SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR - 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2017-21

B. E. (MECHANICAL ENGINEERING)

Published by
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ISO 9001 : 2008 CERTIFIED ORGANISATION

Department Vision

Department of Mechanical Engineering aims to inculcate in students, a flair for excellence to become technological leader in industry and society.

Department Mission

1. To create the learning environment that stimulates students & faculty to enhance the knowledge in Mechanical Engineering.
2. To prepare the students to carry out research intended to cater the needs of the industry and society.
3. To march ahead with dedication, zeal and with a system responsive to the needs of all the stakeholders.

Department Program Educational Objectives:

1. The graduates shall be capable to accept challenges in Engineering industries.
2. The graduates shall demonstrate core competency to design, analyze and evaluate various engineering systems.
3. The graduates shall be able to apply computational and professional skills in corporate world.
4. The program shall prepare the graduates for higher studies, entrepreneurship and create awareness about lifelong learning.

Programme Outcomes:

Engineering Graduates will be able to :

1) **Engineering Knowledge :** Apply the knowledge of Mathematics, Science, Engineering fundamentals, and 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 investigation 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 documentations, 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 ones own work, as a member and leader in a team to manage projects and in multidisciplinary environment.
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.

Programme Specific Outcomes

1) Graduates will be capable of carrying out the analysis of mechanical and allied systems and provide numerical and computer based solution.
2) Graduates will stand for design, production and operations in core mechanical domain and management of interdisciplinary applications.

DEPARTMENT OF MECHANICAL ENGINEERING

Teaching Scheme for First Year (Semester I and II) Bachelor of Engineering

GROUP 1: SEMESTER I / GROUP 2: SEMESTER II

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MAT101 MAT102	Engineering Mathematics-I/II	4	1	0	9	40	60	100	3 Hrs.
2	PHT101	Engineering Physics	4	1	0	9	40	60	100	3 Hrs.
3	PHP101	Engineering Physics lab	0	0	3	3	25	25	50	-
4	EET101	Electrical Engineering	3	1	0	7	40	60	100	3 Hrs.
5	EEP101	Electrical Engineering lab	0	0	2	2	25	25	50	-
6	CST101	Computer Programming	2	0	0	4	40	60	100	3 Hrs.
7	CSP101	Computer Programming lab	0	0	2	2	25	25	50	-
8	HUT101	Communication Skills	2	0	0	4	40	60	100	3 Hrs.
9	HUP101	Communication Skills lab	0	0	2	2	25	25	50	-
10	PEP101	Sports/Yoga	0	0	2	0	-	-	-	-
		TOTAL	**15**	**3**	**11**	**42**	**300**	**400**	**700**	

Teaching Scheme for First Year (Semester I and II) Bachelor of Engineering

GROUP 1 : SEMESTER II / GROUP 2 : SEMESTER I

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MAT102 MAT101	Engineering Mathematics-II/I	4	1	0	9	40	60	100	3 Hrs.
2	CHT101	Engineering Chemistry	4	1	0	9	40	60	100	3 Hrs.
3	CHP101	Engineering Chemistry lab	0	0	3	3	25	25	50	-
4	CET101	Engineering Mechanics	3	1	0	7	40	60	100	3 Hrs.
5	CEP101	Engineering Mechanics lab	0	0	2	2	25	25	50	-
6	MET101	Engineering Drawing	3	0	0	6	40	60	100	4 Hrs.
7	MEP101	Engineering Drawing lab	0	0	3	3	25	25	50	-
8	HUT102	Social Skills	2	0	0	4	40	60	100	3 Hrs.
9	INP102	Workshop	0	0	2	2	25	25	50	-
		TOTAL	**16**	**3**	**10**	**45**	**300**	**400**		

Scheme of Examination of Bachelor of Engineering (Mechanical Engineering) Semester Pattern - III Semester B. E. (Mechanical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MET201	Kinematics of Machinery	4	0	0	8	40	60	100	3 Hrs.
2	MET202	Fluid Mechanics	4	0	0	8	40	60	100	3 Hrs.
3	MET203	Manufacturing Science- I	3	1	0	7	40	60	100	3 Hrs.
4	MEP203	Manufacturing Science- I	0	0	2	2	25	25	50	3 Hrs.
5	MET204	Engineering Metallurgy	4	0	0	8	40	60	100	3 Hrs.
6	MEP204	Engineering Metallurgy	0	0	2	2	25	25	50	3 Hrs.
7	MAT206	Engineering Mathematics-III	3	1	0	7	40	60	100	3 Hrs.
8	CHT201	Environmental Studies-I	2	0	0	0	-	-	SF/USF	-
9	MEP205	Industrial visit	0	0	2	0	-	-	SF/USF	3 Hrs.
10	MEP211	Machine Drawing	0	0	4	4	50	50	100	3 Hrs
		TOTAL	**20**	**2**	**10**	**46**	**300**	**400**	**700**	

(1) New scheme is applicable progressively to students admitted to I year and II year Mech. Engg. from 2015-16.
(2) For students admitted to III Semester before 2015-16, old scheme with new syllabus will be applicable from 2015-16.

Scheme of Examination of Bachelor of Engineering (Mechanical Engineering) Semester Pattern - IV Semester B. E. (Mechanical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MET206	Strength of Materials	3	1	0	7	40	60	100	3 Hrs.
2	MET207	Engineering Thermodynamics	3	1	0	7	40	60	100	3 Hrs.
3	MET208	Dynamics of Machinery	3	1	0	7	40	60	100	3 Hrs.
4	MEP208	Dynamics of Machinery	0	0	2	2	25	25	50	3 Hrs.
5	MET209	Hydraulic Machines	3	1	0	7	40	60	100	3 Hrs.
6	MEP209	Hydraulic Machines	0	0	2	2	25	25	50	3 Hrs.
7	MAT246	Engineering Mathematics-IV	3	1	0	7	40	60	100	3 Hrs.
8	CHT202	Environmental Studies-II	2	0	0	0	-	-	SF/USF	-
9	MEP210	Mini Project	0	0	2	2	50	0	50	3 Hrs.
		TOTAL	**17**	**5**	**6**	**41**	**300**	**350**	**650**	

Scheme of Examination of Bachelor of Engineering (Mechanical Engineering)
Semester Pattern - V Semester B. E. (Mechanical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MET301	Design of Machine Elements-I	4	0	0	8	40	60	100	3 Hrs.
2	MET302	Heat Transfer	3	1	0	7	40	60	100	3 Hrs.
3	MEP302	Heat Transfer	0	0	2	2	25	25	50	3 Hrs.
4	MET303	Mechanical Measurements	3	1	0	7	40	60	100	3 Hrs.
5	MEP303	Mechanical Measurements	0	0	2	2	25	25	50	3 Hrs.
6	MET304	Production Technology	3	1	0	7	40	60	100	3 Hrs.
7	MEP304	Production Technology	0	0	2	2	25	25	50	3 Hrs.
8	INT313	Operations Research	3	1	0	7	40	60	100	3 Hrs.
9	MEP305	Technical Seminar	0	0	2	2	50	0	50	3 Hrs.
10	MEP312	Solid Modeling	0	0	2	0			SF/USF	
		TOTAL	**16**	**4**	**10**	**44**	**325**	**375**	**700**	

(1) New scheme is applicable progressively to students admitted to I year and II year Mech. Engg. from 2015-16.
(2) For students admitted to III Semester before 2015-16, old scheme with new syllabus will be applicable from 2015-16.

Scheme of Examination of Bachelor of Engineering (Mechanical Engineering)
Semester Pattern - VI Semester B. E. (Mechanical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MET306	Thermal Engineering - I	3	1	0	7	40	60	100	3 Hrs.
2	MET307	Automatic Control	4	0	0	8	40	60	100	3 Hrs.
3	MET308	Manufacturing Science- II	4	0	0	8	40	60	100	3 Hrs.
4	MEP308	Manufacturing Science- II	0	0	2	2	25	25	50	3 Hrs.
5	MET309	Open Elective	3	1	0	7	40	60	100	3 Hrs.
6	MCT321	Computer Applications	3	1	0	7	40	60	100	3 Hrs.
7	MCP321	Computer Applications	0	0	2	2	25	25	50	3 Hrs.
8	MEP311	Industrial Case Study	0	0	2	2	50	0	50	3 Hrs.
		TOTAL	**17**	**3**	**6**	**43**	**300**	**350**	**650**	

Course Code	Open Elective 1	Course Code	Open Elective 2
MET309-1	Automobile Engineering	MET309-2	Robotics

Scheme of Examination of Bachelor of Engineering (Mechanical Engineering)
Semester Pattern - VII Semester B. E. (Mechanical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MET401	Thermal Engineering-II	4	0	0	8	40	60	100	3 Hrs.
2	MEP401	Thermal Engineering-II	0	0	2	2	25	25	50	3 Hrs.
3	MET402	Design of Machine Elements - II	3	1	0	7	40	60	100	3 Hrs.
4	MEP402	Design of Machine Elements - II	0	0	2	2	25	25	50	3 Hrs.
5	MET403	Elective -I	4	0	0	8	40	60	100	3 Hrs.
6	MET404	Elective- II	3	1	0	7	40	60	100	3 Hrs.
7	MEP404	Elective- II	0	0	2	2	25	25	50	3 Hrs.
8	INT413	Productivity Improvement Techniques	3	1	0	7	40	60	100	3 Hrs.
9	MEP405	Project Phase-I	0	0	2	4	25	25	50	3 Hrs.
		TOTAL	**17**	**3**	**8**	**47**	**300**	**400**	**700**	

