Scheme of Instruction & Syllabi

of

Bachelor of Technology

4th Year

(Mechanical Engineering)

(With effective from academic session 2023-24)

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs) FOR B.TECH IN MECHANICAL ENGINEERING

The B.TECH program aims to:

PEO1: Develop competent Mechanical engineering technicians with professional skills, knowledge, abilities & attitude for wage employment and/or to become entrepreneur.

PEO2: Provide opportunities and develop competence to work as a leader, manager or team member in multidisciplinary Mechanical engineering works and projects.

PEO3: Develop effective communication skills - Verbal, Written and Graphical, to justify technical solutions for diverse targets associated with mechanical engineering works.

PEO4: Provide opportunities and develop students in terms of social, economic and environment sensitive as responsible professionals.

PEO5: Develop understanding towards use of different codes - local, national and international, for execution of mechanical engineering works.

PEO6: Encourage and provide necessary knowledge, skills and opportunities for higher education and exploring different learning strategies for life-long learning.

PEO7: Provide opportunities and develop responsible professionals in terms of ethics and value systems.

PROGRAM OUTCOMES (POs) FOR B.TECH IN MECHANICAL ENGINEERING

After successful completion of the B.TECH program, learners shall be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2**. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5**. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6**. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional

engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10**. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11**. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Learners will be able to apply technical skills and modern engineering tools for mechanical engineering day to day practice
PSO2	Learners will be able to participate in practical aspects and problem solving of mechanical engineering field that requires analytical and design requirements.
PSO3	Learners will be able to pursue of lifelong learning and professional development to face the challenging and emerging needs of our society.
PSO4	Learners will comply with small to large concepts of components and mechanical engineering practical and field works to bring out safer and aesthetic environment to live.

STUDY AND EVALUATION SCHEME
(With Effective from the academic Session 2022-2023)

B.Tech. in Mechanical Engineering

YEAR IV, SEMESTER-VII

S.NO.	CATEGORY	COURSE CODE	SUBJECTS / COURSE TITLE	Hours Per Week			Evaluation Scheme		SUBJECT TOTAL	CREDITS
				L	T	P	(CA)	(EE)		
THEORY										
1	Professional Core Courses	BME-701	Automation in Manufacturing	3	0	0	25	50	75	3
2	Department Elective Courses	BME 031-034	Elective III	3	0	0	25	50	75	3
3	Department Elective Courses	BME 041-044	Elective-IV	3	0	0	25	50	75	3
4	Open Elective Courses	BOE 071-072	Open Elective-III	3	1	0	30	70	100	4
5	Engineering Science Course	MFG17	Product Design	4	0	0	30	70	100	4
PRACTICALS AND PROJECTS										
6	Professional Core Courses	BME-752	Mechanical Engineering Laboratory III(Manufacturing)	0	0	2	10	15	25	1
7	Project	BME 751	Project-III	0	0	10	25	100	125	5
Total				**16**	**1**	**12**	**170**	**405**	**575**	**23**

L – Lecture **T** – Tutorial **P-** Practical, CA – Continuous Assessment **EE** – End Semester Assessment

STUDY AND EVALUATION SCHEME
(With Effective from the academic Session 2022-2023)

B.Tech. in Mechanical Engineering

YEAR IV, SEMESTER-VIII

S.NO.	CATEGORY	COURSE CODE	SUBJECTS / COURSE TITLE	Hours Per Week			Evaluation Scheme		SUBJECT TOTAL	CREDITS
				L	T	P	(CA)	(EE)		
THEORY										
1	Professional Core Courses	BME 051-053	Elective V	3	0	0	25	50	75	3
2	Professional Core Courses	BME 061-063	Elective VI	3	0	0	25	50	75	3
3	Open Elective Courses	BOE 081-082	Open Elective-III	3	1	0	30	70	100	4
4	Open Elective Courses	BOE 083-084	Open Elective-IV	3	1	0	30	70	100	4
5	Engineering Science Course	MFG28	Product Manufacturing	4	0	0	30	70	100	4
PRACTICALS AND PROJECTS										
6	Project	BME- 851	Project-IV	0	0	12	50	100	150	6
Total				**16**	**2**	**12**	**190**	**410**	**600**	**24**

L – Lecture **T** – Tutorial **P**- Practical
CA – Continuous Assessment **EE** – End Semester Assessment

BME701	Automation in Manufacturing	3L:0T:0P	3 credits

Course Objectives: The various objectives of this course are-

1. To understand the importance of automation in the of field machine tool based manufacturing
2. To provide students the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. To understand the basics of product design and the role of manufacturing automation

Course Outcomes: After learning the course, the students should be able to:

CO1: Recognize the matrix algebra and Lie algebra for computing the kinematics of robot.
CO2: To classify various systems, devices on the basis of automated manufacturing systems, levels of automation, NC systems.
CO3: Calculate the Jacobean for serial and parallel robot, step angle.
CO4: To differentiate between open and closed loops (incremental), adaptive control, and control loop in contouring systems, types, generations and robot programming methods
CO5: To judge the significance of group technology, flexible manufacturing systems, CIM, CAD/CAM, artificial intelligence.
CO6 To develop CNC programs to manufacture industrial components using Manual and APT programming, Classify various automation models.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	1			2	2		1
CO2	1		2	2	1	1					2	
CO3	2	3		2	1	1	1			2		2
CO4	2	2	2	2	2	1	1				3	
CO5	1	1		1	1	1	1		2			1
CO6	3	2	2	2	1	1		2			3	1

