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. 122-211

122	Non Destructive Testing and Evaluation	18PE E04
123	Surface Engineering	18PE E05
124	Dynamics and Vibrations Lab	18ME C15
125	Applied Thermodynamics and Heat Transfer Lab	18ME C16
126	Metal Forming Technology Lab	18PE C06
127	CAD/CAM	18ME C17
128	Machine Design	18ME C18
129	Machine Tool Engineering	18PE C09
130	Object Oriented Programming with C++	18ME E08
131	Mechanics of Composite Materials	18ME E09
132	Robotic Engineering	18ME E10
133	Production and Operations Management	18PE E06
134	Principles of Industrial Engineering	18PE E07
135	Computational Fluid Dynamics	18ME E12
136	Principles of Entrepreneurship	18ME E13
137	Modern Machining and Forming Methods	18PE E08
138	Finite Element Methods	18ME E16
139	Blockchain Technology	18ME E15
140	Renewable Energy Sources	18ME E17
141	Control Systems Theory	18ME E18
142	Artificial Intelligence	18ME E19
143	Industrial Administration and Financial Management	18ME E20
144	Total Quality Management	18PE E10
145	CAD/CAM LAB	18ME C20
146	Machine Tool Engineering Lab	18PE C10
147	Metrology and Instrumentation	18ME C22
148	Operations Research	18ME C23
149	Additive Manufacturing Technologies	18PE C11
150	Power Plant Engineering	18ME E21
151	Engineering Research Methodology	18ME E22
152	Data Analytics	18ME E23
153	Innovation and Intellectual Property Rights	18ME E24
154	Supply Chain Management	18PE E12

155	Object Oriented Programming using JAVA	18IT O01
156	History of Science & Technology	18PY O01
157	Gender Sensitization	18EG O02
158	Principles of Internet of Things	18IT O03
159	Basics of Artificial Intelligence	18CS O09
160	Metrology and Instrumentation Lab	18ME C25
161	Additive Manufacturing Lab	18PE C12
162	Project: Part - 1	18PE C13
163	Remote Sensing and GIS	18EC O01
164	Applied Operations Research	18MT O01
165	Energy Auditing	18EE O03
166	Basics of Cyber Security	18CS O04
167	MEMS and its Applications	18EC O05
168	Technical Writing Skills	18EG O01
169	Basics of Biology	18BT O01
170	Disaster Mitigation and Management	18CE O02
171	Waste Management	18EE O05
172	Systems Automation & Control	18EC O07
173	Technical Seminar	18PE C14
174	Project Part - 2	18PE C15
175	Computer Aided Modeling and Design	20MEC 101
176	Computer Integrated Manufacturing	20MEC 102
177	Research Methodology and IPR	20MEC 103
178	Advanced Machine Design	20MEE 101
179	Advanced Vibrations and Acoustics	20MEE 102
180	Optimization Techniques	20MEE 103
181	Automation	20MEE 104
182	Design for Manufacturing and Assembly	20MEE 105
183	Industrial Robotics	20MEE 106
184	Integrated Design and Manufacturing Lab	20MEC 104
185	Vibrations and Acoustics Lab	20MEC 105
186	Value Education	20ECA 101
187	Pedagogy Studies	20ITA 101
188	Disaster Mitigation and Management	20CEA 101
189	Sanskrit for Technical Knowledge	20EEA 101
190	Finite Element Techniques	20MEC 106
191	Mechanical Design and Analysis	20MEC 107
192	Computational Fluid Dynamics	20MEE 206
193	Mechanics of Composite Materials	20MEE 107
194	Fracture Mechanics	20MEE 108
195	Multibody Dynamics	20MEE 109
196	Tribology in Design	20MEE 110
197	Failure Analysis and Design	20MEE 111
198	Computer Aided Engineering Lab	20MEC 108
199	Computational Fluid Dynamics Lab	20MEC 206
200	Mini Project with Seminar	20MEC 109
201	English for Research Paper Writing	20EGA 101
202	Indian Constitution and Fundamental Rights	20EGA 102
203	Stress Management by Yoga	20EGA 103

204	Personality Development through Life's Enlightenment Skills	20EGA 104
205	Advanced Finite Element Method	20ME E112
206	Digital Manufacturing and Design	20ME E113
207	Waste to Energy	20EE O101
208	Theory of Elasticity and Plasticity	20ME E114
209	Cost Management of Engineering Projects	20CE O101
210	Business Analytics	20CSO101
211	Industrial Project / Dissertation Phase - I	20MEC 110

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.

UNIT - V

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

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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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With Effect from the Academic Year 2021 - 2022

18PE E05

SURFACE ENGINEERING (Core Elective - II)

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

Objectives:

1. To impart knowledge on surface engineering and surface modification methods that will come in handy to solve the industrial problems.
2. This will also serve as a precursor for future research in the same field.
3. Student will understand the basic principles of corrosion and know the methods to reduce the corrosion on mechanical components.
4. Student will understand the role of wear and wear measurement techniques on engineering components.
5. Student will identify the suitable surface processing method from various methods to create surface engineering solutions for specific materials, specific environments and specific applications in modern engineering practice.

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

1. Demonstrate basic understanding of friction, and be familiar with adhesion theories and the effect of adhesion on friction.
2. Demonstrate basic understanding of wear processes, and able to describe wear mechanisms on engineering components.
3. Demonstrate basic understanding of corrosion and know the methods to reduce the corrosion on engineering components.
4. Design a tribological system for optimal performance, and Justify, critical analysis on surface engineering techniques and surface design for relevant applications.
5. Apply surface engineering principles and methods to modify and improve the properties of surfaces for structural and functional applications.

UNIT – I:

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

UNIT–II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Text Books:

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

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Suggested Reading:

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

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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

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.

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
D.S. Kumar," Heat Transfer", S K Kataria Publishers, 2015With Effect from the Academic Year 2020 – 2021

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18PE C06

METAL FORMING TECHNOLOGY LAB

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

Objectives:

Students will learn

1. To demonstrate various operations like sheet metal operations-blanking, punching, deep drawing, extrusion etc with their applications, merits and demerits.
2. To enable the students to determine loading and energy required for metal forming tools and machines.
3. To enable the students to understand different defects that occurring forming operations with remedial measures.
4. To make the students understand working principle, types, and applications of forging process.
5. To make students understand working principle, parameters, types and applications of extrusion process.

Outcomes:

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

1. Understand the practical aspects of metal forming operations.
2. Understand various process parameters that affect product quality under different conditions.
3. Determine load, energy and power required for various processes and machines.
4. Propose suitable metal forming processes for making different products.
5. Design and fabricate various types of dies for sheets metal operations.

List of the Experiments

1. Evaluation of Formability of a given sheet material using Erichsen cupping test.
2. Study of Simple Die design for Blanking/ Piercing operations in sheet metal forming and manufacturing of circular blanks using a mechanical press (capacity30Tons) and measurement of forces and comparing with theoretical loads.
3. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity6Tons) and estimation of forces.
4. Study of Compound die design and manufacturing of washer components using the same on double body fly press (capacity8 Tons) and estimation of forces.
5. Study of Combination die design and manufacturing of cylindrical cups using the same on a Hydraulic power press (capacity 50Tons) and estimation of drawing force.
6. Study of deep drawing die design and measuring forces with/without blank holder for cylindrical/square cups using 10 T load cell on a Hydraulic power Press and comparing them with theoretical values.
7. Measurement of cutting force or Blanking operation using 10T load cell on Mechanical power Press for different materials and comparing theoretical and practical values.
8. Estimation of True stress and True strain for ferrous/ non-ferrous materials encountered in metal forming operations using Universal Testing Machine.
9. Study of extrusion dies and demonstration of extruding lead material.
10. Demonstration of Simulation software for metal forming operations.

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 2015.

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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.
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, Co-ordinate measuring machine), Non-contact inspection (Machine Vision, Scanning LASER Beam, Photogrammetry).

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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.

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.BalaveeraReddy.,"Design Data Hand book for Mechanical Engineers", 3rd, CBS Publisher, 2018
2. PSG College, "Design Data book",2012

18PE C09

MACHINE TOOL ENGINEERING

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

Objectives:

Student will learn

1. To provide the basic understanding of cutting tools, geometry in machining process.
2. The concepts of tool wear
3. Different operations performed on lathe machine.
4. To make the students to understand various machine tools, like drilling, milling and boring machines
5. To make knowledge of Thread manufacturing and gear manufacturing.

Outcomes:

Students will be able to

1. Select tool geometry for various materials.
2. Estimate the tool wear
3. Identify the machine tools for manufacturing various components.
4. Select grinding wheel and Automats.
5. Work on shaper, planner and grinding machines.

UNIT - I

Orthogonal and Oblique Cutting: Cutting forces in turning, drilling milling and grinding, Merchant's analysis, Shear angle, friction angles. Experimental methods for estimation of shear angle, cutting forces and power, types of chips. Built up edge phenomena and its effects. Chip breakers. Sources of heat, its distribution and measurement. Different types of cutting fluids.

UNIT - II

Tool Wear and Tool Life: Criteria for tool wear, flank and crater wear theories, criteria for tool life in roughing and finishing. Measurement of tool wear, Taylor's tool life equation, factors effecting tool life, Machiniability. Single point cutting tool design; Geometry, tool nomenclature, American, DIN, max. rake system. Interrelation between normal rake and orthogonal rake, tool signature, effect of basic tool angles on its performance. Selection of size and angles of S.I. Tools, from tools. Design feature of multipoint cutting tools

UNIT - III

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

Automats: Single spindle and multiple spindle automats, Swiss type of automats, constructions and features of these machines.

UNIT - IV

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

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

Boring Machines: Horizontal, Vertical and Jig boring machines and constructional features.

Thread Production: Thread rolling, thread chasing , thread milling and thread grinding.

UNIT - V

Shaping, Planing & Slotting Machines: Types, Constructional features, Types of work done on it. Quick return motion, manipulation of cutting speeds and feeds, work and tool holding devices, comparison of these machines.

Gear Cutting Machines: Methods of gear cutting, types and classification of gear hobbing, gear shaping machines Bevel gear cutting.

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

Text Books:

1. B.L. JuneJa and Shekon. Fundamentals of "Metal Cutting & Machines Tools", Wiley Eastern Ltd. 1987.

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2. P.N. Rao, "Manufacturing Technology – Metal Cutting & Machine Tools", Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. M.C. Shaw, "Metal Cutting Principles", Clarendon Press, Oxford 1984.

Suggested Reading:

1. Hazra Choudary, "Workshop Technology", Vol. II, Media Pub., New Delhi.
2. Kibbe Richand R, Meyer, R.D, Neely etal, "Machine Tool Practices", 9/e, PHI, 2014.
3. Jain & Chitale, "Text Book of Production Engineering", 2/e, PHI, 2014.

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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.

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.

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.

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

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

18PE E06

PRODUCTION AND OPERATIONS MANAGEMENT
(Core Elective-III)

Instruction week	3	Hours per
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.

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).

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).

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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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18PE E07

PRINCIPLES OF INDUSTRIAL ENGINEERING (Core Elective-III)

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

Objectives: Student will learn the

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

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

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

UNIT - I

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

UNIT - II

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

UNIT - III

Production Planning and Control: Elements of PPC-Planning, Routing, Scheduling, Dispatching., Materials Requirement Planning (MRP), Manufacturing Resource Planning (MRP II).JIT and KANBAN system.

UNIT - IV

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

UNIT - V

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

Text Books:

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

Suggested Reading:

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

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With Effect from the Academic Year 2020 – 2021

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

Suggested Reading:

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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

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.

Chemical Machining : Chemical blanking and chemical milling, advantages, limitations and applications.**ION Etching**: Process description, merits, limitations and applications.

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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 E16

FINITE ELEMENT METHODS (Core Elective - IV)

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

Objectives:

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

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

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

UNIT - I

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

One dimensional problems: 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

UNIT - III

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

UNIT - IV

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

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

UNIT - V

Heat transfer analysis: Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate

3 D elements and FEA software: Introduction to finite element formulation of three dimensional problems in stress analysis, convergence requirements

Introduction to Finite Element analysis software: Modeling, analysis and post-processing

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Text Books:

1. Ramamurthy, G. "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Ltd., New Delhi, 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, "Introduction to Finite Elements in Engineering", Practice Hall of India, 1997.
3. Daryl L. Logan, "A First Course in the Finite Element Method", Cengage Learning, 2011.

Suggested Reading:

1. Rao S S, "The Finite Element Method in Engineering", Pergamon Press, 1989.
2. Segerlind L J, "Applied Finite Element Analysis", Wiley Eastern, 1984.
3. Reddy JN, "An Introduction to Finite Element Method ", McGraw-Hill, 1984.
4. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt., "Concepts and Applications of FiniteElement Analysis", 4/e, Wiley.

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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,

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types of supply 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 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

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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

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

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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

With Effect from the Academic Year 2021 - 2022

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 problem solving Techniques. (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

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.

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:

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

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18PE E10

TOTAL QUALITY MANAGEMENT (Core Elective - V)

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

Objectives: Student will understand

1. The essence of total quality management in design and manufacturing a product
2. The various principles and concepts of total quality management
3. The various technical tools of quality like control charts and ANOVA etc
4. The quality information system
5. The awareness about measuring and satisfying customer needs

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

1. Apply TQM techniques in engineering applications
2. Use various theories and principles related to TQM
3. Use statistical techniques in TQM
4. Have awareness and use quality information system and innovative systems
5. Deal with customer grievances and satisfying the customers

UNIT-I

Strategic Quality Management: Quality policies, quality goals, obstacle to achieving successful strategic quality management, Organization for quality role of {Top, middle, work force team (Quality Circles)}, Developing a quality work culture, Maslow need theory, Herzberg two factor theory, Theory X, Y & Z methods to create and maintain awareness of quality, provide evidence of management leadership, types of self development and empowerment programmes, methods of participations means of inspiring action, recognition and rewards, Supplier quality rating plans (lot plot plan, OC curve, parent analysis), assignment of supplier capability, methods of evaluating supplier products, contract management (Joint economic plan, joint technological forecasting

UNIT-II

Design for Quality: Basic functional requirements of quality, design for (reliability, safety, cost and product performance), concurrent engineering (DFMA) value engineering, support for quality improvement processes (block diagram, brain storming, cause effect analysis, pareto analysis), quality function deployment, reliability analysis, failure rate, failure pattern of complex products (bath tub curve), weibull distribution relationship between part and the system, exponential reliability, availability, FMEA (Fracture Mode and Effect Analysis), Design for experiments: Factorial experiments, construction fractional designs

UNIT-III

Technical Tools for Quality: Analysis of variance (ANOVA), 4 factor ANOVA experiment, 2 levels, analysis of means, Techniques for online quality: data collection plan, variable and attribute charts, interpreting the control charts, Techniques for offline quality control: background to Taguchi method (quality loss and loss function, controllable factor, and non controllable factors in parameter performance, tolerance design

Taguchi analysis techniques: net variation and contribution ratio, estimation of process performance, accumulating analysis, performance measures, Taguchi tolerance design and tolerance (re) design

UNIT-IV

Quality Information System: Scope of Quality Information System, differences between QIS and MIS, creating new software (steps, types, defects) reports on quality (operational and executive reports), features of QIS software, software for inspection

Inspection System: Operational sorting and correlation sorting, AQL, LTPD, AOQL, Nondestructive test, Audit systems: (quality improvement planning and implementation, describing quality function, process control system, control of measurement system, material identification and control, drawing and specification control, process corrective action), the concept of POKAYOKE

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UNIT-V

Measure of Customer Needs: The need to measure customer satisfaction, importance of proper packaging, customer processing and installation of product, dealing with customer complaints, using weibull analysis, field feedback, parameter to measure customer (dis)satisfaction, problems with the customer satisfaction system

Beyond TOM: Difficulties in implementing TOM system, rating your quality system, JIT system, the people side of TOM system, system integration, Kansei engineering and flexibility in manufacturing

Text Books:

1. L. Suganthi, Aanand A. Samuel, "Total Quality Management", PHI Learning Pvt. Ltd., 2004.
2. H.G. Menon, "TQM in view Production Manufacturing", McGraw Hill Publishers.