Course Code	Elective I	Course Code	Elective II (With Lab.)
MET403-1	Advanced Manufacturing Techniques	MET404-1	Finite Element Methods
MET403-2	Synthesis of Mechanisms	MET404-2	Stress Analysis
MET403-3	Advanced I. C. Engines	MET404-3	Refrigeration and Air-conditioning
MET403-4	Advanced Material Handling Systems	MET404-4	Modeling and simulation
MET403-5	Composite Materials	MET404-5	Mechatronics
MET403-6	Energy Conservation and Management		

Scheme of Examination of Bachelor of Engineering (Mechanical Engineering)
Semester Pattern - VIII Semester B. E. (Mechanical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MET406	Automation in Production	3	1	0	7	40	60	100	3 Hrs.
2	MEP406	Automation in Production	0	0	2	2	25	25	50	3 Hrs.
3	MET407	Computer Aided Design	3	1	0	7	40	60	100	3 Hrs.
4	MEP407	Computer Aided Design	0	0	2	2	25	25	50	3 Hrs.
5	MET408	Elective -III	3	1	0	7	40	60	100	3 Hrs.
6	MET409	Elective-IV	3	1	0	7	40	60	100	3 Hrs.
7	MEP409	Elective-IV	0	0	2	2	25	25	50	3 Hrs.
8	INT414	Industrial Management & Entrepreneurship Development	4	0	0	8	40	60	100	3 Hrs.
9	MEP410	Project Phase- II	0	0	6	12	75	75	150	3 Hrs.
		TOTAL	**16**	**4**	**12**	**54**	**350**	**450**	**800**	

Course Code	Elective III	Course Code	Elective IV
MET408-1	Tool Design	MET409-1	Industrial Robotics
MET408-2	Automobile Engineering	MET409-2	Renewable Energy Systems
MET408-3	Vibrations in Mechanical Systems	MET409-3	Mechanical system design
MET408-4	Power Plant Engineering	MET409-4	Simulation of Manufacturing Systems
MET408-5	Optimization Techniques	MET409-5	Industrial fluid power
MET408-6	Cryogenics		

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(2) For students admitted to III Semester before 2015-16, old scheme with new syllabus will be applicable from 2015-16.

Syllabus of Group 1 - Semester I and Group 2 - Semester I, Bachelor of Engineering

Course Code : MAT101 **Course : Engineering Mathematics-I**
L: 4 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 09**

Course Objective

Course objective of this course is to provide understanding the concepts of Mathematics and its application to Engineering. This course introduces the student to Differential Calculus for one and several variable, Differential Equations and Infinite Series.

Course Outcomes

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

1. Solve Engineering problems using the concept of Differential Calculus.
2. Get analytical solution of Ordinary Differential Equations in Engineering.
3. Test convergence of Infinite series.

Syllabus

Unit - I:

Ordinary Differential Calculus: Successive differentiation, Taylor's and Maclaurin's series for function of one variable, indeterminate forms, curvature, radius of curvature and circle of curvature.

Unit - II:

Partial Differentiation: Functions of several variables, first and higher order derivative, Euler's Theorem, Chain rule and Total differential coefficient, Jacobians. Taylor's and Maclaurin's series for function of two variables, Maxima and minima for function of two variables, Lagrange's method of undetermined multipliers.

Unit - III:

Infinite Series: Convergence, divergence and oscillation of series, General properties, Tests of convergence, Alternating series.

Unit - IV:

First Order Differential Equation: First order first degree differential equations: Linear, reducible to linear, exact and reducible to exact differential equations; Non-linear differential equations.

Unit - V:

Higher Order Differential Equation: Higher order differential equations with constant coefficient, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations, simultaneous differential equations, differential equation of the type $d2y/dx2 = f(x)$ and $d2y/dx2 = f(y)$.

Unit - VI:

Applications of Differential Equation: Applications of first order first degree differential equations: Simple electrical circuits in series. Application of higher order differential equations: Mechanical and electrical Oscillatory circuits (free, damped, forced oscillations)

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, Delhi.
2. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India)
3. Advanced Engineering Mathematics, 2 ed , Jain ,Iynger , Narosa publication

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, Neekunj print process, Delhi.
2. Schaum's Outline of Differential Equations, Richard Bronson , TMH, 3ed, New Delhi
3. Engineering Mathematics by Srimanta, Paul
4. A text book of Applied Mathematics I, T. Singh, K.L. Sarda, Professional Publishing House Pvt.Ltd., Nagpur.

Syllabus of Group 1 - Semester I and Group 2 – Semester II, Bachelor of Engineering

Course Code : PHT101 **Course : Engineering Physics**

L: 4 Hrs, T: 1 Hr, P : 0 Hr., Per week **Total Credits : 09**

Course Objectives :

1. To develop the ability to apply concepts in elementary physics to understanding of engineering applications;
2. To introduce more advanced physics concepts, which form the basis of modern engineering;
3. To provide a sound foundation in mathematical formulation of concepts learnt and their applications;
4. To elaborate the general nature of concepts learnt and of possibility of their cross-disciplinary application;
5. To develop skills for numerical problem solving in areas covered

Course Outcomes :

At the end of the course the students

1. will be able to recognize and analyze phenomena of interference, diffraction and polarization of light waves ;
2. will understand principles of laser action and basic working of many types of laser devices ;
3. will understand geometrical theory of optical fibre communication and the phenomena of attenuation and dispersion of electrical signals in the fibre ;
4. will understand fundamental notions in quantum mechanics such as wave particle duality, de Broglie matter waves, Heisenberg uncertainty relations, wave function of system, quantum confinement, quantization of energy and quantum tunneling of potential barriers;
5. will understand concepts like Fermi energy and density of states, understand calculation of carrier density and electrical conductivity in intrinsic and semiconductors and understand the behaviour of pn-junction;
6. will understand broad principles of electromagnetic electron lenses, cyclotron, mass spectrograph and working of the CRO;
7. will understand the reasons for novel properties at nano-scale, be familiar with elements of some of the methods of synthesis and characterization and some of the properties of such materials ;
8. will be able to understand and perform numerical calculations in areas of optics, lasers, optical fibres, quantum physics, semiconductors, charged particle devices and nano physics at the level defined above for these.

Unit-I:

Optics:

Interference in thin films, division of amplitude and wavefront, wedge-shaped films, Newton's rings, antireflection coatings; Diffraction, single slit, double slit, Different types of polarization of light, Malus' law, production of plane polarized light, birefringence, wave plates.

Unit-II:

Quantum Physics:

Wave-particle duality, wave packets, Heisenberg uncertainty relations; Wave function, probability Schrodinger's equation, time dependent equation and its separation; Infinite potential and finite potential wells, phenomenon of tunneling.

Unit-III:

LASERs and Optical Fibres:

Interaction of matter and radiation, LASER, spontaneous and stimulated emission, population inversion; Common types of lasers and their applications; Optical fibres, structure, types, propagation in a fibre, modes of propagation, signal attenuation, signal distortion.

Unit-IV:

Mass Spectrograph and Particle Accelerators :

Principles of electron optics, cathode ray tube, cathode ray oscilloscope, mass spectrographs, particle accelerators.

Unit-V:

Semiconductors:

Band structure of solids, band diagrams of insulators, semiconductors and conductors, Fermi level in conductors and semiconductors, carrier concentration, conductivity, effective mass; Junction diode and its band diagram, depletion region and barrier potential, diode rectifier equation.

Unit-VI:

Nanophysics:

What is Nanotechnology? Fullerenes and nanoparticles; Outline of methods of preparation; Elements of electron microscopy; Scanning probe microscopy, Outline of properties – physical, thermal, optical, electrical, magnetic; Quantum size-effects; CNTs; Applications.

Text Books:

1. Fundamentals of Physics: D. Halliday, R. Resnik and J. Walker, John Wiley.
2. Engineering Physics: S. Jain and G.G. Sahasrabudhe, Universities Press (2010) / Applied Physics : S. Jain Sahastrabuddhe and S.M. Pande.
3. Introduction to Nanoscience and Nanotechnology: K.K. Chattopadhyay and A.N. Banerjee, PHI Learning (2009)

Reference Books:

1. Electronic Engineering Materials and Devices: J. Allison, TMH.
2. Engineering Physics: H. Malik and A.K. Singh, TMH (2010).
3. Engineering Physics: D.K. Bhattacharya and A.Bhaskaran, Oxford University Press (2010)

Syllabus of Group 1 - Semester I and Group 2 – Semester II, Bachelor of Engineering

Course Code: PHP101 **Course: Engineering Physics Laboratory**

L: 0 Hrs., T: 0 Hrs., P: 3 Hrs., Per week **Total Credits: 03**

Course Outcomes :

1. Students should be able to perform tasks like leveling, alignment, reading vernier scales, do specific measurements, systematically record observations, do calculations from data collected and draw conclusions.
2. Students gain working familiarity with instruments like simple spectrometer, travelling microscope, lenses, prisms, ammeter, voltmeter, the CRO, power supplies etc.;
3. Students gain better understanding of concepts like interference, diffraction, polarization, energy band gap \in semiconductor etc.
4. Students gain a working knowledge of estimating errors in an experiment for which background theory is known;
5. Students should be able to subject data collected to statistical and error analysis.

A minimum of 8 experiments to be performed from the following list of experiments.