Detailed Syllabus:

Module I

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated

Material handling. Assembly, Flexible manufacturing

Module II

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC-Adaptive Control, Robotics

Module III

Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques

Text Books:

1. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prenticeHall
2. SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7thedition,Pearson
3. YoramKoren, Computer control of manufacturing system, 1stedition
4. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

BME752	Mechanical Engineering Laboratory III (Manufacturing)	0L:0T:2P	1 credit

Course Objectives: The various objectives of this course are-

1. To provide an understanding of advanced manufacturing methods.
2. To get an idea of the dimensional & form accuracy of products

Course Outcomes:

Upon completion of this course, students will be able to perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced.

List of Experiments:

Eight of the following experiments must carried out-

1. Bresenham's algorithm for line drawing.
2. Wap to draw a line using midpoint algorithm bresenham algorithm.
3. Algorithm to draw a line using DDA algorithm.
4. Bresenham's algorithm to draw a circle.
5. Algorithm to draw an ellipse.
6. Wap to draw an ellipse using midpoint ellipse drawing algorithm
7. Algorithm to clip a line.
8. Program to scale the triangle.

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BME 751 (Project III) & BME 851 (Project IV)

Course Objectives:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

DEPARTMENTAL ELECTIVE - III

BME 031	Finite Element Analysis	3L:0T:0P	3 credits

Course Objectives: The various objectives of this course are-

1. To illustrate the principle of mathematical modeling of engineering problems to the students
2. To introduce students the basics and application of Finite Element Method

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

CO 1 Define mathematical modeling, finite element etc.
CO 2 Represent natural coordinate systems, shape functions and basic concept of FEM
CO 3 Formulate the problem and calculate the different performance parameters for the given problem.
CO 4 Analyze different types of equations like first order, second order etc. and draw stiffness matrix and force vectors.
CO 5 Justify the use of FEM, boundary value and initial value problem.
CO 6 Design various engineering problems and solve them with the finite elements techniques

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1			2			2
CO2	2	1	2	2	1	1		1		1	2	1
CO3	2	3		3	1		1				2	1
CO4	1	3	2	2		1	2			1		
CO5	2	3	2	1	1	1	1					3
CO6	3	2	2	3	1	1			2			

Detailed Syllabus

Module I

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

Module II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Module III

Two dimensional equations, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Natural coordinate systems, shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, Introduction to FE software.

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill,2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi,2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall,1990.

BME 032	Gas Dynamics and Jet Propulsion	3L:0T:0P	3 credits

Course Objectives: The various objectives of this subjects are-

1. To understand the features of compressible isentropic flows and irreversibilities like shocks.
2. To provide a basic knowledge of jet and rocket propulsion technologies to the students.

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

CO 1 .Explain the significance of Mach number on compressible fluid flow.

CO 2 Compute the flow characteristics using Rayleigh and Fanno flow

CO 3 Calculate the flow parameters across normal and oblique shock wave

CO 4 Classify the propulsion performance in various aircraft engines

CO 5 Compute the performance characteristics of space propulsion system

CO 6 Apply gas dynamics principles in the jet and space propulsion

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	2	1						1
CO2	3	2	1	2	1	1				1		
CO3	1	3	2	3	1		1		2			3
CO4	2		2	2		1	1				1	1
CO5	2	2	2	1	1	1	1			3		2
CO6	3	3	2	2	1	1			2			1

Detailed Syllabus

Module I

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

Module II

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

Module III

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

Text Books:

1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press,2008.
2. H.S. Mukunda, " Understanding Aerospace Chemical Propulsion" , Interline Publishing, 2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley,1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York,1986.

BME 033	Process Planning and Cost Estimation	3L:0T:0P	3 credits

Course Objective: Upon completion of this course, the students will be able to use the concepts of process planning and cost estimation for various products.

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

CO 1 Lists the elements of operations management and various transformation processes to enhance productivity and competitiveness.
CO 2 Represents and evaluate various facility alternatives and their capacity decisions, develop a balanced line of production & scheduling and sequencing techniques in operation environments
CO 3 Revaluate aggregate capacity plans and MPS in operation environments
CO 4 Differentiate and implement suitable materials handling principles and practices in the operations
CO 5 Monitor suitable quality control measures in Quality Circles to TQM.
CO6 Explain the principles of various planning techniques.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	2	1				1		3
CO2	2	2	3		1	1				3		
CO3	2		2	2	1		1	2			1	
CO4	3	3	1	1	1	1	1			1		
CO5		2	1	1	1	1	1		1		3	
CO6	1	2		1	1	1				3		3

Detailed Syllabus:

Module I

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

Module III

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost
Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding

Module III

Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost

Text Books:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech.2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.