Suggested Reading:

1. Joel E. Ross & Susan Perry, "Total Quality Management: Text, Cases, and Readings", 3/e, CRC Press, 1999.
2. John S Oakland, "Total Quality Management: The route to improving performance", 2/e, A Butterworth-Heinemann Title, 1994.
3. Jankiraman, "Total Quality Management: Text and Cases", 1/e, PHI Learning Private Limited-New Delhi, (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

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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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18PE C10

MACHINE TOOL ENGINEERING LAB

Instruction	2 Hours per week
Duration of Semester End Examination	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 on lathe and drilling machines
3. The gear cutting and to cut gear on milling machine.
4. Measure cutting forces during machining on Lathe machine, milling.
5. Unconventional machining operations like EDM & ECM.

Outcomes:

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

1. Grind single point cutting tool with various angles.
2. Perform various machines on lathe.
3. To manufacture a gear using milling machine.
4. Do operation on shaper.
5. Get exposure to various unconventional processes.

List of the Experiments

1. Introduction to Machine Tools, like Lathe, Drilling, Milling and Shaper.
2. Plain and step turning operations on Lathe.
3. Step turning and Knurling on Lathe machine.
4. Taper turning on Lathe.
5. Drilling and Boring on Lathe.
6. Thread Cutting on Lathe.
7. Grinding of Single Point Cutting Tool.
8. Gear Cutting using (a) Plain Indexing (b) Compound Indexing.
9. Measurement of Cutting forces during machining on Lathe machine and Milling machine.
10. Finding Shear angle experimentally in turning operation.

Text Books:

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

Suggested Reading:

1. Hazra Choudary, "Workshop Technology", Vol. II, Media Pub., New Delhi.
2. Kibbe Richand R, Meyer, R.D, Neely etal, "Machine Tool Practices", 9/e, PHI, 2014.
3. Jain & Chitale, "Text Book of Production Engineering", 2/e, PHI, 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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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.

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.

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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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18PE C11

ADDITIVE MANUFACTURING TECHNOLOGIES

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

Objectives:

1. To introduce to students the basics of Additive Manufacturing, its advantages and limitations and concept of mass customization.
2. To familiarize students with various Additive Manufacturing processes.
3. To teach students about STL file issues and familiarize them with various AM 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 a student will be able to

1. Explain the process chain of Additive manufacturing and their classification, advantages and disadvantages
2. Critically explore and compare the technologies used for additive manufacturing in terms of their material, parameters, applications and limitations
3. Analyse various software issues for rapid prototyping and related operations for STL file and features of various slicing softwares.
4. Identify different post processing techniques involved in enhancing the properties of the 3d printed components, understand rapid tooling
5. Understand applications of Additive Manufacturing in various fields

UNIT - I

Introduction to AM: Customization and mass customization, types of mass customization. Classification of fundamental fabrication processes (additive/subtractive/formative), Difference between AM and CNC. Process chain for Additive Manufacturing(AM) processes. Classification of additive (layered) Manufacturing processes. Advantages and Limitations of AM

UNIT - II

AM Techniques: Photopolymerization, Stereolithography (SLA) , Fused Deposition Modeling (FDM), Solid Ground Curing(SGC) , Shape deposition manufacturing(SDM) - Working principles and their applications, advantages and disadvantages. Laser sintering based technologies (SLA and DMLS) and their related details.

UNIT - III

Pre-processing in AM: Pre-processing of CAD model- STL conversion, STL error diagnostics, STL file Repairs: Generic Solution. Newly Proposed Formats. Support generation, transformations, slicing, surface preparation of materials, pre-heating of powders.
Rapid Prototyping Softwares: Features of various RP softwares - Magics, Mimics, Solid View, Rhino.

UNIT - IV

Post processing in AM: Post processing equipment, Support material removal , Surface texture improvement, Accuracy improvement, Aesthetic improvement, Preparation for use as a pattern, Property enhancements using Non–thermal and Thermal techniques.
Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM , LOM Tools, EOS Direct Tool Process.

UNIT - V

AM Applications: Application in Design, Engineering, Analysis & Planning. Application in Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry..
RP in Medical and Bioengineering Applications: Planning and simulation of complex surgery, Forensic

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Science.

Text Books:

1. Gibson, DW. Rosen and B.Stucker; "Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing ", Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, "3D printing and additive manufacturing : principles and application" , 4/e of rapid prototyping.
3. PK. Venuvinod, "Rapid prototyping – Laser based and other technologies", Kluwer, 2004.

Suggested Reading:

1. Jacob, Paul, "Rapid tooling : Technologies and industrial applications"
2. Andreas Gebhanrdt, "Understanding Additive anufacturing", Hanses, 2012.
3. Alain Brnard, Georges Talliander, "Additive Manufacturing", Wiley, 2014.

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18ME E21

With Effect from the Academic Year 2021 - 2022

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, 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.

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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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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.

Suggested Reading:

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

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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.

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:

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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

With Effect from the Academic Year 2019 – 2020

INNOVATION AND INTELLECTUAL PROPERTYRIGHTS

(Core Elective - VI)

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

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.

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

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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

With Effect from the Academic Year 2020 - 2021

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

With Effect from the Academic Year 2019 – 2020

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.

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

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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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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.

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.

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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

With Effect from the Academic Year 2019 – 2020

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".
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.

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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,

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.

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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.

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.

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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:

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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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18PE C12

ADDITIVE MANUFACTURING LAB

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

Objectives:

The objectives of the course are

1. To introduce to the students the additive manufacturing machines
2. To impart knowledge about various materials used for the digital fabrication
3. To demonstrate rapid tooling concept
4. To demonstrate reverse engineering process
5. To impart knowledge about tool path generation

Outcomes:

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

1. Generate tool path data for any component using slicing software
2. Compare different Additive manufacturing processes and select a subtractive or an AM process for a particular application for product development of engineering components
3. Use different post processing techniques to enhance the component after fabrication
4. Generate STL file from digital data input
5. Operate themselves the 3d printing machine.

List of the Experiments

1. Introduction to RP machine. Machine Specifications, Materials,
2. Review of modeling of resin and metal parts in cad software.
3. STL file Generation , Slicing of STL files, Obtaining the tool path data and sending it to RP Machines
4. 3d printing of jigs, fixtures and other manufacturing tools
5. 3d printing of bottle die
6. Prototyping of petrol engine Connecting rod.
7. Fabrication of Components of Screw jack and assembling them.
8. Demonstration of working of Stereo lithography machine
9. Removing the supports & post processing (cleaning the surfaces) Post curing of fabricated resin parts.
10. Reverse engineering: from scanner to model validation (solid works).

Text Books:

1. Gibson, DW. Rosen and B.Stucker; "Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing ", Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, "3D printing and additive manufacturing : principles and application of rapid prototyping" 4/e ,
3. PK. Venuvinod, Ma, W, "Rapid prototyping – Laser based and other technologies", Kluwer , 2004.

Suggested Reading:

1. Jacob, Paul, "Rapid tooling : Technologies and industrial applications".
2. Andreas Gebhanrdt, "Understanding Additive Manufacturing", Hanses, 2012.
3. Alain Brnard, Georges Talliander, "Additive Manufacturing", Wiley, 2014.

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18PEC13

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 – II)

Instruction	3 Hours per week
Duration of Semester End Examination	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. Understand the fundamental concepts of remote sensing.
2. Analyze types of remote sensing and digital imaging techniques.
3. Analyze the hyperspectral imaging and thermal remote sensing techniques.
4. Apply Microwave remote sensing techniques
5. Understand GIS data models and carryout geospatial 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, Photogrammetry: definition and process, photogrammetry and LIDAR, radargrammetry.

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. BasudebBhatta, "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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18MT O01

APPLIED OPERATIONS RESEARCH (Open Elective – II)

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

Objectives:

1. Identifying and develop Operations Research Models from the verbal description of real system.
2. Able to learn different techniques to get optimum solution LPP.
3. Able to understand the Mathematical tools that are needed to solve optimization problem.
4. Able to analyse the results of the different real world problems.
5. Able to formulate the problems and solve situation using dynamic programming problem technique.

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

1. Define and formulate LPP and appreciate their limitations.
2. Solve the problem using different optimization techniques.
3. Solve the problem of transporting the products from origins to destination with least cost.
4. Convert and solve the practical situations into Dynamic programming problem.
5. Identifying the resources required for a project and generate a plan and work schedule.

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, Dynamic programming approach for priority management employment smoothening, capital budgeting, stage coach/shortest path, cargo loading and Reliability problems.

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", 3/e, Macmillan India Ltd, 2007.
2. P.K.Gupta and D.S.Hira, "Operations Research", S.Chand& Co, 2007

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With Effect from the Academic Year 2019 – 2020

18EE O03

ENERGY AUDITING (Open Elective – II)

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

Objectives:

1. To know the concept of Energy auditing
2. To understand the formulation of efficiency for various engineering systems
3. To explore the different ways to design various technologies for efficient engineering systems.

Outcomes: After completion of this course, students will be able to:

1. Know the current energy scenario and importance of energy auditing.
2. Understand the concepts of energy auditing.
3. Evaluate the performance of existing engineering systems
4. Explore the methods of improving energy efficiency in different engineering systems
5. Design different energy efficient devices.

UNIT-I

Basics of Energy and its various forms: Overview of engineering, elements Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bio energy, bio mass energy conservation, elements of geothermal energy, sources of geothermal energy, sources of chemical energy, fuel cells, Energy Scenario in India

UNIT-II

Energy Auditing-1: Introduction: Need for energy audit, directions for the study of energy auditing, inclusions for energy auditing, types of energy audit: preliminary audit, general/mini audit, investment-grade/ comprehensive audit. Major energy consuming equipments and systems, energy audit team, energy auditing methodology: preliminary and detailed. Process flow diagram, energy audit report format

UNIT-III

Energy Auditing-2: For Buildings: Energy auditing instruments, energy efficiency, energy auditing for buildings: stages in programs, surveying, measurements and model analysis. Energy audit form of commercial buildings, checklist for energy saving measures

UNIT –IV

Energy Efficient Technologies-I: Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure;

UNIT-V

Energy Efficient Technologies-II: Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper

Text Books:

1. Umesh Rathore, 'energy management', Kataria publications, 2nd 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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20EE A101

SANSKRIT FOR TECHNICAL KNOWLEDGE

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

Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).
Themeasurementsystem-time-mass-length-temp,Matterelasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-

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crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

Text Books:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015

Suggested Reading:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN-10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007.
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1,2005.

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20ME C106

FINITE ELEMENT TECHNIQUES

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

Objectives: To make the students to

1. Understand finite element analysis fundamentals andformulations
2. Formulate the axial, truss, beam and 2D problems
3. Formulate the heat conduction and dynamics problems, understand the use of numerical integration and Gauss quadrature
4. Understand the convergence requirements and 3D problems
5. Perform engineering simulations using finite element analysis software (ANSYS)

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

1. Apply FE method for solving field problems using virtual work and potential energy formulations
2. Analyze linear problems like axial, truss and beam, torsional analysis of circular shaft
3. Analyze 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve theproblems.
4. Evaluate the eigen values and eigen vectors for stepped bar, formulate 3 D elements, check for convergence requirements
5. Solve linear 1 D and 2 D heat conduction and convection heat transfer problems, Use of FEAsoftware ANSYS for engineering solutions

UNIT - I

Introduction to Finite Element Method of Solving Field Problems: Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. **Potential Energy Approach**: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

UNIT - II

Analysis of Trusses: Analysis of plane truss with number of unknowns not exceeding two at each node.

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Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element

Analysis of Frames: Analysis of frames with two translations and a rotational degree of freedom at each node.

UNIT- III

Two Dimensional StressAnalysis: Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

UNIT - IV

Steady State Heat TransferAnalysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.

Time Dependent Field Problems: Application to one dimensional heat flow in a rod.

Dynamic Analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.

Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT - V

Three Dimensional Problems in StressAnalysis: 3D elements: Introduction to tetrahedron and brick elements.

Introduction to thin and thick plates

Introduction to non-linear formulation through FE.

Text Books:

1. R. Tirupathi, Chandrupatla and A.D Ashok,"Introduction of Finite Element in Engineering", Prentice Hall of India, 2004
2. S.S. Rao,"The Finite Element Methods in Engineering", 2/e Pergamon Press, 2001.
3. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill,2003

Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley andsons,2009
2. K..J Bathe, "Finite element procedures", 2/e,Prentice Hall of India,2007
3. D.L. Logan, "First course in finite element method", (5/e). Mason, OH: South Western, Cengage Learning, 2011.

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20ME C107

MECHANICAL DESIGN AND ANALYSIS

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

Objectives: To make the students to

1. Develop the necessary skills to understand and analyze problems in pressure vessels
2. Achieve fundamental understanding of the theory of bending offlat plates with various loading and boundary conditions
3. Understand design principles of a component and structures using fracture mechanics approaches
4. Enable the importance of vibrations in mechanical design to understand the basic concepts of matrix algebra and understand the different mode extraction methods in vibrations
5. Understand the fundamental concepts various algorithms used for dynamic analysis

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

1. Apply knowledge of mathematics, sciences and computations in solving the stresses & strains in pressure vessels
2. Demonstrate the ability to identify, formulate and solve problems for a given flat plate bending applications
3. Design a system or a component to meet the desired needs of fracture mechanics
4. Understand, solve various Eigen value and Eigen vectors and will understand different mode extraction methods to calculate frequencies
5. Understand methods in solving single degree freedom dynamic analysis problems

UNIT - I

Design of Pressure Vessels: Introduction and selection of materials for pressure vessels, stresses in thick walled cylindrical pressure vessels subjected to both internal and external pressures, shrink fit stresses in built up cylinders, auto frettage of thick cylinders, thermal stresses and their significance.

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UNIT - II

Stresses in Flat Plates: Introduction, Bending of plate in one direction, Bending of plate in two perpendicular directions, Thermal stresses in plates, Bending of circular plates of constant thickness, Bending of uniformly loaded plates of constant thickness

UNIT- III

Fracture Mechanics: Introduction, Modes of fracture failure Griffith Analysis, Energy release rate, Stress Intensity Factor: SIF's for edge and centre line crack, Fracturetoughness, Elasticplasticanalysisthrough J-integralmethod: Relevance and scope, Definition of J-integral, Path independence, Strain Energy Release Rate VsJ-integral

UNIT - IV

Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence method. Subspace iteration and Lanczo's method, Component mode synthesis

UNIT - V

Dynamic Analysis: Direct integration method, Central difference method, Wilson-q method, Newmark method, Mode superposition, Single degree of freedom system response, Rayleigh damping. (Note: The related algorithms and codes to be practiced by students)

Text Books:

1. John, V. Harvey, "Pressure Vessel Design: Nuclear and Chemical Applications", Affiliated East West Press Pvt. Ltd., 1969.
2. Prasanth Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, NewDelhi-1999.
3. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2003.