List of Experiments :

In addition to the demo experiments, the Lab turns will be utilized for performing the experiments based on the following list:

1. Study of diodes
2. Study of transistors
3. Study of thermistors
4. Study of phenomena of interference due to thin films.
5. Diffraction of light by slit(s), an edge, obstacles, etc.
6. Hall effect
7. Study of CRO
8. Graph plotting, curve fitting, visualization using Mathematica

Reference Books:

1. Physics Lab Manual written by the Teaching Faculty of Physics Department, RCOEM.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : EET101 **Course : Electrical Engineering**

L:3 Hr., T:1 Hrs., P:0 Hrs., Per week **Total Credits : 07**

Course Outcomes :

Upon completion of this course, the students shall be able to,

1. Apply the basic laws of electric and magnetic circuits to obtain the unknown quantities.
2. Represent and interpret the sinusoidal electrical quantities mathematically as well as graphically in the form of waveforms/phasors and analyze the 1-phase/3-phase AC circuits to determine the unknown quantities.
3. Determine the power losses/efficiency and voltage drop/voltage regulation of a 1-phase transformer at full load condition and demonstrate the knowledge related with its need, construction, principle, types and applications.
4. Describe the construction, principle, applications and performance characteristics of DC machines and Induction motors.
5. Demonstrate the concept of electrical power generation, transmission, distribution and the understanding about conventional/renewable energy sources.
6. Demonstrate the understanding about necessity of electrical earthing, safety & protecting devices, electrical energy utilization, illumination sources and their selection.

Unit-I:

DC Electric Circuits: Definition of EMF, Current, Power, Energy Resistance, Variation of resistance with physical parameters viz. length, area, specific resistivity and temperature. Ohm's law, resistances in series and parallel, current and voltage division rules, KVL & KCL, star delta transformation and related numerical. Measurement of DC electrical quantities.

Magnetic Circuit: Concept of MMF, Flux, reluctance, analogy with electric circuits, B-H curve, simple numerical on series magnetic circuits.

Unit-II:

AC Circuits: Generation of single phase and three phase alternating EMF. Average and RMS values for sinusoidal waveform. Phasor representation of sinusoidal electrical quantities, Steady state behavior of RLC circuits with sinusoidal excitation. Reactance, impedance, Power & Energy in AC Circuits. Simple numerical on series and parallel AC circuits. Concept & importance of power factor & its improvement (with simple numerical).

Simple analysis of balanced three phase AC circuits, Star-delta resistive networks. Measurement of AC electrical quantities.

Unit-III:

Introduction to Electrical Power System :

Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind and Solar) with block schematic representation only. Single line diagram for Generation, Transmission & Distribution through different voltage levels; Low voltage radial distribution system (Over head & underground, single phase and three phase).

Necessity of equipment earthings, Fuses (Rewirable and HRC), MCB, ELCB.Basic operation of UPS and Inverters (Block schematic representation).

Unit-IV:

Single phase Transformer :

Principle of operation, Construction Transformer ratings, No load and On load operation with leakage reluctance, losses, efficiency, Definition & formula for voltage regulation, OC/ SC test, equivalent circuit referred to primary side of transformer.

Unit-V:

Rotating Electric Machines :

DC Machines: DC Generator-Principle of working, construction (without details of armature winding), classification of DC generators. DC Motors-Back EMF, necessity of starters, speed and torque equations, characteristics of motors, speed control of DC motors (without numerical), Application of DC motors.

Three Phase Induction Motors: Working principles, types and construction of three phase Induction Motor, synchronous speed, torque, slip, torque slip characteristics, applications of three phase Induction motor.

Single Phase Induction Motors: operating principle of capacitor start and run single phase induction motor and its applications.

Unit-VI:

Utilization of Electrical Energy :

Illumination: Definition of luminous flux, luminous intensity, Candle power, illumination, Luminance, Luminous efficiency (lumens/watt) of different types of lamps, working principle of Fluorescent/Sodium Vapour/ Mercury vapor & CFL Lamps. Simple numerical to determine number of lamps to attain a given average lux level in an area.

Electric Heating: Advantages of Electrically produced heat, types and applications of Electric heating equipment, transfer of heat (conduction, convection, radiation); Resistance ovens, Induction heating (Core & coreless type), Dielectric heating. (Note. Numerical excluded)

Tariff: One part (KWH based) tariff with simple numerical; to calculate the domestic electricity charges.

Text Books :

1. Elements of Electrical sciences: P. Mukhopadhyay, N. Chand & Bros Roorkee (1989).
2. Electrical Technology: B. L. Thareja, S. Chand Publications.
3. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

Reference Books :

1. Basic Electrical Engineering: T.K. Nagasarkar& M. S. Sukhija, Oxford Univ. Press.
2. Utilization of Electrical Energy: H. Pratab, Dhanpatrai& Sons.
3. Utilization of Electrical Energy: E. Openshaw Taylor, Orient Longman.
4. Websites: www.powermin.nic.in, www.mnes.nic.in, www.mahaurja.com.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : EEP101 — **Course: Electrical Engineering Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week — **Total Credits : 02**

Course Outcomes :

Upon completion of this course, the students shall be able to,

1. Connect the electric circuits based on the syllabus of theory subject EET101 and test the performance by way of observation, calculations and conclusion.
2. Demonstrate the concept and significance of power factor and how it can be improved.
3. Conduct an electrical energy survey of connected load at residential premises and demonstrate the understanding of energy tariff by calculating the energy bill in accordance with the norms of State Electricity Distribution Company.

List of Experiments :

1. To verify Kirchoff's voltage and current law using D.C. source.
2. To study the R-L-C series circuit with AC source
3. To study R-L-C parallel circuit with AC source
4. To perform direct load test on 1-phase transformer for finding regulation and efficiency
5. To perform open circuit and short circuit tests on 1-phase transformer
6. To study 3-phase star delta connections and verify different relations of voltage ,current and power
7. To study the speed control techniques for DC shunt motor
8. To study the importance of power factor and improvement of power factor using static capacitors.
9. To analyze energy bill of residential category and prepare energy sheet.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code: CST101 — **Course : Computer Programming**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week — **Total Credits: 4**

Course Outcomes

On successful completion of the course, students will be able to

1. Understand basics of computer, software, number systems, flowchart and algorithms.
2. Design and code well-structured C programs.
3. Write program on the basis of decision control structures and loop control structures.
4. Perform sorting and various other operations on 1-D and 2-D array.
5. Perform operations on structures, functions and pointers.

Syllabus

Unit-I:

Computer Fundamentals: Basic Structure of a computer, Input/output devices and memories, types of computer. Introduction to DOS and Windows OS, Number Systems: Decimal, Binary, Octal, Hexadecimal and conversion from one to another. Algorithm – Conventions used in writing algorithm, Software Life Cycle, Program and Programming Languages Procedural, Object oriented, High level, Assembly, Machine Language. System Software - Translator, Compiler, Interpreter, Linker, Loader and Flowchart.

Unit-II:

C Programming Language: Keyword, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case.

Unit-III:

Loop Control Structure: go to, while, for, do while, break, continue. Storage classes, Enumerated Data types, Renaming Data types with typedef(), Type Casting, Bitwise Operators.

Unit-IV:

Array: Introduction, array Declaration, Single and multidimensional array. Pointers: Introduction, Definition and use of pointer, Pointer arithmetic, pointer operators, pointer and array, pointer to pointer

Unit-V:

Structures and Union: Declaring and using structure, Structure initialization, Structure within structure, array of structure, pointer to structure.

Unit-VI:

Function Programming: Introduction, User Defined and Library Function, Parameter passing, Return value, Recursion, pointer and function

Text Books:

1. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill
2. Programming in ANSI C,5th ed. : E. Balguruswami McGraw Hill

Reference Books:

1. Let Us C.9thed: Yashwant Kanetkar, BPB Publication
2. Programming with C: Byron Gottfried, Schaums Outline Series.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code: CSP 101 **Course : Computer Programming Lab**

L: 0 Hrs., T: 0 Hrs., P:2 Hrs. Per week **Total Credits: 2**

Course Outcomes :

On successful completion of the course, students will be able to

1. Implement programs based on if-else, switch and loop structure.
2. Implement programs based on 1-D and 2-D numeric and character arrays.
3. Perform operation on structure and pointer.
4. Design programs based on functions.

CSP101practicals based on above CST 101 syllabus

Syllabus of Group 1- Semester I and Group 2-Semester II, Bachelor of Engineering

Course Code : HUT101 **Course:-Communication Skills**

L:2 Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits:4**

Course Outcomes :

1. Students have better reading comprehension, pronunciation, and functional English grammar.
2. Students are able to write letters and resumes
3. Students are able to organize their thoughts for effective presentation and writing.
4. Students are able to learn skills to present themselves well in an interview, and handle a Group Discussion

Syllabus

Unit-I :

Communication:

What is Communication, the Media of Communication, Channels of Communication, Barriers to Effective Communication, Role of Communication Skills in Society.

Unit-II :

Reading Comprehension :

The Process of Reading, Reading Strategies Central idea, Tone and Intention, Comprehension Passages for practice.

Unit-III :

Professional Speaking:

Components of an effective talk, Idea of space and time in public speaking, Tone of voice, Body language, Timing and duration of speech, Audio-Visual Aids in speech. Presentation Skills, Group Discussion and Job Interviews

Unit IV :

Orientation to Literary and Scholarly Articles:

Preferably two fictional and two non-fictional texts (Selected by the teachers and the Head). The art of writing articles on social, cultural, scientific and technical issues (Paragraph Writing), Exercises.

Unit V :

Business Correspondence:

Types and Formats of Business letters, Routine Business Letters (Inquiry, Order, Instruction, Complaint, Adjustment), Sales Letters, Resumes and Job applications, Business Memos, Emails.

Unit VI:

Grammar:

Synonym and Antonym, Give one word for, Voice, Narration and Comparison of Adjectives and Adverbs, Transformation of sentences and Common Errors, Idioms and Phrases, Note Making, Précis writing.

Text Book :

1. M. Ashraf. Rizvi. Effective Technical Communication. Tata Mc Graw-Hill Publishing Company Limited.2009

Reference Books :

1. Sanjay Kumar and Pushp Lata. Communication Skills. Oxford Publication
2. Meenakshi Raman and Sangeeta Sharma. Technical Communication. Second Edition Oxford Publication.2011
3. Anne Nicholls. Mastering Public Speaking. Jaico Publishing House.2003
4. Dr Asudani .V. H An easy approach to English. Astha Publication Nagpur. 2009 , 3rd Edition.

