; coal petrology; classification of coal; other solid fuels-wood, wood charcoal, coke, fuel briquettes.

Gaseous fuels: Natural gas, methane from coal mines, coal gas, blast furnace gas, liquefied petroleum gas (LPG); properties and testing of fuel gases; alcohols and biogas.

UNIT-II

Liquid Fuels: Origin of petroleum-deposition of organisms , reservoir rock; chemistry of petroleum-paraffins, olefins , napthenes, aromatics; refining of petroleum-fractional distillation, cracking, reforming, alkylation, polymerization, isomerisation; properties and tests for petroleum products; important petroleum products-motor gasoline, aviation gasoline, kerosene, jet fuels, diesel oils, fuel oils.

UNIT-III

Combustion of Fuels: Combustion Stoichiometry-- stoichiometric air, excess air, flue gas analysis, dew point of flue gases. Thermodynamics of Combustion--gross calorific value, net calorific value, enthalpy of combustion, enthalpy of formation; adiabatic flame temperature at constant pressure and constant volume.

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.

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UNIT-V

Environmental Considerations: Air pollution types-grit and dust, smoke, gaseous pollutants; combustion generated air pollution and its control-air pollution from combustion of fossil fuels, air pollution from automobiles; effects on environment and human health; emission Standards.

Text Books:

1. Samir Sarkar, "Fuels & Combustion" Orient long man, 1996.
2. S.P. Sharma and Chander Mohan, "Fuels and Combustion", Tata McGraw Hill, 2004.
3. Roger A Strehlow, "Combustion Fundamentals ", Tata McGraw Hill, 1985.

Suggested Reading:

1. Shaha A K,"Combustion Engineering and Fuel Technology ", Oxford and IBH, 1974.
2. Stephen R. Turns,"An introduction to combustion", McGraw Hill International Edition, 2011.

Combustion Data Tables:

1. Combustion enthalpy tables from "Thermodynamics-An engineering approach" by Yunus A. Cengel, Michael A. Boles, McGraw Hill, 9th edition, 2019

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18ME C15

DYNAMICS AND VIBRATIONS LAB

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

Objectives:

1. To demonstrate basic principle and exposure to evaluate CAM Follower Motion and Gyroscopic effects.
2. The importance of static and dynamic balancing.
3. The methods of controlling speeds of prime movers
4. To acquire the knowledge in evaluating the stability of vehicles
5. Frequency response of spring mass system with damping and without damping - Undamped torsional vibrations of single and double rotor systems

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

1. Demonstrate the dynamic behavior of mechanical systems. (BL-3)
2. Analyze the cam profile for different motion characteristics. (BL-4)
3. Examine the performance of governors and the gyroscopic effect on vehicles. (BL-3)
4. Evaluate the static and dynamic balancing masses in a rotating mass system. (BL-5)
5. Determine the natural frequency of different single degree freedom vibrating systems. (BL-3)

List of the Experiments

1. To study the motion of follower with the given profile of the cam. To plot the 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 vibrations.
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.
13. Determine the equivalent link parameters and centre of mass of connecting rod theoretically and validate the result by experiment by choosing suitable methods and devices.

NOTE: Students should complete a minimum of 10 experiments including experiment 13 which is compulsory.

Text Books:

1. S.S. Rattan, "Theory of Machines", Fourth edition Tata-Mc Graw Hill, ,2014
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, "Theory of Machines & Mechanisms", Oxford University Press, 2003.
3. William T.Thomson "Theory of Vibration with Application", 5th edition, Pearson education 2008

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Suggested Reading:

1. Robert L. Norton, "Design of Machinery", Tata Mc Graw Hill, 2005.
2. Benson H. Tangue, "Principles of Vibration", 2/e, Oxford University Press, 2007

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18ME C16

APPLIED THERMODYNAMICS AND HEAT TRANSFER LAB

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

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.

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

1. Evaluate the performance of petrol and diesel engines. (BL-5)
2. Evaluate the heat losses in heat balance sheet of IC engine. (BL-5)
3. Determine the performance of multi stage reciprocating air compressor and its importance over single stage air compressor. (BL-3)
4. Estimate the effect of insulation on conduction heat transfer and also estimate the value of convection heat transfer coefficients under different scenario. (BL-5)
5. Determine Stefan - Boltzmann constant, emissivity of grey plate and LMTD of heat exchanger. (BL-3)

List of the Experiments:

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

8. Determination of thermal conductivity of composite wall.
9. Determination of convective heat transfer coefficient under Natural and Forced convection phenomena using pin-fin apparatus.
10. Determination of Emissivity of a given plate.
11. Determination of the value of Stefan-Boltzmann constant.
12. Determination of Heat transfer coefficient in parallel and counter flow heat exchanger.
13. Evaluate the performance parameters of an alternative fuel on a vertical stroke single cylinder diesel engine.

Note: Students should complete a minimum of 10 experiments including experiment 13 which is compulsory.

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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, 2009

Suggested Reading:

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

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18PE C08

METAL CUTTING AND MACHINE TOOL ENGINEERING LAB

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

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. Work shop practice on lathe drilling and milling machines
4. Measure cutting forces during machining on Lathe machine, milling
5. Unconventional machining operations like EDM & ECM

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

1. Identify tool geometry and grind to a given tool signature. (BL-2)
2. Perform various machining operations to produce components of different shapes and also using jigs &fixtures. (BL-3)
3. Determine the shear angle at various cutting conditions. (BL-4)
4. Evaluate cutting forces using dynamometer, estimate MRR & power consumption under different cutting conditions. (BL-5)
5. Plan and create components of utility using various manufacturing facilities in the laboratory. (BL-6)

List of the Experiments

1. Facing and plain turning operations on lathe.
2. Step turning and knurling on lathe machine.
3. Taper turning on lathe.
4. Drilling and boring on lathe.
5. Thread cutting on lathe.
6. Influence of process parameters on MRR in turning operation.
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 during machining on lathe machine and milling machine.
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).
13. Design utility component, prepare process sheet for the manufacturing of the same and produce the component in the lab. .

Note: Student should complete a minimum of 10 experiments including experiment number 13 which is compulsory.

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Text Books:

1. P N Rao, "Manufacturing Technology – Metal Cutting & Machine Tools", 3/e Tata McGraw-Hill Publishing Company Limited, 2013.
2. B L Juneja and G S Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age International publishers, 2001.
3. Kalpakjian S. and Steven R. Schmid, "Manufacturing, Engineering & Technology", Pearson Education, 2007

Suggested Reading:

1. David A. Stephenson, Johs S. Agapiou, "Metal Cutting Theory and Practice", CRC Press, 3rd Edition, March 2016
2. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd. 2nd Edition, 2010

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18ME C17

CAD/CAM

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

Objectives:

1. To teach the basic design process and the importance and types of geometric modeling techniques
2. To teach the theory for modeling of surface and solid modeling techniques
3. To impart the basic skill in writing CNC part programming
4. To teach basic configurations of robot Manipulator
5. To teach concepts of part classification coding, computer aided process planning, automated inspection methods

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

1. Understand the applications of computer in design, manufacturing, and geometric transformation techniques (BL-2)
2. Apply Wireframe, surface, and solid modeling techniques for the generating various parts. (BL-3)
3. Distinguish various NC systems and develop the CNC program. (BL-4)
4. Demonstrate the fundamentals knowledge of robotics (BL-2)
5. Understand automated manufacturing environment. (BL-2)

UNIT-I

Introduction: Introduction to CAD, Product life cycle, Design Process, Design criteria, Alternative solutions, Hardware integration and networking, Graphic Standards and Exchange Formats (IGES, STEP, STL)
Geometric Transformations: Introduction, Translation, Rotation, Scaling, Reflection Transformations, Homogenous Representation, Concatenated Transformation, Transformations about fixed point

UNIT-II

Wire frame 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 non-uniform rational B-splines.
Surface Modeling: Surface representation Analytic surfaces: definition of Plane surface, Ruled surface, Surface of revolution, Tabulated cylinder, Synthetic Surfaces- Hermite cubic and Bezier surfaces.
Solid Modeling: Solid entities, Boolean operations, B – rep and CSG approaches, feature based modeling, assembly modeling and mating conditions

UNIT-III

Numerical Control of Machine Tools: Features and elements of NC, Types of NC systems: PTP, straight Cut and Contouring, definition of axes, definition of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, tool length and cutter radius compensation. Manual part programming and computer aided part programming for simple components (APT).

UNIT-IV

CNC: Introduction to CNC, Typical configurations, Machining centers, Introduction to FANUC, SINUMERIC controllers
DNC: Typical configurations, CNC vs DNC.
Adaptive Control Systems: ACO and ACC.

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Industrial Robots: Robot anatomy, configurations, control systems, drivers, accuracy and repeatability, end effectors, sensors in robotics, programming methods.Robot industrial applications: material handling, processing and assembly and inspection.

UNIT-V

GT: Part families, layout, part classification and coding system- OPITZ, MICLASS.

CAPP: Variant and Generative process planning.

FMS and CIM: FMS 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).

Text Books:

1. Ibrahim Zeid, "CAD/ CAM Theory and Practice", McGraw Hill Inc, New York, 2011.
2. Mikell P.Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Publication, 4/e, 2016.
3. P.N. Rao, "CAD/CAM - Principles and Applications", 2/e, Tata McGraw Hill, New Delhi, 2004.

Suggested Reading:

1. Yoram koren, "Computer Control of Manufacturing Systems", McGraw Hill Int, New York, 1994.
2. C. Elanchezhian, T. Sunder Selwyn, G. Shanmuga Sunder, "Computer Aided manufacturing", 2/e, Laxmi Publications (P) Ltd, New Delhi 2007.

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18ME C18

MACHINE DESIGN

(Use of data book is permitted)

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

Objectives:

1. Design principles of helical coiled and leaf springs. types of materials used for springs
2. The design principles of gears
3. The design principles of sliding contact bearings
4. The Selection of rolling contact bearings and roller chains
5. Design principles of IC engine piston, connecting rod, crank shaft, C-clamp and crane hooks

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

1. Understand the stresses in helical, leaf springs under static and fluctuating loads. (BL-2)
2. Design the spur, helical and bevel gears. (BL-6)
3. Demonstrate the ability in designing sliding contact bearings. (BL-3)
4. Selection of rolling contact bearings and roller chains. (BL-4)
5. Design of IC engine piston, connecting rod, crank shaft, C-clamp and crane hooks. (BL-6)

UNIT-I

Mechanical Springs: Introduction, types of springs, Materials used for springs.
Helical Springs: Wahl's factor, calculation of stresses, deflection and energy stored in spring. Design for staticand 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 and Bevel 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 oflubricants.
Design of Sliding Contact Bearings: Hydrodynamic bearings: journal bearing and thrust bearings.
Selection of Rolling Contact Bearings: Types of rolling elements and their constructional details, Static anddynamic 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 overhang crank shaft.

UNIT-V

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

Text Books:

1. V.B. Bhandari, "Design Machine Elements", Mc Graw Hill Publication, 2017.
2. J.E. Shigley, C.R. Mischne, "Mechanical Engineering Design", Tata Mc Graw Hill Publications, 2015.
3. R.S.Khurmi and J.K.Gupta, "Machine design", 34th edition, S Chand publications, 2018.

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Suggested Reading:

1. P. Kannaiah, "Machine Design", Sci-Tech Publications, 2010
2. M.F. Spotts, "Design of Machine Elements", Prentice Hall of India, 2013.

Machine Design Data Books:

1. K.Mahadevan, K.BalaveeraReddy.,"Design Data Hand book for Mechanical Engineers", 3/e, CBS Publisher, 2018
2. PSG College, "Design Data book",2012

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18ME C19

THERMAL TURBO MACHINES

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

Objectives:

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

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

1. Design various configurations of nozzles and diffusers with the principles of Thermodynamics, Fluid mechanics and Heat transfer to meet specified needs. (BL-6)
2. Predict the compressible flow properties behavior with friction, heat transfer and shock waves for complex engineering problems (BL-3)
3. Estimate the power required for various types of rotary compressors using the principles of gas dynamics for engineering problems. (BL-5)
4. Understand the working principle of steam turbines, velocity triangles and performance parameters using principles of turbo machinery. (BL-2)
5. Discuss the working principle of gas turbine, jets and rocket propulsions incorporating methods for efficiency improvement in gas turbine cycles. (BL-2)

UNIT-I

Introduction to Compressible Flows: Speed of propagation of pressure waves, Mach number, Acousticvelocity 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 Machnumber with duct length, isothermal flow with friction, Prandtl – Meyer relation, Rankine-Hugoniot equations and Stagnation pressure ratio across shock.

UNIT-III

Rotodynamic Compressors: Introduction and general classification, Comparison of Reciprocating and Rotarycompressors, 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, Impulseturbine, 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.

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UNIT-V

Gas Turbines: Applications and classification of Gas Turbines- constant pressure and constant volume gasturbines, 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-Rocketapplications.

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, 2014

Suggested Reading:

1. V. Ganeshan, "Gas Turbines", Tata Mc Graw Hills, New Delhi, 2010.
2. R Yadav, "Steam and Gas Turbines", Central Publishing House Ltd, Allahabad, 2003.

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Gandipet, Hyderabad-500 075. Telangana

18ME E08

OBJECT ORIENTED PROGRAMMING WITH C++

(Core Elective-III)

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

Objectives:

1. To understand difference between OOP and structured programming
2. To know classes, objects, constructors and destructors.
3. How to overload operators.
4. To understand inheritance and polymorphism
5. Knowledge about templates and exception handling.

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

1. Identify fundamental object oriented concepts of C++ programming Language. (BL-1)
2. Distinguish between object oriented program and structured programming (BL-2)
3. Use operator overloading to give comfort in the programming. (BL-3)
4. Illustrate Exception handling and templates (BL-4)
5. Solve basic mechanical engineering problems by developing programs using object oriented features (BL-5)

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 andfunctions, 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 / binaryoperators, 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, functionoverriding and containership.