Suggested Reading:

1. G.Ramamurti, "Computer Aided Mechanical Design and Analysis", Tata Mc Graw Hill-1992.
2. J. Bathe, "Finite Element Procedures", Prentice Hall of India-1996.

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20ME E206

COMPUTATIONAL FLUID DYNAMICS

(Programme Elective – III)

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

Objectives: To make the students to learn the

1. Basic equations and concept of CFD
2. Concept of pdes and finite difference methods
3. Various types of grid generation and errors in numerical solution
4. Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods
5. Importance of FVM

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

1. Derive CFD governing equations and turbulence models
2. Apply elliptical, parabolic and hyperbolic pdes and forward, backward and center difference methods
3. Understand errors, stability, consistency and develop O,H and C grid generated models
4. Evaluate the use of Crank-Nihcolson, Implicit and Explicit methods and analyze problem by Jacobi, Gauss Seidel and ADI methods
5. Solve conduction and convection problems using FVM.

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT- III

Classification of PDEs: Elliptic, parabolic and hyperbolic equations. Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference

UNIT - IV

Finite Difference Solutions: Finite difference solutions - Crank Nicholson, Implicit and Explicit, ADI - Jacobi, Gauss Seidel, solution for Viscous incompressible flow using Stream function – Vorticity method

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLEAlgorithm

Text Books:

1. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill, Inc., 2015.
2. H.K.Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015

Suggested Reading:

1. K. Muralidhar and T. Sundararajan, "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.
2. S.V.Patankar, "Numerical Heat transfer and Fluid flow", Hemisphere Publishing Company, New York,1980.

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20ME E107

MECHANICS OF COMPOSITE MATERIALS

(Programme Elective – III)

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

Objectives: To make the students to learn the

1. Basics of composite materials, types of fibers and reinforcements.
2. Evaluation of material properties using micro-mechanics approach and semi-empiricalrelations..
3. Analysis of laminates using classical laminate plate theory.
4. Failure analysis of an orthotropic lamina.
5. Analysis of composite beams and plates for simple cases.

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

1. Understand different types of composites and their fabrication methods.
2. Characterize a UD lamina using micromechanics.
3. Analyze a given laminate for strains and stress.
4. Decide the failure of a UD lamina.
5. Design simple composite beams and plates.

UNIT - I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT - II

Micromechanics of lamina and mechanical properties: Prediction of elastic constants, thermal properties, moisture properties using mechanics of materials approach. Halpin-Tsai equations for elastic constants. Mechanics of load transfer from matrix to fiber.

UNIT- III

Macro-mechanical Analysis: Introduction, Hooke's law for different types of materials, Hooke's law for 2D UD lamina, relationship between compliance and

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stiffness matrix to engineering elastic constants of a lamina, engineering constants of an angle lamina. Laminate code, stress-strain relationships for a laminate using CLT, force and moment resultants related to mid-plane strains and curvatures.

UNIT - IV

Strength and fracture: Tensile and compressive strength's of unidirectional fiber composites, fracture modes in composites: single and multiple fractures, de-bonding, fiber pullout and de-lamination. Interlaminar stresses and edge effects.

Strength of an orthotropic lamina: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;

UNIT - V

Composite Beams: comparison of CLTto Isotropic beam theory, effective axial and flexural rigidities of rectangular composite beams.

Governing equations of thin –plate theory: equations of equilibrium for symmetric laminates and specially orthotropic laminate. Levy –Navier solution applied to specially orthotropic laminates.

Text Books:

1. R.M. Jones, "Mechanics of Composite Materials", Mc Graw Hill Co., 1967
2. B.D. Agarwal et.al, "Analysis and performance of fiber composites", 3/e, Wiley sons., 2013
3. P.K. Mallick, "Fiber Reinforced Composites Materials",
4. Taylor & Francis, "Manufacturing, and Design", 3/e, 2007

Suggested Reading:

1. Ever J Barbero, "Introduction to composite materials design", Taylor &Francis, 1999.
2. M.W. Hyer, "StressAnalysis of Fibre Reinforced Composite Materials", McGraw Hill Co., 1998.
3. Carl. T.Herakovich, "Mechanicsof Fibrous Composites", John Wiley Sons Inc, New York, 1998.

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20ME E108

FRACTURE MECHANICS
(Programme Elective – III)

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

Objectives: To make the students to learn the

1. Classification of fracture
2. Importance of crack tip
3. Experimental setup while performing standard test
4. About R curve
5. Fatigue crack propagation.

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

1. Analyze the fracture mechanism
2. Gain familiarity with thedifferent modesoffailure under thepresence of crack
3. Establish specimen size in accordance with the standardprocedures
4. Distinguish between Plane stress fracture toughness and Plane strain fracture toughness
5. Accomplish the relationship between crack propagation and stress intensity factor

UNIT - I

Introduction: Crack in a structure – Griffith criterion

Mechanism of Fracture and Crack Growth: cleavage fracture – ductile fracture – fatigue cracking – service failure analysis

UNIT - II

Elastic Crack Tip Stress Field: Solution to crack problems – effect of finite size – stress intensity factor – special cases

Crack Tip Plastic Zone: Irwin plastic zone correction – actual shape of plastic zone

UNIT- III

Energy Principle: Energy release rate – criterion for crack growth – J integral

Plane Strain Fracture Toughness: Standard test – size requirement – nonlinearity

UNIT - IV

Plane Stress and Transitional Behavior: concept of plane stress – R curve concept – thickness effect – plane stress testing

Elastic Plastic Fracture: crack tip opening displacement.

UNIT - V

Fatigue Crack Propagation: Crack growth and stress intensity factor – factors affecting crack propagation – variable amplitude service loading and its numerical – retardation model

Text Books:

1. David Broek ,"Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers , The Hague – 1984.
2. Prashant Kumar., "Elements of fracture mechanics", Mc Graw Hill Education (India) Private Limited, New Delhi - 2014.

Suggested Reading:

1. T.L. Anderson, "Fracture Mechanics - Fundamentals and Applications", 3/e, Taylor and Francis Group, 2005.
2. R.N.L.Smith, "Basic Fracture Mechanics", Butterworth Heinemann Publications, 1991.
3. K. Ramesh," e-Book on Engineering Fracture Mechanics", IIT Madras, 2007. URL:http://apm.iitm.ac.in/smlab/kramesh/book_4.htm
4. K. R.Y. Simha, "Fracture Mechanics for Modern Engineering Design", Universities Press (India) Limited, 2001

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20ME E109

MULTI BODY DYNAMICS
(Programme Elective – IV)

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

Objectives: To make the students to learn the

1. Equations of motions in 3D for a multibody systems
2. Implementation and demonstration methods for formulation of motion equations in interconnected bodies
3. Constrained differential equations
4. Static and dynamic analysis in a multibody systems
5. Modeling and simulation of multibody dynamic systems

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

1. Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motions.
2. Implement and analyze methods of formulating equations of motion for interconnected bodies.
3. Write programs to solve constrained differential equations for analyzing multi-body systems.
4. Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis.
5. Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems

UNIT - I

Introduction: The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints.

UNIT - II

Basic Principles for Analysis of Multi-body Systems: The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations

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UNIT- III

Dynamics Of Planar Systems: Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints.

UNIT - IV

Kinematics of Rigid Bodies in Space: Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between theangular velocity vector and the timederivativesof Euler parameters.

UNIT - V

Kinematic Analysis of Spatial Systems: Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems.

Text Books:

1. J. Wittenburg, J., "Dynamics of Systems of Rigid Bodies", B.G. Teubner, Stuttgart, 1977.
2. T.R. Kaneand D.A. Levinson,"Dynamics: Theory andApplications", McGraw-HillBook Co., 1985.
3. P.E. Nikravesh, "Computer Aided Analysis of Mechanical Systems", Prentice-Hall Inc., Englewood Cliffs, J,1988.
4. R.E. Roberson, and R. Schwertassek,"Dynamics of Multibody Systems", Springer-Verlag,Berlin,1988.

Suggested Reading:

1. R.K.Turton, "Principles of Turbomachinery", E & F N Spon Publishers, London & New York.
2. Dennis G. Shepherd, "Principles of Turbomachines", Macmillan, 2007

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20ME E110

TRIBOLOGY IN DESIGN

(Programme Elective – IV)

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

Objectives: To make the students to learn the

1. Material properties which influence the tribological characteristics of surfaces
2. Concepts of wear
3. Lubrication aspects of machine components.
4. Analytical behavior of different types bearings
5. Design of bearings based on analytical /theoretical approach.

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

1. Understand surface topography and model a rough engineering surface.
2. Understand friction and wear aspects of machine.
3. Decideuponlubricantsandlubricationregimesfordifferentoperating conditions.
4. Understand Hertz contact and rough surface contact.
5. Select material/surface properties based on the tribological requirements

UNIT - I

Topography of Surfaces: Surface features -Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction propertiesofmetallic and non-metallicmaterials – friction in extreme conditions –Thermal considerations in sliding contact

UNIT - II

Wear: Types of wear – Mechanism of various types of wear – Laws of wear – Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements –Laser methods – instrumentation - International standards in friction and wear measurements.

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UNIT- III

Lubricants and Properties: Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication-Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT - IV

Reynolds and Sommerfield boundary conditions: Reynolds Equation - Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfield boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings- Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing-Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT- V

Rolling Contact Bearings: Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings.

Text Books:

1. E. Rabinowicz. "Friction and Wearof materials", John Willey &Sons, UK,1995
2. A. Cameron,"Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981
3. J. Halling, "Principles of Tribology" , Mac Millan – 1984.

Suggested Reading:

1. Kenneth C Ludema and Layo Ajay, "Friction, wear , lubrication", A text book in Tribology, 2e, CRC Press, Taylor and Francis Group, 2019
2. Ross Beckett,"Engineering Tribology", Larsenand Keller Education, 2017.
3. Stachon Iak, Andrew W Batchelor, "Engineering Tribology", 4e, Butterworth – Heinemann, 2015.

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20ME E111

FAILURE ANALYSIS AND DESIGN

(Programme Elective –IV)

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

Objectives: To make the students to learn

1. Design methodology and various aspects involved in design process
2. Creative and inventive problem solving techniques
3. Different types of design processes, concepts of reliable and robust design
4. Concept of buckling of cylinders under various loading conditions
5. Fundamentals of fracture, fracture types and concepts of fatigue crack growth, fatigue life prediction and various stress theories of failure, crack propagation concepts under combined loading, fracture toughness of weld metals.

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

1. Apply the concepts of design processes
2. Provide solutions by inventive problem solving techniques
3. Develop reliable and robust design
4. Analyze the behavior of buckling of cylinders under various loading conditions
5. Predict the fracture behavior under static and fatigue loads , apply the crack propagation concepts , fracture toughness of weld metals

UNIT - I

Importance of design: The design process-Considerations of Good Design – Morphology of Design –Organization for design– Computer Aided Engineering – Concurrent Engineering – Product and process cycles –Market Identification – Competition Bench marking. Identification of customer needs- customer requirements- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics.

UNIT - II

Creativity and Problem Solving: Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts-

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Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Design for Reliability –Introduction to Robust Design-Failure mode Effect Analysis.

UNIT- III

Buckling Phenomenon: Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT - IV

Theories of Failure: Failure analysis and determination of stress patterns from plastic flow observations – Dynamicloading– Fracturetypes in tension—Fatigue crack growth– Fatigue life prediction- Cumulative fatigue damage-Stress theory of failure vessels-Thermal stress fatigue

UNIT - V

Fracture Mechanics: Introduction –Through cracks emanating from holes – Corner cracks at holes – Cracks approaching holes-Combined loading-Fatigue crack growth binder- Mixed mode loading-Fracture toughness of weld metals-Service failureanalysis

Text Books:

1. Dieter and E. George, "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.
2. David Broek, "Elementary Engineering Fracture Mechanics", Fifthoff and Noerdhoff International Publisher, 1978.
3. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.

Suggested Reading:

1. G. Pahl and W. Beitz,,"Engineering Design", Springer –Verlag, NY. 1984.
2. Prashant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
3. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.

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20ME C108

COMPUTER AIDED ENGINEERING LAB

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

Objectives: To make the students

1. Model one and two-dimensional elements in ANSYS
2. Understand vibration, harmonic and transient analysis
3. Carry out buckling analysis
4. Analyze forming and sheet metal operations by FEA
5. Model crackelement

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

1. Understand the applications of one and two-dimensional elements
2. Solve engineering problems
3. Find buckling factors
4. Understand industrial applications of forming and sheet metal operations
5. Find fracture toughness

List of Exercises:

1. Introduction to Finite Element Analysis Software
2. Statically indeterminate reaction force analysis and determination of Beam stresses and Deflection
3. Static analysis of a corner bracket
4. Analysis of cylindrical shell under pressure
5. Bending of a circular plate using axisymmetric shell element.
6. Vibration analysis of a simply supported beam
7. Harmonic analysis of plates and shells
8. Transient analysis of vehicle crash
9. Buckling analysis of shells
10. Analysis of forming
11. Analysis of sheet metal operation
12. Stress intensity factor in cracked plates

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Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

Text Books:

1. R. Tirupathi, Chandrupatla and B.D. Ashok, "Introduction of Finite Element in Engineering", Prentice Hall of India, 2004
2. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill,2003

Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, JohnWiley and sons,2009
2. S.S. Rao, ,"The Finite Element Methods in Engineering", 2 /e, Pergamon Press,2001.

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20ME C206

COMPUTATIONAL FLUID DYNAMICS LAB

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

Objectives: To acquaint the student with

1. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
2. Simulation of laminar, turbulent, internal flow, steady and unsteady problems
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of thermal related problems

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

1. Analyze laminar flow problems in plates and pipes
2. Solve steady and unsteady flow past a cylinder
3. Perform analysis for free and forced convection
4. Evaluate the effect of angle of attack and velocity on NACA aerofiol
5. Simulate compressible flow in a nozzle, premixed combustion

List of Experiments:

1. Laminar Flow over Flat plate
2. Laminar PipeFlow
3. Steady Flow past aCylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Aerofoil.
9. Study of compressible flow through a nozzle
10. Partially premixed combustion analysis
11. Supersonic flow over a wedge
12. Study of flow over wind turbine blade/flow through bifurcation artery

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Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

Text Books:

1. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill, Inc., 2015.
2. H.K. Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015.

Suggested Reading:

1. J.H. Ferziger and M. Peric, "Computational Methods for Fluid Dynamics", Springer.
2. K. Muralidhar and T. Sundararajan T, "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.