BME 034	Automobile Engineering	3L:0T:0P	3 credits

Course Objectives: The various objectives of this course are-

- To understand the construction and working principle of various parts of an automobile
- The anatomy of the automobile in general, location and importance of each part
- The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels, suspension, frame, springs and other connections
- Emissions, ignition, controls, electrical systems and ventilation

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

CO 1	Define various engine tuning parameters like caster angle, wheel camber, toe-in, toe-out etc., free wheel, braking ratio, brakes, tractive force,
CO2	Understand the concepts of valve mechanism, weight transfer and classify various resistances, cooling and lubrication system.
CO3	Calculate various resistances, tractive force, gear ratio & draw main components of automobile
CO4	Analyze power and torque characteristics, Hook's joint, various loads on frame and distinguish between toe-in and toe-out, vacuum and air brake and modern techniques and fuel used
CO5	Check the requirements of cooling and heating system in an automobile, test and correct the various issues so that vehicle can be brought to initial conditions (overhauling).
CO6	Explain the principle of different mechanisms used in Automobile & design a gear box.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	2	1						
CO2	1	2	1	2	3	1			1	2	1	3
CO3	1	3		3	1		2	2				3
CO4	2	2		2		1				2		
CO5	1	3	3	1	1	2	1				2	1
CO6	3	3	2	1		1	2		2			2

Detailed Syllabus:

Module I

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Module II

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Module III

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Text books:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.

3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press,1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA,1998.

DEPARTMENTAL ELECTIVES - IV

BME 041	**Production and Operations Management**	**3L:0T:0P**	**3 credits**

Course Objectives: The various objective of this course are-

- To develop an understanding of how the operations, have strategic importance and can provide a competitive advantage in the workplace.
- To understand the relationship between operations and other business functions.
- To make students familiar with the techniques of location and facility planning; line balancing; job designing; and capacity planning in operations management.

Course outcomes: At the end of this course the students will be able to-

CO1 List the elements of operations management and various transformation processes to enhance productivity and competitiveness.

CO2 Represent various facility alternatives and their capacity decisions, develop a balanced line of production & scheduling and sequencing techniques in operation environments

CO3 Determine aggregate capacity plans and MPS in operation environments.

CO4 Differentiate and implement suitable materials handling principles and practices in the operations.

CO5 Judge and implement suitable quality control measures in Quality Circles to TQM.

CO6 Classify various operation techniques.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	3	2	1				1		3
CO2	1			1	2	3		2				
CO3	1	3	2	1	1	1	2			3		3
CO4	1	2	3	2	2	3	1		2	2		
CO5	1	3	2	1	1	1	1				2	2
CO6	1	2	3		1	1		2			2	1

Detailed Syllabus:

MODULE-I

Operations Management – An overview, Definition of production and operations management, Operations Strategies for Competitive Advantage Production Cycle, Classification of operations, Responsibilities of Operations Manager, New Product Development, Product Design, Plant Location, Layout Planning.

MODULE-II

Forecasting as a planning tool, Forecasting types and methods, Exponential smoothening, Measurement of errors, Monitoring and Controlling forecasting models, Box- Jenkins Method. Productivity and Work study, Method study, Work Measurement.

MODULE-III
Material Requirements Planning

Planning for needs, applying MRP, Detailed capacity planning, MRP II.

Production Planning techniques, Routing Decisions, Line of Balance, Scheduling types & principles, master production schedule, Inventory Management – Objectives, Factors, Process, Inventory control techniques ABC, VED, EOQ, SED,FSN analysis. Concept of JIT and Lean Manufacturing

Text Books:

1. Adam Jr Everetl E. R J – Production and Operations Management (Prentice-Hall, 2000, 5th Edition)
2. Chary - Production and Operations Management (Tata McGraw-Hill, 1997, 9th Edition)
3. Hill T- Operations Management (Palgrave, 2000)
4. Johnston R et al – Cases in Operations Management (Pitman, 1993)
5. McGregor D – Operations Management (McGraw-Hill, 1960)
6. Morton - Production and Operations Management (Vikas)
7. Haleem A- Production and Operations Management (Galgotia books, 2004)
8. Bedi Kanishka - Production & Operations Management (Oxford University Press, 2nd Edition)

BME 042	Design of Transmission Systems	3L:0T:0P	3 credits

Course Objective: The objective of this course is to learn about the design procedures for mechanical power transmission components.

Course outcomes: At the end of this course the students will be able to-

CO1 List the design parameters of flexible transmission elements like belts, chains and wire ropes for given condition

CO2 Clear the spur and helical gear terminology considering strength and wear.

CO3 Compute the required parameters in designing worm, bevel and double helical gear power transmission.

CO 4 Integrate the speed ratio and gear box parameters for the given application.

CO 5 Monitor the parameters require to design cam, clutches and brakes for varied applications

CO 6 Classify the parameters to design power transmission elements using standard catalogue tents.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2					2		1
CO2	1	1	3		1			2				
CO3	2	1	1		1	1	1			1	1	2
CO4	1	2	2	2		1	1		3		3	
CO5	3	2	1	1		1	1			2		3
CO6	1	2	2	2	1	1		2			2	1

Detailed Syllabus:

Module I

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; forces for helical gears.

Module II

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair, Cross helical gears, terminology, helix angles.