Pointers and Polymorphism: Pointers and Generic pointer, Pointer to Objects and Derived Classes, thispointer, 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.

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Text Books:

1. Rohit Khurana, "Object oriented programming with C++", Vikas publications. 2/e, 2014.
2. Ashok Kamtani, "Object Oriented Programming with ANSI and Turbo C++", Pearson Education, 2017.
3. Somshekara, "Object Oriented Programming with C++", Eastern Economy Edition, 2/e, 2012.

Suggested Reading:

1. E. Balagurusamy, "Object Oriented Programming with C++", McGraw-Hill Education (India), 6/e, 2018.
2. Robert Lafore, "Object-Oriented Programming in C++", 4/e, Sams Publishing, 2016.

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18ME E09

MECHANICS OF COMPOSITE MATERIALS

(Core Elective - III)

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

Objectives:

1. Application and use of composite materials in industry.
2. Types of fibers and matrix materials used in commercial composites.
3. Prediction of the properties of UD lamina based on the constituent materials.
4. Analysis of composite laminates based on classical lamination theory.
5. Method of predicting failure in composite lamina using different theories.

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

1. Differentiate between composite materials and conventional materials using basic concepts. (BL-2)
2. Analyze macro and micro mechanical behaviour of a lamina. (BL-4)
3. Determine role of constituent materials in defining the average properties and response of composite materials on macroscopic level. (BL-3)
4. Analyze the laminates for stresses and strains using Classical lamination theory (BL-4)
5. Summarize the various fabrication methods of composite materials and measurements of properties through tests. (BL-2)

UNIT-I

Introduction: Definition, characteristics, overview of advantages and limitations of Composite materials. classification, significance, objectives of composite materials and applications.

UNIT-II

Basic concepts and characteristics: Scale of analysis; Micromechanics, Macromechanics, Macro and micro mechanical behaviour of a lamina: Stress strain relations for anisotropic materials, Restrictions on engineering constants, transformation of stress, Strain and elastic parameters.

UNIT-III

Elastic behaviour of UD Lamina: Elastic constants of a lamina using MOM approach, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation. Tensile and compressive strength of unidirectional fibre composites, Macromechanical failure theories, applicability of various failure theories. Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria.

UNIT-IV

Elastic Behaviour of Laminate: Basic assumptions, Strain-displacement relations, classical Lamination Theory [CLT], Stress-strain relation of layer within a laminate, Force and moment resultant, classification of laminates. Analysis of different types of laminates.

UNIT-V

Manufacturing Processes& Testing: Hand lay-up, bag molding, autoclave processing, RTM, pultrusion, filament winding, gel time test for resins, curing cycle, Testing: Fiber and matrix tests, tensile test, compressive test, in-plane shear test, inter-laminar shear test, flexure test.

Text Books:

1. R. M. Jones, "Mechanics of Composite Materials", Mc Graw Hill Co., 2006.
2. B. D. Agarwal, "Analysis and performance of fiber composites", Wiley & Sons 3/e, 2013.
3. Ronald F Gibson, "Principles of composite material mechanics", CRC press. 4/e, 2016.

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Suggested Reading:

1. Isaac M. Daniels and Ori Ishai, "Engineering Mechaincs of Composite Materials", Oxford University Press, 1994.
2. M.W.Hyer, "Stress Analysis of Fibre Reinforced Composite Materials", McGraw Hill Co., 1998.

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18ME E10

ROBOTIC ENGINEERING

(Core Elective–III)

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

Objectives:

1. Principle of working of a robot, types and specifications,configuration, work envelop and motion controls and applications
2. Transformations, kinematics and dynamics of robots
3. Singularities, Jacobian and trajectory planning of a robot to prepare the robot for various tasks
4. Design of end effectors, drives, working of sensors and controllers for finding position and orientation.
5. Robot vision for image acquisition and processing and plan for various tasks and various Languages and Programming methods of robot.

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

1. Understand the basic components and specifications of the Robots (BL-2)
2. Solve the problems of transformations, direct and inverse kinematics of robots (BL-3)
3. Analyze forces in links and joints of a robot and find the singularities, Jacobian and trajectory planning of a robot for various tasks (BL-4)
4. Recommend sensors and controllers for finding position and orientation to take corrective action based on feedback (BL-5)
5. Design an intelligent robot using machine vision and sensors (BL-6)

UNIT - I

Overview of Robots and Subsystems: Brief History, Types of robots, resolution, repeatability and accuracy,degrees of freedom of robots, Robot configurations, 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 of different industrial robots.

UNIT – II

Direct Kinematics: Rotation matrices, Euler angle and RPY representation, Homogeneous transformationmatrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics.

UNIT - III

Inverse Kinematics: inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: jointinterpolation, task space interpolation, executing user specified tasks, sensor based motion planning.

UNIT - IV

Analysis of RP and RR Type Robots: Static force analysis of RP type and RR type planar robots, Dynamicanalysis 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

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UNIT - V

Sensors and Controllers: Internal and external sensors, position, velocity and acceleration sensors, proximitysensors, force sensors, laser range finder. Robot vision: image processing fundamentals for robotic applications, image acquisition and preprocessing. 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 Vidyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
3. Mikell P. Groover " Industrial Robotics", McGraw-Hill, 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.

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18PE E06

PRODUCTION AND OPERATIONS MANAGEMENT

(Core Elective-III)

Instruction	3	Hours per week
Duration of SEE	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 students are able to

1. Understand the role of production system and its design in Production and Operations Management. (BL-2)
2. Apply forecasting techniques for predicting demand. (BL-3)
3. Use Aggregate Planning, Master Scheduling and Materials Requirement Planning in a production system. (BL-3)
4. Compare various inventory control techniques used in production system. (BL- 4)
5. Apply the quality control tools to improve performance of production system. (BL- 3)

UNIT-I

Introduction: Production systems classification and characterization

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

Work Study: Productivity, Introduction to method study and work measurement, standard time calculations, work sampling, wages and 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 aggregateplanning, strategies in aggregate planning, master production scheduling

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

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UNIT-IV

Inventory Control: Importance of Inventory control, Inventory control systems, Types of Inventories, Inventory costs, Deterministic Inventory models - Basic Purchase model, Purchase model with Instantaneous replenishment and with shortages, Basic Production model, Production model with shortages, Inventory model with price breaks.

UNIT-V

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

Text Books:

1. William J. Stevenson, "Operations Management", 8/e, Tata Mc Graw Hill Edition, 2005.
2. Joseph G. Monks, "Operations Management: Theory and Problems", 3/e, McGraw Hill International Edition, 1987.
3. ElwoodS. Buffa, "Modern Production/Operations Management", 5/e, 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. Panneerselvam, "Production and Operations Management," 2/e, PHI Learning Pvt. Ltd., New Delhi, 2006.

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18ME E11

ADVANCED IC ENGINES

(Core Elective-III)

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

Objectives:

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 and working principles of analyzers for measurements of pollutants.
4. Concept of alternative fuel technology to improve the performance of the engine.
5. Concepts of recent trends in IC engines.

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

1. Evaluate the performance of SI/ CI engines with emphasis on environment (BL-5)
2. Understand the combustion phenomenon in IC engines with remedial methods for controlling abnormal combustion. (BL-2)
3. Discuss the need and control of I.C Engine emissions in the context of human health and environment. (BL-2)
4. Understand the need for professional and engineering practices required for identifying alternative fuels in the context of fossil fuels depletion to address health, safety and societal issues. (BL-2)
5. Choose appropriate technologies to improve engine performance with alternative power sources for automobiles. (BL-5)

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; cooling, lubrication systems, battery and magneto ignition systems of IC engines.working principle of simple carburetor, Zenith carburetor and fuel Injector, injection systems-MPFI and CRDI systems.

UNIT - II
Combustion Phenomena: Stages of combustion in SI and CI engines, normal and abnormal combustion phenomenon in SI and CI engines, remedies. combustion chambers for SI & CI engines; supercharging of IC engines: need of supercharging, advantages, limitations and configurations of supercharging.

UNIT - III
Pollutant Formation And Control: Pollutant– sources – formation of carbon monoxide, unburnthydrocarbon, aldehydes, NOx, smoke and particulate matter – methods of controlling Emissions – thermal and catalytic converters, particulate traps, chemical methods and EGR, SCRT- various methods of measurements like flame ionization detector, Infrared gas analyzer, chemiluminescence method and opacity meters; emission norms.

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
Technological Advances in Vehicles: Lean burn engines, stratified charge engines, homogeneous charge compression ignition (HCCI) engines and GDI concepts.
Electric vehicles: Introduction, limitations of IC engines as prime mover, history of EVs, EV system, components of EV-DC and AC electric machines, Introduction and basic structure, electric vehicle drive train, advantages and limitations.

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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, 2007
3. Heywood, J.B, "Internal Combustion engine fundamentals", McGrave Hills, Book Co, New York, 1988

Suggested Reading:

1. M.L. Mathur and R.P. Sharma, "Internal Combustion Engine", DhanpatRai&Sons,New Delhi, 2010.
2. Seth Leitman and Bob Brant "Build your own electric vehicle" McGraw Hill Co. 2nd edition, 2009.

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18ME E12

COMPUTATIONAL FLUID DYNAMICS

(Core Elective - IV)

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

Objectives:

1. To understand governing equations of fluid flow
2. To understand turbulence and how to model them.
3. To know how to descretize governing equations of fluid flow by FDM and their stability.
4. To learn various iterative methods to solve N-S equation.
5. To understand FVM to solve fluid flow equations.

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

1. Describe and develop mathematical models for flow phenomena. (BL-1)
2. Classify PDE for fluid flow and heat transfer applications. (BL-2)
3. Apply Finite Difference Method for fluid flow and heat transfer problems (BL-3)
4. Test the discretized equations for stability and solve the system of linear equations (BL-4)
5. Formulate numerical equations by Finite Volume Method for fluid flow and heat transfer problems (BL-6)

UNIT-I

Basic Equations: Continuity, momentum and energy equations, Navier-Stokes equations, Heat transferconduction 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 andboundary 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, TDMA, Viscous incompressible flow,Vorticity Stream function method.

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. Ghoshdastidar, "Computational Fluid Dynamics & Heat Transfer", Cengage Pub., 2018.
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", 3/e ,Pearson, , 2016

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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.

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18ME E13

PRINCIPLES OF ENTREPRENEURSHIP

(Core Elective - IV)

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

Objectives:

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

1. Understand the concept and essence of entrepreneurship. (BL-2)
2. Identify business opportunities and nature of enterprise. (BL-3)
3. Analyze the feasibility of new business plan. (BL-4)
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects. (BL-3)
5. Use behavioral, leadership and time management aspects in entrepreneurial journey. (BL-3)

UNIT-I
Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, women entrepreneurs, innovation and Intellectual property in entrepreneurial journey, conception and evaluation of ideas and their sources, need and importance of startups and incubation centers.

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, Business model canvas, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary. Choice of Technology and Collaborative interactions, Sources of finance and Incentives for entrepreneurs.

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, 2012

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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.

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18PE E08

MODERN MACHINING AND FORMING METHODS

(Core Elective - IV)

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

Objectives:

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

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

1. Compare the Traditional and Non Traditional Machining process and recognize the need for Non traditional Machining process. (BL-2)
2. Illustrate constructional features, performance parameters, process characteristics, applications, advantages and limitations of Non Traditional Machining process. (BL-3)
3. Classify mechanisms of material removal of various non traditional machining processes. (BL-4)
4. Describe the principles, characteristics, advantages, limitations and applications of various unconventional methods of forming, HERF. (BL-1)
5. Compare the principles, constructional features and applications among explosive forming, EHF and EMF. i. (BL-4)

UNIT-I

Ultrasonic Machining (USM):Introduction, Process description, abrasive slurry, Abrasive materials and theircharacteristics, 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 onMRR 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

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 ofelectron beam, equipment used, advantages, disadvantages and applications.

UNIT-III

Electro-chemical machining (ECM): Schematic of processparameters, function and characteristics of electrolyte, MRR for pure metal and alloys, electrode feed rate (EFR), advantages, limitations and applications.

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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, standoffoperation 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

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

Stretch Forming: Introduction, types of stretch forming, stretch draw forming, rotary stretch forming or stretchwrapping, 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", 1/e, 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.

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18ME E14

HEAT AND MASS TRANSFER

(Core Elective - IV)

(Use of data book is permitted)

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

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 and understand the working principle of heat exchanger and their effectiveness.
5. Student will come to know mass transfer phenomena in gases and liquids.

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

1. Apply various laws pertaining to conduction heat transfer using basic principles of thermodynamics.(BL-3)
2. Determine heat transfer coefficient for free and forced convection phenomena along with boundary layer for various complex engineering problems. (BL-5)
3. Understand the concept of radiation phenomena of heat transfer. (BL-2)
4. Design of heat exchangers using the principles of engineering sciences. (BL-6)
5. Understand the concept of mass transfer and co-relate with heat transfer and provide valid conclusions. (BL-2)

UNIT-I

General Heat Conduction Equation: Derivation of the equation in Cartesian and Polar Co-ordinate systems.
Steady-state one-dimensional heat conduction problems in Cartesian and Polar System: Steady-state 1-D heat conduction problems with and without heat generation and varying thermal conductivity for different boundary conditions, Thermal Resistances in Series and in Parallel. Critical thickness of insulation
Fins: Classification, Rectangular Fins, Fin Efficiency and Fin Effectiveness, Applications,
Transient heat conduction: Lumped heat analysis, Semi-infinite Body, use of Heisler and Grober charts,

UNIT-II

Convection: Boundary Layer Theory, Velocity and Thermal Boundary Layers over a flat plate and through pipes.
Forced convection: Flow over flat plates, cylinders, internal flows -laminar and turbulent flow, Empirical solutions.
Free convection: Flow over vertical Plates, Internal flows-Vertical Tubes and Horizontal Tubes- Laminar and Turbulent flows, Empirical solutions. Dimensional analysis, Buckingham π theorem, Physical significance of different dimensionless numbers.