Syllabus of Group 1- Semester I and Group 2-Semester II, Bachelor of Engineering

Course Code : HUP101 **Course : Communication Skills Lab**

L:0Hrs.,T:0Hrs.,P:2Hrs.,Per week **Total Credits:2**

Course Outcomes

On successful completion of the course, students will be able to

1. Learn presentation skills
2. Understand effective strategies for Personal Interview and Group Discussions
3. Learn and apply effective language skills – listening, speaking, reading and writing

Sr. No	Name of the Practical	Activities Taken	Medium of Practical
1	Speaking Skills	1. Introduction to effective ways of speaking 2. Oral presentations Extempore / Debate / JAM/Self-introduction	PPT Based, Activity Based
2	Presentation Skills	1. Preparing visual aids/PPTs on given topics	PPT Based, Activity Based, Open Source CDs
3	Group Discussion-Orientation	1. GD types 2. GD techniques/rules - videos 3. General/familiar topics for discussion	Open Source CDs PPT based Activity based
4	Group Discussion-Practice session	1. Divide in group of 6 2. Classification of topics 3. Feedback	PPT Based, Activity Based
5	Group Discussion-Mock	1. Divide in group of 6 2. Mock GDs - types 3. Feedback	Activity Based
6	Interview Techniques-Orientation	1. Various types of interviews 2. Types of interviews 3. Self-analysis 4. KYC sheet 5. Self-introduction	Open Source CDs Activity Based
7	Interview Techniques Practice Sessions	1. Video 2. Non-verbal communication 3. Types of interview questions	Open Source CDs Activity Based
8	Interview Techniques-Mock Interviews Optional Practicals	1. Mock Interviews (One to One) Teacher can decide any other Practical apart from the ones mentioned below	Activity Based
9	Listening Skills	1. Listening Barriers	PPT Based, Activity Based
10	Non Verbal Communication	1. Kinesics in com/interviews 2. Activities/Role play	Open Source CDs PPT based
11	Use Figurative Language	1. Intro phrases/ Idioms/proverbs/ pronunciation	PPT Based, Activity Based

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code :PEP101 **Course: Sports/Yoga**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 00**

Course Outcomes

On successful completion of the course, students will be able to

1. Understand fundamental skills and basic rules of games.
2. Gain health related physical fitness.
3. Develop body-mind coordination through games and yogasans.

BRIEF OBJECTIVES OF SPORTS/YOGA PRACTICAL CLASSES

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, Physical Education department at RCOEM will conduct sports/yoga classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be todevelop team spirit, social skills as well as identify and develop leadership qualities in students through various sports group activities. Training of students to understand the rules of various national and international games would also be an important objective. Sport activities would also be conducted with the objective to provide recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate fitness of students so as to recommend and conduct specific Yoga and Sport activities.

PROGRAMME OUTLINE

1. Sports

1. Introduction to sports i.e. volleyball, cricket, football, basketball, badminton, T.T., Athletics.
2. Health and safety issues related to sports; Knowledge, recognition and ability to deal with injuries and illnesses associated with sports.
3. Awareness about sports skills, techniques and tactics.
4. Rules, regulations and scoring systems of different games (Indoor & Outdoor).
5. Trials of students to participate in inter-collegiate/University level games.

2. Yoga: Includes asanas like sitting, standing and lying, Surayanamaskar, Pranayam.

3. Physical fitness test : this would include speed, Cardiovascular Endurance, strength, skill & flexibility.

Syllabus of Group 1 - Semester II and Group 2 – Semester II, Bachelor of Engineering

Course Code: MAT102 **Course: Engineering Mathematics-II**

L: 4 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 09**

Course Objective

The objective of this course is to expose student to understand the basic importance of Integral Calculus and Vector calculus. The student will become familiar with fitting of curves and regression analysis.

Course Outcomes

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

1. Understand and use the concepts of Integral Calculus for Engineering problems.
2. Apply technique of Vector differentiation and integration to various Engineering problems.
3. Know basic statistical techniques required for Engineering.

Syllabus

Unit-I:

Integral Calculus I: Beta and Gamma functions, Differentiation of definite integrals, Mean value and root mean square values.

Unit-II:

Integral Calculus II: Tracing of curves (Cartesian, polar and parametric curves), rectification of simple curve, quadrature, volumes and surface of solids of revolutions(Cartesian, polar and parametric forms).Theorem of Pappus and Guldin.

Unit-III:

Multiple Integrals and their Applications: Elementary double integrals, change of variable (simple transformation), change of order of integration (Cartesian and polar), application to mass, area, volume and centre of gravity (Cartesian and polar forms), elementary triple integrals.

Unit-IV:

Vector Calculus I: Scalar point function, Vector point function, vector differentiation, gradient, divergence and curl, directional derivatives with their physical interpretations, solenoidal and irrotational motions, Scalar potential function.

Unit-V:

Vector Calculus II: Vector integration: Line integrals, work done, conservative fields, surface integrals and volume integrals, Stoke's theorem, Gauss divergence theorem, Green's theorem and their simple applications.

Unit VI:

Statistics: Fitting of straight line, $y = a + bx$, parabola $y = a + bx + cx2$ and the exponential curves by method of least squares, Coefficient of linear correlation, lines of regression, rank correlation, multiple regression and regression plane of the type $z = a + bx + cy$, coefficient determination.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, Delhi
2. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India)
3. Advanced Engineering Mathematics, 2 ed, Jain, Iynger, Narosa publication.

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, Neekunj print process, Delhi.
2. Engineering Mathematics: Principal and Applications Srimanta, Paul, Oxford Univ Press,(2011).
3. Higher Engineering Mathematics: B.V. Ramana, TMH.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course No. CHT101 **Course : Engineering Chemistry**

L: 4 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 09**

Course Outcomes of Engineering Chemistry :

Upon successful completion of the course, the student shall be :

1. Able to understand the basic scientific principles underlying the troubles caused by impurities present in water and treatment to remove the same.
2. Understand the applications of different nanomaterials with their synthtic routes.
3. Able to characterize the fuels and analyze their combustion mechanism.
4. Able to understand the effect of constituents on quantity of cement manufactured with their setting and hardening reactions.
5. Able to understand principles of lubrication along with chemical properties of lubricants.
6. Knowledge of proper engineering materials having better corrosion resistance and sustainability and implement the effective measures to minimize the corrosion wherever possible.

Syllabus

Water Treatment :

Water Treatment for Industrial Applications: Brief introduction regarding sources, impurities in water, hardness of water and their types. Softening of water using lime-soda process: principles in hot and cold lime-soda process. Zeolite softener, demineralization by synthetic ion exchange resins. Boiler troubles: Carryover, Priming and Foaming, Scales and Sludges, Caustic Embrittlement, Boiler Corrosion-causes and effects on boiler operation and methods of prevention. External and Internal conditioning : Phosphate, Carbonate and Calgon conditioning.

Water Treatment for Domestic Water:

Domestic water treatment : Brief discussion and Chemistry involved in the process of sedimentation, coagulation, filtration and sterilization by UV, Ozone, Chlorination including Break point chlorination. Desalination of water using reverse osmosis and electro dialysis.

Numericals Based on Water Softening: Numericals based on (1) lime-soda (2) zeolite / ion-exchange water treatment processes.

Cement :

Process parameters involved in the manufacturing of portland cement, manufacture of portland cement, microscopic constituents of cement and their effects on strength; setting and hardening of cement.

Types and uses of cement : Pozzolonic; Rapid hardening, Low heat and High alumina cements. Additives and admixtures used in cement: Accelerators, Retarders, Air entrainment agents, Water repellants.

Chemical approach to Nanomaterials :

General introduction to nanotechnology, timeline and milestone, overview of different nanomaterials available, potential use of nanomaterials in electronics, sensors, medical applications, catalysis, environment and cosmetics.

Physical chemistry related to nanoparticles such as colloids and clusters: conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state.

Synthesis of nanomaterials: ' Top-Down'- photolithography and 'Bottom-Up'- sol-gel method .

Carbon nanotubes: Single-walled and multi-walled carbon nanotubes, their structures, properties and applications.

Potential risks of nanomaterials- Health and environmental impact.

Fuels and combustion :

Introduction, Calorific value, Higher and Lower calorific value, flame temperature and flame intensity , determination of calorific value by Bomb calorimeter and Boy's calorimeter, numericals based on the determination of calorific value by Bomb and Boy's Calorimater.

Solid Fuels:

Types of coals, proximate and ultimate analysis of coal, its significance, Carbonization of Coal.

Liquid and Gaseous Fuels:

Liquid fuels: mining & fractional distillation of crude petroleum, use of gasoline in internal combustion engine, octane number, cetane number, flash point of combustible liquid fuel, knocking. Fisher-Tropsch's process for manufacture of synthetic gasoline, thermal and catalytic cracking: fixed bed and fluid bed catalytic cracking, aviation gasoline.

Gaseous fuels:

CNG and Significance of flue gas analysis by Orsat apparatus.

Numericals based on Combustion Calculations:

Numericals based on combustion calculations for solid fuels. Numericals based on combustion calculations for liquid and gaseous fuels.

Friction, Wear and Lubricants :

Introduction, lubrication mechanism : Hydrodynamic, Boundary and Extreme pressure lubrication. Classification of lubricants- Solid, Semisolid and Liquid lubricants, Blended oils using different additives viz.:-

Anti-oxidants, E. P. additive, corrosion inhibitor, viscosity index improver, etc. synthetic lubricants viz.:- Dibasic acid esters, Polyglycol ethers and Silicones, Lubricating Emulsions. Properties of Greases: Drop point and consistency test, Properties of liquid lubricants: Viscosity and Viscosity Index, Aniline point, Cloud & Pour point and Decomposition stability. Criteria for selection of lubricants under different conditions of load and speeds.