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

Module III

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill,2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley,2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

BME 043	Total Quality Management	3L:0T:0P	3 credits

Course Objectives: The objective of this course is to aware the students about the total quality management principles and processes.

Course outcomes: At the end of this course the students will be able to-

CO1 Define quality with different views, dimensions of quality, online and offline quality control, quality circle.

CO2 Understand the various concepts of TQM, silent contribution of quality gurus in the evolution of TQM, different phases of quality function deployment, Kano model, benchmarking and JIT

CO3 Calculate the cost of poor quality, response table, response graph, strong effect and S/N ratio using Taguchi approach and draw the organizational structure for quality

CO4 Analyze general barriers to implement TQM. Distinguish between philosophies of various quality gurus, old and new concept of quality, quality characteristics and quality attributes.

CO5 Judge the tools and techniques of quality management to manufacturing and services industry.

CO6 Develop a strategy for implementing TQM in an organization. Design and apply various quality improvement frameworks and standards and control limits & control charts.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	2					2		3
CO2		2	2	2	2			2	2			2
CO3	2	1	1		1	1	2			2	2	2
CO4		3	1	2		1	1		3		3	1
CO5	3	1	1	3	2	1	1			2		1
CO6	1	3	2	2	1	1		2			2	1

Detailed Syllabus:

Module I

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Module II

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Module III

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Text Books:

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia,2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning,2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India,2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice HallIndia, 2006.

BME 044	Energy Conservation and Management	3L:0T:0P	3 credits

Course Objective: The objective of this course is to provide an overview of power plants and the associated energy conversion issues to the students.

Course outcomes: At the end of this course the students will be able to-

CO 1 Recognize the importance of renewable energy.
CO 2 Clear the need of stopping exploitation of fossil fuel.
CO 3 Estimate how to utilize non-conventional form of energy.
CO 4 Analyze different types of power plants used to produce power from renewable and non-renewable energy sources
CO 5.Detect various problems related to energy conservation
CO 6 Explain the various methods of energy management and classify different types of power plants.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2	1	2		3			1		1
CO2	2	1	2		2		2	2	1			
CO3	1		1	2	1	1	1	3		1	1	3
CO4	2	1		2		2	2		2		2	
CO5	1	1	1	3	2	1	1	3	1	2	1	2
CO6	2		2	2	1	2		2			2	2

Detailed Syllabus

Module I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment

Module II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization,

components of gas turbine power plants, combined cycle power plants.

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Module III

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants..

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill,2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

DEPARTMENTAL ELECTIVES - V

BME 051	**Maintenance Engineering & Management**	**3L:0T:0P**	**3 credits**

Objectives: The basic objective of this course is to understand the fundamental concepts, the necessary knowledge and the basic skills related to systems reliability and systems maintenance function.

Course outcomes: At the end of this course the students will be able to-

CO1: Define and describe different types of accidents, hazards, maintenance, and failure rates.

CO2: Explain reconditioning and retrofitting process and describe reasons of corrosion & the methods to reduce corrosion, assignment model, PERT.

CO3: Calculate service life of equipment, Maintenance cost & its relation with replacement economy.

CO4: Analyze different methods to reduce the wear, corrosion and increase the life.

CO5: Justify the need and significance of maintenance in industry and select appropriate lubricants, lubrication method.

CO6: Develop decision trees to diagnose faults in equipment. Prepare test chart of given equipment.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2		3			1		1
CO2		1			3		2	2	1			
CO3	1		2	2		1	1	3		1	1	2
CO4	2	2	1	2	3	2	2		2		3	
CO5		1	1	3	2	1	1	2	1	2	2	3
CO6	1	3		2	2	2		2			2	1

Detailed Syllabus:

Module I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off.

Module II

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.

Module III

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT. Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

Books

1. The concept of reliability and to help them learn the techniques of estimating reliability and related characteristics of components/ systems.
2. Moreover, it exposes them to the necessary engineering techniques used for analyzing, planning and controlling maintenance systems

Text Books-

1. Management of systems – R.N. Nauhria & R.Prakash.
2. Operations Research –Wangner

BME 052	Mechanical System Design	3L:0T:0P	3 credits

Course Objectives: The basic objective of this course are-

1. To Capstone design objectives—assign students a project that will allow them to integrate a majority of their skills acquired in the last four years regarding both engineering science, design, and communication
2. Students will learn a "customer" ethic in providing a deliverable and appropriate level of engineering service to their industrial sponsor.
3. Students will consider cost and time constraints (economic considerations) in execution of their design project
4. Students will consider safety, ethical, and other societal constraints in execution of their design projects

Course outcomes: At the end of this course the students will be able to-

CO1: Understand how to prepare a needs-assessment for a given project and basic system approach

CO2: Describe the simulation and simulation models.

CO3: Calculate and optimize the decision variables.

CO4: Analyze a system by applying different system theories.

CO5: To deliver a final oral presentation for their project, including intermediate oral updates of their project as required by the project sponsor.