UNIT-III

Basic Relations: 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.
Radiation Heat Exchange between Surfaces: Radiation shape factor, Concept of surface, space resistances, Heat exchange between non-black bodies, Radiation shields.

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UNIT-IV

Heat Exchangers: Definition, Classification, LMTD method, Effectiveness - NTU method, chart Solution for Heat Exchanger Problem, correction factor charts and Effectiveness-NTU charts.
Boiling: Boiling Heat Transfer Phenomena, Pool boiling Curve
Condensation: Laminar film wise condensation on a vertical plate.

UNIT-V:

Mass Transfer: Applications, concentrations, velocities and fluxes, Fick's law of diffusion, General three dimensional equation for mass transfer in stationary media, diffusion coefficient, steady state molecular diffusion through a plain membrane, equimolal diffusion, evaporation process in atmosphere, significance of dimensionless numbers in mass transfer.

Text Books:

1. Sachdeva, R.C, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publications, 2014.
2. Holman, J. P., Heat Transfer, Tata McGraw Hill, New Delhi, 2010
3. M. Necati Ozisik, Heat Transfer - A Basic Approach, McGraw Hill, New York, 1985

Suggested Reading:

1. Yunus A Cenegal, Heat Transfer: A Practical Approach, Tata McGrahill, 2nd Edn,2002
2. Incropera, F. P. and De Witt, D. P., Fundamentals of Heat and Mass Transfer, John Wiley and Sons, New York, 2006

Data Book:

1. C. P. Kothandaraman, S. Subramanyan ,"Heat and Mass Transfer Data Book", New Age International Publishers, 2018

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18ME E15

BLOCKCHAIN TECHNOLOGY

(Core Elective -IV)

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

Course Objectives:

1. To provide Conceptual understanding of how blockchain technology can be used to improve business processes.
2. To facilitate understanding of bit coin and working with consensus in Bitcoin.
3. To impart knowledge about designing and building Permissioned blockchains.
4. To introduce supply chain management and internet enabled supplychains.
5. To familiarize with blockchain applications.

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

1. Outline the concepts of blockchain technology. (BL-2)
2. Understand the bit coin, working with consensus in Bitcoin. (BL-2)
3. Develop knowledge about designing and building Permissioned block chains. (BL-3)
4. Explain the concepts of supply chain management and internet enabled supply chains. (BL-2)
5. Make use of blockchain applications involved in various sectors. (BL-3)

UNIT- I

Introduction: History, blockchain Architecture, nodes, crypto currency, tokens, cryptography- private and public keys, hash, ledgers, bitcoin, design Primitives- digital Signature, protocols, security, consensus, understanding Crypto currency.

UNIT- II

Bitcoin and block chain: creation of coins, payments and double spending, bitcoin scripts, bitcoin p2p network, transaction in bitcoin network, block mining, block propagation and block relay.

Working with consensus in bitcoin: distributed consensus in open environments, consensus in a bitcoin network, proof of work (pow) – basic introduction, hashcash pow, bitcoinpow, attacks on pow and the monopoly problem, proof of stake, proof of burn and proof of elapsed time, the life of a bitcoin miner, mining difficulty, mining pool.

UNIT- III

Permissioned Block chain: Definition, merits and demerits, differences between permissioned and permissionless blockchain, overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT, Byzantine fault tolerant (BFT) system, Lamport-Shostak-Pease BFT Algorithm.

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food security, Mortgage over Blockchain, Blockchain enabled Trade.

UNIT- IV

Blockchain and the world economy: Supply chain industry-past and future, supply chain using blockchain technology, building blocks of a supply chain network, business processes in supply chains, types of supply

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chains and examples, strategic, tactical, and operational decisions, supply chain performance measures. ERP and automation.

Internet-enabled supply chains: e-marketplaces, e-procurement, e-logistics, e-fulfillment, customer relationship management, web services.

UNIT -V

Applications of blockchain technology: Uses of blockchain in e-governance, land registration, property records, notary, titles, micropayments, medical information systems, next generation of industry 4.0 and additive manufacturing, government identity management, auto executing contracts, three signature escrow, triple entry.

Text Books:

1. Melanie Swan, "Block Chain: Blueprint for a New Economy", 1st Edition O'Reilly, 2015.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Crypto currencies", 1st Edition, O'Relly, 2015.
3. Tiana Laurence, "Introduction to blockchain technology", Van Haren Publishing, 's-Hertogenbosch, 2019.

Suggested Reading:

1. Daniel Drescher, "Block Chain Basics", 1st Edition, Apress, 2017.
2. RiteshModi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain", Packt Publishing, 2018.

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18ME E17

RENEWABLE ENERGY SOURCES

(Core Elective - V)

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

Objectives:

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 need for renewable energy sources in the context of environmental issues. (BL-2)
2. Apply the principles of solar energy for domestic and industrial usages. (BL-3)
3. Understand the working principle of wind power plants along with merits and demerits. (BL-2)
4. Describe the concepts of geothermal energy sources and biomass as a source of energy. (BL-2)
5. Explain the principles and impact of wave, tidal and OTEC plants on the environment. (BL-2)

UNIT-I

Energy Sources: Energy characteristics, forms of energy, energy chain (route), energy sectors, Indian energy scenario, energy pricing in India, energy and environment, energy security, energy conservation and its importance, energy strategy for future, classification of energy sources, availability of conventional and non-conventional (renewable) energy sources, classification of RES - solar, wind, geothermal, bio-mass, ocean tidal, ocean wave and ocean thermal energy conversion (OTEC), advantages and limitations of conventional and renewable energy sources.

UNIT-II

Solar Energy: Solar radiation, solar thermal collectors, working of flat plate and concentrating (focusing) solar collectors and their limitations, comparison of flat plate and focusing collectors, applications of solar collectors - water heating, space heating, low temperature power generation, solar cookers, water pumping, SODIS, solar thermal power plant, advantages and limitations of solar energy systems, PV materials, PV cells and their manufacturing, space based solar power (SBSP), solar satellite system, advantages and disadvantages of SBSP.

UNIT-III

Wind Energy: Sources of wind, merits and demerits of wind energy, site selection for wind energy conversion system, wind turbine (wind mill), classification of wind mills, working principle horizontal axis and vertical axis windmills, horizontal vs vertical axis windmills, power extracted from the wind, effect of velocity on power generation, new developments and problems in operating large wind power generators.

UNIT-IV

Geothermal Energy: Layers in earth, resources of geothermal energy, hydrothermal, petrothermal and geopressure resources, advantages, disadvantages, applications and environmental effects of geothermal energy sources.

Biomass Energy: Resources, biogas and its composition, process of biogas generation, wet process and dry process, raw materials available for biogas fermentation, economical, social, environmental and health benefits of biogas utilization, selection of site and constructional techniques of a biogas plant, working of KVIC, Pragathi

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design, Janata and Deenbandu biogas plants, common operational problems, causes and remedies relating to a biogas plant.

UNIT V

Tidal power: Tidal systems, site selection for tidal power plant, schematic layout of tidal power house, principle of operation of single basin and double basin tidal plants, advantages and disadvantages of tidal power.

Wave energy - Differences between tides and waves, advantages and disadvantages of wave power, problems associated with wave energy collection, working principle of wave energy conversion devices.

Ocean thermal energy conversion (OTEC) - OTEC power plants, location, open cycle and closed cycle OTEC plants, advantages, limitations and applications of OTEC, environmental impact of OTEC plants.

Text Books:

1. S. Hasan Saeed and D.K. Sharma, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2017.
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.

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18ME E18

CONTROL SYSTEMS THEORY

(Core Elective - V)

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

Objectives:

1. To provide with basic knowledge of control systems, associated terminologies, transfer function.
2. Familiar with basic electrical, mechanical & electromechanical system and their representation in Differential Equation /Transfer function form.
3. To make students familiar with system performance analysis in time & frequency domain.
4. To understand different methods of stability analysis
5. To provide basic pathway to space representation and controllability and observability

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

1. Understand control system, modeling and transfer functions of different systems. (BL-3)
2. Apply the concept of block diagram and signal flow graphs to different systems. (BL-3)
3. Differentiate between time domain and frequency domain techniques. (BL-2)
4. Examine the stability of a system using different approaches. (BL-3)
5. Analyze the system in state space and to find out the controllability and observability. (BL-4)

UNIT-I

Mathematical Modeling: Introduction to control systems , Open loop & closed loop systems, Mathematicalmodeling & Mechanical systems, Transfer functions from Governing equations, Electrical, hydraulic systems pneumatic, thermal systems, AC,DC servomotors &Electromechanical servo systems

UNIT-II

Components of Control System: Introduction to Block diagrams & Problems, Signal flow graph & mason'sgain formula, Transient response &time domain specifications of 1st order systems, 2nd order systems & time domain specifications, Steady state error, error coefficients, Sensitivity Performance Indices

UNIT-III

Time Domain Analysis: Routh criteria & root locus method, Frequency response, Bode & polar plots,Correlation between Transient & frequency response, Band width, Experimental determination of transfer function

UNIT-IV

Stability Analysis: Nyquist Criteria, Phase & gain margins, Lead, lag compensator design lead-lagcompensator design, PID-controller, linearization of non linear systems

UNIT-V

State Space Representation: State space representation of linear control systems, State transition matrix, **Solution of State Space Equations**: Zero input response and Zero state response, Concept of controllability &observability

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Text Books:

1. K. Ogata, "Modern control Engineering", Prentice Hall, 2015.
2. M. Gopal., "Control Systems", Tata McGraw Hill, 2012.
3. D. Roy Choudhury, "Control System Engineering", PHI, 2005

Suggested Reading:

1. Norman S.Nise., "Control Systems Engineering", John Wiley & sons, Inc., 2018.
2. R.C. Dorf, "Modern Control systems", Addison Wesley, 2011

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18ME E19

ARTIFICIAL INTELLIGENCE

(Core Elective - V)

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

Objectives:

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.
4. Familiarize with the types of machine learning.
5. Applications of AI in the field of mechanical engineering.

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

1. Differentiate between a rudimentary Problem and an AI problem, its Characteristics and Techniques. problem solving (BL-2)
2. Compare and contrast the various knowledge representation schemes of AI. (BL-4)
3. Analyze various reasoning and planning techniques involved in solving AI problems. (BL-4)
4. Understand the different learning techniques. (BL-2)
5. Apply the AI techniques in the field of mechanical engineering. (BL-3)

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. Scope and applications of AI in Mechanical Engineering

Text Books:

1. Elaine Rich, Kevin Night, Shivashankar B Nair, "Artificial Intelligence", 3/e, TMH, 2008
2. Russell Norvig, "Artificial Intelligence-Modern Approach", 3/e, PearsonEducation, 2010
3. Nilakshi Jain "Artificial Intelligence: Making a System Intelligent", Wiley India, 2019

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Suggested Reading:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2012
2. Deepak Khemani, "A First Course in Artificial Intelligence", TMH, 2017

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18ME E20

INDUSTRIAL ADMINISTRATION AND FINANCIAL MANAGEMENT

(Core Elective - V)

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

Objectives:

1. Various types of business organizations and organization structures and importance of plant location and plant layout
2. Importance of industrial engineering techniques like method study and work measurement.
3. The significance of quality control and production planning and control
4. The importance of project management techniques
5. The total cost of a product based on elements of cost

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

1. Understand different types of business organizations, functions of management and importance of various types of plant layouts. (BL-2)
2. Apply techniques of method study and work measurement in organizations to enhance productivity (BL-3)
3. Usequality control charts and tools in industries. (BL-3)
4. Apply various optimization and project management techniques for solving real time problems. (BL-3)
5. Understand basic concepts of Cost accounting and financial management . (BL-2)

UNIT-I

Industrial Organization: Definition of an organization, types of various business organizations, organizationstructures and their relative merits and demerits, functions of management.

Plant location and layouts: Factors affecting the location of plant and layout, types of layouts and their meritsand demerits.

UNIT-II

Work study: Definitions, objectives of method study and time study, steps in conducting method study,symbols and charts used in method study, principles of motion economy, calculation of standard time by time study and work sampling, performance rating factor, types of ratings, job evaluation and performance appraisal, wages and incentive plans.

UNIT-III

Inspection and quality control: Types and objectives of inspection, S.Q.C., its principles. Quality control charts and sampling plans, quality circles, introduction to ISO.

Production planning and control (PPC): Types of production systems, principles of PPC and itsfunctions.

UNIT-IV

Optimization: Introduction to linear programming and graphical solutions, assignment problems.

Project Management: Introduction to CPM and PERT, determination of critical path.

Material Management: Classification of materials, materials planning, duties of purchase manager,determination of economic ordering quantities, types of materials purchase.

UNIT-V

Cost accounting: Elements of cost, various costs, types of overheads, break even analysis and its applications,depreciation, methods of calculating depreciation fund, nature of financial management, time value of money, techniques of capital budgeting and methods, cost of capital, financial leverage.

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Text Books:

1. O.P. Khanna "Industrial Engineering and Management", Dhanapat Rai & Sons, 2018
2. S.D. Sharma, "Operations Research" , Kedarnat , Ramnath & Co., Meerut,2012
3. Pandey I.M. , " Financial Management", Vikas Publ. House, New Delhi, 2016

Suggested Reading:

1. William J Stevenson, "Operations Management", McGraw Hill, 2018
2. Paneer Selvam, "Production and Operations Management", Pearson Education, 2012.