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20MEC 109

MINI PROJECT WITH SEMINAR

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

Outcomes: Students are able to

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

1. As part of the curriculum in the II- semester of the progarmme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Eachstudentwillbeallottedtoafacultysupervisorformentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Miniprojectsshallhaveinterdisciplinary/ industryrelevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

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Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks:50		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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20EG A101

ENGLISH FOR RESEARCH PAPER WRITING

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

Objectives: The Course will introduce the students to

1. Understand the nuances of language and vocabulary in writing a Research Paper.
2. Develop the content, structure and format of writing a research paper.
3. Produce original research papers without plagiarism.

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

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT - I

Academic Writing : Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT - II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT- III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT - IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

UNIT - V

Research Paper Publication: Reputed Journals– National/International– ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Books:

1. C. R Kothari, Gaurav, Garg, "Research Methodology Methods and Techniques", 4/e, New Age International Publishers.

Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. "MLA Hand book for writers of Research Papers", 7/e, East West Press Pvt. Ltd, New Delhi
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers", Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

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20EG A102

INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS

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

Objectives: The Course will introduce the students to

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

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

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT - I

History of making of the Indian constitutions: History, Drafting Committee (Composition &Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT - II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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UNIT- III

Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions

Union Executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT - IV

Local Administration - District's Administration head: Role andimportance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role. Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT - V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodiesfor the welfare of SC/ST/OBCand women.

Text Books:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1/e, 2015.
2. M. P. Jain, "Indian Constitution Law", 7/e, Lexis Nexis, 2014.

Suggested Reading:

1. "The Constitution of India", 1950 (Bare Act), Government Publication
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

Online Resources:

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

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20EG A103

STRESS MANAGEMENT BY YOGA

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

Objectives: The Course will introduce the students to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

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

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

UNIT - I

Meaning and Definition of Yoga- Historical perspective of Yoga- Principles of Astanga Yoga by Patanjali.

UNIT - II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT- III

Concept of Stress According to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

UNIT - IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

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UNIT - V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. "Yogic Asanas for Group Training - Part-I": Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

Suggested Reading:

1. Nagendra H.R nad Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore,

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

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20EG A104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

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

Objectives: The Course will introduce the students to

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awaken wisdom amongthem.

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT - I

Neetisatakam – Holistic Development of Personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT - II

Neetisatakam – Holistic Development of Personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT- III

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV

Statements of Basic Knowledge - Shrimad Bhagavadgeetha: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

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UNIT - V

Role of Bhagavadgeetha in the Present Scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. "Srimad Bhagavad Gita" , Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Suggested Reading:

1. "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Online Resources:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

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20MEE112

ADVANCED FINITE ELEMENT METHOD

(Programme Elective - V)

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

Objectives: To make the students to learn the

1. FE formulation for isoparametric elements.
2. Validation of isoparametric elements.
3. Parameters to be checked to get solution.
4. Formulation of curved shells.
5. Formulation of non-linear problems.

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

1. Demonstrate understanding of FE formulation for isoparametric element.
2. Understand to evaluate the stresses in the elements.
3. Model effectively and checks the parameters to get the converged solution and verify the solutions.
4. Demonstrate use of FE formulation to shell elements and analyse for buckling loads.
5. Solve nonlinear problems with a FE formulation.

UNIT – I

Isoparametric Elements-I: Bar element, Bilinear quadrilateral element (Q4), Quadratic quadrilaterals (Q8, Q9), Hexahedral isoparametric elements, Numerical integration.

UNIT - II

Isoparametric Element-II: Incompatible modes (nodeless dof), Static condensation, Choices in Numerical integration, Selective integration and substitution, Load considerations (edge, surface traction), Body forces and initial stresses, Stress calculation (stress at Gauss points), Extrapolation calculations, Effect of element geometry, Validity of isoparametric elements, Patch test.

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UNIT- III

Modelling Considerations and Software Use: Introduction, Physical behaviour versus

element behaviour, Thin-walled construction, Element shapes and interconnection, Test cases and pilot studies, Material properties, Loads and reactions, Connections in structures, Boundary conditions, Repetitive symmetry, Stress considerations and substructures, Common mistakes, Checking the model and result.

UNIT – IV

Shell Elements Formulation: Three and four nodes shell elements, Curved isoparametric shell elements, Evaluation of stiffness and stresses in the shells, Stress stiffness and buckling of shells.

UNIT – V

Non-Linear Analysis: Non-linear problems, Solution methods, Plasticity: General formulation for calculations in uni axial stresses, General formulation for small strains, Formulation for Von-mises theory, Non-linear dynamic problems.

Text books:

1. Robert D.cook, David S.Malkus, Micheal E.Plesha, Robert J.Witt., Concepts and applications of finite element analysis, 4th edition, John wiley and sons, INC 2002.
2. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India Private Limited, New Delhi,1996

Suggested Reading:

1. O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, 5th edition, Butterworth-Heinemann, Oxford.
2. J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer- Verlag New York, Inc., New York, 1998
3. T. Belytschko and W. K. Liu and B. Moran, Nonlinear Finite Elements for Continua and Structures, John Wiley & Sons Ltd., England

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20MEE113

DIGITAL MANUFACTURING AND DESIGN

(Programme Elective - V)

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

Objectives: To make the students to learn the

1. FE formulation for isoparametric elements.
2. Validation of isoparametric elements.
3. Parameters to be checked to get solution.
4. Formulation of curved shells.
5. Formulation of non-linear problems.

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

1. Understand the concept of digital manufacturing, technology and its potential in modern manufacturing process.
2. Design and manufacture sophisticated parts using subtractive manufacturing including metal-based additive manufacturing.
3. Implement and manage digital factory by adopting virtual manufacturing
4. Analyse the role of product life cycle and database management systems in manufacturing systems.
5. Understand the concepts of digital design and shape digitization in manufacturing

UNIT – I

Introduction to digital manufacturing: Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System, Impact on manufacturing careers, Advantages of digital manufacturing and design, Information sharing in the digital thread, Multiple organizations in the manufacturing process.

Introduction to Industry 4.0, Case study of car manufacturing by Bosch

UNIT – II

Subtractive manufacturing: Basic architecture, Control hardware and software details,Tooling, Sculptured surface machining.

Additive Manufacturing: Basics, Hardware detailsand capabilities of commercial systems, planning of material addition, Rapid tooling solutions.

UNIT – III

Reverse engineering: Need, Reverse engineering process, Reverse engineering hardware and software, Geometric model development.

Digital factory and virtual manufacturing: Introduction, Scope, Methods and Tools Used in Virtual Manufacturing, Benefits, Virtual factory simulation, case study on a Biscuit factory.

UNIT –IV

Product database management systems: Types, Management information system, Manufacturing data preparation, Shop-floor control, Automatic identification systems (sensors, trackers)

Product life cycle management: Introduction, Types of Product Data, Product life cycle management (PLM) systems, integrated information systems in product lifecycle, Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

UNIT – V

Digital design: Geometrical design of curves, Surfaces and solids, Digital twins, Digital threads and Files format (STL, AMF, 3MF).

Shape digitization: 3D object scanning, Solid reconstructionfrom point cloud and tessellated data, downstream applications.

Text Books:

1. Fundamentals of Digital Manufacturing Science, by Z.Zhou,S.Xie, D. Chen, Springer, 2012.
2. Ibrahim Zeid and Sivasubramanian R, "CAD/CAM - Theory and Practice", Tata McGraw Hill Education, 2011.
3. Antti Saaksvuori and AnselmiImmonen, "Product Lifecycle Management", Springer, 2004.

Suggested Reading:

1. Vinesh Raja and Kiran J Fernandes, "Reverse Engineering- An Industrial Perspective", Springer-Verlag, 2008.

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20EEO101

WASTE TO ENERGY
(Open Elective)

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

Objectives:

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

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

1. Understand the concept of conservation of waste
2. Identify the different forms ofwastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

UNIT - I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, Gasifiers, Digestors

UNIT – II

Biomass Pyrolysis: Pyrolysis, Types, Slow, Fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, Yields and applications.

UNIT – III

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, Construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power,

Equilibrium and kinetic consideration in gasifier operation.

UNIT–IV

Biomass Combustion: Biomass stoves, Improved chullahs, Types, Some exotic designs, Fixed bed combustors, Types, Inclined grate combustors, Fluidizedbed combustors, Design, Construction and operation, Operation of all the above biomass combustors.

UNIT – V

Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, Biomass gasification, Pyrolysis and liquefaction, Biochemical conversion, Anaerobic digestion, Types of biogas plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

Text Books:

1. V.Ashok.,Non Conventional Energy, Desai, Wiley Eastern Ltd., 1990.
2. K.C. Khandelwal and S.S. Mahdi., Biogas Technology - A Practical Hand Book, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

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Suggested Readings:

1. D.S. Challal., Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd.,1991.
2. C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, John Wiley & Sons, 1996.

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20ME E114

THEORY OF ELASTICITY AND PLASTICITY

(Programme Elective – V)

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

Objectives: To make the students to learn the

1. Concepts of Stress & Strain.
2. Problems related to Stress and Strain tensor.
3. Stress tensor for a given strain tensor and vice versa for an isotropic and orthotropic material.
4. Derivations of the constitutive equations in plasticity.
5. Evaluation of the load required in deformation process such as forging, rolling, extrusion and wire drawing processes by various methods and compare them.

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

1. Describe concepts of stress and strain.
2. Estimate principle components, normal & stress components, deviatoric and hydrostatic components of a given stress or strain tensor.
3. Compute the stress tensor for a given stress tensor and vice versa for isotropic and orthotropic materials under various conditions.
4. Express the stress strain relations of plastic deformation
5. Compute load required in various bulk deterministic processes such as forging, rolling, extrusion, wire drawing with various methods and compose them.

UNIT-I

Basic Concepts of Stress: Definition, State of Stress at a point, Stress tensor, invariants of stress tensor, principle stresses, stress ellipsoid, derivation for maximum shear stress and planes of maximum shear stress, octahedral shear stress, Deviatoric and Hydrostatic components of stress, Invariance of Deviatoric stress tensor, plane stress.

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UNIT-II

Basic Concepts of Strain: Deformation tensor, Strain tensor and rotation tensor; invariants of strain tensor, principle strains, derivation for maximum shear strain and planes of maximum shear strain, octahedral shear strain, Deviatoric and Hydrostatic components of strain tensor, Invariance of Deviatoric strain tensor, plane strain.

UNIT-III

Generalized Hooke's Law: Stress-strain relationships for an isotropic body for three dimensional stress space, for plane stress and plane strain conditions, differential equations of equilibrium, compatibility equations, Material (D) matrix for Orthotropic Materials.

UNIT-IV

True Stress and True Strain: Von-Mise's and Tresca yield criteria, Haigh–Westergard stress space representation of von - Mise's and Tresca yield criteria, effective stress and effective strain, St. Venants theory of plastic flow, Prandtle–Reuss and Levy–Mise's constitutive equations of plastic flow, Strain hardening and work hardening theories, work of plastic deformation.

UNIT-V

Analysis Methods: Slab method, Slip line field method, uniform deformation energy method, upper and lower bound solutions, Application of Slab method to forging, wire drawing, extrusion and rolling processes.

Text books:

1. Timoshenko and Goodieer, "Theory of Elasticity", 3/e, McGraw Hill Publications, 2004
2. J. Chakrabarty, "Theory of Plasticity", 2/e, McGraw Hill Publications 1998.

Suggested Reading:

1. George E Dieter, "Mechanical Metallurgy", McGraw Hill Publications 1988.
2. L.M. Kachanov, "Fundamentals of Theory of Plasticity", Dover Publications, 2004.

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2021-22

With Effect from the Academic Year

20CEO101

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

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

Objectives:

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis
4. To provide adequate knowledge to the students on Recourse Management Costing-variance Analysis
5. To train the students with the concepts of Budgetary Control for cost management and to provide a basic platform on Quantitative techniques for cost management.

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

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

UNIT- I:

Project Management: Introduction to project managements, Stakeholders, Roles, Responsibilities and functional relationships, Principles of project management, Objectives and project management system, Project team, Organization, roles and

responsibilities, Concepts of project planning, Monitoring, Staffing, Scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III:

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost, Project direct and indirect costs.

UNIT- IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and leveling, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis: Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector. Just-in-time approach, Material Requirement

UNIT- V:

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets, Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

Text Books:

1. Charles T Horngren., Cost Accounting A Managerial Emphasis, 14th edition, Pearson Education, 2012,
2. Charles T. Horngren and George Foster., Advanced Management Accounting, 6th revised edition, Prentice Hall, 1987.

Suggested Reading:

1. K. K Chitkara., Construction Project Management: Planning, scheduling

and controlling, Tata McGraw Hill Education, 2004.

2. Kumar Neeraj Jha., Construction Project Management Theory and Practice, 2nd edition, Pearson Education India, 2015.
3. Robert S Kaplan and Anthony A. Atkinson, Management & Cost Accounting, 2nd edition, Pearson, 1996.

CBIT (A)

20CSO101

BUSINESS ANALYTICS
(Open Elective)

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

Course Objectives: **The objectives of this course are**

1. **Understanding the basic concepts of business analytics and applications.**
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics.
3. Prepare the students to model business data using various data mining, decision making methods.

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

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics.
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.
6. Create viable solutions to decision making problems.

UNIT-I

Introduction to Business Analytics: **Introduction to business analytics, Need and science of data driven decision making, Descriptive, Predictive, Prescriptive analytics and techniques, Big data analytics, Web and social media analytics, Machine learning algorithms, framework for decision making, Challenges in data driven decision making and future.**

UNIT-II

Descriptive Analytics: **Introduction, Data types and scales, Types of measurement**

scales, Population and samples, Measures of central tendency, Percentile, Decile and quadrille, Measures of variation, Measures of shape skewness, Data visualization.

UNIT-III

Forecasting Techniques: **Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient.**

UNIT-IV

Decision Trees: **CHAID, Classification and regression tree, Splitting criteria, Ensemble and method and random forest, Clustering, Distance and similarity measures used in clustering, Clustering algorithms, K-Means and hierarchical algorithms, Prescriptive analytics, Linear programming and LP model building.**

UNIT-V

Six Sigma: **Introduction, Introduction, Origin, 3-Sigma Vs Six-Sigma process, Cost of poor quality, Sigma score, Industry applications, Six sigma measures, DPMO, Yield, Sigma score, DMAIC methodology, Six Sigma toolbox**

Text Books:

1. **U. Dinesh Kumar, Data Analytics, Wiley Publications, 1st Edition, 2017.**
2. **Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, Business**

Analytics Principles, Concepts and Applications with SAS, Associate Publishers, 2015.

Suggested Reading:

1. **S. Christian Albright and Wayne L. Winston, Business Analytics - Data Analysis and**
   Decision Making, 5th Edition, Cengage, 2015.

Web Resources:

1. **https://onlinecourses.nptel.ac.in/noc18-mg11/preview**
2. **https://nptel.ac.in/courses/110105089/**

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

20ME C110

INDUSTRIAL PROJECT / DISSERTATION PHASE - I

Instruction	20	Hours per week
Duration of SEE	——	
SEE	——	
CIE	100	Marks
Credits	10	

Outcomes: At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/ international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

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Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 1		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Department committee has to assess the progress of the student for every two weeks.