CO6: Formulate the problems with the suitable constraints.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	2		1		1	2	1
CO2	2	3	1	2	1			1	1		2	2
CO3	1		3			1	1	2		1	1	2
CO4	2	3	2		3	1		3	2	2	3	
CO5	1	2	1	1	2	1		1	1	2	2	3
CO6	3	2	1	2		2		2		3	2	1

Detailed Syllabus:

MODULE-I

Engineering process and System Approach

Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study- Viscous lubrication system 0in wire drawing

Problem Formulation

Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint

System Theories

System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

MODULE- II

System modeling

Need of modeling, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system

Graph Modeling and Analysis

Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system

Optimization Concepts

Optimization processes, Calculus Method for Optimization Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints,

MODULE-III

Decision Analysis

Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function,

System Simulation

Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach,

Books/References-

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse

2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-SS Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

BME 053	Management Information System	3L:0T:0P	3 credits

Course Objectives: The basic objective of this course is to make students familiar with the various information system used in the management.

Course outcomes: At the end of this course the students will be able to-

CO1. Recognize the basic concepts and technologies used in the field of management information systems;

CO2. Clarity of the processes of developing and implementing information systems,

CO3. Determine the role of the ethical, social, and security issues of information systems.

CO4. Focus on the role of information systems in organizations, the strategic management processes, with the implications for the management.

CO5. Judge how various information systems like DBMS work together to accomplish the information objectives of an organization.

CO 6 Classify various information system

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2		3	1		1
CO2	3	1	1		2			2	1			1
CO3	1	2	1	3	1	1	1	1		1	1	2
CO4	3			1		2	2	2			2	
CO5	2	1	3		2	3	1	2		2		1
CO6			2	2	1	2		1			3	2

Detailed Syllabus:-

MODULE-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS.

Foundation of Information System: Introduction to Information System in Business. Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc.

MODULE-II

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage.

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change. Reports: Various types of MIS reports, GUI & Other Presentation tools.

MODULE-III

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies.

Books

1. O.Brian, “Introduction to Information System”, Mc-Graw Hill.
2. O.Brian, “Management Information System”, TMH.
3. Alter, “Information Systems : A Management Perspective”, Addison Wesley.
4. Arora & Bhatia, “Information Systems for Managers”, Excel
5. Bansal, “Information System Analysis & Design”, TMH.
6. Jawadegar, “Management Information System”, TMH.
7. Murdick, “Information System for Modern Management”, PHI.
8. Alexis Leon, “Enterprise Resource Planning”, TMH.

DEPARTMENTAL ELECTIVES - VI

BME 061	Power Plant Engineering	3L:0T:0P	3 credits

Course Objectives: The basic objective of this course is to understand the working of different types of power plant and their justification on the basis of use.

Course outcomes: At the end of this course the students will be able to-

CO1: To know about load distribution curves, power plant economics, steam cycles, optimization of relevant cycles for power generation plant.

CO2: To understand the different power generation plants and its economics.

CO3: Calculation based on power generation, efficiency of power plant, fuel combustion process.

CO4: To analyze the power requirement according to process requirement into different industries like petrochemical, fertilizer and steel plant etc.

CO5: Judgment of the ways that new power plant establishment in industry or urban areas.

CO6: Design calculations based on power generation devices.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1	1	3	1	1	3		1	2	
CO2	3	2	2	2	1			2		2		3
CO3	1	1	1	3		2	1	2		1	1	2
CO4	2		2	3	1	3						3
CO5	2	1		2	2	2	1	2		2	3	1
CO6	1	3	2	1	3	1		1		2		1

Detailed Syllabus:-

MODULE-I

Introduction

Load estimation, Load curves, Various terms and factors involved in power plant calculations, Effect of variable load on power plant operation, Selection of power plant units, Power plant economics and selection, Effect of plant type on costs, Fixed elements, Energy elements, , Depreciation and replacement, Economics of plant selection, Other considerations in plant selection.

MODULE-II

Steam power plant

General layout of steam power plant, Power plant boilers including critical and super critical boilers, Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, combustion system, draft, ash handling system, Feed water treatment, feed heating, reheating, efficiency of Steam power plant, Site selection of a steam power plant.

MODULE-III

Diesel power plant

General layout, Components of Diesel power plant, Performance of diesel power plant, Supercharging and turbocharging system, Site selection of diesel power plant

Gas turbine power plant

Layout of gas turbine power plant, Elements of gas turbine power plants, cogeneration, combined cycle power plants, Site selection of gas turbine power plant,

Nuclear power plant

Principles of nuclear energy, Basic elements used in nuclear reactor, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear waste disposal, Site selection of nuclear power plants.

Hydro Electric Power Plant

Hydroelectric station, Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units.

Books and References:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd
2. Power Plant Engineering by Hedge, Pearson India
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.
6. Power Plant Engineering by Gupta, PHI India
7. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

BME 063	Advanced Dynamics of Machinery	3L:0T:0P	3 credits

Course Objectives: The basic objective of this course is to make students understand the principles of the dynamics of the machines, gyroscope and balancing.

Course outcomes: At the end of this course the students will be able to-

CO1 Define the basic terminology and principles of Dynamics related to the Machinery,

CO2 Represent the concept of static and dynamic balancing.

CO3 Calculate the natural frequency of any complex system by using fundamental equations

CO4 Discrimination of various vibration systems and find its application.