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18PE E11

PRINCIPLES AND APPLICATIONS OF ADDITIVE MANUFACTURING

(Core Elective - V)

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

Objectives:

1. To introduce students the basics of additive manufacturing, its advantages and limitations and concept of mass customization.
2. To familiarize students with different additive manufacturing techniques.
3. To teach students about STL file issues and familiarize them with various RP softwares.
4. To demonstrate various post processing techniques and rapid tooling concept.
5. To demonstrate the applications of rapid prototyping in various fields

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

1. Understand the fundamental concepts of Additive manufacturing, its advantages and Disadvantages (BL-2)
2. Select suitable process and materials used in Additive Manufacturing (BL-5)
3. Analyze pre-processing issues for Additive Manufacturing and related operations for STL file generation. (BL-4)
4. Identify different post processing techniques for enhancing the properties of the 3D printed components (BL-3)
5. Infer the prospects of additive manufacturing in various industrial sectors. (BL-2)

UNIT-I

Introduction: Need for Additive Manufacturing, Generic AM process, Difference between AM and CNC, Classification of Additive Manufacturing processes, Metal systems,Milestones in AM development .Materilas used in Additive Manufacturing Related Technologies-Reverse Engineering.Advantages and Limitations of AM.

UNIT-II

Photo polymerization process: Stereolithography (SL), Materials, SL resin curing process, Process Benefits and Drawbacks, Applications of Photo polymerization Process.

Powder bed fusion process: Introduction, Selective laser Sintering (SLS), Materials, Powder fusion mechanism, Process Benefits and Drawbacks, Applications of Powder Bed Fusion Process.

Extrusion-based systems: Fused Deposition Modelling (FDM), Principles, Materials, Process Benefits and Drawbacks, Applications of Extrusion-Based Process.

Material Jetting Process: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Process.

UNIT-III

Binder Jetting Process: Materials, Process Benefits and Drawbacks, Technical challenges in printing, Applications of Binder Jetting Process

Sheet Lamination Process: Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM, and UC applications

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Directed Energy Deposition Process: Process Description, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Benefits and drawbacks, Applications of Directed Energy Deposition Process.

UNIT-IV

Pre-processing in Additive Manufacturing: Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path.

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.

UNIT-V

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs Rapid Tooling

AM Applications: Application in Design, Engineering, Analysis & Planning, Application in Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, Biomedical applications.

Text Books:

1. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.
2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015
3. K. Venuvinod and Weiyin Ma, "Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.

Suggested Reading:

1. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
2. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

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18ME C20

CAD/CAM LAB

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

Objectives:

1. To teach the basic design process and the importance and types of geometric modeling techniques
2. To teach Assembly modeling by applying suitable assembly constraints
3. To generate orthographic views of components and assemblies.
4. To demonstrate the Indication of size, form and positional tolerances on the drawing sheets
5. To demonstrate the working of CNC machines and write part programs for different operations

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

1.	Model components using CAD software. Select appropriate commands to generate 3D model	(BL-3)
2.	Select constraints to assemble the components	(BL-3)
3.	Develop manufacturing drawings from 3D models	(BL-3)
4.	Analyze the concept CNC part program to generate tool path for different machining operations	(BL-4)
5.	Develop a product using CAD/CAM technology	(BL-6)

List of the Exercises:

1. Introduction to CAD Package, Working with sketch mode and introduction to various Part Features.
2. Part modeling of various machine components
3. Format of drawing sheet, title block, Generating and editing drawings
4. Assembly modeling of Stuffing Box
5. Assembly modeling of Screw Jack
6. Assembly modeling of Crosshead
7. Production drawing of components and indicating tolerances on size and geometrical form, Position; Indicate Surface finish, surface treatments if any and writing process sheet for anyone component
8. Introduction to CNC machines, Working, writing of process sheets, Contouring on CNC Milling Machine.
9. Rectangular & Circular Pocketing on CNC Milling Machine
10. Step Turning and Taper Turning on CNC Lathe Machine
11. Multiple Turning on CNC Lathe Machine
12. Study of 3D printer
13. Design a product and Manufacture / generate CNC Machining tool path for its components

Note: Student should complete a minimum of 10 exercises including exercise number 13 which is compulsory.

Text books:

1. P.N. Rao, "CAD/CAM: Principles and Applications",Tata McGraw-Hill, July 2017
2. N Mehta, "Machine Tool Design and Numerical Control", McGraw Hill Education, 3/e, 2017
3. Dassault Systems, "SOLIDWORKS Essentials: Training", SolidWorks corp., 2011

Suggested Reading:

1. https://my.solidworks.com/solidworks/guide/SOLIDWORKS_Introduction_EN.pdf
2. https://help.solidworks.com

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18ME C21

THERMAL ENGINEERING LAB

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

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 working principle of axial flow fan and centrifugal blower.
4. Student will understand to evaluate the COP of Refrigeration tutor and AC tutor.
5. Student will come to know to evaluate drag and lift coefficients for contoured bodies.

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

1. Determine thermal conductivity of a metal rod and critical heat flux of a copper wire (BL-3)
2. Estimate the convective heat transfer coefficients for phase change heat transfer and effectiveness of cross flow heat exchanger. (BL-3)
3. Evaluate the performance of rotary compressors, refrigeration and air conditioned tutors. (BL-5)
4. Evaluate drag and lift coefficients for different profiles of automobiles. (BL-5)
5. Determine the pressure distribution in a nozzle and around symmetrical bodies. (BL-3)

List of the Experiments

1. Study of Thermal conductivity of metal rod.
2. Determination of critical heat flux for copper wire in water.
3. Evaluate the convective heat transfer coefficient for condensation and boiling equipment.
4. Determination of pressure distribution for convergent and divergent nozzle
5. Study of overall efficiency of axial flow fan
6. Determination of overall efficiency of centrifugal blower
7. Study of COP of refrigerating tutor
8. Study of COP of air conditioning tutor
9. Evaluate the effectiveness of cross flow heat exchanger.
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
13. Investigation of the wind tunnel performance by using the modeling and simulation

Note: Student should complete a minimum of 10 experiments including experiment number 13 which is compulsory.

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, 2014

Suggested Reading:

1. V. Ganeshan, "Gas Turbines", Tata Mc Graw Hills, New Delhi, 2010.
2. R.K. Rajput, "Heat Transfer", Laxmi Publication, 2014

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18ME C22

METROLOGY AND INSTRUMENTATION

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

Objectives:

1. To familiarize with limits, fits & tolerances and fundamental concepts of linear and angular measurements.
2. To have adequate skill in the usage of various precision measuring instruments and the concepts 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. Understand the need, accuracy and associated concepts of measurements. (BL-2)
2. Select appropriate gauges for inspection and design. (BL-3)
3. Calculate surface roughness by using appropriate instruments. (BL-3)
4. Analyze and interpret the types of errors, strain measurement and instrument characteristics. (BL-4)
5. Evaluate measuring methods and devices for displacement, pressure & temperature. (BL-5)

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, 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.

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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. RegaRajendra,"Principles of Engineering Metrology", Jaico Publishing House, Mumbai, 2008.
2. B.C. Nakra& K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e, McGrawhill, 2014 .

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18ME C23

OPERATIONS RESEARCH

Instruction		3 Hours per week
Duration of SEE		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 are able to

1. Understand the concepts of linear programming problems. (BL-2)
2. Solve the given transportation problem. (BL-3)
3. Develop optimum pair of operations and resources by using Assignment technique. (BL-3)
4. Analyze project management techniques like CPM and PERT to plan and execute projects successfully. (BL-4)
5. Apply sequencing and queuing theory concepts for industry applications. (BL-3)

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.

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Queuing theory: Introduction, Kendall's notation, single channel - Poisson arrivals-exponential service times.

Text Books:

1. Hamdy A. Taha, "Operations Research-An Introduction", 10/e, Pearson education India, 2017.
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. R. PaneerSelvam, "Operations Research", 2/e, PHI Learning Pvt. Ltd., New Delhi,2008.
2. Nita H. Shah, Ravi M. Gor, HardikSoni, "Operations Research", PHI Learning Private Limited,2013.

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18ME C24 **FINITE ELEMENT ANALYSIS**

Instruction	3 Hours per week
Duration of SEE	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, 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, the students are able to

1. Understand FE method for solving field problems using energy formulations. (BL-2)
2. Analyze bars, trusses, beams and circular shafts for static and dynamic analysis. (BL-4)
3. Formulate 2D structural components using triangular element for plane stress, plane strain and axi-symmetric problems. (BL-4)
4. Derive stiffness matrix for 4 node quadrilateral isoparametric element for static analysis and 3 D elements. (BL-6)
5. Solve heat transfer problems and apply finite element analysis software for engineering solutions. (BL- 3)

UNIT - I

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

One dimensional problem: Finite element modeling co-ordinates 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 and frames: 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 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 nodedisoparametric 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, applications to one dimensional heat flow in a rod.

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3D 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 Chandraputla 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.

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18ME E21

POWER PLANT ENGINEERING

(Core Elective - VI)

Instruction	3	Hours Per Week
Duration of SEE	3	Hours
SEE	70	Marks
CIE	30	Marks
Credits	3	

Objectives:

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 students are able to

1. Select the suitability of site for a power plant in the context of environment. (BL-4)
2. Discuss ash handling and coal handling methods in thermal power plants. (BL-2)
3. Understand the importance of site selection for a hydro-power plant in the context of societal and environment. (BL-2)
4. Explain the safety aspects of nuclear waste disposal. (BL-2)
5. Estimate the economic factors and pollutant formation from power plants. (BL-3)

UNIT – I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants, merits and demerits of conventional and non-conventional power plants.

Steam power plant: Selection of site for steam power plant, plant layout, formation and types of coal, stages in coal handling, working of coal handling equipment – belt conveyors, screw conveyors, bucket elevators and grab bucket conveyors, general layout of ash handling and dust collection system, uses of ash and dust, ash handling systems – mechanical, pneumatic, steam jet and hydraulic systems of ash handling.

UNIT- II

Combustion process in steam power plant: Stoker firing, overfeed stokers - travelling grate stokers and spreader stokers, underfeed stokers - single retort and multi-retort underfeed stokers, elements of pulverized fuel burning system, advantages and disadvantages of pulverized fuel burning system, pulverized fuel burners – long flame, short flame, tangential and cyclone burners, fluidized bed combustion (FBC), benefits and disadvantages of FBC.

UNIT- III

Hydro electric power plant: Hydrological cycle, hydrograph, flow/mass duration curve, selection of site for hydro-electric plant, advantages and disadvantages of hydro-electric plants, elements (flow-sheet) of hydro-electric power plant, types and working of hydroelectric power plants, storage and pondage, parts and terminology of a dam,

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selection of site for dams, classification and working of different types of dams, spillways, necessity and location of spillways, classification and working of different types of spillways.

UNIT - IV

Nuclear power plant: Nuclear fuel, breeding and fertile materials, distinction between fissionable, fissile and fertile materials, advantages and disadvantages of nuclear power, components of nuclear reactor, types of nuclear reactors, working of pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor and gas cooled reactors – radioactive (nuclear) waste disposal methods.

UNIT - V

Power plant economics and environmental considerations: Definition and related exercises on connected load, demand (load), maximum demand (peak load), demand factor, average load, load factor, diversity factor, utilization factor, plant capacity factor and plant use factor, fixed cost and variable cost, methods to find depreciation cost and related numerical problems, economics in plant selection, 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, McGraw-Hill Education (India) Private Limited, New Delhi, 2014.
3. P.C. Sharma, "A Text Book of Power Plant Engineering", S.K. Kataria& sons, 2019

Suggested Reading:

1. R. Yadav, "Fundamentals of Power Plant Engineering", Central Publishing House, Allahabad, 2012.
2. S.C. Arora and S. Domkundwar, "A Course in Power Plant Engineering", DhanpatRai& Sons, New Delhi, 2005.

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18ME E22

ENGINEERING RESEARCH METHODOLOGY

(Core Elective - VI)

Instruction	3 Hours per week
Duration of SEE	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 ofthe course, the students are able to

1. Define researchproblem. (BL-1)
2. Review and assess the quality of literature from varioussources. (BL-2)
3. Understand and develop various research designs. (BL-2)
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square. (BL-4)
5. Improve the style and format of writing a report for technical paper/ Journalreport. (BL-4)

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 vs. methodology, research process, criteria of good research, problems encountered by researchers in India, technique involved in defining aproblem.

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 formulation and presentation: Synopsis, dissertation, technical paper and journal paper, writing research grant proposal, making presentation with the use of visual aids,writing a proposal for research grant.

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. Vijay Upagade and AravindShende, "Research Methodology", S. Chand &Company Ltd., NewDelhi, 2009.

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ya Bharathi Institute of Technology (
et, Hyderabad-500 075. Telangar

Suggested Reading:
1. G. NageswaraRao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.
2. Naval Bajjai, "Business Research Methods", Pearson Education, 2011.

18ME E23

DATA ANALYTICS
(Core Elective - VI)

Instruction	3Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarise the students with the concept of descriptive and inferencial statistics.
2. To make the students to understand the concept of machine learning.
3. To make the students to understand various techniques of supervised learning.
4. To make the students to learn the concepts of unsupervised learning.
5. To make the students to learn the prescriptive analytics.

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

1. Solve the problems using statistics, regression analysis and ANOVA. (BL-3)
2. Understand the concept of machine learning. (BL-2)
3. Apply various supervised learning techniques to a given problem. (BL-3)
4. Understand unsupervised learning and problems in big data analysis. (BL-2)
5. Demonstrate prescriptive analytics methods to the given data. (BL-2)

UNIT-I

Introduction: Introduction to data and analytics ,taxonomy of data analytics, typical data challenges (data quality, enrichment, integration of ERP & PLM data) ,preparing data for analytics (techniques to improve data quality, integration - ETL).