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CBIT (A)
2021-22

With Effect from the Academic Year

20MEC111

INDUSTRIAL PROJECT / DISSERTATION PHASE - II

Instruction	32 Hours per week
Duration of SEE	Viva-Voce
SEE	100 Marks
CIE	100 Marks
Credits	16

Outcomes: At the end of the course:

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. The dissertation should be presented in standard format as provided by the department.
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the

examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.

6. The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report standard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

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Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project 1. Innovations 2. Applications 3. Live Research Projects 4. Scope for future study 5. Application to society
	20	Viva-Voce

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20ME C201

THERMO DYNAMICS AND COMBUSTION

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

Objectives: To make the students to

1. Review the basic laws of thermodynamics and create awareness of the importance of thermodynamic principles in engineering applications
2. Understand the behavior of real gases vis-à-vis ideal gas
3. Create awareness about the importance of combustion reactions in real timeapplications
4. Understand the basic principles of power cycles and its relation with combustion processes
5. Understand various methods of direct energy conversion

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

1. Apply various laws of thermodynamics to suit the engineering applications.
2. Apply the knowledge of thermodynamics for the behavior of real gases.
3. Understand the phenomenon of combustion
4. Understand the application of power cycles to engineeringpractice.
5. Understand various non-conventional energy conversion methods like fuel cells etc

UNIT – I

Thermodynamic Laws: Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamicpropertiesofworkingsubstance. Third law of thermodynamics, Nerst heat theorem, Introduction to - Statistical thermodynamics, statistical interpretations of first and second law and Entropy

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UNIT – II

Real Gas Behaviour: P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal'sequation - Generalized compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – Clapeyron Equation – Throttling – Joule – Thompson coefficient, Non-reactive Mixture of perfect Gases – Governing Laws, Real Gas Mixture

UNIT – III

Combustion: Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Heat of Reaction – Adiabatic flame Temperature, General product – Enthalpies – Equilibrium. Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions. The Van Hoff's Equation - The chemical potential and phase Equilibrium – The Gibbs phase Rule

UNIT – IV

Power Cycles: Power cycles, Review Binary vapour cycle, co-generation and combined cycles – Second law analysis of cycles – Refrigeration cycles. Thermo Dynamics of irreversible processes – Thermo electric circuits

UNIT – V

Direct Energy Conversion: Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation -Thermodynamic devices - Magneto Hydrodynamic Generations – Photo voltaic cells

Text Books:

1. Younus. A. Cengel & Michael. A. Boles, "Thermodynamics: An Engineering Approach", 7/e, TMH.
2. Y.V.C. Rao. "Postulates and Statistical Thermodynamics", Allied Publishers Inc., 1994.

Suggested Reading:

1. P.K. Nag, "Basic and Applied Thermodynamics", TMH, 2008.
2. J.P. Holman, "Thermo Dynamics", Mc Graw Hill, 2008
3. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.

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20ME C202

ADVANCED FLUID DYNAMICS

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

Objectives: Student will understand

1. Understanddifferent typesoffluid flowsand variousfunctionsrelated to fluids
2. Learn important equations related to fluids
3. Understand the concept of boundary layer
4. Understand the isentropic behavior of gas in nozzles
5. Learn about shocks of fluids

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

1. Understand the concept of stream and velocity potential function
2. Apply of the knowledge of equations for analysis in cfd
3. Calculate thickness of boundary layer and shear stress
4. Design nozzles and diffusers
5. Estimate various parameters in fluids subjected to shocks

UNIT - I

Fluid Flows: Classification of fluids. Lagrangian and Eularian Methods of Study of fluid flow. Velocity and acceleration vectors. Circulation and Vorticity. Stream lines. Stream tube. Path lines. Streak lines and Time lines. Stream function and Potential function

UNIT - II

Laws of Fluid Flow: Continuity. Euler's and Bernoulli's equations. Incompressible and Compressible flows. Potential and viscous flows. Navier – Stoke's equation and applications

UNIT- III

Concept of Boundary Layer: Flow over an aerofoil– Lift and Drag coefficients. Boundary layer theory – laminar and turbulent boundary layers. Hydrodynamic and thermal boundary layer equations. Flow separation in boundary layers

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UNIT - IV

Gas Dynamics: Energy equation for flow and non flow processes. Application of Steady flow energy equation for turbines, turbo-compressors, nozzles and diffusers. Adiabatic energy equation. Acoustic velocity, Mach Number. Stagnation properties. Relationships between static and stagnation properties. Various regimes of flow – Steady flow ellipse

UNIT - V

Principles of Gas Dynamics Applicable to Shocks: Isentropic flow through variable area passages. Design of supersonic and subsonic nozzles and diffusers. Supersonic flows. Expansion and Shock waves. Normal and Oblique Shock waves. Prandtl-Meyer and Rankine-Hugoniot Relations. Simple problems on normal and oblique shock waves.

Text Books:

1. C. P. Kothandaraman, R. Rudramoorthy, "Basic Fluid Mechanics", New Age Intl. Publishers, 2014.
2. S. M. Yahya,"Fundamentals of Compressible flow", Wiley Eastern Ltd, 2014.
3. S. Radhakrishnan, "Fundamentalsof Compressibleflow", TMH, 2014.

Suggested Reading:

1. Shapiro, "Compressible fluid flow", Ronold Press, New York, 1956.
2. Liepmen & Rosko, "Elements of Gas Dynamics", Wiley, New York, 1956.
3. Zoeb Hussain, "Gas Dynamics Though Problems", Wiley, New York, 1980.

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20ME M103

RESEARCH METHODOLOGY AND IPR

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

Objectives: To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

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

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques:ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report Writing: Literature Survey: Importanceandpurpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing

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a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT- III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copy Right: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C. R. Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.
3. Y. P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004.

Suggested Reading:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India ltd, 2006
2. B. L. Wadehra, "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India2000.
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010.

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20ME E201

THERMAL AND NUCLEAR POWER PLANTS

(Programme Elective – I)

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

Objectives: Student will understand

1. Performance of steam power plant and to observe the importance of combustion of coal
2. Combined cycle effect in gas turbine power plants
3. Different nuclear reactors and estimate the economical benefits
4. Calculation of different energy tariffs under various load conditions
5. Pressure, temperature and flow parameters of a power plant

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

1. Analyze on combustion of coal and find performance of different power plant cycles
2. Analyze the combined cycle power plants and waste heat recovery systems
3. Design various types of nuclear reactors taking safety precautions and making economically beneficial
4. Calculate the energy rates of power distribution considering the factors affecting the economy
5. Determine the pressure, temperature and flow measurements of steam and water to operate the power plant most efficiently and suggest various remedies to control pollutants

UNIT - I

Layout of Power Plants: Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, and Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, and Flue gas analysis. Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors

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UNIT - II

Combined Cycle Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages

UNIT- III

Nuclear Power Plant: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants. Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power

UNIT - IV

Economics of Power Plant: Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems

UNIT - V

Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control

Text Books:

1. E.L Wakil, "Power Plant Technology", Mc Graw Hill, New York, 1985.
2. J. Weis Man and R Eckert, "Modern Power Plant Engineering", PHI, NewDelhi, 1983.

Suggested Reading:

1. S.C. Arora and S. Domkundwar, "A course in Power Plant Engineering", Dhanpat Rai & Sons 2002.
2. P. K. Nag, "Power Plant Engineering", TMH, 2003.
3. P.C. Sharma, "Power Plant Engineering", Kataria Publications. 2007.

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20ME E202

ENVIRONMENTALENGINEERINGAND POLLUTION CONTROL

(Programme Elective – I)

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

Objectives: Student will understand

1. Harmful effects of pollutants and their control
2. Different techniques adopted in solid waste management
3. Causes and remedies for waterpollution
4. Other types of pollution like oils, pesticides, noiseetc
5. Controlling methods adopted to reduce pollution from their power plants

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

1. Estimate air pollutants and suggest suitable remedial methods to control them
2. Suggest a suitable solid waste disposal system
3. Suggest suitable remedy to control water pollution
4. Suggest suitable remedy to control other pollutants like oils, pesticides, noise etc.
5. Suggest a suitable instrumentation for pollution control

UNIT - I

Air Pollution: Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues inAir Pollution control.

UNIT - II

Solid Waste Management: Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste

UNIT- III

Water Pollution: Sources and Classification of Water Pollutants - Characteristics - Waste Water Sampling Analysis - Waste Water Treatment - Monitoring compliance with Standards - Treatment, Utilization and Disposal of Sludge

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UNIT - IV

Other Types of Pollution: Noise Pollution and its impact- Oil Pollution - Pesticides - Radioactivity Pollution Prevention and Control

UNIT - V

Pollution from Thermal Power Plants and Control Methods: Instrumentation for pollution control - Water Pollution from Tanneries and other Industries and their control

Text Books:

1. G. Masters, "Introduction to Environmental Engineering and Science", Prentice –Hall, International Editions, 1988..
2. S. Peavy, D. R. Rowe and G. Tchobanoglous, "Environmental Engineering", McGraw- Hill Book Company, NY, 1985.

Suggested Reading:

1. H. Ludwig and W. Evans, "Manual of Environmental Technology in Developing Countries", 1991.
2. "Environmental Considerations in Energy Development", Asian Development Bank (ADB), Manilla, 1991.

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20ME E103

OPTIMIZATION TECHNIQUES

(Programme Elective – I)

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

Objectives: The students will

1. Come to know the formulation of LPP models
2. Understand the Algorithms of Graphical and Simplex Methods
3. Understand the Transportation and Assignmenttechniques
4. Come to know the procedure of Project Management along with CPM and PERTtechniques
5. Understand the concepts of sequencing and queuing theory

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

1. Formulate a managerial decision problem into a mathematical model.
2. Apply Operations Research models to real time industry problems
3. Build and solve Transportation Models and Assignment Models.
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing and concepts in industry applications

UNIT - I

Basic Concepts: Operations Research definition, scope, Models, Linear programming problems, Formulation, Graphical Method, Simplex Method, and Duality insimplex.

UNIT - II

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

UNIT- III

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times,

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Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT - IV

Queuing Theory: Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two Machines, processing 'n' jobs through three machines. Game Theory – definition saddle point Principle of Dominance.

Text Books:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi,2008

Suggested Reading:

1. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
2. Pannerselvam, "Operations Research", Prentice Hall of India 2010
3. Harvey M Wagner,"Principles of Operations Research", Prentice Hall of India 2010

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20ME E203

AIR CONDITIONING SYSTEM DESIGN

(Programme Elective – II)

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

Objectives: Student will understand

1. The difference between refrigeration and air conditioning
2. Working principles of simple vapour compression refrigeration cycle and absorption refrigeration
3. Necessity of psychrometry chart in air conditioning system design
4. Classification of air conditioning systems
5. How to calculate loads on air conditioning sysem

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

1. Effect of refrigerants on environment and ozone depletion,
2. List out merits and demerits of absorption refrigeration systemover simple vapour compression refrigerationsystem
3. List out factors effecting design of air conditioning system
4. Importance of air conditioning in engineering applications
5. Design components used in air conditioning circuits

UNIT - I

Refrigeration and Air Conditioning: Differentiation of refrigeration and air conditioning, COP, tone of refrigeration, classification of refrigerant, properties of refrigerants, eco-friendly refrigerants, green-house effect, ozone depletion, air refrigeration, Bell Coleman cycle, air craft refrigeration, classification of ari craft refrigeration

UNIT - II

Refrigeration Systems: Simple vapor compression refrigeration system, COP, pressure-enthalpy, temperature-entropy diagrams, theoretical and practical cycles, absorption refrigeration cycle, COP of absorption refrigeration cycle, simple and practical NH3 refrigeration cycle, Electrolux refrigeration cycle, lithium bromide refrigerationcycle

UNIT- III

Psychrometry : Introduction to psychrometry, psychrometric processes, comfort air conditioning, factors effecting comfort air conditioning, thermodynamic

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human being, effective temperature, comfort chart, by-pass factor, indoor air quality, infiltration, problems on summer air conditioning and winter air conditioning

UNIT - IV

Air Conditioning Systems : Classification of air conditioning systems, window air conditioning system, split air conditioning system, year round air conditioning system, ERSH, GSHF, industrial air conditioning, transport air conditioning, food processing industries, photographic industries, food preserving industries, chillers

UNIT - V

Design of Air Conditioning System: Loads on air conditioning system, factors effecting design of air conditioning system, design of condensers, evaporators, fillers, humidifiers, de-humidifiers, fans, blowers and ducts, expansion devices, case studies of calculation of heat loads like auditorium, operation theatre, chilling centers, software used in design of air conditioning system.

Text Books:

1. C. P. Arora, "Refrigeration &Air Conditioning", Tata Mc Graw Hill, 1985.
2. Stoecker, "Refrigeration &Air Conditioning", Mc Graw Hill, 1992.
3. W. P. Jones, "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.

Suggested Reading:

1. Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill,1974.
2. Manohar Prasad, "Refrigeration &Air Conditioning", New Age Publishers, 2014.
3. ASHRAE Hand book.

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20ME E205

DESIGN OF SOLAR AND WIND SYSTEMS

(Programme Elective – II)

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

Objectives: Student will understand

1. Need and importance of NCES and extent of Solar Energy as source.
2. Concepts of Solar collectors, applications and Storage.
3. Concepts of Solar Energy storage
4. Wind Energy Conversion Fuel cell and MHD principles
5. Biomass conversion principles and also about Geothermalenergy

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

1. Understand the implementation status of NCES in India along with basic concepts of Solar Energy
2. Analyze the performance of Solar Collectors
3. Understand PV Cell technology and storage methods
4. Conceptually design the wind turbine and understand fuel cells functioning.
5. Understand various Waste to Energy conversion technologies.

UNIT - I

Basics And Solar Energy: Definition-Concepts of Non Conventional Energy Sources (NCES), potential and limitations of NCES, their Classification and comparison, Solar Radiation, Basic definitions, Sun to Earth angles, Sun rise, Sunset and Day length

UNIT - II

Solar Energy Collectors: Flat plate and concentrating collectors along with their applications. Performance of flat plate and concentrating collectors. P-V Cell.

UNIT- III

Solar Energy Storage and Applications: Solar Satellite, Different Methods of storage, Sensible, Latent and Stratified, Solar engine Stirling and Brayton engines Solar Ponds, solar chimney, solar satellite, Stand alone grid connection

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UNIT - IV

Wind Energy: Wind energy conversion, General formula -Lift and Drag- Basics of wind energy conversion -Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors- Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle, Fuel Cells and MHD Working principles

UNIT - V

Bio-mass and Geothermal Energy: Availability of Biomass and various conversion process; Direct Combustion, Thermo chemical and Bio chemical conversion process, Factors effecting generation of Biogas and various types of biogas plants, Introduction to Geothermal Energy

Text Books:

1. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley.
2. Hasan Sayed, and D K Sharma, "Non Conventional Energy Sources", Katson Publishing.
3. G.D. Rai, "Non Conventional Energy Sources".

Suggested Reading:

1. S.P. Sukhatme. "Solar Energy", Tata Mcgraw Hill Publishing, 2014..
2. N.K. Bansal, "Non Conventional Energy Sources", Vikas Publishers, 2012.

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20CE A101

DISASTER MITIGATION AND MANAGEMENT

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

Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

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

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management.