CO5 Monitor the critical speed of shaft unbalanced rotors and natural frequency of a vibratory system.

CO6 Design and explain a vibrating system, modify according to the need and discuss the concept of gyroscope and its effect in daily life problems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	2				1	2	1
CO2		2	1	1	1				1		2	3
CO3	1	1	3			1	1			1	1	
CO4	1	3	2	3	3	1			2		3	2
CO5	1	2	1	1	2	1		2	1		3	2
CO6	2	2	1	2		2		2			2	1

Detailed Syllabus:-

MODULE-I

Dynamic Analysis of Mechanisms and Machines: Introduction, Motion of Rigid Body under a System of Forces, Principle of Virtual Work, D'Alembert's Principle and Dynamic Equilibrium, Dynamic Force Analysis, Stresses in Moving Members, Motion Analysis.

Dynamics of Direct Acting Engine Mechanisms: Introduction, Piston Motion Turning Moment on Crank-Shaft, Dynamically Equivalent Link, Approximate Expression for Turning Moment, Turning Moment Diagram, Fluctuation of Crank-Shaft Speed, Flywheel Analysis.

MODULE-II

Balancing of Inertia Force and Moments in Machines: Introduction, Balancing of Rotating Masses, Two-Plane Balancing, Determination of Balancing Masses, Balancing of Internal Combustion Engines.

Gyroscopic action in Machines: Introduction, Motion of a Rigid Body in Three- Dimensions, Principal

Axes, Angular Velocity and Momentum about Principal Axes, Euler's Equation of Motion, ,

MODULE-III

Gyroscope: Simple Precession of a Symmetrical Gyroscope in Angular Precession, Gyroscopic Effects in Machines, Gyroscopic Stabilization.

Dynamics of Rotating Shafts: Introduction, Critical Speed, Shaft with an Unbalanced Disc at Mid-Span, Generalized Forces, Lagrange's Equation of Motion, Gyroscopic Effect on Critical Speed.

Text Book:

1. *Theory of Mechanisms and Machines by Amitabh Ghosh and Ashok Kumar Malik, Affiliated East- West Press Pvt. Ltd, New Delhi.*
2. *Theory of Machines and Mechanisms by Joseph Edward Shigley and John Joseph Uicker, J.R. International Student Edition, Mc-Graw Hill International Company.*

BME 063	Concurrent Engineering	3L:0T:0P	3 credits

Course Objectives: The basic objectives of this course are-

1. To make students familiar with the role of indirect features that affect the manufacturing process and quality of the product.
2. To understand the basic tools and methodologies available in CE and to learn conventional and intelligent manufacturing system design.

Course outcomes: At the end of this course the students will be able to-

CO1 Learn CE approach to economic project management

CO2 Understand major concepts of the concurrent product design, QFD.

CO3 Relate and Utilize rapid manufacturing modeling techniques,

CO4 Analyze a framework for robust system and process design.

CO5 Monitor the plan for project management on new product development.

CO6 Design concurrent engineering system for product and process in manufacturing enterprises to in-built the quality by design,

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			2	2	2				1	2	1
CO2	2	2	1		3		2		1	2		2
CO3	1		2	2	2	3	1		2	1		3
CO4	3	3	2	3			2		2		3	2
CO5	3		2	1	1	3			1	3		
CO6	2	2	1			2	2				2	

Detailed Syllabus:-

MODULE-I

Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs.

Support for CE

Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

MODULE-II

Design Product for Customer

Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD)

Modeling of Concurrent Engineering Design

Compatibility approach, Compatibility index, implementation of the Compatibility model

MODULE-III

Design for Manufacture (DFM)

Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assimilability

Quality by Design

Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

Books

1. Concurrent Engineering Kusiak John Wiley
2. Concurrent Engineering Menon Chapman & hall

OPEN ELECTIVES - II

BOE 071	Entrepreneurship Development	3L:1T:0P	4 credits

Course Objectives: The basic objective of this course is to understand entrepreneurship development methods and techniques.

Course outcomes: At the end of this course the students will be able to-

CO1 Describe the concept of entrepreneurship, project identification.

CO2 Clarity the operations and management of planning for business,

CO3 Relate the social and ecological impacts of entrepreneurship

CO4 Select case studies of successful entrepreneurship

CO5 Detect various options available for funding the project

CO6 Organize various development models and describe various laws concerning entrepreneur

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2	2	1					1	
CO2		2	2	1	1	1		1			2	2
CO3	2		3	2	2	2	1			1		2
CO4		3	2	1	1	1					1	
CO5	3	1		1	2	3	1		2		2	
CO6	3	2	2	3	1	1					1	3

Detailed Syllabus:-

Module I

Entrepreneurship – definition, growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types.

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

Module II

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies. Government policy for small scale industry; stages in starting a small scale industry

Module III

Project Planning and control: The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.
Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. , Role of various national and state agencies which render assistance to small scale industries.

Text / Reference Books:

1. Forbat, John, “Entrepreneurship” New Age International.
2. Havinal, Veerbhadrappa, “Management and Entrepreneurship” New Age International
3. Joseph, L. Massod, “Essential of Management", Prentice Hall of India.