Descriptive and inferential statistics: Descriptive statistics: introduction, probability distributions, inferential statistics, inferential statistics through hypothesis tests permutation & randomization test, regression & ANOVA.

UNIT-II

Machine Learning: Introduction and concepts, differentiating algorithmic and model based frameworks, regression, ordinary least squares, K nearest neighbours regression & classification.

UNIT-III

Supervised learning with regression and classification techniques: Model validation approaches, discriminantanalysis, quadratic discriminant analysis, regression and classification trees, support vector machine.

Ensemble Methods: Neural networks, deep learning.

UNIT-IV

Unsupervised learning and challenges for big data analytics: Clustering, associative rule mining, challenges for big data analytics.

UNIT-V

Prescriptive analytics: Creating data for analytics through designed experiments, creating data for analytics through active learning, creating data for analytics through reinforcement learning.

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Text Books:

1. Hastie, Trevor, "The elements of statistical learning", Vol. 2. No.1.New York, springer, 2009.
2. Montgomery, Douglas C., and George C. "Ranger.Applied statistics and probability for engineers", John Wiley & Sons, 2010
3. Christopher Tong and D. Sriram, "Artificial Intelligence in Engineering Design:Knowledge acquisition, commercial systems, and integrated environments", Boston : Academic Press,1992.

Suggested Reading:

1. Anil Maheswari, "Data Analytics", McGraw-Hill,2017.
2. V.K.Jain "Data Science and Analytics (with Python, R and SPSS Programming)", Khanna Publishers, 2018.

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18ME E24

INNOVATION AND INTELLECTUAL PROPERTYRIGHTS

(Core Elective - VI)

Instruction 3 Hours per Week	3 Hours
Duration of SEE	70 Marks
SEE	30 Marks
CIE	3
Credits	

Objectives:

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, the students are able to

1. Understand the evolution of Intellectual property, working of organization's at global level to protect and promote intellectual property. (BL-2)
2. Apply the patent filing process at national and international level. (BL-3)
3. Derive logical conclusion of research, innovation and patent filing. (BL-4)
4. Compare different kinds of Intellectual property and their patenting system. (BL-2)
5. Understand the techno-legal-business angle of Intellectual property, infringement and enforcement Mechanismsfor protection. (BL-2)

UNIT-I

Overview of IPR: Introduction and the need for intellectual property rights (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, protection of industrial design, kind ofprotection available, term of protection of industrial design and need for protection.

UNIT-III

Trademarks: Definition oftrademarks, types of trademarks and functions of a trademark, registration of Trademark, benefits of registration of trademark, procedure for registration of trademark and term of validity of trademark, infringement and passing off.

UNIT-IV

Copyright: What is copyright, what is covered by copyright, term of enforcement of copyright and need for copyright protection, copyright and related rights, copyrights in computer programming.

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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. AjitParulekar 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.R, "Intellectual Property; Patents, copyright, Trademarks and allied rights", Sweet & Maxwell, 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern Law Edn, 1997.

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18PE E12

SUPPLY CHAIN MANAGEMENT

(Core Elective - VI)

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

Objectives:

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 students are able to

1. Understand fundamentals of supply chain and its key concepts. (BL-2)
2. Design an effective supply chain network. (BL-4)
3. Understand the essence of demand and supply and associated gaps. (BL-2)
4. Apply inventory management techniques. (BL-3)
5. Evaluate pricing and revenue management systems. (BL-5)

UNIT-I

Concept of SCM: Supply chain definition, stages of supply chain, objectives, drivers of SCM-facilities, inventory, transportation, information, sourcing and pricing, decision phases in Supply chain, pull and push processes introduction to logistics management.

UNIT-II

Designing the supply chain network: Role of distribution in supply chain and factors influencing its network design and decisions, types of distribution networks – manufacturer storage with direct shipping, manufacturer storage with direct shipping and in transit merge, distributor storage with package carrier delivery, distributor storage with last mile delivery, manufacturer/distributor storage with customer pickup, retail storage with customer pick up, framework for network design decisions-supply chain strategy, regional facility configuration, desirable sites and location choices.

UNIT-III

Planning supply and demand: Planning demand & supply in a supply chain, demand forecasting- moving averages, exponential smoothing, trend and seasonality, aggregate planning, master scheduling, materials requirement planning, time phased order plan, critical ratio, product tree structures.

UNIT-IV

Planning & managing inventories in a supply chain: Inventory control, objectives of inventory management in supply chain, deterministic inventory and probabilistic inventory control, economic order quantity, quantity discounts, Reorder point, basics of ABC analysis, FNSD analysis, VED analysis.

UNIT-V

Sourcing, pricing, coordination and IT in supply chain: Sourcing decisions, key sourcing related processes, In-house or outsource, pricing & revenue management, differential pricing strategies, coordination in supply chain, bullwhip effect, information technology and supply chain, supply chain macro processes-CRM, ISCM, SRM, TMF.

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Text Books:

1. Sunil Chopra & Peter Meindl, "Supply Chain Management – Strategy, Planning and Operation", Pearson Education, Inc., Upper Saddle River, New Jersey, 2003.
2. N. J. Kumar &Mukesh Bhatia, "Supply Chain Management", Neha publishers & Distributors, 2010.
3. Michael H. Hugos, "Essentials of Supply Chain Management", 3/e, John Wiley & Sons, Inc, Hoboken, New Jersy, 2011.

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.

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18IT O01

OBJECT ORIENTED PROGRAMMINGUSING JAVA

(Open Elective)

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

Course 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 are 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 CollectionAPI and Stream classes.
5. Design and Develop GUI applications with the integration of event handling, JDBC.

Modified Course Outcomes:

1. Understand the concepts of Object-Oriented Programming and class concept in Java.
2. Apply concepts of OOP such as Inheritance, Interfaces, Packages and Inner classes.
3. Handle exceptions and demonstrate the concepts of Multithreading and Generic classes.
4. Develop programs using Java Collection API and Stream classes.
5. Design and Develop GUI applications with 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.

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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 areExceptions? 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.

UNIT-V

GUI Design and Event Handling: Component, Container, window, Frame classes. Working with Frame windowGUI 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", 8th Edition, Tata McGraw Hill Publications, 2011.
2. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I, Fundamentals", 8th Edition, Prentice Hall, 2008.

Suggested Reading:

1. E Balagurusamy "Programming with JAVA", 6th Edition , Tata McGraw-Hill Publishing company Ltd,2019.
2. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2nd Edition, Oxford University Press, 2014.
3. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4th Edition, Tata McGraw-Hill Publishing company Ltd., 2010.
4. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide" 2nd Edition, 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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18 PY O01

HISTORY OF SCIENCE AND TECHNOLOGY

(Open Elective)

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

Course Objectives: The objectives of the course is to make the student

1. Gains the knowledge about origin of science in the Stone Age and its progress during Antiquity period.
2. Familiar with scientific views in the Medieval period and during the Industrial revolution..
3. Aware of modern scientific developments from 19th century onwards.

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

1. Demonstrate the process of beginning of science and civilization, knowledge acquisition and philosophical approach of science and its advancements in the Stone Ages and Antiquity period.
2. Illustrate the advancements in science and technology in the medieval period across Asia and Arab countries and decline and revival of science in Europe.
3. Explain the scientific approach and its advances of the Europeans and how the role of engineer during the industrial revolution and the major advancements.
4. Make use of the advancements in the field of science and technology by adopting new philosophies of 19th and first half of 20th century in finding ethical solutions to the societal problems.
5. Interpret the changes in specializations of science and the technology and build the relation between information and society from second half of 20th century onwards.

UNIT-I

Science - The Beginning (through 599 BCE): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions, Civilization, Major advances.

Science in Antiquity (600 BCE- 529 CE): Philosophy- a precursor to science, Hellenistic world and the Roman Empire, Other cultures of the period, Major advances.

UNIT-II

Medieval Science (530 CE - 1452 CE): 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 CE – 1659 CE): Renaissance, Scientific Revolution, Technology, Major advances.

UNIT-III

Scientific Method: Measurement and Communication (1660 CE – 1734 CE): European domination,The scientific method, Major advances.

The Industrial Revolution (1735 CE – 1819 CE): Industrial Revolution, Rise of the engineer, Major Advances.

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UNIT-IV

Science and Technology in the 19th Century (1820 CE – 1894 CE): Philosophical basis of 19th-century science,Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 CE – 1945 CE): The growth of 20th century science, Newphilosophies, Quantum reality, Energy sources, Electricity: a revolution intechnology, Majoradvances.

UNIT-V

Big Science and the Post-Industrial Society (1946 CE – 1972 CE): Big science, Specialization and changing categories, Technology changes society, Major advances.

The Information Age (1973 CE – 2015 CE): 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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18EG O 02

GENDER SENSITIZATION
(Open Elective)

Instruction	3 Periods per week
Duration of SEE Examination	3 Hours
SEE Examination	60 Marks
CIE	40 Marks
Credits 3	

Objectives: This course will introduce the students to:

1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

Outcomes: After completion of the course the students are able to

1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

UNIT – I
Understanding Gender:
Gender: Why Should We Study It? (Towards a World of Equals: Unit -1)
Socialization: Making Women, Making Men (Towards a World of Equals: Unit -2) Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II
Gender And Biology:
Missing Women: Sex Selection and Its Consequences (Towards a World of Equals: Unit -4) Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (Towards a World of Equals: Unit -10) Two or Many? Struggles with Discrimination.

UNIT – III
Gender and Labour:
Housework: the Invisible Labour (Towards a World of Equals: Unit -3) "My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (Towards a World of Equals: Unit -7) Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV
Issues Of Violence
Sexual Harassment: Say No! (Towards a World of Equals: Unit -6) Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu".

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Domestic Violence: Speaking Out (Towards a World of Equals: Unit -8) Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice. Thinking about Sexual Violence (Towards a World of Equals: Unit -11) Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

UNIT – V

Gender: Co - Existence

Just Relationships: Being Together as Equals (Towards a World of Equals: Unit -12) Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Additional Reading: Rosa Parks-The Brave Heart.

Textbook:

1. A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu **"Towards a World of Equals: A Bilingual Textbook on Gender"** published by Telugu Akademi, Hyderabad, Telangana State, **2015.**

Suggested Reading:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. **"I Fought For My Life…and Won."** Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:

1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

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18ITO03

PRINCIPLES OF INTERNET OF THINGS

(Open Elective)

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

Course Objectives:

1. To provide an overview of Internet of Things, building blocks of IoT andreal-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 are able to:

1. Comprehend the terminology, protocols and communication modelsof 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.

Modified Course Outcomes:

1. Outline the terminology, protocols, Communication models and Communication APIs of IoT.
2. Define the various IoT enabling technologies, Levels, Domain Specific applications and differentiation between M2M and IoT.
3. Make use the basics of Python Scripting Language for developing IoT applications.
4. Infer the steps involved in IoT system design methodology with Home Automation case study.
5. Examine IoT systems using the Raspberry Pi board and interfacing sensors.

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, Languagefeatures 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.

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UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose andRequirements Specification, Process Specification, Domain Model Specification, InformationModel Specification, Service Specifications, IoT Level Specification, Functional ViewSpecification, Operational View Specification, Device and Component Integration, ApplicationDevelopment, Case Study on IoT System for Weather Monitoring.

UNIT-V

IoT Physical Devices and End Points: Basic building blocks of an IoT device, RaspberryPi abouttheRaspberry Pi board, Raspberry Pi interfaces-Serial, SPI,I2C, Other IoTDevicespcDuino,BeagleBone Black, Cubieboard.Python Web Application Framework: Django Framework-Roles of Model, Template and View.

Text Books:

1. ArshdeepBahga 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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18CSO 09

BASICS OF ARTIFICIAL INTELLIGENCE

(Open Elective)

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

Pre-requisites: Basic Mathematics.

Course Objectives: The main objectives of this course are:

1. To Provide 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.

Course Outcomes: On Successful completion of this course, student will be able to

1. Identify various search strategies to solve problems.
2. Compare and contrast knowledge representation schemes.
3. Apply Bayesian Networks and Dempster Shafer theory for reasoning
4. Explain the role of agents and interaction with the environment
5. Determine different learning paradigms.
6. Explain robotic architectures and expert systems.

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.

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Text Books:

1. Elaine Rich, Kevin Night, Shivashankar B Nair, "Artificial Intelligence", 3rd Edition, 2008
2. Russell Norvig, "Artificial Intelligence-Modern Approach", 3rd edition, 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:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

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18ME C25

METROLOGY AND INSTRUMENTATION LAB

Instruction	3Hours per week
Duration of SEE	3 Hours
SEE	50Marks
CIE	25 Marks
Credits	1.5

Objectives:

1. To choose the proper measuring instrument for the precise measurement of length, height and diameter.
2. To classify the different measuring instruments used for the angular measurement.
3. To develop gear & screw thread parameters using optical projector and tool maker's microscope.
4. To analyze the limits, fits and tolerances for selection and design of gauges.
5. To determine the working principles in the measurement of Flatness, Roundness and Surface roughness.

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

1. Measure the linear dimension by using appropriate method & device. (BL-3)
2. Demonstrate the knowledge of angular measurementsand use measuring instruments as per requirements. (BL-2)
3. Determine the gear and screw thread parameters using profile projector and tool makers' microscope. (BL-3)
4. Design and test plain limit gauges for a given specimen. (BL-3)
5. Evaluate and estimate the measurement of flatness, roundness and surface roughness. (BL-5)

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 plugand snap gauges for a given component.
10. Surface roughness measurement by Taylor Hobson -Talysurf.
11. Measurement of gear tooth thickness by gear tooth vernier.
12. Displacement measurement with LVDT.
13. Analyze, assess, measure and document all Measuring attributes of a selected component by using appropriate methods and devices.