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UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Casestudies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT- IV:

Disaster Impacts: Disasterimpacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects-gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

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Text Books:

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh,"Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, "Government of India, "National disaster management plan, Part I and II"
2. K. K. Ghosh,"Disaster Management", APH Publishing Corporation, 2006.
3. "Hazards, Disasters and your community: Abooklet for students and the community", Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/(National Disaster management in India, Ministry of Home Affairs)

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20EG A101

ENGLISH FOR RESEARCH PAPER WRITING

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

Objectives: The Course will introduce the students to

1. Understand the nuances of language and vocabulary in writing a Research Paper.
2. Develop the content, structure and format of writing a research paper.
3. Produce original research papers without plagiarism.

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

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT - I

Academic Writing : Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT - II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT- III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT - IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

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UNIT - V

Research Paper Publication: Reputed Journals– National/International– ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Books:

1. C. R Kothari, Gaurav, Garg, "Research Methodology Methods and Techniques", 4/e, New Age International Publishers.

Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. "MLA Hand book for writers of Research Papers", 7/e, East West Press Pvt. Ltd, New Delhi
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers", Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

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20EG A102

INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	----------
Credits	0

Objectives: The Course will introduce the students to

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

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

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT - I

History of making of the Indian constitutions: History, Drafting Committee (Composition &Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT - II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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UNIT- III

Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions

Union Executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT - IV

Local Administration - District's Administration head: Role andimportance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role. Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT - V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodiesfor the welfare of SC/ST/OBCand women.

Text Books:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1/e, 2015.
2. M. P. Jain, "Indian Constitution Law", 7/e, Lexis Nexis, 2014

Suggested Reading:

1. "The Constitution of India", 1950 (Bare Act), Government Publication
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

Online Resources:

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

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20EG A104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

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

Objectives: The Course will introduce the students to

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awaken wisdom amongthem.

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT - I

Neetisatakam – Holistic Development of Personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT - II

Neetisatakam – Holistic Development of Personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT- III

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV

Statements of Basic Knowledge - Shrimad Bhagavadgeetha: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

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UNIT - V

Role of Bhagavadgeetha in the Present Scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. "Srimad Bhagavad Gita" , Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

Suggested Reading:

1. "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Online Resources:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

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20ME C203

THERMAL SYSTEMS LAB

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

Objectives: Student will understand to

1. Evaluate the performance of I.C Engine
2. Determine heat transfer coefficient in two phase heat transfer
3. Determine effectiveness of cross flow heat exchanger
4. Evaluate the thermal properties of fluids
5. Evaluate the COP of Refrigeration & Air conditioning Tutors

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

1. Estimate the thermal efficiency of IC engine
2. Prove that value of convection heat transfer coefficient is very high with two phase heat transfer
3. Estimate the effectiveness of cross flow heat exchanger and prove that it is very high compared with other configurations
4. Find out properties of fluids such as coefficient of thermal expansion, enthalpy of fusion
5. Determine COP of Refrigeration and air conditioned tutors

List ofExperiments:

1. Performance Evaluation on single/multi cylinder 4-stroke SI Engine.
2. Performance Evaluation on single/multi cylinder 4 stroke CI Engine.
3. Determination of heat transfer coefficient in Film wise and Drop wise condensation
4. To determine the effectiveness of Cross flow Heat Exchanger.
5. Heat Pipe Demonstration
6. Performance text on Axial flow compressor
7. Determination of coefficient of thermal expansion of Solids, Liquids and Gases
8. Determination of thermal capacity of Solids
9. Determination of isentropic coefficient of air by Clement-Desormes method
10. Measure of enthalpy of fusion and solidification
11. Determination of COP of Refrigeration tutor
12. Determination of COP of Air-conditioning tutor

Note : Out of the above 12 experiments, any ten experiments have to be carried out.

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Text Books:

1. Younus. A. Cengel & Michael A. Boles, "Thermodynamics An Engineering Approach", 7/e, TMH.
2. Y.V.C. Rao. "Postulates and Statistical Thermodynamics", Allied Publishers Inc., 1994.

Suggested Reading:

1. P.K. Nag, "Basic and Applied Thermodynamics", TMH, 2008.
2. J.P.Holman, "Thermo Dynamics", Mc Graw Hill, 2008.
3. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.

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20ME C204

DESIGN OF SOLAR AND WIND SYSTEMS LAB

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

Objectives: To make the students to understand

1. Concepts of solar energy collection and measurements
2. Wind and solar thermal applications
3. Direct conversion using solar PV cell
4. Wind turbine working and factors effecting its performance
5. Bio energy conversion principles

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

1. Measure radiation using various instruments
2. Find the performance of solar water pump, water heater
3. Determine the effect of tilting angle on pv cell
4. Evaluate efficiency of wind turbine
5. Differentiate KVIC and JANATAbio energy conversion systems

List of Experiments:

1. Study of direct and diffused beam solar radiation (Solar Radiation Measurement)
2. Performance evaluation of solar flat plate collector (water heating, water pumping)
3. Performance evaluation of concentrating solar collector
4. Performance of PV panel in series and parallel combination: (Charging characteristics of a battery using PV panel, Effect of tilt angle on solar PV panel, Effect of shadow on solar PV panel , Effect of surrounding temperature on PV panel)
5. Study of direct and indirect solar dryer (how to dry various types of Agricultural products)
6. Analysis of KVIC Bio gas plant
7. Performance studies of Gasifier
8. Study of Janata Bio gas plant, Deenabandhu Biogas plant for demonstration
9. Small wind turbine of 500kw for the purpose of demonstration

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Text Books:

1. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley.
2. Hasan Sayed and D. K. Sharma, "Non Conventional Energy Sources", Katson Publishing.
3. G.D. Rai, "Non Conventional Energy Sources".

Suggested Reading:

1. P. Sukhatme "Solar Energy", Tata Mcgraw Hill Publishing, 2004
2. N.k. Bansal, "Non Conventional Energy Sources". Vikas Publishing, 2009.

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20ME E204

ENERGY CONSERVATION AND MANAGEMENT

(Programme Elective – II)

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

Objectives: Student will understand

1. Know the importance of energy sector in countries' development
2. Identify various auditing services
3. Prepare the organizational structure energy policy
4. Get the concept of management in process industries
5. Explain how to take tax considerations

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

1. Know energy scenario both India and world
2. Review and asses the various audit tools
3. Understand energy policy planning and take energy management as a profession
4. Analyze energy security, codes, standards
5. Arrange the financial arrangements forindustries

UNIT - I

Global & Indian Energy Scenario: Classification of Energy sources-Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns, Basics of Energy and its various forms.

UNIT - II

Energy Audit: Types of energy audit, Energy Auditing Services Basic Components of an Energy Audit Specialized Audit Tools Industrial Audits Commercial Audits Residential Audits Indoor Air Quality

UNIT- III

Energy Management: Program Organizational Structure, Energy Policy Planning Audit Planning Educational Planning Strategic Planning, The Value of Energy Management The Energy Management Profession Some Suggested Principles of Energy Management, Energy Management Systems Justification of EMCSs Systems Integration

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UNIT - IV

Waste Heat Recovery: Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act. Economics of Waste-Heat Recovery, Energy management in water and waste water treatment – solid waste treatment- air pollution control systems . Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration –

UNIT - V

Capital Investments: Introduction General Characteristics of Capital Investments, Sources of Funds Tax Considerations Time Value of Money Concepts Project Measures of Worth Economic Analysis-Financing Energy Management Projects Introduction Financial Arrangements: A Simple Example Financial Arrangements: Details and Terminology Applying Financial Arrangements: A Case Study "Pros" & "Cons"

Text Books:

1. W. C. Turner, "Energy Management Handbook", 5/e, Marcel Dekker, Inc, New York, 2005.
2. W. R. Murphy and G. McKay, "Energy Management", Butterworth Heinemann, 2007.

Suggested Reading:

1. "General Aspects of Energy Management and Audit", National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management).
2. B. L. Capehart, W. C. Turner, W. J. Kennedy, "Guide to Energy Management", CRC Press, New York, 2005.

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20ME C106

FINITE ELEMENT TECHNIQUES

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

Objectives: To make the students to

1. Understand finite element analysis fundamentals andformulations
2. Formulate the axial, truss, beam and 2D problems
3. Formulate the heat conduction and dynamics problems, understand the use of numerical integration and Gauss quadrature
4. Understand the convergence requirements and 3D problems
5. Perform engineering simulations using finite element analysis software (ANSYS)

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

1. Apply FE method for solving field problems using virtual work and potential energy formulations
2. Analyze linear problems like axial, truss and beam, torsional analysis of circular shaft
3. Analyze 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve theproblems.
4. Evaluate the eigen values and eigen vectors for stepped bar, formulate 3 D elements, check for convergence requirements
5. Solve linear 1 D and 2 D heat conduction and convection heat transfer problems, Use of FEA software ANSYS for engineering solutions

UNIT - I

Introduction to Finite Element Method of Solving Field Problems: Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. **Potential Energy Approach**: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

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UNIT - II

Analysis of Trusses: Analysis of plane truss with number of unknowns not exceeding two at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element

Analysis of Frames: Analysis of frames with two translations and a rotational degree of freedom at each node.

UNIT- III

Two Dimensional StressAnalysis: Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

UNIT - IV

Steady State Heat TransferAnalysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.

Time Dependent Field Problems: Application to one dimensional heat flow in a rod.

Dynamic Analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.

Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT - V

Three Dimensional Problems in StressAnalysis: 3D elements: Introduction to tetrahedron and brick elements.

Introduction to thin and thick plates

Introduction to non-linear formulation through FE.

Text Books:

1. R. Tirupathi. Chandrupatla and D.B. Ashok, "Introduction of Finite Element in Engineering", Prentice Hall of India, 2004.
2. S.S. Rao. "The Finite Element Methods in Engineering", 2/e, Pergamon Press, 2001.
3. David. V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill, 2003.

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Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, John Wiley and sons, 2009.
2. K.J. Bathe, "Finite element procedures", 2/e, Prentice Hall of India, 2007.
3. D.L. Logan, "First course in finite element method", 5/e, Mason, OH: South Western, Cengage Learning, 2011.

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20ME C205

ADVANCED HEAT AND MASS TRANSFER

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

Objectives: To make the students to

1. Understand the basic principles of fins and unsteady state heat transfer applied to industries.
2. Learn various equations and their application in engineering heat transfer
3. Understand boundary layer concept and their applications
4. Learn about principles of phase heat transfer and radiation heat transfer
5. Learn about mass transfer and its applications in process industries

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

1. Apply the equations pertaining to unsteady state heat transfer and knowledge in extended surfaces
2. Evaluate mass, momentum and energy equations with approximate and exact methods
3. Apply heat transfer knowledge in calculation of boundary layer thickness and various dimensionless numbers
4. Evaluate heat transfer coefficients under phase change phenomena and radiation heat transfer
5. Apply the knowledge of mass transfer in process industries

UNIT - I

Brief Introduction to Different Modes of Heat Transfer: Conduction: General heat conduction equation-Initial and Boundary conditions Steady State Heat Transfer: Simplified heat transfer in 1D and 2D – Fins. Transient heat conduction; Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – product solutions

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UNIT - II

Finite Difference Methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems – implicit and explicit methods. Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum

equations – Derivation of Energy equation - Methods to determine heat transfer coefficient: Analytical Methods - Dimensional Analysis and concept of exact solution.Approximate Method – Integral analysis

UNIT- III

External Flows: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometrics for Laminar and Turbulent flows. Internal flows: Fully developed flow: Integral analysis for laminar heat transfer coefficient – Types of flow – Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic & thermal entry lengths; use of empirical correlations

UNIT - IV

Free Convection & Radiation: Approximate analysis on laminar free convective heat transfer – Boussinesque Approximation - Different geometries – combined free and forced convection, Boiling and condensation: Boiling curve – Correlations- Nusselt's theory of film condensation on a vertical plate – Assumptions & correlations of film condensation for different geometrics

UNIT - V

Mass Transfer: Radiation Heat Transfer, Radiant heat exchange in grey,non-greybodies, withtransmitting, reflectingandabsorbingmedia, specularsurfaces, gas radiation – radiation from flames. Mass Transfer: Concepts of mass transfer – Diffusion & convective mass transfer Analogies – Significance of non-dimensional numbers.

Text Books:

1. Necati Ozisik, "Heat Transfer", TMH, 1998.
2. Incropera Dewitt, "Fundamentals of Heat & Mass Transfer", John Wiley, 2007.
3. Yunus A. Cengel, "Heat Transfer: A basic approach", TMH, 2008.

Suggested Reading:

1. R. C. Sachdeva, "Fundamentals of Engineering Heat & Mass Transfer", New Age International Publications, 2010.
2. J.P. Holman, "Heat Transfer", Mc Graw Hill, 2008.

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20ME E206

COMPUTATIONAL FLUID DYNAMICS
(Programme Elective – III)

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

Objectives: To make the students to learn the

1. Basic equations and concept of CFD
2. Concept of pdes and finite difference methods
3. Various types of grid generation and errors in numerical solution
4. Crank-Nihcolson, Implicit and Explicit methods & Jacobi, Gauss Seidel and ADI methods
5. Importance of FVM

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

1. Derive CFD governing equations and turbulence models
2. Apply elliptical, parabolic and hyperbolic pdes and forward, backward and center difference methods
3. Understand errors, stability, consistency and develop O,H and C grid generated models
4. Evaluate the use of Crank-Nihcolson, Implicit and Explicit methods and analyze problem by Jacobi, Gauss Seidel and ADI methods
5. Solve conduction and convection problems using FVM.

UNIT - I

Governing Equations: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-å turbulence Model.

UNIT - II

Grid Generation: Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria

UNIT- III

Classification of PDEs: Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference

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UNIT - IV

Finite Difference Solutions: Finite difference solutions - Crank Nicholson, Implicit and explicit, ADI - Jacobi, Gauss Seidel, solution for Viscous incompressible flow using Stream function – Vorticity method

UNIT - V

Finite Volume Method: Introduction to Finite volume method, Finite volume formulations for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm

Text Books:

1. John D. Anderson, "Computational Fluid Dynamics", Mc Graw Hill Inc., 2015.
2. H. K. Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015.

Suggested Reading:

1. K. Muralidhar and T. Sundararajan T., "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003.
2. S.V. Patankar, "Numerical Heat transfer and Fluid flow", Hemisphere Publishing Company, New York, 1980.