BOE 072	Operation Research	3L:1T:0P	4 credits

Course Objectives: The basic objectives of this course are to Identify and develop operational research models from the verbal description of the real system and understand the mathematical tools that are needed to solve optimization problems.

Course outcomes: At the end of this course the students will be able to-

CO 1 List various characteristics and scope of Operation Research

CO 2 Represent problems using Linear Programming technique,

CO 3 Estimate and solve the problems related to transportation and assignment

CO 4 Solve the simple models of game theory and analyze various methods of linear programming

CO 5 Justify the significance of crashing in project management and validate various inventory control models

CO 6 Explanation of various research models for optimization and design the appropriate queuing model for given problem

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2	2	2				1	2	1
CO2		2	1		3	1	2		1	1		3
CO3	3			2	2			3	2	1		1
CO4		3		3			3		2		3	2
CO5	3	2	2	1	1	3		2	1	3		2
CO6	2	2	1			2	2	2			2	

Detailed Syllabus:-

Module I

Linear Programming: Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal & dual problem sensitivity analysis

Transportation & Assignment problems. Deterministic Dynamic Programming- Multistage decision problems & solution, Principle of optimality. Decision under various conditions.

Module II

Game Theory: Two Person Zero sum game, Solution with / without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Linear Programming

Sequencing: Basic assumption**,** n Jobs through two / three machines, 2 Jobs on m machines.

Inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy Use, advantages& limitations, Monte-carlo simulation, Application to queuing, inventory & other problems.

Module III

Queuing models: Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration

Project Management: Basic concept, Rules for drawing the network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation..

Text Books:

1. Operations Research by : Wangner
2. Operations Research by : Taha
3. Introduction to Management Science by: Hiller & Hill

OPEN ELECTIVES - III

BOE 081	**Non-Conventional Energy Resources**	**3L:1T:0P**	**4 credits**

Course Objectives: The basic objective of this course is to understand the students the energy resource which can be used again and again and their future scope.

Course outcomes: At the end of this course the students will be able to-

CO 1	Define various nonconventional energy resources (NCER)
CO2	Understand the theory of solar cells, Magneto Hydrodynamics, ocean thermal energy, wave energy
CO3	Calculate efficiency of different NCER based power plants.
CO4	Analyze solar radiation geometry, performance of various power generation systems and Distinguish among various NCER, autonomous and grid connected power plant,
CO5	Judge the appropriateness of different NCER based power plants and derives the condition for maximum efficiency.
CO6	Design and plan the various power plant like solar power plant, and explain the principle, construction and working of different NCER based power plants.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1		3		1
CO2	3	2		1	3	1		2		1		2
CO3	1	1				2	2	1	2	1		
CO4	3	3	2	1		2		2		2		
CO5	2	2	1	2		1	2			1		3
CO6	1	1	2	1		1		1	2	1	3	1

Detailed Syllabus:

Module I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits

Solar Cells: Theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

Module II

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations

Thermo-electrical and thermionic Conversions: Working Principle, performance and limitations

Module III

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics

Bio-mass: Availability of bio-mass and its conversion theory

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations

Wave and Tidal Wave: Principle of working, performance and limitations, Waste Recycling Plants

Text/References Books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006

3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional "BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

BOE 082	Product development	3L:1T:0P	4 credits

Course Objectives: The basic objective of this course is to understand the various phases and methodologies of product design and development.

Course outcomes: At the end of this course the students will be able to-

CO1 Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
CO2 Describe the product design and development processes in manufacturing industry.
CO3 Evaluate and apply the methodologies for product design, development and management.
CO4 Analyse a methodical approach to the management of product development to satisfy customer needs.
CO5 Carry out cost and benefit analysis through various cost models.
CO6 Be familiar with the design techniques, technological forecasting and Environment and safety considerations.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1							1	
CO2	2	2	1		1		1				1	1
CO3	2	3	2	2	1	1	1					1
CO4	1	1	3		2	1		2	2			2
CO5	1		2	3	2	1						1
CO6	2	3	2	3	2	1	1	1				2

Detailed Syllabus:-

MODULE- I

Introduction to PD, Applications, Relevance, Product Definition, Scope, Terminology, Design definitions, the role and nature of design, old and new design methods, Design by evolution, Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts,

MODULE- II:

Transformations

Brainstorming & Synectic, Morphological techniques. Utility concept, Decision making under multiple criteria, Economic aspects of design. Fixed and variable costs, Break-even analysis,

MODULE- III

Reliability

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration, Ergonomic aspects. Anthropometric data and its importance in design, Applications of Computers in product design.

Product Appraisal

Information and literature search, patents, standards and codes. Environment and safety considerations, Existing techniques such as work-study, SQC etc .

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.
7. Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
8. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
9. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
10. Industrial Design In Engineering – A marriage of Techniques – Charles H . Flurscheim, The Design Council - London.
11. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.

OPEN ELECTIVES - V

BOE 083	Advanced Materials Technology	3L:1T:0P	4 credits

Course Objective: The basic objectives of this course is to study the different conventional and advanced materials used in current technology.