Note: Student should complete a minimum of 10 experiments including experiment number 13 which is compulsory.

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. RegaRajendra," Principles of Engineering Metrology", Jaico Publishing House, Mumbai, 2008.
2. B.C. Nakra& K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e, McGraw-Hill, 2014 .

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18ME C26 **COMPUTER AIDED ENGINEERING LAB**

Instruction	3 Hours per week	
Duration of SEE	3 Hours	
SEE		50 Marks
CIE	25 Marks	
Credits	1.5	

Objectives:

1. Trusses , Bars of constant cross section area, tapered cross section area and stepped bar.
2. Beams -Simply supported, cantilever, beams with UDL, and beams with varying load etc.
3. Stress analysis of a rectangular plate with a circular hole, axisymmetric problems.
4. Buckling analysis and Dynamic Analysis.
5. Steady state and Transient heat transfer analysis.

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

1. Apply basics of Theory of Elasticity to continuum problems. (BL- 3)
2. Analyze finite elements like 1D, 2D and 3D structures for linear static analysis. (BL-4)
3. Solve heat transfer problems. (BL- 3)
4. Examine problems of limited complexity in buckling and dynamic analysis. (BL-4)
5. Evaluate solutions to practical problems by finite element software. (BL-5)

List of Exercises:

1. Analysis of plane truss & special truss with various cross sections and materials.
2. 2D & 3D 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 casting.
11. Non linear analysis of cantilever beam.
12. Coupled field analysis.
13. Static/Buckling/Modal/Harmonic/Transient/Non-Linear/ heat transfer analysis of a selected component.

Note:

1. **Students should complete a minimum of 10 exercises including exercise number 13 which is compulsory.**
2. Students may use any or combination of FEA software(ANSYS/ABAQUS/NASTRAN/NISA/CAEFEM/ADINA).

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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18ME C27

PROJECT: PART - 1

Instruction	4 Hours per week
Duration of SEE	----
SEE	----
CIE	50 Marks
Credits	2

Objective: The objectiveof Project Part -1 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 theguidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D.

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

1. Identify a topic in advanced areas of Mechanical / Allied fields of Engineering. (BL-1)
2. Review literature to identify the gaps, define the objectives and scope of the work. (BL-2)
3. Generate innovative ideas for societal benefit and Nation building. (BL-6)
4. Develop prototypes/models, experimental setup and software systems necessary to meet the objectives. (BL-6)
5. Prepare a technical report and present before the departmental committee (BL-5)

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:

Evaluation by	Maximum Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Departmental Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

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18EC O01

REMOTE SENSING AND GIS

(Open Elective)

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

Course Objectives:

This course aims to:

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the understanding of basic concepts of remote sensing and interpret energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply an appropriate data model from the acquired knowledge of the basics of GIS.
5. Explain the procedure for encoding data and geospatial data analysis.

UNIT-I

Concept of Remote Sensing: Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages and limitations of Remote sensing, Orbits of Remote sensing satellites, Indian remote sensing satellites.

UNIT-II

Digital Imaging: Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

UNIT-III

Microwave Remote Sensing: Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

UNIT-IV

Concept of Geographic Information Systems: Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

UNIT-V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

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18MTO 01

DECISION THEORY
(OPEN ELECTIVE)

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

Course Objectives:

1. To explain procedure of LPP
2. To discuss various methods to get optimum solution.
3. To analyse the optimum solution by Hungarian method.
4. To demonstrate the algorithm for job sequencing.
5. To discuss method of finding solution of Dynamic programming problem..

Course Outcomes:

On the successful completion of this course, the student shall be able to

1. Calculate the optimum values for given objective function by LPP
2. Solve the solution for maximise the profit with minimum cost by Transportation problem.
3. Determine the optimum feasible solution for sequencing the Jobs
4. Arrange the jobs for different Machines to get optimum values
5. Measure the solution of dynamical system problems

UNIT-I: Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research, Linear Programming Problem-Formulation of LPP, Graphical solution of LPP, Simplex Method, Artificial variables, big-M method.

UNIT-II: Transportation problems, Formulation, solution, unbalanced transportation problems, finding basic feasible solutions-Northwest corner rule, least cost method and Vogel's approximations method, Optimality test: the stepping stone method and MODI method.

UNIT-III: Assignment model, formulation, Hungarian method for optimal solution, solving unbalanced problem, Traveling salesman problem and assignment problem

UNIT IV: Sequencing models, solution of sequencing problem-processing n jobs through 2 Machines-processing n jobs through 3 Machines-processing 2 jobs through m machines-processing n jobs through m machines.

UNIT-V: Dynamic Programming, Characteristics of dynamic programming, Solution of LPP by dynamic programming and Network scheduling by PET/CPM.

Text Books:

1. P.SankaraIyer, "Operations Research", Tata McGraw-Hill, 2008.
2. A.M.Natarajan, P.Balasubramani, A.Tamilarasi, "Operations Research", Pearson Educairons, 2005.

Suggested Reading:

1. J K Sharma, "Operations Research Theory & Applications, 3e", Macmillan India Ltd, 2007.
2. P.K.Gupta and D.S.Hira, "Operations Research", S.Chand& Co, 2007.
3. Kranti Swarup , P.K.Gupta and Man Mohan "Operations Research", Sultan Chand & Sons, 2019.

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18EE O 03 **ENERGY AUDITING**

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

Course 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 are 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, electricitygeneration 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 forbuildings: 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)

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18CSO 07

BASICS OF CYBER SECURITY

(Open Elective)

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

Pre-requisites: Operating System, Computer Network, Cryptography.

Course 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. Listthe different types of cybercrimes and analyze legal frameworks to handle cybercrimes.
2. Identify the Tools and Methods used in cybercrimes.
3. Analyze and resolve cyber security issues and laws governing Cyberspace.
4. Describe the need of Digital Forensics and the importance of digital evidence in prosecution.
5. Interpret the commercial activities in the event of significant information security incidents in the Organization.
6. Discuss the vulnerabilities in networking protocols and their mitigation techniques.

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.

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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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18EC O05

MEMS AND ITS APPLICATIONS

(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course 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.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand various materials used for MEMS.
2. Design the micro devices and systems using the MEMS fabrication process.
3. Analyze the operation of different Sensors and Actuators.
4. Interpret 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 Combo 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.

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UNIT- IV

Piezo resistive Sensors: Origin and Expression of Peizo resistivity, Piezo resistive Sensor Materials: Metal Strain Gauges, Single crystal Silicon, Polycrystalline Silicon, Applications of Piezo resistive 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.

Reference Books:

1. P. Rai Choudary, "MEMS and MEMS Technology and Applications", PHI publications, 2009.
2. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC press, 2001.

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18EG O01

TECHNICAL WRITING SKILLS
(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 marks
CIE	40 marks
Credits	3

Objectives : The course will introduce the students to:

1. Process of communication and channels of communication in general and technical writing.
2. Technical Writing and also contextual use of technology specific words.
3. Business letters and technical articles.
4. Technical reports and technical proposals.
5. Transferring data from verbal to graphic and vice versa and making technical presentations.

Outcomes : After successful completion of the course students are able to:

1. Understand the channels of communication and define nature and aspects of Technical communication
2. Compare and contrast technical communication to that of general communication while constructing error free sentences applying features of technical writing.
3. Analyze data, draw inferences to write Journal articles and conference papers and to compose business letters.
4. Evaluate data to draft technical reports and technical proposals.
5. Design a technical presentation by understanding the nuances of presentation skills and also transfer data from verbal to graphic and vice versa.

Unit I

Communication – Nature and process.
Channels of Communication – Downward, upward and horizontal and lateral 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, significance and types of technical articles. Writing an abstract. 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

Information Transfer – Graphic to verbal (written) and verbal to graphic.
Technical Presentations : Important aspects of oral and visual presentations.

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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**

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18BT O01

BASICS OF BIOLOGY

(Open Elective-I)

Instruction	3LHoursperWeek
DurationofSEE	3Hours
SEE	70Marks
CIE	30Marks
Credits	3

Course Objectives: This course aims to:

1. Impart knowledge of origin and evolution of biological organisms.
2. Understand the structure and functions of humanorgan systems.
3. Understand theprinciples behind medicaldevices for diagnosis of human health and environment protection.
4. Give an insight of biological information, relationship and genome sequencing of various organisms.

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

1. Explain the theories of origin and evolution of life.
2. Describe the anatomical structure and physiological functions of thehuman organ systems.
3. Outline the principle and applications of medical devises.
4. Discussthe technology advancements in improving human health and environment
5. Explain the biological information, sequencing and evolutionary relationship among organisms.

UNIT-I

IntroductiontoBiology: ClassicalVsModernBiology;ImportanceofBiological Science and Historical developments; Origin of Life, UreyMillerExperiment, Spontaneous Generation Theory; Three Domains of Life; Principle and ApplicationsofMicroscope(LightandElectronMicroscope),Prokaryoticand Eukaryotic Cell-Structure and their differences.

UNIT-II

Humanorgansystemsandtheirfunctions -I: Introduction to various organ systems of humanbody and their functions; SkeletalSystem-Bones,Tendon,Ligaments,principleandapplicationsinknee replacement; Nervous System - Structure of Brain, Spinal Cord, Neuron, Neurotransmitters,Synapse,Alzheimer's-acasestudy,principleandapplications ofImagingTechniques(CT&MRIscans);CirculatorySystem-Heartstructureand functions, principle and applications of cardiac devices (Stent and Pacemaker), Artificial heart, blood components and typing, haemocytometer.

UNIT-III

HumanAnatomyandFunctions-II: RespiratorySystems-Lungstructureand function, principle and applications of Peak FlowMeter.ECMO(ExtraCorporeal Membrane Oxygenation); Excretory Systems-Kidney structure and function, principleandapplicationsofDialysis;Prenataldiagnosis;Assistedreproductive techniques- IVF,Surrogacy.

UNIT-IV

Medical Biotechnology and Bioremediation: Cells of Immune System, Etiology of cancer, Cancer treatment (Radiation Therapy); Stem Cells and its Clinical applications; Scaffolds and 3D printing of organs; Bio sensors and their applications; Parts of bioreactor and its types; Bioremediation.

UNIT-V

Bioinformatics: Nucleic acid composition, Genetic Code, Amino acid, Polypeptide, Levels of protein structure, Homolog, Ortholog and Paralog, Phylogenetics, Genome Sequencing, Human GenomeProject, Next generation sequencing.

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TextBooks:

1. Campbell,N.A.,Reece,J.B.,Urry,Lisa, Cain,M,L.,Wasserman,S.A.,Minorsky,P.V.,Jackson,R.B. "Biology: A Global Approach", 11th edition,Pearson EducationLtd. 2017
2. Shier,David,Butler,Jackie, Lewis,Ricki., "Hole'sHumanAnatomy&Physiology", 13th edition, McGrawHill2017.
3. Dubey RC " A Text book of Biotechnology" 5th Edition, S Chand and Company limited, 2014.
4. Bernard R. Glick, T. L. Delovitch, Cheryl L. Patten, "Medical Biotechnology", 1st edition, ASMPress,2014.

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18CE O02

DISASTER MITIGATION AND MANAGEMENT (M)

(Open Elective)

Instruction	3 L Hours per Week
End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: This course aims to,

1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities.
2. Impart knowledge in students about the nature, causes, consequences and mitigation measures of the various Hydro-meteorological disasters.
3. Introduce the concepts of causes, consequences and mitigation measures of the various Geographical disasters.
4. Enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters.
5. Equip the students with the knowledge of the impacts of disaster, chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of Central and State Level Authorities.

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

1. Identify and understand the fundamental terminologies in disaster management.
2. Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and non- structural mitigation measures.
3. Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
4. Analyze various mechanisms and consequences of human induced disasters.
5. Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central and State Government bodies at different levels.

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and manmade; Introduction to Disaster management cycle; 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; Applications. Case studies related to various hydro-meteorological disasters.

UNIT- III:

Geographical based disasters: 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 geographical based disasters.

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UNIT- IV:

Human Induced Disasters: 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 leakage; Management of chemical terrorism disasters and biological disasters; Case studies related to power break downs, fire accidents, traffic accidents, oil spills and stampedes, building failure disasters.

UNIT- V:

Concept of Disaster Impacts and Management:

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.

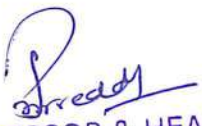
Disaster management cycle and its phases, risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; 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. http://www.indiaenvironmentportal.org.in/files/file\disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of Home Affairs.
6. Disaster Medical Systems Guidelines, Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings, Geneva: IASC.
8. http://ndma.gov.in/ (Home page of National Disaster Management Authority)



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With effect from the academic year 2020-21

18EEO 05 **WASTE MANAGEMENT**

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

Course 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.

Course Outcomes:

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. Basics of Solid and Hazardous Waste Mgmt. Tech. by Kanti L.Shah 1999, Prentice Hall.
2. Solid and Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & Dist.

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18EC O07

SYSTEM AUTOMATION AND CONTROL
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course 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.

Course Outcomes: After completion of this course, students are able to:

1. Understand the features of various automatic and process control systems.
2. Define and analyze various measuring parameters in the industry.
3. Compare performance of various controllers (P, PD, PI, and PID).
4. Illustrate the role of digital computers in automation.
5. Develop various robot structures for different applications.

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.

Sensors: Sensor definition, Different types of 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, Bridge measurements: General equation for bridge balance, 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 steps and other troubleshooting aids.

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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 B. C, "Automatic Control Systems", 9th edition
2. A.K Sawhney,"A course on Electrical and Electronic Measurements and Instrumentation".