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20ME E207

REFRIGERATION AND CRYOGENICS

(Programme Elective – III)

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

Objectives: To make the students to learn the

1. Importance of selection of refrigerant,
2. Utility of simple vapour compression refrigeration cycle
3. Working principle of absorption refrigeration cycle,
4. The design principles of components of refrigeration system
5. Working principle of gas liquefaction

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

1. Learn the applications of refrigeration and ODP, GWP and related environment issues
2. To design the refrigeration systems for domestic applications
3. Understand absorption refrigeration system and its advantages over vapor compression refrigeration
4. Design equipment needed for refrigeration system like evaporators, condensers.
5. To understand the applications in cryogenics and gas-liquefaction system

UNIT - I

Fundamentals of Refrigeration: Definition of refrigeration, applications of refrigeration, COP, tone of refrigeration, refrigerants and their classification, properties of refrigerants, designation of refrigerants, ozone depletion, eco-friendly refrigerants, Air Refrigeration, Bell Coleman cycle, air craft refrigeration, classification

UNIT - II

Vapor Compression Refrigeration System: Actual cycle, theoretical cycle, flash chamber, accumulator, sub-cooling, superheating, cascade refrigeration, wet compression, dry compression, improvements in the performance of cycle, multi-stage compression with Intercooling, multi-evaporator system

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UNIT- III

Vapor Absorption Refrigeration System: Absorption Refrigeration, Simple and Practical NH3 refrigeration, Electrolux refrigeration, LiBr refrigeration system, Efficiency of absorption refrigeration system, steam jet refrigeration, merits and demerits of steam jet refrigeration over simple vapour compression cycle

UNIT - IV

Refrigeration Applications and Psychrometry: Design, selection of evaporators, condensers, control systems, motor selection, Refrigeration applications, food preservation, transport, Introduction to psychrometry, psychrometric processes, humidifiers, de-humidifiers, filters, ducts

UNIT - V

Cryogenics: Application of cryogenics, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claudecycle, merits of one system over other system, Production of liquid air, Production of liquid nitrogen and production of liquid oxygen.

Text Books

1. C. P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2000.
2. Stoecker & Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, 1992.
3. Bailey, "Advanced Cryogenics", Plenum Press, London, 1971.

Suggested Books.

1. Jordan & Priester, "Refrigeration and Air-conditioning", Prentice-Hall, 2/e, 1957.
2. G.G. Hasseldon, "Cryogenic Fundamentals", Academic Press, 1992.

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20ME E208

DESIGN OF HEAT EXCHANGERS

(Programme Elective – III)

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

Objectives: To make the students to learn the

1. Importance of heat exchanger in engineering application
2. Various co-relations for forced convection heat transfer coefficients for differentgeometries
3. Importance of pressure drop and its effect on heat transfer rate
4. Working principle of hair pin heat exchanger
5. Design concepts of condensers and heat pipe

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

1. Explain different types of heat exchangers, LMTD method and NTU methods
2. List out co-relations for forced convection heat transfer coefficient for various geometries
3. Estimate the pressure drop in laminar and turbulent flow in heat exchangers
4. Determine pressure drop in hair pin and finned tube heat exchangers
5. Explain design and operational considerations in condensers and heat pipes

UNIT - I

Heat Exchanger Types and Design Methods: Tubular heat exchangers, plate heat exchangers, extended surface heat exchangers, flow arrangements, applications, overall heat transfer coefficient, multi-pass and cross flow heat exchangers, LMTD method, NTU method for heat exchanger analysis

UNIT – II

Forced Convection Heat Transfer Coefficient: Laminar forced convection in ducts and concentric annuli, turbulent forced convection in ducts and circular pipes, heat transfer in helical coils, and spirals and heat transfer in bends

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UNIT – III

Pressure Drop and Fouling: Tube side pressure drop in laminar and turbulent flows, pressure drop in bends and fittings, Fouling of heat exchangers, basic considerations, effect of fouling on heat transfer and pressure drop.

UNIT - IV

Hair Pin and Finned Heat Exchangers: Pressure drop-hydraulic diameter, hair pin heat exchanger, parallel and series arrangements of hairpins, total pressure drop, compact heat exchangers, plate-fin heat exchangers, tube fin heat exchangers, pressure drop for fin tube heat exchanger

UNIT - V

Condensers: Horizontal shell and tube condensers, plate condensers, air cooled condensers, design and operational considerations, Heatpipe, workingprinciple, heat pipe components and materials

Text Books:

1. Donald Q. Kern, "Process Heat Transfer", TMH Publications, 1963.
2. Sadik Kakac and Hongtan Liu, "Heat Exchangers-Selection,Rating and Thermal Design", 3/e, CRC Press, 2012.
3. David Reay and Peter Kew, "Heat Pipes, Theory, design and Applications", Butterworth-Heinemann (Elsevier), 5/e, 2006.

Suggested Reading:

1. S. Kakac, A. E. Bergles and F. Mayinger, "Heat Exchangers, Thermal, Hydraulic Fundamentals and Design", Hemisphere Publications, 1981.
2. "Standards of Tubular Exchangers Manual Association (TEMA)", 7/e, 1988.

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20ME E209

TURBO MACHINES

(Programme Elective – IV)

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

Objectives: Student will understand

1. Principles and equations of turbo machinery
2. Velocity triangle and power developed by steam turbines
3. Working principles of Pelton, Francis and Kaplan turbines
4. Working principles of axial flow compressor and centrifugal compressor and their performance
5. Power required for rotary compressors and power developed bygas turbines

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

1. Apply gas dynamics equations depending upon applications
2. Estimate the power developed by steam turbines
3. Calculate hydraulic efficiency of impulse and reaction turbines
4. Find the efficiency, pressure rise, degree of reaction, slip factor and performance of axial flow and centrifugal compressors
5. Understand cycles and improve the cycle efficiency in gas turbines

UNIT - I

Fundamentals of Turbo Machines: Classifications, Applications, Isentropic flow, Energy transfer, Efficiencies, Static and Stagnation conditions, Fluid equations - continuity, Euler's, Bernoulli's equation and its applications. Euler's flow through variable cross sectional areas.

UNIT - II

Steam Turbines: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure, Design of nozzles. Steam Turbines: Impulse turbines, Work done and Velocity triangle, Efficiencies, Compounding

UNIT- III

Hydraulic Turbines: Introduction, Classification of turbines, Impulse and reaction turbines, construction, working and performance of Pelton, Francis and Kaplan Turbines, Selection of turbines: specific speed, unit quantities.

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UNIT - IV

Axial Flow Compressors and Centrifugal Compressors: Work and velocity triangles, Efficiencies, Stage pressure rise, Degree of reaction, Performance of compressors, Velocity triangles and efficiencies; slip factor, performance of compressors.

UNIT - V

Gas Turbines: Principle of working – Classification – Joule's cycle – work done and efficiency – Brayton Cycle – Optimum Pressure ratio for maximum power and maximum efficiency – P_{max} and η_{max} – Improvement in cycle performance – Intercooling, Reheating and Regeneration (Heat exchanging) – Problems using these principles.

Text Books:

1. S. M. Yahya, "Turbines, Compreessors and Fans", 4/e, Tata McGraw-Hill Education Pvt. Ltd., 2010.
2. G. Gopalakishnan and D. Prithvi Raj, "Atreatise on Turbomachines", Scitec Publications, Chennai, 2002.
3. Seppo. A. Korpela, "Principles of Turbomachinery", John Wiley & sons Inc. Publications, 2011.

Suggested Reading:

1. R. K. Turton, "Principles of Turbomachinery", E & F N Spon Publishers, London & New York,2004.
2. Dennis G. Shepherd, "Principles of Turbomachines", Macmillan, 2007.

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20ME E210

GAS TURBINES
(Programme Elective – IV)

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

Objectives: Student will understand

1. Adiabatic energy equation ofnozzle.
2. Thermodynamic cycle of gas turbine
3. Working principle of rotarycompressors.
4. Working principle of gas turbine power plant.
5. Working principle of jets and propulsions.

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

1. Design nozzle with known inlet conditions
2. Evaluate thermal efficiency of gas turbines and its improvement
3. Determine overall efficiency of Axial flow compressor and Centrifugal compressors
4. Design combustion system for gas turbine plant
5. Determine thrust and propulsive force developed by jets and rockets.

UNIT - I

Gas Dynamics Fundamentals: Conservation Lawsand governing equationsfor Mass, Momentum and Energy for Compressible flows; Basic definitions for Static and Stagnation Pressure, Mach Wave, Mach Angle and Over expanding Nozzle, Adiabatic Flow through Converging-Diverging Nozzle, Adiabatic Flow through a constant area duct, Phenomenon of Shock, Rayleigh Lines, Fanno Lines in ductflows

UNIT - II

Gas Turbines: Relative merits over conventional IC Engines, Introduction to Brayton and Atkinson cyclefor Gas turbines, Pressure Ratio, Thermal Efficiency, Specific Output, optimum pressure ratio, Enhancement of Thermal Efficiency and/or specificpower outputusing inter cooling, heatexchangers, reheatburners

UNIT- III

Compressors: Centrifugal Compressor-Major components – Inducer, Impeller, Vaneless Diffuser, Vaned Diffuser, Volute Casing, Velocity & Pressure variation

in a stage, Degree of Reaction, Prewhirl and Surging. Axial Flow Compressor : Stage consisting of a Rotor and a Stator, Pressure Rise in a Stage, Polytropic Efficiency, Losses in a Compressor stage, Phenomenon of Blade Stall & Surging and Phenomenon of Chocking, Performance Curves

UNIT - IV

Gas Turbine Power Plants: Fuel and fuel feed systems; combustion systems-design considerations and flame stabilization; regenerator types and design; gas turbine power; plant performance. Application of airfoil theory to the study of flow through turbine blades; aerodynamic and thermodynamic design considerations; blade materials; blade attachments and blade cooling.

UNIT - V

Jets and Propulsion: Concept of Propulsion and Thrust, Variety of Propulsion systems for flying vehicles – Turboprop, Turbojet, Ram Jet, Pulse Jet, Analysis of propulsion cycle. Thrust Augmentation: Water Injection, Liquid Injection, Afterburning, Bleed Air system

Rocket Propulsion: Distinction between Turbojets and Rockets, Rocket Thrust, Specific Impulse, Total Impulse, Thermal Efficiency, Rocket Equation and applications.

Text Books:

1. H. I. H. Saravanamuttoo, G. F. C. Rogers, H. Cohen , Paul Straznicky, "Gas Turbine Theory", Pearson education. Ltd, 6/e, 2009.
2. V.Ganesan, "Gas Turbines", Tata McGraw-Hill Education, 3/e, 2010.

Suggested Reading:

1. S. M. Yahya, "Turbines, Compressors and Fans", Tata McGraw-Hill Education, 1992.
2. Vincent, "The Theory and design of Gas Turbines and Jet Engines", McGraw-Hill Education,1950.

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20ME E211

POWER PLANT CONTROL AND INSTRUMENTATION
(Programme Elective – IV)

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

Objectives: Student will understand

1. Principles of static and dynamic characteristics ofinstruments
2. Working principles of feedback control concepts of electrical parameters
3. Create awareness of the importance of working principles of various measuring instruments, their applications in engineering industry and understand characteristics of instruments
4. Familiarize the principles of data acquisition along influence of electrical parameters on instrumentation
5. Understand the principles of modeling of power systems

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

1. Estimate static and dynamic characteristics ofinstruments
2. Estimate the influence of electrical parameters on measurements
3. Understand theory on stability of instruments used for thermal systems and model power systems using various numerical methods
4. Estimate the role of computers for data acquisition
5. Represent various types of process control system

UNIT - I

Static & Dynamic Characteristics of Instruments: Static & dynamic characteristics of instruments, sensors, signal processing & data transmission elements, indicating & recording elements

UNIT - II

Data Acquisition: Use of computers for data acquisition & instrumentation for measuring temperature, pressure flow, speed, vibration & noise

UNIT- III

Electrical Parameters: On-lineprocessinstruments. Automaticprocesscontrol systems Representation. Feedback control concepts. Transient & Frequency response. Types of controllers

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UNIT - IV

Stability Of Instruments: Stability, Digital Control System Modern Control theory. Boiler Control, Governing & Control of turbo-machines

UNIT – V

Computer Aided Power Systems Analysis: Modelling of power system, components, Formation of bus admittance and impedance matrices, Power flow solution Gauss-Seidel, Newton Raphson, and fast de-coupled load flow, Short Circuit studies, Static equivalents of power system, Basic concepts of security analysis and state estimation.

Text Books:

1. T.G.Beckwith and N. Lewis Buck, "Mechanical Measurements". Wesley Publishing, 1961.
2. K. Tayal, "Instruments and Mechanical Measurements", Galgotia Publications.
3. Mc Cloy and H.R. Martin, "The Control of Fluid Power", Longman Publication, 1973.
4. D.A. Williams and G. James, "Liquid Fuels", London Pergamon, 1963.

Suggested Reading:

1. David Lindsley, "Power-Plant Control and Instrumentation", IEE Control Engineering Series 585.
2. W. Bolton, "Instrumentation and Control Systems", 1/e, Elsevier, 2004.

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20EE A101

SANSKRIT FOR TECHNICAL KNOWLEDGE

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

Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series). Themeasurementsystem-time-mass-length-temp,Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):

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Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

Text Books:

1. M Krishnamachariar, "History of Classical Sanskrit Literature", TTD Press, 1937.
2. M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students", Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015

Suggested Reading:

1. Kapail Kapoor, "Language, Linguistics and Literature: The Indian Perspective", ISBN-10: 8171880649, 1994.
2. "Pride of India", Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007
3. Shri RamaVerma, "Vedas the source of ultimate science", Nag publishers, ISBN:81-7081-618-1,2005

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20EC A101

VALUE EDUCATION

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

Objectives: This course aims to:

1. Understand the need and importance of Values for self-development and for Nationaldevelopment.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

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

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Valuesfor self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive

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Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books : Self-management and Good health; internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

Text Books:

1. Chakroborty, S.K. "Values & Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998.

Suggested Reading:

1. Jaya Dayal Goyandaka, "Srimad Bhagavad Gita with Sanskrit Text, Word Meaning and Prose Meaning", Gita Press, Gorakhpur, 2017.

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20IT A101

PEDAGOGY STUDIES

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

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

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UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journalof Curriculum Studies, 36 (3): 361 – 379, 2004.

Suggested Reading:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID,2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272-282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

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20EG A103

STRESS MANAGEMENT BY YOGA

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

Objectives: The Course will introduce the students to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

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

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

UNIT - I

Meaning and Definition of Yoga- Historical perspective of Yoga- Principles of Astanga Yoga by Patanjali.

UNIT - II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT- III

Concept of Stress According to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

UNIT - IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

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UNIT - V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. "Yogic Asanas for Group Training - Part-I": Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

Suggested Reading:

1. Nagendra H.R nad Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore,

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

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20ME C108

COMPUTER AIDED ENGINEERING LAB

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

Objectives: To make the students

1. Model one and two-dimensional elements in ANSYS
2. Understand vibration, harmonic and transient analysis
3. Carry out buckling analysis
4. Analyze forming and sheet metal operations by FEA
5. Model crackelement

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

1. Understand the applications of one and two-dimensional elements
2. Solve engineering problems
3. Find buckling factors
4. Understand industrial applications of forming and sheet metal operations
5. Find fracture toughness

List of Exercises:

1. Introduction to Finite Element Analysis Software
2. Statically indeterminate reaction force analysis and determination of Beam stresses and Deflection
3. Static analysis of a corner bracket
4. Analysis of cylindrical shell under pressure
5. Bending of a circular plate using axisymmetric shell element.
6. Vibration analysis of a simply supported beam
7. Harmonic analysis of plates and shells
8. Transient analysis of vehicle crash
9. Buckling analysis of shells
10. Analysis of forming
11. Analysis of sheet metal operation
12. Stress intensity factor in cracked plates

Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

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Text Books:

1. R. Tirupathi, Chandrupatla and B.D. Ashok, "Introduction of Finite Element in Engineering", Prentice Hall of India, 2004
2. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill,2003

Suggested Reading:

1. Robert Cook , "Concepts and applications of finite element analysis", 4/e, JohnWiley and sons,2009
2. S.S. Rao, ,"The Finite Element Methods in Engineering", 2 /e, Pergamon Press,2001.