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

CO 1 To define and explain the properties of various ferrous and non-ferrous materials and the effect of alloying elements on the properties of plain carbon steels,

CO2 To describe the various heat treatment operations performed on different materials, use and application of composite material, refractory materials, smart materials and biomaterials as newer materials in present day situations,

CO3 To develop a combination chart for various types of materials and their specific application in various machining operations and their advantages.

CO4 To analyze the various properties of different materials like bio-materials, smart materials, radio-active materials.

CO5 To judge the significance, importance and use of modern materials over conventional materials, their feasibility analysis to various practical engineering situations

CO6 To discuss the procedure of producing composites, effect of radioactive elements and smart materials.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1		1	2	1	1			2
CO2	2		2	1	2		3		2		3	
CO3	1	3	1	2	3	2			3			3
CO4	2		2	1	2		2		2	2	3	2
CO5	2	2	1	1	2	1		1	1			1
CO6	1	2	1	1		1			1		2	1

Detailed Syllabus:-

MODULE-I

Introduction to Ferrous Materials

Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, availability of steel. Cast irons-white, grey, modular malleable and alloy cast irons

Heat Treatment of Steels

TTT diagrams, annealing, normalizing, hardening and tempering of steel, Austempering and martempering of steel. Surface hardening of steel-Carbonizing nitriding carbonitriding cyaniding, flues and induction hardening microscopic determination

MODULE-II

Nonferrous materials

Ultra light materials, Properties and application, brasses, bronzes, cupro-nickel alloys, aluminum, magnesium and titanium alloys, bearing materials, Heat treatment of nonferrous materials– solution zing, Aging and precipitations hardening

Composites

Polymer – polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal-polymer composites. Dispersion reinforced, particle reinforced, laminated and fiber reinforced composites. **Refractory materials** and coatings for high temperature applications.

Smart Materials-introduction, types and applications. Thin film shape memory alloys.

MODULE-3

Biomaterials

Classes and application of materials in medicine and dentistry, The mechanical properties including elasticity, hardness, viscoelasticity, surface and fatigue properties of skin; soft tissues; bone;. Biocompatible materials and its applications.

Nuclear Materials

Introduction to nuclear materials. Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials. Control & Construction Materials for Nuclear reactors, Moderators, Radiation proof materials. Brief discussion of safety and radioactive waste disposal,

Text Books:

1. Biomaterials Science- An Introduction to Materials in Medicine. Buddy D. Rattner, A.S. Hoffman, F.J. Sckoen, and J.E.L Emons, Academic Press, second edition, 2004.
2. Biomaterials: An Introduction (second edition) Joon B.Park & Roderic S.Lakes, Plenum Press, 3. Handbook of Materials for Medical Devices, Edited by J. R. Davis, ASM international, 2003.
3. Manufacturing Processes for Engineering Materials, Kalpak Jain, Pearson Publication,2004
4. Introduction to Nuclear Engineering, by J.R Lamarsh.
5. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesly Publishing Co.
6. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.
7. A textbook of Manufacturing Processes:Workshop Technology, R.S. Khurmi, S.Chand Publication,2008

BOE 084	Non- Destructive Testing	3L:1T:0P	4 credits

Course Objective: The basic objective of this course is to make students familiar with the different Non- destructive testing methods for materials inspection.

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

CO1 Define powder metallurgy and recognize the concept of destructive and Non-destructive testing
CO2 Understand the die penetrant test and magnetic particle inspection.
CO3 Relate the working principle of eddy current inspection.
CO4 Analyze the radiographic techniques for testing.
CO5 Co-ordinate the principle of Ultrasonic testing for medical and engineering area and various super finishing techniques
CO6 Create some basic machines for testing and explain the working principle of various material coating processes

Mapping of course outcomes with program outcomes

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	1		2	1	1				3	
CO2	2		3	1	1							2
CO3	3	2		2	1		3		2			
CO4		3	1	2	3					2		2
CO5	1	2	2	3	2		3				2	3
CO6	3	3	2	1	1							2

Detailed Syllabus:

Module I

Introduction
Scope and advantages of NDT, Comparison of NDT With DT some common NDT Method used since ages, Terminology, Flaws and Defects, Visual Inspection, Equipment used for visual inspection

Ringing test chalk test (OIL weighting test) Attractive uses of above test in detecting the surface cracks bond strength and surface defect machining, Plasma arc machining

Module II

Processing of Plastic and Rubber, Powder Metallurgy

Industrial uses of plastics and rubber; Situation where for Machining and forming plastics, Potential and limitations in the use of plastics and rubber, Introduction to powder metallurgy

Module III

Surface finishing & roughness

Purpose of finishing surfaces, Surface roughness, honing process; its applications Description of hones, Brief idea of honing machines, lapping process; its application. Description of lapping compounds and tools Brief idea of lapping,machines, Superfinishing process; its applications
Use of super finishing attachment on centre lathe, Polishing, Buffing, Metal coating processes – types, Metal spraying, Galvanizing, Electroplating, Anodizing, Wire cut EDM, Electric chemical machining, Chemical machining, Ultrasonic machining, Laser beam

Text Books:

1.Non- Destructive Testing Techniques by Ravi Prakash
2.Practical Non- Destructive Testing by Baldev Raj, M. Thavasimuthu and T. Jayakumar