Corrosion :

Electrochemistry and Theories of Corrosion :

Introduction to corrosion, Cause and Consequences of corrosion, Measurement of corrosion rate, Galvanic series, Dry and Wet corrosion, Pilling-Bedworth rule, factors affecting the rate of corrosion.

Types of corrosion and Preventive Methods; Different types of corrosion (Pitting, Stress, Intergranular and

Galvanic), protection against corrosion, design and selection of engineering materials, cathodic and anodic protection, Brief discussion about Protective Coatings: Metallic, Inorganic, Organic coatings, Corrosion inhibitors.

Text Books :

1. Text Book of Engineering Chemistry, S. S. Dara, S. Chand and Company Ltd., New Delhi.
2. Textbook of Engineering Chemistry, P. C. Jain and Monica Jain, Dhanpat Rai and Sons, New Delhi.
3. Text Book of Environmental Chemistry and Pollution Control, S. S. Dara; S. Chand and Company Ltd., New Delhi.
4. Textbook of Engineering Chemistry, S. N. Narkhede, R. T. Jadhav, A. B. Bhake, A. U. Zadgaonkar, Das Ganu Prakashan, Nagpur.
5. Applied Chemistry, A. V. Bharati and Walekar, Tech Max Publications, Pune.
6. Engineering Chemistry, Arty Dixit, Dr. Kirtiwardhan Dixit, Harivansh Prakashan, Chandrapur.

Reference Books :

1. Engineering Chemistry by Gyngell, McGraw Hill Publishing Company, New Delhi.
2. Engineering Chemistry (Vol I), Rajaram and Curiacose, Tata McGraw Hill Publishing Company, New Delhi.
3. Engineering Chemistry (Vol II), Rajaram and Curiacose, Tata McGraw Hill Publishing Company, New Delhi.
4. Engineering Chemistry, Saraswat and Thakur, Vikas Publication, New Delhi.
5. Engineering Chemistry, B. S. Sivasankar, Tata Mcgraw Hill Publishing Company, New Delhi.
6. Engineering Chemistry, O. G. Palan, Tata Mcgraw Hill Publishing Company, New Delhi.
7. Engineering Chemistry, R. Shivakumar, Tata Mcgraw Hill Publishing Company, New Delhi.
8. Chemistry of Cement, J. D. Lee, Mcgraw Hill Publishing Company, New Delhi.
9. Nanomaterials Chemistry, C. N. R. Rao, A. Muller, A. K. Cheetam, Wiley VCH verlag GmbH and Company, Weinheim.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : CHP101 — **Course: Engineering Chemistry Lab**

L:0 Hr., T:0Hrs., P:3 Hrs., Per week — **Total Credits : 03**

Course Outcomes of Engineering Chemistry Lab

After successful completion of the course, the student will be able to

1. Be conversant with various chemical processes involved in qualitative as well as quantitative analysis of different materials, water pertaining to various impurities and to record the information in the scientific way.
2. Understand applicability of different physico-chemical properties of fluids such as viscosity and flash point for various industrial machineries.

Text Books :

1. Text Book on Experiments and Calculations in Engineering Chemistry: S. S. Dara; S. Chand and Company Ltd., New Delhi.
2. Practical Engineering Chemistry : S. N. Narkhede, R. T. Jadhav, A. B. Bhake, A.U. Zadgaonkar, Das Ganu Prakashan, Nagpur.

Reference Books :

1. Concise Laboratory Manual in Engineering Chemistry: R. Shivakumarand J. Prakasan, Tata McGraw Hill Publishing Company, New Delhi.

Syllabus of Group 1 - Semester II and Group 2 - Semester I, Bachelor of Engineering

Course Code: CET101 **Course: Engineering Mechanics**

L:3 Hr., T:1 Hrs., P:0 Hrs., Per week **Total Credits : 07**

Course Outcomes

After Completion of the course in Engineering Mechanics, the student should be able to

1. Define and Describe various parameters related to static and dynamic behaviour of the rigid bodies.
2. Understand and describe physical phenomenon with the help of various theories.
3. Explain and analyse various physical phenomenon with the help of diagrams.
4. Describe and analyse the engineering problems with the acquired knowledge of engineering mechanics

Syllabus

Unit-I:

Fundamental of Engineering Mechanics:

Fundamentals of Engineering Mechanics, axiom's of mechanics, resultant of concurrent force system. Moment of a force, couples, resultant of non-concurrent force system

Unit-II:

Equilibrium of Force System :

Equilibrium of concurrent force system, Equilibrium of non-concurrent force system Friction: Law's of friction, simple application, wedge friction, belt friction.

Unit-III:

3-D Force system & Analysis of trusses :

Moment of a force about a point and about an axis, resultant of spatial concurrent & Non concurrent force system, wrench, equilibrium of concurrent and non-concurrent force system. Analysis of simple trusses (Joint & Section Method)

Unit-IV:

Centroids and moment of inertia :

Centroids locating by first principle, centroid of composite areas, Second moment and product of inertia of plane areas. Moment of Inertia of composite areas. Transfer theorems for moment of Inertia and Product of Inertia.

Virtual work method

Virtual work principle, application of virtual work principle.

Unit-V

Kinematics & Kinetics of Particles :

Rectilinear motion of a particle with variable acceleration, Projectile motion, normal and tangential components of acceleration, kinetics of particle and several interconnected particles. D'Alembert's principle, problems on connected system of particles.

Unit-VI:

Collision of elastic bodies:

Principle of conservation of momentum, Impulse momentum equation, work energy equation, coefficient of restitution, impact of elastic bodies.

Text Books:

1. Engineering Mechanics: F. L. Singer, Harper & Row Publications.
2. Fundamentals of Engineering Mechanics : A.K. Sharma, Sai Publications.
3. Engineering Mechanics :A.K.Tayal, Umesh Publications, New Delhi.
4. Engineering Mechanics : P.B. Kulkarni, Professional Publishing House Pvt. Ltd.

Reference Books:

1. Engineering Mechanics: Timoshenko & Young, Tata McGraw Hill Publications, New Delhi.
2. Engineering Mechanics: Bear and Johnston, Tata McGraw Hill Publications, New Delhi.
3. Engineering Mechanics: I. H. Shames, Phi Pvt. Ltd., India.

Syllabus of Group 1 - Semester II and Group 2 - Semester I, Bachelor of Engineering

Course Code : CEP101 **Course : Engineering Mechanics Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 02**

Course Outcome

After Completion of the course in Engineering Mechanics Lab; the student should be able to

1. Define and explain different terminologies of simple lifting machines.
2. Understand and perform practicals on equilibrium of concurrent and non-concurrent force systems.
3. Describe various terminologies related to friction and mass moment of inertia.
4. Explain graphical solutions of equilibrium conditions in engineering mechanics.
5. Analyse the experimental data collected based on practicals and discuss the results.

Minimum of Eight Practical will be performed based on the theory

List of Experiment

Experiments On"Simple Lifting Machines"

1. Law of machine for Differential Axle and Wheel
2. Law of machine for Single Purchase Crab
3. Law of machine for Double Purchse Crab

Experiments On"Equilibrium of force systems"

4. Jib Crane (Equilibrium of concurrent Forces)
5. Simple Beam (Equilibrium of Non-concurrent Forces)
6. Shear Leg Apparatus(Equilibrium of 3-D concurrent forces)

Experiments On"Friction & Inertia"

7. Inclined Plane (Coefficient of friction using Inclined Plane)
8. Belt Friction(Coefficient of friction using coil friction set-up)
9. Fly-Wheel (Mass moment of Inertia of fly-wheel)

Graphical Methods in Engineering Mechanics

10. Resultant of concurrent force systems
11. Resultant of Non-concurrent force system
12. Reactions for simply supported beams
13. Forces in members of simple Trusses
14. Moment of Inertia (Mohr's Circle)

Syllabus of Group 1- Semester II & Group 2- Semester I, Bachelor of Engineering

Course Code: MET101 **Course : Engineering Drawing**

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 06**

Course Outcomes : The expected learning outcome is that, the students shall be able to :

1. Draw & interpret technical drawings.
2. Convert 2-D drawing to 3-D drawing & vice-versa.
3. Represent the various positions of planes & solids in different orientations.
4. Develop the solid surface for sheet metal working.

Syllabus (Only First Angle Method of Projection)

UNIT 1

Introduction: Lines, Lettering & Dimensioning, Preparation of Sheet Layout.
Scales - Plain Scale, Diagonal Scale, Vernier Scale.
Engineering Curves; Ellipse: Directrix Focus, Concentric Circles & Rectangle Method.
Parabola: Directrix Focus, Rectangle Method, Tangent Method.
Hyperbola: Directrix Focus & Asymptote Method.

UNIT 2

Theory of Projections - Concept of Projection, First & Third angle projection methods.
Orthographic Projections: Conversion of given 3 dimensional View to 2 dimensional representation.

UNIT 3

Projections of Lines: Oblique Lines, Traces, Applications of lines.

UNIT 4

Projections of Planes - Polygonal Lamina, Circular Lamina.
Projections of Solids- Cube, Prism, Pyramid, Tetrahedron, Cylinder, Cone.

UNIT 5

Sections of Solids & Development of Lateral Surfaces- Cube, Prism, Pyramid, Tetrahedron, Cylinder, Cone.

UNIT 6

Isometric Projections: Isometric Scale, Conversion of given 2 dimensional views to Isometric Projection/View.

Books:

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House Pvt. Ltd.
2. Engineering Drawing by D. A. Jolhe, Tata McGraw Hill Publications
3. Engineering Graphics by H. G. Phakatkar, Nirali Publication.
4. Engineering Graphics by A. R. Bapat, Allied Publishers

References:

1. Engineering Drawing by R.K. Dhawan, S. Chand Publications
2. Engineering Drawing by K.L. Narayana & P. Kannaiah, SciTech Publication.