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20ME C206

COMPUTATIONAL FLUID DYNAMICS LAB

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

Objectives: To acquaint the student with

1. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
2. Simulation of laminar, turbulent, internal flow, steady and unsteady problems
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of thermal related problems

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

1. Analyze laminar flow problems in plates and pipes
2. Solve steady and unsteady flow past a cylinder
3. Perform analysis for free and forced convection
4. Evaluate the effect of angle of attack and velocity on NACA aerofiol
5. Simulate compressible flow in a nozzle, premixed combustion

List of Experiments:

1. Laminar Flow over Flat plate
2. Laminar PipeFlow
3. Steady Flow past aCylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Aerofoil.
9. Study of compressible flow through a nozzle
10. Partially premixed combustion analysis
11. Supersonic flow over a wedge
12. Study of flow over wind turbine blade/flow through bifurcation artery

Note: Out of the above 12 experiments, any **ten (10)** experiments have to be carried out.

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Gandipet, Hyderabad-500 075, Telangana

Text Books:

1. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill, Inc., 2015.
2. H.K. Versteeg and Malala Shekara, "Introduction to Finite Volume Method", Pearson, 2015

Suggested Reading:

1. J.H. Ferziger and M. Peric, "Computational Methods for Fluid Dynamics", Springer.
2. K. Muralidhar and T. Sundararajan T, "Computational Fluid flow and Heat transfer", Narosa Publishing House, 2003

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20ME C207

MINI PROJECT WITH SEMINAR

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

Outcomes: Students are able to

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

1. As part of the curriculum in the II- semester of the progarmme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Eachstudentwillbeallottedtoafacultysupervisorformentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Miniprojectsshallhaveinterdisciplinary/ industryrelevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

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Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks:50		
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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20ME E212

EXPERIMENTAL METHODS IN THERMAL ENGINEERING

(Programme Elective - V)

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

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

1. Understand the concepts of errors in measurements.
2. Recognize different techniques of temperature measurement.
3. Manage with different pressure and flow measuring instruments.
4. Understand working of radiation measuring equipment.
5. Familiarize with advanced measurement techniques.

UNIT - I

Basics of Measurements: Introduction, General measurement system, Signal flow diagram of measurement system, Inputs and their methods of correction, Presentation of experimental data, Errors in measurement, Propagation of errors, Uncertainty analysis, Regression analysis, Design of experiments.

UNIT - II

Temperature Measurement: Bimetallic thermometers, Liquid-in-glass, Pressure thermometer, Semiconductor sensors, Digital thermometers, Pyrometers

Thermal Analysis Techniques: Measurements in combustion: Species concentration, Reaction rates, Flame visualization, charged species diagnostics, Particulate size measurements.

UNIT - III

Fluid pressure measurement: Mechanical & Electrical types, High pressure & Low pressure measurements, Differential Pressure Transmitters.

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Flow measurements: Industrial flow measuring devices, selection and calibration, 2d/3d flow measurement and turbulence measurement, Anemometers, Weirs and flumes, Laser Doppler anemometer, Ultrasonic flow meter, Flow visualization techniques, Totalizer for Industrial Liquids

UNIT - IV

Thermal and Transport Property Measurement: Measurement of thermal conductivity of solids and fluids, Diffusivity, Viscosity, Humidity and gas composition

Nuclear and Thermal Radiation Measurement: Nuclear radiation and neutron detection, Measurement of reflectivity, Transmissivity and emissivity, Solar radiation measurements.

UNIT - V

Advancement in measurements: Data logging and acquisition, Use of sensors for error reduction, Elements of micro computer interfacing, Intelligent instruments and their use, Basics of P, PI, PID controllers, Pneumatic and hydraulic controllers, Electronic controllers

Text Books:

1. Thomas G Beckwith., Mechanical Measurements, Pearson publications, 2007.
2. Ernest O Doebelin., Measurement systems, Tata McGraw Hill publications, 2006.

Suggested Reading:

1. J P Holman., Experimental Methods for Engineers, Tata McGraw Hill publications, 2004.
2. C.S. Raman, G.R. Sharma and V.S.V. Mani., Instrumentation Devices and Systems, 2nd Edition, Tata McGraw-Hill., 2001.
3. A.S. Morris., Principles of Measurements and Instrumentation, 3rd Edition, Butterworth-Heinemann, 2001.

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20ME E213

FLUID POWER SYSTEMS

(Programme Elective - V)

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

Outcomes: After studying this course, students will be able to:

1. Identify and analyze the functional requirements of a fluid power transmission system for a given application.
2. Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
3. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.
4. Select and size the different components of the circuit.
5. Develop a comprehensive circuit diagram by integrating the components selected for the given application.

UNIT – 1:

Fluid Power System: Components, Advantages and applications, Transmission of power at static and dynamic states, Pascal's law and its applications

Fluids for Hydraulic System: Types, Properties, Selection, Additives, Effect of temperature and pressure on hydraulic fluid, Seals, Sealing materials, Compatibility of seal with fluids, Types of pipes, Hoses, Quick acting couplings, Fluid conditioning through filters, Strainers, Classification of filters, Sources of contamination and contamination control, Heat exchangers.

UNIT – II:

Pumps: Classification of pumps, Pumping theory of positive displacement pumps, Construction and working of gear pumps, Vane pumps, Piston pumps, Pump performance characteristics, Pump selection factors

Accumulators: Types, Working of various types of accumulators

Actuators: Classification, Working of various types of hydraulic cylinders (actuators).

UNIT – III:

Components of Hydraulic Circuit: Classification of control valves, Directional control valves, Symbolic representation, Constructional features of poppet check valve, Pilot operated directional control valve, Shuttle valve, Sliding spool valve, Pressure proportional control valves, Types, Pressure relief valve and pilot operated pressure control valve, silencers, Flow control valves, Compensated and non-compensated flow control valves

Hydraulic Circuit Design: Control of single and double acting hydraulic cylinders, Regenerative cylinder circuit, calculation of cylinder size, Meter-in and meter-out circuits, Pump unloading circuit, Double pump hydraulic circuit, Counter balance valve application circuit, Hydraulic cylinder sequencing circuits

UNIT – IV:

Introduction to Pneumatic Systems, Choice of working medium, Advantages, Limitations, Applications, Structure of a pneumatic power system, Production of compressed air, Working of various types of air compressors, Fluid conditioners, Air filters, Air dryers, Lubricators and air pressure regulator.

Pneumatic Actuators: Linear cylinders, Classification, Working, Seals, End position cushioning, Rodless cylinders and advantages

Pneumatic Control Valves: Classification, Directional control valves such as poppet, Suspended seat type slide valve, Non return valves, Check valve, Quick exhaust valve and time delay valve

UNIT – V:

Simple Pneumatic Control: Direct and indirect actuation of pneumatic cylinders, Flow control valve, Speed control of cylinders using flow control valves, Supply air throttling and exhaust air throttling.

Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications, Practical examples involving the use of logic gates.

Multi Cylinder Application: Motion and control diagrams, Sequential motion control, Signal elimination methods, Cascade control action, Principle and signal elimination techniques

Electro Pneumatic Control: solenoid, Relay and contactors, Solenoid operated directional control valve, Solenoid controlled pilot operated of directional control valves, Control circuit for single acting cylinder

Text Books:

1. Anthony Esposito., Fluid Power with applications, Pearson edition, 2011.
2. Majumdar S.R., Pneumatic systems - Principles and Maintenance, Tata McGraw-Hill, New Delhi, 2005

Suggested Reading:

1. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.
2. Thomson, Introduction to Fluid power, Prentcie Hall, 2004
3. John Watton, Fundamentals of Fluid Power Control, Cambridge University press, 2012.

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20ME E214

ENGINE EMISSIONS AND POLLUTION CONTROL

(Programme Elective - V)

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

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

1. Understand the importance of IC engine as prime mover and the combustion phenomenon in SI engine.
2. Understand the phenomenon of combustion in CI engine along with turbocharging and supercharging
3. Understand the formation of different pollutants in IC engines and their effect on environment and human beings.
4. Understand the measurement and control techniques of various pollutants from IC engines.
5. Understand the significance of various alternative liquid and gaseous fuels in IC engines

UNIT - I

Introduction to IC Engines: IC engine as a prime mover, Contribution of IC engines for global warming and green house effect.

Spark Ignition Engines: Flame Propagation, Combustion phenomena (normal and abnormal), Factors affecting flame speed, Detonation, Ignition quality, Octane number, Carburetion and fuel injection systems for SI Engines, Types of combustion chambers, Performance of leaded and unleaded petrol

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UNIT - II

Compression Ignition Engines: Advantages of CI engines, Importance of air motion and compression ratio, Normal and abnormal combustion, Ignition quality, Cetane number, Characteristics of a good combustion chamber, Types of combustion chambers, Effect of supercharging and

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turbocharging on pollutants

UNIT- III

Pollutant emissions from IC Engines: Sources of pollutants, Effect of emissions on environment and human beings, Pollutants of carbon monoxide, UBHC, Oxides of Nitrogen (NO-NO_X), Particulate matter and aldehydes, Mechanism of formation of pollutants, Engine variables those affecting pollutant formation and methods to control pollutants

.

UNIT - IV

Measurement of engine emissions-NDIR and FID techniques, Smoke analyzer, NO_x analyzers, Pollution control strategies, EGR technique, SCRT, Reduction of pollutants by chemical methods, Catalytic converters and thermal reactors, Particulate traps, Fumigation, Secondary air injection, PCV system, Emission norms, EURO and Bharat stage norms.

UNIT - V

Alternative Fuels: Need for alternative fuels, Desirable characteristics of good alternative fuel, Liquid and Gaseous fuels for SI and CI Engines, Alcohols, Manufacturing of Methanol, Ethanol and Butanol, Vegetable oils and manufacturing of biodiesel by single-stage and two-stage methods, LPG, CNG, Bio gas, Hydrogen, performance and emission characteristics with above alternative fuels.

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Text Books:

1. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Co., 2018
2. Obert, E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.

Suggested Reading:

1. C.R.Ferguson, A.T. Kirpatrick, IC Engines : Applied Thermosciences, Wiley publications, 2015
2. Gill P.W, Fundamentals of Internal Combustion Engines, Oxford and IBH publishing Co Pvt Ltd, 2007.

3. B.P. Pundir, Engine Emissions: Fundamentals and advances in control, Narosa Publishing House, 2017

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CBIT (A)
2021-22

With Effect from the Academic Year

20CEO101

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

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

Objectives:

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis
4. To provide adequate knowledge to the students on Recourse Management Costing-variance Analysis
5. To train the students with the concepts of Budgetary Control for cost management and to provide a basic platform on Quantitative techniques for cost management.

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

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

UNIT- I:

Project Management: Introduction to project managements, Stakeholders, Roles, Responsibilities and functional relationships, Principles of project management, Objectives and project management system, Project team, Organization, roles and responsibilities, Concepts of project planning, Monitoring, Staffing, Scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III:

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost, Project direct and indirect costs.

UNIT- IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and leveling, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis: Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector. Just-in-time approach, Material Requirement

UNIT- V:

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets, Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

Text Books:

1. Charles T Horngren., Cost Accounting A Managerial Emphasis, 14th edition, Pearson Education, 2012,
2. Charles T. Horngren and George Foster., Advanced Management Accounting, 6th revised edition, Prentice Hall, 1987.

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Suggested Reading:

1. K. K Chitkara., Construction Project Management: Planning, scheduling and controlling, Tata McGraw Hill Education, 2004.
2. Kumar Neeraj Jha., Construction Project Management Theory and Practice, 2nd edition, Pearson Education India, 2015.
3. Robert S Kaplan and Anthony A. Atkinson, Management & Cost Accounting, 2nd edition, Pearson, 1996.

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CBIT (A)
2021-22

With Effect from the Academic Year

20EEO101

WASTE TO ENERGY

(Open Elective)

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

Objectives:

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

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

1. Understand the concept of conservation of waste
2. Identify the different forms ofwastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

UNIT - I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, Gasifiers, Digestors

UNIT – II

Biomass Pyrolysis: Pyrolysis, Types, Slow, Fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, Yields and applications.

UNIT – III

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, Construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

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UNIT–IV

Biomass Combustion: Biomass stoves, Improved chullahs, Types, Some exotic designs, Fixed bed combustors, Types, Inclined grate combustors, Fluidizedbed combustors, Design, Construction and operation, Operation of all the above biomass combustors.

UNIT – V

Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, Biomass gasification, Pyrolysis and liquefaction, Biochemical conversion, Anaerobic digestion, Types of biogas plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

Text Books:

1. V.Ashok.,Non Conventional Energy, Desai, Wiley Eastern Ltd., 1990.
2. K.C. Khandelwal and S.S. Mahdi., Biogas Technology - A Practical Hand Book, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Suggested Readings:

1. D.S. Challal., Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd., 1991.
2. C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, John Wiley & Sons, 1996.

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20CSO101

BUSINESS ANALYTICS
(Open Elective)

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

Course Objectives: The objectives of this course are

1. Understanding the basic concepts of business analytics and applications.
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics.
3. Prepare the students to model business data using various data mining, decision making methods.

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

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics.
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.
6. Create viable solutions to decision making problems.

UNIT-I

Introduction to Business Analytics: Introduction to business analytics, Need and science of data driven decision making, Descriptive, Predictive, Prescriptive analytics and techniques, Big data analytics, Web and social media analytics, Machine learning algorithms, framework for decision making, Challenges in data driven decision making and future.

UNIT-II

Descriptive Analytics: Introduction, Data types and scales, Types of measurement scales, Population and samples, Measures of central tendency, Percentile, Decile and quadrille, Measures of variation, Measures of shape skewness, Data visualization.

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient.

UNIT-IV

Decision Trees: CHAID, Classification and regression tree, Splitting criteria, Ensemble and method and random forest, Clustering, Distance and similarity measures used in clustering, Clustering algorithms, K-Means and hierarchical algorithms, Prescriptive analytics, Linear programming and LP model building.

UNIT-V

Six Sigma: Introduction, Introduction, Origin, 3-Sigma Vs Six-Sigma process, Cost of poor quality, Sigma score, Industry applications, Six sigma measures, DPMO, Yield, Sigma score, DMAIC methodology, Six Sigma toolbox

Text Books:

1. U. Dinesh Kumar, Data Analytics, Wiley Publications, 1st Edition, 2017.
2. Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, Business

Analytics Principles, Concepts and Applications with SAS, Associate Publishers, 2015.

Suggested Reading:

1. S. Christian Albright and Wayne L. Winston, Business Analytics - Data Analysis and

Decision Making, 5th Edition, Cengage, 2015.

Web Resources:

1. **https://onlinecourses.nptel.ac.in/noc18-mg11/preview**
2. **https://nptel.ac.in/courses/110105089/**

Freddy

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CBIT (A)
2021-22

With Effect from the Academic Year

20ME C110

INDUSTRIAL PROJECT / DISSERTATION PHASE - I

Instruction	20	Hours per week
Duration of SEE	———	
SEE	———	
CIE	100	Marks
Credits	10	

Outcomes: At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/ international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

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