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18ME C28

TECHNICAL SEMINAR

Instruction	2 Hours per week
Duration of SEE	----
SEE	----
CIE	50 Marks
Credits	1

Objective: 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.

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

1. Identify the recent advances in the field of engineering/technology. (BL-1)
2. Develop the skills and expertise in report writing. (BL-6)
3. Compile the content and prepare comprehensive report. (BL-4)
4. Demonstrate skills required for preparation of a technical report. (BL-3)
5. Present technical know-how and professional skills before the committee. (BL-3)

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 noticeboard.
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 10minutes.
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 be preferably 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
Total Marks		**50**

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18ME C29

PROJECT: PART - 2

Instruction	20Hours per week
Duration of SEE	----
SEE	100 Marks
CIE	100 Marks
Credits	10

Objectives: The objective of Project Part-2 is to enable the student extend further the investigative study taken up, 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 toprovide a good training for the student(s) in R&D work and technical leadership.

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

1. Summarize the literature review for the identified problem. (BL-2)
2. Identify methods and materials to carry out experiments/ develop code/simulation. (BL-4)
3. Integrate the methodology and engineering tools adopted for solving the problem. (BL-6)
4. Analyze and discuss the results to draw valid conclusions. (BL-4)
5. Exhibit knowledge, skill, attitude and technical knowhow in preparing report as per format and presenting as a professional engineer. (BL-3)

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 teamwork.
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:

Evaluation by	Maximum Marks	Evaluation Criteria / Parameter
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

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Guidelines for awarding marks in SEE:

Evaluation by	Maximum 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

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With Effect from the Academic Year 2020 – 2021

18ME C12 **DYNAMICS OF MACHINES**

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

Objectives:

1. To understand static and dynamic forces on planar mechanisms and turning moment Diagrams for Flywheels
2. To understand the Gyroscopic effect and the performances of Governors
3. To know the Balancing of rotating and reciprocating masses
4. To determine natural frequencies of undamped, damped and forced vibrating systems of single degree freedom systems.
5. To understand the modes of vibrations, Two degree of Freedom and Torsion Vibrations

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

1. Determine the fluctuation of energy and decide the cross section of flywheel. (BL-3)
2. Understand the gyroscopic effects in ships, aero planes and road vehicles. (BL-2)
3. Analyze the characteristics of various centrifugal governors. (BL-4)
4. Analyze balancing problems in rotating and reciprocating machinery. (BL-4)
5. Understand free and forced vibrations of single degree freedom systems and two-degree freedom linear systems. (BL-2)

UNIT- I

Force analysis: Dynamic force analysis of single slider crank mechanism, concept of dynamically equivalent link.

Flywheels: Working principle of flywheel, turning moment on the crank shaft, turning moment diagrams, maximum fluctuation of energy and its determination, coefficient of fluctuation of speed, design of flywheels, rim type flywheel versus solid type flywheel.

Gyroscope: Principle of gyroscope, roll, yaw and pitch motions, gyroscopic effect in a two-wheeler, car, ship and aeroplane, practical problems.

UNIT- II

Governors: Necessity of governor, different types of governors, working principle of centrifugal governors, characteristics of Watt governor, Porter governor, Proell governor, Hartnell governor, Hartung governor, hunting of governors, concept of control force, control force diagram, definition of stability of governor, condition for stability, concept of isochronism, sensitivity of governor, energy of governor.

UNIT- III

Balancing of Rotating masses: Balancing and its types, rotor balancing, single plane and two plane balancing, unbalanced forces and couples, static and dynamic balancing, balancing of rotors by analytical and graphical methods.

Balancing of reciprocating machines: Primary and secondary unbalanced forces, balancing of in line and radial engines.

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 and three degree freedom systems: Natural frequencies of two degree freedom linear systems. Nodes in two and three rotor systems, modes of vibration, determining natural frequencies by Holzer's method for multi-rotor systems. Dunkerley's and Rayleigh's approximate methods.

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Text Books:

1. S.S. Rattan, "Theory of Machines", Fourth edition ,Tata-Mc Graw Hill, ,2014
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, "Theory of Machines & Mechanisms", Oxford University press, 2003.
3. William T.Thomson "Theory of Vibration with Application", 5th edition, Pearson education 2008

Suggested Reading:

1. A. Ghosh and Mallick, "Theory of mechanisms and machines", Affiliated to E-W Press, 1988.
2. J.S. Rao and Gupta, "Theory and Practice of Mechanical Vibrations", PHI, 1984

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With Effect from the Academic Year 2020 – 2021

18ME C13

APPLIED THERMODYNAMICS AND HEAT TRANSFER

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 working principles of reciprocating air compressor and its applications in engineering
2. the working principle of diesel and petrol engine, their combustion phenomena and problems pertaining to abnormal combustion
3. Student will understand the features of IC engine like ignition system and injection system
4. the basic modes of heat transfer
5. the classification of heat exchanger, concepts of radiation heat transfer and phase heat transfer

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

1. Estimate the power required for reciprocating air compressor using the basic principles of thermodynamics for many engineering applications. (BL-4)
2. Evaluate the performance of C.I. and S.I. engines with appropriate consideration for public health and safety. (BL-5)
3. Understand the functioning of components of I.C. engines and the concept of abnormal combustion with remedial measures. (BL-2)
4. Derive the expressions for the heat transfer in conduction and convection with the basic principles of thermodynamics. (BL-3)
5. Understand the basic principles of heat exchangers, boiling and condensation. (BL-2)

UNIT – I

Reciprocating Air Compressors: Classification of compressors, advantages of reciprocating compressors over rotary compressors, applications of compressed air, working principle of reciprocating compressors - single stage and multi stage compressors with and without clearance, concept of optimum pressure ratio, minimum work input, various efficiencies of multi stage compressors, simple problems on reciprocating compressors.

UNIT - II

Internal Combustion Engines: Classification, working principles of 2 stroke, 4 stroke SI and CI engines, valve and port timing diagrams, performance of IC engines, Morse test, various methods of determining frictional power, various efficiencies, heat balance sheet.

UNIT - III

Combustion Phenomena: Stages of combustion in SI and CI engines, octane and cetane number, factors affecting, normal and abnormal combustion phenomenon in SI and CI engines, methods to control the abnormal combustion, types of combustion chambers, cooling systems, 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.

UNIT - V

Radiation: Various laws of radiation, concept of black-body.

Heat Exchangers: Classification, concept of LMTD and simple problems.

Condensation and boiling: Types of condensation, heat transfer coefficient for laminar parallel flow condensation, pool boiling curve, simple problems on condensation and boiling.

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,

Suggested Reading:

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

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With Effect from the Academic Year 2020 – 2021

18ME C14

DESIGN OF MACHINE ELEMENTS

(Use of data book is permitted)

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

Objectives:

1. To understand the principles of machine design and design considerations, types of loads, failure criteria.
2. To design machine members for static, fluctuating loads and impact loads
3. Learn the design principles of shafts, keys, couplings, belt drives and pulleys.
4. Understand the principles of design of permanent joints such as riveted and welded joints.
5. Understand the principles of design of bolted joints, power screws and gasket joints.

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

1. Understand the standards, codes, various design considerations and failure criteria of members (BL-2)
2. Analyze and evaluate machine members subjected to static and dynamic loads (BL-4)
3. Recommend suitable shafts, couplings and belt drives for a given application (BL-5)
4. Design permanent joints for a given application (BL-6)
5. Design bolted joints, power screws and screw jack (BL-6)

UNIT – I

Introduction: Materials used in machine design and their specifications to Indian standards, codes and standards used in design. Reliability, principles of Ergonomics and Manufacturing considerations. Preferred numbers, analysis of stress and strain: Types of loading and stresses. Cotter and knuckle joints. 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 shafts, Keys & Couplings: Solid, hollow and splined shafts under torsion and bending loads, types & design of Keys, muff , split muff , flange, marine type and flexible type of couplings.
Design of Belt Drive Systems: selection of belts and design of pulleys.

UNIT – IV

Design of Permanent Joints: Types of Riveted joints, efficiency of the joint. Design of riveted joints subjected to direct and eccentric loads. Types and design of welded joints subjected to direct and eccentric loading.

UNIT – V

Design of Bolted Joints, Power Screws: 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, "Design Machine Elements", Mc Graw Hill Publication, 2017.
2. J.E. Shigley, C.R. Mischne, "Mechanical Engineering Design", Tata Mc Graw Hill Publications, 2015.
3. R.S.Khurmi and J.K.Gupta, "Machine design", 34/e, S Chand publications, 2018.

Suggested Reading:

1. P. Kannaiah, "Machine Design", Sci-Tech Publications, 2010
2. M.F. Spotts, "Design of Machine Elements", Prentice Hall of India, 2013.

Machine Design Data Books:

1. K. Mahadevan, K. Balaveera Reddy., "Design Data Hand book for Mechanical Engineers", 3/e, CBS Publisher, 2018
2. PSG College, "Design Data book", 2012

With Effect from the Academic Year 2019 – 2020

18PE C05

METAL FORMING TECHNOLOGY

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

Objectives:

1. To introduce students to metal forming technology while understanding the fundamentals of theory of plastic deformation and stress strain relations.
2. To explain the working principle of various operations like sheet metal operations, extrusion, drawing, rolling, forging etc with their applications, merits and demerits.
3. To explain different deformation mechanisms and effect of the process variables on different process and product quality.
4. To enable the students to determine loading and energy required for metal forming tools and machines.
5. To enable the students to understand different defects that occurring forming operations with remedial measures.

Outcomes:

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

1. Apply theory of plasticity to analyze metal forming processes.
2. Understand the basic principles and practical aspects of metal forming operations.
3. Understand various process parameters that affect product quality in various processes under different conditions.
4. Determine load, energy and power required for various processes and machines.
5. Propose suitable metal forming processes for making different products.

UNIT - I

Theory of Plasticity: Plastic deformation, work hardening, cold, warm and hot working with their advantages and disadvantages, true stress and true strain, flow curve, effect of strain-rate and temperature on flow stress. yield criterion: von-Mises and Tresca

UNIT - II

Forging: Open and closed die forging, Drop, Press and Machine forging operations, types of hammers and presses, their principles of operation and applications, Forging load calculation with slab method and empirical methods, forge ability , forging defects, Methods of heating and types of furnaces, Isothermal forging Hot Isostatic Pressing.

UNIT - III

Extrusion and Drawing: Types of extrusion, Tube extrusion Rod/wire/tube drawing ,load calculation of extrusion and drawing using uniform deformation energy method and slab method. maximum reduction in drawing, effect of friction, die angles, deformation speeds on extrusion/drawing forces, die materials and lubrication in these operations, extrusion and drawing defects.

UNIT - IV

Rolling: Principles of Metal rolling, roll load, torque and mill power calculation for homogenous deformation, classification and description of rolling mills, their applications, rolling defects, shape rolling, ring rolling thread rolling, roll bending and powder rolling.

UNIT - V

Sheet Metal Working: Sheet Metal working operations-shearing, blanking, piercing, bending, drawing and squeezing operations, estimation of loads and energy required for these operations, Formability, FLD, types of presses, specifications and their applications, comparison of simple, compound, progressive and combination dies. Other sheet metal forming operations like Embossing, Stretch forming, Spinning and Flow forming.

Text Books:

1. Serope Kalpakjian, "Manufacturing Engineering and Technology", 4/e, Pearson education INC., 2015.
2. George.E. Dieter, "Mechanical Metallurgy", SI Metric Edition, McGraw –Hill, 1988.
3. P.N. Rao, "Manufacturing Technology", 4/e, TMH, 2015.

Suggested Reading:

1. R.K. Jain, S.C. Gupta, "Production Technology", 17/e, Khanna Publications, 2012.
2. Roy A lindberg, "Materials and Process of manufacturing", 4/e, PHI, 2004.
3. John A Schey, "Introduction To Manufacturing Processes", 3/e, McGraw Hill education, 2012.

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With Effect from the Academic Year 2020 – 2021

18ME E01

REFIGRERATION AND AIR CONDITIONING

(Core Elective-I)

(Use of data book is permitted)

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

Objectives:

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 and comfort air conditioning.
5. Acquire knowledge in estimating air conditioning loads.

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

1. Evaluate COP of various air craft refrigeration systems using principles of thermodynamics along with necessity of eco-friendly refrigerants for public health and safety. (BL-4)
2. Analyze COP of vapor compression refrigeration system with the appropriate concern for environment. (BL-4)
3. Understand the Vapour absorption, steam jet refrigeration and non-conventional refrigeration in order to provide valid conclusions over simple vapor compression refrigeration system. (BL-2)
4. Understand the working principle of air conditioning system including human comfort and its importance over environment, society with balance of ecological system. (BL-2)
5. Apply the principles of engineering which are complex in nature, having lifelong learning to design air conditioning system for various environments. (BL-3)

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, Simplecooling 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 Refrigerationcycle. 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.

UNIT - III

Vapour Absorption Refrigeration System: Simple absorption systems, COP, Practical ammonia absorptionrefrigeration 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 andapplications.

Thermoelectric refrigeration systems: Seebeck effect, Peltier effect and Thompson effect, Analysis of the thermoelectric refrigeration systems using Peltier effect, Expression for COP, Vortex tube refrigeration – principle and working.

UNIT - IV

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation of variousPsychrometric processes on the chart.

Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics of humanbody, ASHRE comfort chart, Effective temperature.

UNIT - V

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Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, ApparatusDew Point, Various Heat Loads.
Design of air conditioning systems: Simple Problems on summer, winter and year Round Air conditioningsystems 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, 2017.
2. Stoecker, W.F., and Jones, J.W., Refrigeration and Air-Conditioning, Mc.Graw Hill, New Delhi, 2014.
3. R.K. Rajput, "Refrigeration and Air Conditioning", Laxmi Publications, New Delhi, 2013.