Syllabus of Group 1- Semester II & Group 2- Semester I, Bachelor of Engineering

Course Code: MEP101 **Course: Engineering Drawing Lab**

L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week **Total Credits: 03**

Course Outcome : The expected learning outcome is that, the students shall be able to:

1. Draw & interpret technical drawings.
2. Plan the sheet layout for the given drawing.
3. Convert 2-D drawing to 3-D drawing & vice-versa.
4. Represent the various positions of planes & solids in different orientations.
5. Develop the solid surface for sheet metal working.
6. Use & demonstrate drafting package.

List of Sheets: (50% of the sheets to be drawn in Auto CAD)

Sheet No.1: Engineering Scales & Curves
Sheet No.2: Orthographic Projections
Sheet No.3: Projection of Lines
Sheet No.4: Application of Lines
Sheet No.5: Projection of Planes
Sheet No.6: Projection of Solids
Sheet No.7: Section & Development of Solids
Sheet No.8: Isometric Projections

Books:

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House Pvt. Ltd.
2. Engineering Drawing by D. A. Jolhe, Tata McGraw Hill Publications
3. Engineering Graphics by H. G. Phakatkar, Nirali Publication.
4. Engineering Graphics by A. R. Bapat, Allied Publishers

References:

1. Engineering Drawing by R.K. Dhawan, S. Chand Publications
2. Engineering Drawing by K.L. Narayana & P. Kannaiah, SciTech Publication.
3. AutoCAD 14 for Engineering Drawing by P. Nageshwara Rao, Tata McGraw Hill Publications

Syllabus of Group 1- Semester II and Group 2-Semester I, Bachelor of Engineering

Course Code: HUT102 **Course:-Social Skills**

L:2 Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits:4**

Course Outcomes

On successful completion of the course, students will be able to

1. Learn the basic concepts of personnel management or manpower planning and the process of recruitment and selection that they will go through as engineers.
2. Learn leadership skills, industrial relations, work organizations, and impact of industry on society.
3. Learn about the political systems and institutions working in India, laws and legislations affecting industry and the application of political principles like democracy in industry.
4. Learn the importance and application of Economics in Engineering.
5. Learn about culture/civilization and develop cross cultural capacity.
6. Learn about Personal, Professional and social ethics.

Syllabus

Unit-I:

Industrial Sociology:-

- Meaning and scope of Industrial Sociology
- Work Organization and its types.
- Concept of Leadership: Meaning, changing roles and its types.
- Concept of Power and Authority: Meaning, Importance, sources and Delegation
- Industrial Culture in India: Effects of Industrialization and Urbanization on Indian Society.

Unit-II:

Industrial Psychology:-

- Meaning and scope of Industrial Psychology
- Recruitment, Selection and Training
- Industrial fatigue
- Motivation, Theories of motivation: Maslow's Need Priority Theory, Macgregor's X And Y Theory, McClelland's Needs Theory
- Dealing with Self: Stress, health, and coping; interpersonal relationships; gender roles; environmental adjustments.

Unit-III:

Political Orientation:-

- Indian Constitution, features and federal structure.
- Fundamental rights
- Directive principles of state policy
- Industrial Democracy.
- Role of Bureaucracy in Modern Democratic states.

Unit-IV:

Economics:-

- Development of Indian Economy
- Infrastructure in the Indian Economy: Energy, power, transport system, road transport system, Rail-Road co ordination, water transport, Civil aviation, communication system, urban infrastructure, science and technology, private investment in infrastructure.
- Role of Public and Private sector in Indian Economy.
- Challenges before Indian Economy in 21st Century.
  Poverty, Unemployment, Corruption, Regional Imbalance, Growth of educational sector.

Unit-V:

Culture and Civilization:-

- Concept of Culture and Civilization.
- Study of engineering skills with special reference to Egyptian and Indus Valley Civilization.
- Role of Engineers as agent of change with specific reference to change in Indian Society during 20th and 21st century.
- Multiculturalism: Meaning, scope and significance especially in Indian context.

Unit-VI:

Ethics and social responsibility:-

- Personal and professional ethics
- Corporate social responsibility
- Social capital, social audit.
- Role of entrepreneurship in nation building.
- Developing scientific and humanitarian outlook for the welfare of nation and society.

Text Books :

1. A new look into Social Sciences by Sheikh and Shabbir
2. RuddarDatt and K.P.M.Sundharam, (67th Revised edition-2013), Indian Economy, S .Chand and Company Ltd, New Delhi.
3. Edmund G. Seebauer and Robert L Barry (2010 reprint) Fundamental of Ethics for Scientists and Engineers, Oxford University Press.

Reference Books:

1. P.C. Tripathi and P.N. Reddy, Principles of Management, (4th edition, 2008), Tata MacGraw Hill Publishing Co. Ltd., New Delhi
2. Martand.T. Telsang, Industrial and Business Management, (2001), S.Chand and Co. Ltd. New Delhi
3. Dr. V.H. Asudani: An Easy Approach To Social Science, (3rd edition, 2008), Astha Publication, Nagpur
4. Tariq Modood, Multiculturalism (Themes for 21st Century Series)(1st Publication 2007), Polity Press, Cambridge, U.K. ISBN-13:97807456-3288-9.
5. Social & Human Skills by Dr. Vinod Asudani and Dr. Monika Seth.

Syllabus of Groups 1- Semester II and Group 2 – Semester I, Bachelor of Engineering

Course Code : INP102 **Course: Workshop**

L: 0 Hr., T: 0 Hrs., P : 02 Hrs., Per week **Total Credits : 02**

Course Objectives :

To impart practical training (hands-on experience) regarding use and operations of various tools, equipment and machine with basic knowledge of manufacturing process and materials.

Course Outcomes :

1. Student will be able to read job drawing, identity and select proper material, tools, equipments and process / machines for manufacturing the required job.
2. Student will be able to use basic marking and measuring instruments to inspect the job for confirming desired dimensions and shape.
3. Student will be able to observe and follow precautions during operation.

List of Experiments :

SHOP	No. of Experiments /Jobs
Fitting Shop	1. Introduction of fitting tools, equipments, machines, material & processes.
	2. Manufacturing & fitting practice for various joints & assembly.
	3. Drilling, tapping & pipe threading operations.
Carpentry Shop	1. Introduction of carpentry tools, equipments, machines, material & processes.
	2. Manufacturing of carpentry joints.
	3. Turning practice on wood working lathe.
	4. Demonstration & practice on universal wood working machine.
Welding Shop	1. Introduction of welding tools, equipments, machines, material & processes.
	2. Fabrication of joints like lap, butt, corner, T etc.
	3. Fabrication of lap joint by spot welding process.
Smithy Shop	1. Introduction of smithy tools, equipments, machines, material & processes.
	2. Forging of combine circular/square/hexagonal cross section.

Text Books :

1. Elements of workshop technology vol -1 by Hajra Choudhari
2. Elements of workshop technology vol -1 by Raghuwanshi

Reference Book:

1. Manufacturing technology by P.C. Sharma
2. Workshop manual by Kannaiah Narayan

III SEMESTER

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET201 **Course: Kinematics of Machinery**

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1) Demonstrate and analyze knowledge of different mechanisms used in various machines
2) Demonstrate ability to estimate velocity and acceleration of links
3) Classify and synthesize the cams for different follower motions
4) Demonstrate the understanding of successfully addressing issues relating to gears and gear trains
5) Exhibit skills towards application of static force analysis and synthesis of mechanisms

Syllabus

Unit -I:

Mechanisms and Machines: Basic concept of mechanism, link, kinematics pairs, kinematics chain, mechanism, machine, simple & compound chain, Degree of freedom, Grubber's criterion and other methods. Harding's notations, Class-I & Class-II mechanisms, Inversions, Kutzbach theory. Various types of mechanism such as Geneva wheel, Pawl and ratchet mechanism.

Unit- II:

Kinematics analysis of Mechanisms: Displacement, Velocity and Acceleration analysis of planer mechanism by graphical method as well as analytical method, Coriolis component of acceleration, Instantaneous center method, Kennedy's theorem.

Unit -III:

Cams and Followers: Concepts, comparison with linkages. Types of cams and followers and applications. Synthesis of cam for different types of follower motions Analysis of follower motion for cams with specified contours. Pressure angle in cam, parameters affecting cam performance

Unit -IV:

Kinematics of Spur Gear: Concept of motion transmission by toothed wheels, gear tooth terminologies, various tooth profiles, their advantages and limitations, law of gearing, kinematics of involute gear tooth pairs during the contact, contact ratio, interference, undercutting for involute profile teeth.

Unit-V:

Kinematics of Gear and Gear Trains: Helical gear tooth terminologies, Kinematics of helical, bevel, spiral, worm gears, rack and pinion gears, kinematics analysis, and torque analysis of simple epicyclical and double epicyclical gear trains.

Unit-VI:

Static Force Analysis and Synthesis: Free body diagram, condition of equilibrium. Linkage analysis, cam, gear mechanism and their combinations without friction. Introduction to coupler curves, Robert's Law of cognate linkages. Synthesis of four bar chain, transmission angle, optimization, Freudenstein equation and its application for function generation.