Suggested Reading:

1. V.K. Jain, "Refrigeration and Air Conditioning", S Chand & Company, New Delhi, 2019.
2. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, Allahabad, 2015.

Refrigeration and air conditioning data books:

1. Manohar Prasad, "Refrigeration and Airconditioning Data Book", New Age International Publishers, 2010.

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18ME E02

VALUES, ETHICS AND SOCIETY

(Core Elective - I)

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

Objectives:

1. Develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. Understand the values, the need for value adoption and prepare them meet the challenges
3. Develop the potential to adopt values, develop a good character and personality and lead a happy life
4. Practice the values in life and contribute for the society around them and for the development of the institutions/organization.
5. Understand the professional ethics and their applications to engineering profession

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

1. State basic values and the need for value education. (BL-2)
2. Differentiatebetween values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual. (BL-2)
3. Demonstrate the knowledge of ethics at their work place and apply different theoretical approaches to solve ethical dilemmas. (BL-3)
4. Apply risk and safety measures in the engineering practice. (BL-3)
5. Understand the role of a human being in ensuring harmony in society and nature. (BL-2)

UNIT- I

Concepts and Classification of Values –Need and Challenges for Value Adoption: Definition of Values, Concept of Values, Classification of Values, Hierarchy of Values, Types of Values, Espoused and Applied Values, Value judgement based on Culture, Value judgement based on Tradition, Interdependence of Values, Need for value education, Findings of Commissions and Committees, Corruption and illegal practices, Science and Technology without values, Exploitation of nature, Increasing use of violence and intoxicants, Lack of education in values, Implications of education in values, Vision for a better India, Challenges for Value adoption, Cultural, Social, Religious, Intellectual and Personal challenges.

UNIT -II

Process for Value Education: Right Understanding, Relationship and Physical Facilities,basicrequirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and prosperity correctly, a critical appraisal of the current scenario, Method to fulfill the above human aspirations; understanding and living in harmony at various levels.

UNIT-III

Basic Concepts of Professional Ethics: Ethics, Morals and Human life , Types of Ethics, Personal Ethics,Professional ethics, Ethical dilemmas, Indian and Global thoughts on ethics, Profession, Professional and Professionalism, Ethical role of a professional Basic ethical principles, Some basic ethical theories, use of ethical theories, Science, Religion Ethics, Genders and ethics, Media and ethics, Computer Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities.

UNIT- IV

Ethics in Engineering Profession: Engineering profession-Technology and Society-Engineering as SocialExperimentation-Engineering ethics-Ethical obligations of Engineering Professionals, Role of Engineers-Engineers as Managers, Professional responsibilities of Engineers, Engineers Responsibility for Safety, A few Case Studies on Risk management, Conflicts of Interest, Occupational Crimes- Plagiarism-Self plagiarism-Ethics Audit-Consideration for ethics audit-Ethics Standards and Bench Marking.

UNIT - V

Understanding Harmony in the Family and Society: Understanding harmony in the family, the basic unit ofhuman interaction, Understanding values in human relationship; meaning of Nyaya and Program for its fulfillment to ensure Ubhay-tripti, Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.

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Text Books:

1. Subramanian R., "Professional Ethics", Oxford University Press , 2017

2. Dinesh Babu S., "Professional Ethics and Human Values", Laxmi Publications , 2016
3. Nagarajan R.S., "A Text Book on Human Values and Professional Ethics", New Age Publications, 2007

Suggested Reading:

1. Santosh Ajmera and Nanda Kishore Reddy, "Ethics, Integrity and Aptitude", Mc Graw Hill Education Private Limited , 2014
2. Govinda Rajan M., Natarajan S., Senthil Kumar V.S., "Professional Ethics and Human Values", Prentice Hall India Private Limited, 2013.

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18PE E01

PLASTICS, CERAMICS AND COMPOSITE MATERIALS

(Core Elective-I)

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

Objectives:

1. Understand various types of plastics, their properties and uses.
2. Understand various methods of manufacturing plastic components.
3. Understand types of ceramics, refractoriness, and their uses.
4. Understand the manufacturing processes of ceramics.
5. Understand composites and their uses.

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

1. Recall the types of plastics, properties and applications. (BL-1)
2. Select the suitable method of manufacturing a plastic component. (BL-5)
3. Describe refractories, their manufacturing methods and applications. (BL-2)
4. Describe the properties, uses and Manufacturing methods of white wares, ceramic coatings and glass. (BL-2)
5. Understand the concept of composites, properties in engineering applications. (BL-2)

UNIT - I

Introduction to Polymers: Plastics and elastomers, polymerization, degree of polymerization, thermoplasticsand thermosetting plastics, properties and applications of various thermoplastic and thermosetting plastics, mechanical properties of plastics and their influencing parameters.

UNIT - II

Processing of Plastics and Elastomers: Constructional features, working principles, advantages, disadvantages and applications of Injection moulding, Extrusion, calendaring, thermoforming, Blowmoulding, 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 technologyincluding 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, Fiber reinforced composites, Applications of various types of composites, Production techniques for glass fiber, carbon fiber and ceramic fiber, manufacturing methods of composites.

Text Books:

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

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Suggested Reading:

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

18PE E02

PRODUCT DESIGN AND PROCESS PLANNING

(Core Elective-I)

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

Objectives:

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

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

1. Define the needs of the customer while designing a new product or modifying existing product in the competitive environment. (BL-1)
2. Understand creativity, brainstorming and ergonomic concepts. (BL-2)
3. Apply the concept of design for manufacture, assembly, maintenance, reliability and product life cycle in developing a product. (BL-3)
4. Implement the Intellectual Property Rights to a new product or a process. (BL-3)
5. Evaluate and recommend an effective Process Plan and principles of value engineering to new product development. (BL-5)

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 brainstorming 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, andmarketing. 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 and Copy Rights.

Process Planning: Need and significance of process planning, Process capability studies, Process sheets, Benefits and Types of Computer Aided process planning.

UNIT - V

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

Text Books:

1. B.W. Niebel & A.B.Draper, "Production Design & Process Engg", McGraw Hill, 1974.
2. K. G. Swift & J. D. Booker, "Process Selection: From Design to Manufacture", Butterworth-Heinemann Ltd; Revised 2/e, 2003.
3. BhaskaranGopalakrishnan, "Product Design and Process Planning in CE (Design & Manufacturing", Chapman and Hall publishers, 1994.

Suggested Reading:

1. A.K. Chitale& R.C. Gupta, "Product Design & Manufacturing", PHI, 1997.
2. Karl T. Ulrich, Stephen Eppinger, "Product Design and Development", McGrawHill Publication, 2012.

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18PE E03 **POWDER PROCESSING** (Core 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 different

1. Powder properties & characteristics.
2. Powder mixing & compaction methods.
3. Powder Sintering methods.
4. Post Sintering processes.
5. Testing's of sintered parts.

Outcomes:

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

1. Characterize the Powders in different techniques.
2. Suggest appropriate compaction technique for a particular powder.
3. Suggest appropriate sintering technique for a particular powder.
4. Choose correct post sintering processes.
5. 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.

Suggested Reading:

1. G.S.Upadhya, "Powder Metallurgy Technology", Cambridge international Science publishing,1997.
2. B.K Dutta, "Powder Metallurgy: An advanced technique and processing of engineering materials", PHI Publications , 2011.
3. Clark Frances Hurd, "Advanced Techniques in Powder Metallurgy", Literary Licensing,2017.

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18ME E04

AUTOMOBILE ENGINEERING

(Core Elective-II)

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

Objectives:

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

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

1. Understand the basic layout of automobiles. (BL-2)
2. Understand the various systems in an automobile like engine cooling, lubrication, ignition, electrical and air conditioning systems with the principles of thermodynamics. (BL-2)
3. Describe the principles of suspension and steering system using modern tool usage. (BL-2)
4. Explore therecent systems in Braking and Transmission. (BL-3)
5. Evaluate the effect of automobile pollution on environment and necessity of pollution norms along with trouble shooting (BL-5)

UNIT - I

Types of Automobiles: Normal, Hybrid and Hydrogen Fuel vehicles.

Engine: Engine location and its components, chassis layout - parts of the automobile body, terminology, automobile frames : crank shaft, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion – Zenith carburettor, Fuel injection system, Mechanical Fuel Injection system- MPFI, Electronic Fuel Injection system.

UNIT - II

Lubricating Systems: Wet sump, dry sump and petroil systems

Cooling systems: Water pumps, radiators, thermostat control, anti-freezing compounds

Ignition Systems: Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems- Batteries used in Electric and Hybrid Vehicles, starting motors,

Electrical Systems : Main electrical circuits, generating & starting circuit, lighting system, indicating devices, warning lights, speedometer, automobile air-conditioning.

UNIT - III

Steering Systems: Linkage arrangements and its components, steering gear box types,recent trends, Davis Steering , Modified Ackerman linkage, Steering geometry: caster, camber, King Pin Inclination, Toe in, toe out.

Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, wheel alignment

Suspension systems: 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: Disc and drum types, leading and trailing shoe layout, Description and operation of hydraulic brake, hand brake linkage, Pneumatic, air and vacuum brakes

UNIT – V

Maintenance: Trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment

Pollution control: Pollution control techniques used for petrol and diesel engines, PCVS, EGR, SCRT, Thermal Reactors, Catalytic converters; Euro norms and Bharat Norms.

Text Books:

1. Crouse & Anglin, "Automotive Mechanics", 10/e, TMH. Publishing Co. Ltd., New Delhi, 2006.
2. Kirpalsingh., "Automobile Engineering", Vol. I & II Standard Publishers, Delhi, 2007.
3. Joseph Heitner, "Automotive Mechanics", 2/e, Affiliated East West Pvt. Ltd. 2015.

Suggested Reading:

1. R.K. Rajput, "A Textbook of Automobile Engineering", Laxmi Publications, New Delhi, 2012.
2. D S Kumar, "Automobile engineering", S K Kataria Publications, New Delhi, 2015.

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With Effect from the Academic Year 2019 – 2020

18ME E05

NANO SCIENCE AND TECHNOLOGY

(Core Elective –II)

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

Objectives:

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, the students are able to

1. Understand the basic concepts, developments and challenges in Nano technology. (BL-2)
2. Describe the methods of evaluating magnetic and electronic properties, microstructure by SPM, atomic force microscopy, friction force microscopy. (BL-2)
3. Apply homogenous & heterogeneous methods and characterization techniques of Zero & One dimensional Nano structures. (BL-3)
4. Evaluate various Nano Material Fabrication Techniques. (BL-5)
5. Analyze Nano materials and Nano bio materials for obtaining solutions to societal problems. (BL-4)

UNIT - I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance ofNanotechnology, 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 (HI-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

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 polymerceramic, 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, 2004
3. Carl C Koch, "Nano materials Synthesis, Properties and applications", Jaico Publishing House, 2008

Suggested Reading:

1. Willia Tllsey Atkinson, "Nano Technology", Jaico Publishing House, 2009
2. George W. Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009

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With Effect from the Academic Year 2021 - 2022

18ME E06

RIGHTS, DUTIES AND LEGISLATION
(Core Elective - II)

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

Objectives:

1. Understand the value of human rights
2. Understand the Lawful rights available to him and others
3. Create understanding the rights of under privileged and respect them
4. Understand role of an individual in the Civil Society
5. Understand the safety aspects while using technology and to understand the role of NGO's in protecting human rights and environment.

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

1. Recall the human rights in the global and national context. (BL-1)
2. Understand the overall view on working of Indian constitution. (BL-2)
3. Analyse the societal problems in the context of human rights. (BL-4)
4. Evaluate implementation of right to development and right to information. (BL-5)
5. Application of human rights for human safety and clean environment. (BL-3)

UNIT-I

Conceptual Background Of Human Rights And Duties: Rights, inherent, inalienable,universal, indivisible. Values, Dignity, liberty, equality, justice, unity in diversity, Need for balance between Rights and Duties, Freedom and Responsibility, Theories of human rights, History of human rights civilization, Human rights movements. Universal declaration of human rights 1948, classification and three generations of human rights and sarvodaya.

UNIT-II

Human Rights And Duties In India: Evolution, Independence movement, making of theConstitution, Indian Constitution. Fundamental Rights, Directive Principles, Fundamental duties, Their Interrelationship, Enforcement and protection mechanism of human rights in India, Judiciary, Article 32 and 226 of Indian Constitution. National Human Rights Commission and other Commissions and Committees, Non-governmental organizations. Information Media, Education.

UNIT-III

Societal Problems: Core Problems, Poverty, underdevelopment and illiteracy, Women, children andthe disadvantaged groups. National and state commissions of Women/children/minority/SC/ST.

UNIT-IV

Right to Development: Socio-Economic and Cultural Effects of Globalization, Right to Education.Transparency in Governance and Right to Information, Consumer Protection act.

UNIT-V

Environment Rights Such as Right to Clean Environment and Public Safety: Issues of Industrial Pollution.Prevention. and Rehabilitation, Safety aspects of New Technologies such as Chemical and Nuclear Technologies. Issues of Waste Disposal, Protection of Environment.

Text Books:

1. Mr. Ishay, "The history of Human rights", Orient Longman, New Delhi, 2004.
2. S.N. Chaudhary. "Human Rights and Poverty in India: Theoretical Issues", Delhi: Concepts, 2005.
3. Anuradha Kumar. "Encyclopedia of Human Rights Development of under Privilege", New Delhi: Sarup, 2002.

Suggested Readings:

1. K.P. Saksena. "Human Rights and the Constitution: Vision and the Reality", New Delhi: Gyan Pub., 2003.
2. Dr.J.N.Pandey. "Constitutional Law of India", Central Law Agency; Central Law Agency; 57th Edition, 2001.