Text Books:

1. Theory of Machines: S.S. Rattan, Tata McGraw Hill
2. Theory of Mechanisms and Machines: Ghosh& Malik, Tata McGraw Hill
3. Theory of Machines and Mechanisms: Uicker and Shigley, Tata McGraw Hill

Reference Books:

1. Mechanism and Machine Theory: J.S. Rao & R.V. DukkiPati, New Age International
2. Theory of Machines: Thoman Bevan, CBS publication
3. Mechanism Design: Analysis and Synthesis, Volume 1: Arthur Guy Erdman, George Nason Sandor, Prentice Hall
4. Kinematics & Dynamics of Machinery: Wilson & Sadler, HarperCollins Publishers, 1983
5. Theory of Machines: Sadhu Singh, Khanna Publisher, Delhi

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET202 **Course: Fluid Mechanics**

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. To understand types and properties of fluid & learn various methods to measure pressure.
2. To apply hydrostatic laws on submerged surfaces and analyse stability of floating body based on principles of buoyancy & floatation.
3. To evaluate the fluid flow kinematics for fluids in motion.
4. To understand formulate, analyze & apply basic principles of fluid dynamics.
5. To apply flow theories to engineering flow systems.
6. To evaluate head losses for flow through pipe for given hydraulic systems and apply dimnsional technique to fluid flow problems.

Syllabus

Unit I

Introduction to Fluid Mechanics: Properties of fluids, Newton's law of viscosity and its Applications (Numericals), Types of Fluids. Fluid pressure & its Measurement, Manometers (Numericals) .

Unit II

Hydrostatic: Pascal's Law, Forces on submerged plane surfaces and curved surfaces (Numericals), Pressure variations in incompressible fluids. Buoyancy & Floatation: Principle of Flotation, Stability of floating and submerged bodies (Numericals).

Unit III

Kinematics of Fluid Flow: Types of flow. Continuity equation in Cartesian Coordinates, Velocity and Acceleration at a point (Numericals). Stream function & Velocity potential function (Numericals), Stream line, Equipotential lines, Path line, Streak line, Stream tube, Flow net. Introduction to Circulation & Vorticity.

Unit IV

Dynamics of Fluid Flow: Linear Momentum Equation. Euler's equation, Bernoulli's equation. Applications of Bernoulli's equation (Numericals): Venturimeter, Orifice, Pitot tube.

Unit V

Viscous Flow: Introduction to laminar and turbulent flow, Reynolds number and its Significance. Flow of viscous fluids through pipe (Numericals). Boundary layer Theory, Boundary layer Separation. Drag and Lift on immersed bodies (Numericals).

Unit VI

Flow Through Pipes: Losses in pipes. Pipes in series and parallel. Power Transmission Through Pipe. Hydraulic gradient line and total energy line. (Numericals on all topics of flow through pipes) Dimensional analysis: Buckingham's π- theorem (Numericals).

Text Books:

1. A text book of Fluid Mechanics : R.K. Rajput, S.Chand Publication.
2. Fluid Mechanics: Som & Biswas - Tata McGraw-Hill.
3. Fluid Mechanics & hydraulic machines, R.K. Bansal, Laxmi Publications.

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET203 **Course: Manufacturing Science – I**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Identify the machining parameters, cutting tool materials and cutting fluids for different machining operations.
2. Understand the concept of theory of metal cutting and force analysis for different machining operations.
3. Distinguish with constructional details, mechanisms involved and working principle of various production machines.
4. Distinguish and select the appropriate methods of manufacturing various types of gears.
5. Select appropriate jigs, fixtures and locating devices for various machining operations.

Syllabus

Unit -I :

Introduction to Machining Parameters: Introduction to machining, Tool materials, nomenclature and tool geometry of single point cutting tool, tool materials, properties, classification, HSS, carbide tool, coated tools, diamond coated tool, coolant materials.

Unit –II :

Theory of metal cutting: Introduction, Orthogonal and Oblique cutting, Mechanics of metal cutting, Shear plane, Stress, Strain and Cutting Forces, Merchant Circle, Chip formation, Cutting force calculations, Determination of Torque and Power required for turning, Influence of tool angle, Cutting Fluids, cutting speed, Feed and depth of cut, Power requirement, Estimation of Tool life.

Unit –III :

Lathe: Introduction, type, construction of simple lathe, mechanism and attachments for various operations, machine specifications, basis for selection of cutting speed, feed and depth of cut, time estimation for turning operations. Capstan, Turret Lathe, Machining centers, CNC lathe machine.

Unit –IV :

Milling: Introduction, specifications, types, special purpose milling machines such as thread milling machines, profile milling machine, Gear Milling, CNC milling machine. Mechanisms & Attachments for Milling. Cutting parameters, Types of milling operations, Types of milling cutters, Tool geometry & their specifications. Indexing- simple, compound and differential. Mechanics of milling process, Milling time and power estimation.

Unit –V:

Gear Manufacturing : Gear casting, Gear shaping, Gear Hobbing for Spur, Helical and Bevel Gear, Gear stamping process, Gear drawing process, Rolling Process, Gear finishing, Gear shaving, Gear Lapping, Gear Honing. Tooling and selection of Cutting Parameters, Process accuracy and quality of Gears.

Unit –VI:

Drilling: Introduction, drill nomenclature, types of drilling machines, time estimation for drilling. Drilling operations. Reaming, Boring and Broachining.

Jigs and Fixtures : Introduction, Difference between Jigs and Fixtures, Classification of Fixtures, Uses, Principles of Jigs and Fixture Design, Materials, Principles of Location, Methods of Location, Clamping of Requirements, Types of Clamps, Jig Bushes, Drilling Jigs, Milling Fixtures,.

Text Books:

1) Manufacturing Technology (Metal Cutting & Machine Tools) – P. N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
2) Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi.
3) Jigs and Fixtures: Design Manual- Prakash Hiralal Joshi, McGraw-Hill Professional *Publishing*.

Reference Books:

1) Manufacturing Engineering & Technology – S Kalpakjian and S R Schmid, Pearson Education Inc.
2) Processes & Materials of Manufacture – R Lindberg , Prentice Hall of India (P) Ltd.
3) Production Technology – HMT, Tata McGraw-hill
4) Workshop Technology (Volume I & II) - By Bawa ,Tata McGraw-hill

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP203 **Course: Manufacturing Science-I**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Outcomes

1. The students should be able to understand the working principles of different machines.
2. The students should be able to make different jobs on lathe, shaper, milling and drilling machine.
3. The students should be able to understand basic components and working of CNC machines.

Sr. No.	List of Practical
1	Study of single point cutting tool
2	Study of constructional features and working of Lathe machine
3	To carry out plain turning, step turning, taper turning, facing & knurling operations on lathe machine.
4	To carry out turning, chamfering & threading operations on given work piece.
5	Study of constructional details & working of shaper and planer machines.
6	To carry out plain shaping, angular shaping, on given workpiece.
7	Study of constructional features & working of milling machine.
8	To study constructional details and working of drilling machine.
9	To perform various operations on drilling machine.
10	To study basic components of CNC machine
11	To study part programming fundamentals for CNC operations.

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET204 **Course : Engineering Metallurgy**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand the fundamentals of various engineering materials and their crystal structure.
2. Interpret and explain the equilibrium diagram and make use of this knowledge to illustrate the Iron-Iron carbide equilibrium diagram.
3. Realize the significance and general procedure of heat treatment processes.
4. Explain the composition, microstructure, properties and application of alloy steel, tool steel and cast iron.
5. Understand the fundamentals of various non-ferrous alloys and powder metallurgy.
6. Compute the mechanical properties of engineering materials using various destructive and non-destructive testing.

Syllabus

Unit – I:

Structure of Material: Classification and properties of materials, Introduction to composite material, Crystal structure and crystallography,Alloys and solid solutions. Modified Gibbs's phase rule.Equilibrium diagram: Types and construction of equilibrium dia. Lever rule.

Unit – II:

Iron-Iron carbide diagram.Invariant reaction.Microstructural study of slowly cooled steels.

Cast Iron: Classification, Production route, Composition, Microstructure and applications.

Unit - III:

Heat treatment: Types and importance of heat treatment process. Hardenability test. TTT diagram, Retained austenite, Surface and case hardening processes.

Unit – IV:

Steel: Classification of steel and their composition and applications.

Alloy and tool steel: Effect of alloying elements. Classification, composition, properties, applications and designation of steel.

Unit - V:

Non-Ferrous Alloys: Study of non-ferrous alloys such as brasses, Bronzes(Tin based), Aluminum Alloys. Bearing materials.

Introduction to Powder metallurgy.

Unit – VI:

Mechanical testing and evaluation of properties: Tension Test, Compression Test, Hardness Test, Charpy and Izod Impact Test. Introduction to Non-destructive testing.

Text Books:

1. Engineering Metallurgy and Material Science by Kodgire, Everest Publication
2. Principles of Engineering metallurgy by L. Krishna Reddy, New Age International Publication
3. Introduction to Physical Metallurgy by Avner, Tata Mc-Graw Hill publications.

Reference Books:

1. Introduction to Engineering Metallurgy by Dr. B K Agrawal, Tata Mc-Graw Hill publications.
2. Engineering Physical Metallurgy and Heat Treatment by Yu LakhtinTata Mc-Graw Hill publications.
3. Metallurgy for Engineers by E C Rollason, Edward Arnold publications.
4. Engineering Metallurgy and material science by S. P. Nayak, Charotar Publishing House
5. Materials and Metallurgy by G. B. S. Narang and K. Manchanedy.

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code : MEP204 **Course: Engineering Metallurgy**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Ability to identify phases and composition of various alloys by metallographic examination using metallurgical microscope.
2. Ability to measure hardness of engineering materials using Rockwell & Brinell Hardness tester.
3. Ability to understand working, principle and utilization of UTM to derive various material properties.
4. Ability to get hands on experience on various heat treatment processes.
5. Ability to get hands on experience and understand complete methodology of toughness measurement.

The laboratory will have minimum Eight Practical based on the syllabus of MET204

Sr. No.	Name of Experiment
1.	To study the Metallurgical Microscopes
2	Preparation of specimen for metallographic examination.
3	Micro-structural examination of different types of Steels.
4	Micro-structural study of White Cast Iron and Grey Cast Iron.
5	Micro-structural study of Malleable Cast Iron and Nodular Cast Iron.
6	To study the effect of normalizing on properties of steel.
7	To study the effect of annealing on properties of steel.
8	Measurement of hardness with the help of Rockwell Hardness Tester.
9	Measurement of hardness with the help of Brinell Hardness Tester.
10	Determination of tensile properties of ductile material.
11	Determination of impact properties by Izod /Charpy test.
12	Effect of hardening process on properties of steels.

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MAT206 (ME), MAT203 (EN/EC/EDC/EE) **Course: Engineering Mathematics-III**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

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

1. Understand Laplace transforms, Fourier series, Fourier Transforms and Partial Differential equations to solve engineering problems.
2. Understand Matrices to solve system of equations.
3. Make use of complex variables to evaluate Contour Integrations.

Syllabus

Unit – I:

Laplace Transforms: Laplace transforms and their properties, Application for Laplace Transform to solve ordinary differential equations including simultaneous Differential Equations. Solution of one dimensional Partial differential equations by Laplace Transform method.

Unit – II :

Functions of a Complex Variable: Function of a complex variable, Analytic functions, Cauchy-Riemann conditions, Conjugate functions, singularities, Cauchy's integral theorem and integral formula, Taylor's and Laurent's theorem, Residue theorem, contour integration.

Unit – III :

Fourier Series: Periodic Function and their Fourier series expansion, Fourier Series for even and odd function, Change of interval, half range expansions. Practical Harmonic Analysis.

Unit – IV :

Fourier Transform: Definition, Fourier Integral Theorem, Fourier Sine and Cosine Integrals, Finite Fourier Sine and Cosine Transform.

Unit – V :

Partial Differential equations: Partial differential equation of first order first degree i.e. Lagrange's form. Linear homogeneous PDE of n^{th} order with constant coefficient, method of separation of variables, Applications of partial differential equations.

Unit – VI:

Matrices: Rank of matrix, consistency of system of equations, Linear dependence, linear and orthogonal transformations. Characteristics equations, eigen values and eigen vectors. Reduction to diagonal form, Cayley Hamilton theorem, Sylvester's theorem, determination of largest eigen values and eigen vector by iteration method.

Text Books:

1. Higher Engineering Mathematics: *B. S. Grewal, 43rd ed, Khanna Publishers, Delhi (India).*
2. A text book of Applied Mathematics Volume I & II: *P. N. Wartikar & J. N. Wartikar, 9th ed, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).*

Reference Books:

1. 1. Advanced Engineering Mathematics,8th ed: Erwin Kreyszig Neekunj print process, Delhi.
2. Schaum's Outline of Complex Variables, 2nd ed: Murray R Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman, TMH, New Delhi.
3. Advanced Engineering Mathematics, 2nd ed :Jain, Iyengar , Narosa publication.
4. Advanced Engineering Mathematics: H K Dass, S.Chand Publications

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: CHT201 **Course: Environmental Studies-I**

L: 2 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 00**

Course Outcomes

1. Students will get the wealth of information that will clearly clarify modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
2. Students will realize the need to change the way in which we view our own environment, using practical approach based on observation and self learning.
3. Students will be aware about the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.
4. By studying environmental science, students may develop a breadth of the interdisciplinary and methodological knowledge in the environmental fields that enables them to facilitate the definition and solution of environmental problems.
5. At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and understand what it is to be a steward in the environment, studying how to live their lives in a more sustainable manner.

Syllabus

Unit – I :

Multidisciplinary Nature of Environmental Studies: Definition, scope and importance; Need for public awareness.

Unit – II :

Natural Resources Renewable and Non-renewable Resources: Natural resources and associated problems. (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. (e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and decertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit – III :

Ecosystems: Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers, and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem (Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems i. e. ponds, streams, lakes, rivers, oceans, estuaries)

Unit – IV:

Biodiversity and its Conservation: Introduction – Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Text Books:

1. Environmental Chemistry and Pollution Control: N. W. Ingole, D. M. Dharmadhikari, S. S. Patil, Das GanuPrakashan, Nagpur.
2. Environmental Chemistry: K. Bhute, A. Dhamani, A. Lonkar, S. Bakare, Celebration Infomedia, India.

Reference Books:

1. Text Book of Environmental Chemistry and Pollution Control:S. S. Dara; S. Chand and Company Ltd., New Delhi.
2. Environmental Studies-From Crisis to Cure, Second Edition:R. Rajagopalan, Oxford University Press, New Delhi.
3. Text Book of Environmental Studies:E. Bharucha, University Press (India) Private Ltd., Hyderabad, India.

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP205 **Course: Industrial Visit**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 00**

Course Outcomes

1. Ability to co-relate the theoretical knowledge with its practical implementation.
2. Ability to understand the various manufacturing processes studying in their curriculum.
3. Familiarization with various mechanical components/elements such as Boiler, Turbine, Gears, Bearings, etc.
4. Ability to understand the working of industry like plant layout, material handling, dispatch, sells, marketing, and safety criteria.
5. Able to understand interaction between various subsystems in industry.

Students should be taken for visit to Industries. Visits to minimum two different types of industries are expected. Students should submit a visit report in the format given below after the visit. Preferably they should make a presentation.

Report should consist of –

1. Name of industry.
2. Nature of ownership.
3. Year of establishment.
4. List of finished products.
5. Annual turnover of company.
6. Number of employees.
7. List of departments.
8. Classification of Industry.
   a. Based on turnover.
   b. Based on product / process.
9. List of major machines / equipment.
10. List of raw material used.

Syllabus of Semester III, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP211 **Course: Machine Drawing**

L: 0 Hrs., T: 0 Hrs., P: 4 Hrs., Per week **Total Credits: 04**

Course Outcomes

1. Ability to draw and read production drawings.
2. Ability to convert 3D object to its 2D representation.
3. Ability to select standard machine elements as per the standards.
4. Ability to use the drafting package e.g. AutoCAD.

Drawing Standards for Lines, Lettering, Dimensioning, Drawing Sheets, and Name Blocks.
Actual & Conventional representations of standard machine elements like**:** Bolts, Nuts, Washers, Rivets, and Keys & Couplings. Selection of standard machine elements. Thread terminology, Types of Threads & their representations.
Machining Symbols, Welding Symbols & Piping Symbols.
Orthographic Projections, Types of Sections & Sectional Views, Missing Views.
Limits: Terminology, Fits: Types & Applications of fits.
Dimensional Tolerance, Geometrical Tolerance. Introduction to Tolerance Grades & Tolerance Charts.
Assembly and Dismantling Principles: Study of some Standard Assemblies. Subassembly Drawing, Full Assembly Drawing. Preparation of Bill of material.
Production drawing preparation, blue print reading.
Introduction to AutoCAD: Study of Draw, Dimension & Modify commands. Preparation of 2-D drawings using AutoCAD.

Term Work:

Assignments:

1. Conventional representation
2. Standard machine components
3. Missing view

Manual Drafting:

1. One full imperial sheet on standard assemblies. (2 Problems)
2. One full imperial sheet on Assembly and Dismantling. (2 Problems)
3. One full imperial sheet on production drawing.(3 Problems)

AutoCAD:

1. Preparation of Assembly from given details.
2. Preparation of detailed drawing from given assembly.

Text Books:

1. Machine Drawing by N. D. Bhat, Charotar Publications
2. Machine Drawing by R. K. Dhawan, S. Chand Publications
3. Machine Drawing by P. S. Gill, S. K. Kataria & Sons
4. Machine Drawing by K.L.Narayan, R. Kannaiah, K.V.Reddy, New Age Int. Publishers
5. Production drawing by K.L.Narayan, R. Kannaiah, K.V.Reddy, New Age Int. Publishers

Reference Books:

1. Engineering Drawing Practice for Schools & Colleges (SP-46:2003): Bureau of Indian Standards.

IV SEMESTER

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET206 **Course: Strength of Materials**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand basic concepts of stress, strain and their relations based on linear elasticity, material behaviors due to different types of loading.
2. Learn analytical and graphical analysis of compound stresses and analysis of strain energy.
3. Develop shear-moment diagrams of beams and analyze bending & shear stresses in beams.
4. Understand deflection of beams and stresses in thin & thick cylinders.
5. Analyze stresses due to torsion of circular shaft and buckling of columns & struts.

Syllabus

Unit- I:

Concept of simple stresses and strains: Types of stresses, Stress - Strain diagram, Hooks law, Elastic constants, factor of safety, analysis of tapered rod and composite section. Relation between Young's modulus (E), Modulus of rigidity (G), and Bulk modulus (K).

Thermal stresses and strain.

Unit- II:

Compound stresses and strain: Analytical and graphical (Mohr's circle) method of determining stresses on oblique plane, Principal stresses, maximum shear stresses.

Normal and shear strain, principal strain, principal shear strain, strain rossets, determination of principal stresses from principal strains.

Strain energy: Strain energy stored in a body when subjected to axial loading, & impact loading, bending & torsion, shear strain energy, strain energy in three dimensional system.

Unit –III:

Shear force and bending moment: Relation between load, shear force and bending moment, Shear force and bending moment diagrams for different types of beams subjected to different types of loads.

Unit –IV:

Bending stresses in beams: Theory of simple bending**,** Derivation of bending equation, section modulus for various shapes of beam, bending stresses in symmetrical and unsymmetrical sections, composite beams.

Shear stresses in beams: Derivation of shear stress equation, shear stresses across standard sections, shear stresses in built up sections.

Compound stresses in beam.

Unit –V:

Torsion of circular shafts: Derivation of torsion equation, Strength and rigidity criterion for design of shaft, torque transmitted by solid and hollow shafts, Derivation of maximum, minimum principal stresses and maximum shear stress induced in shaft when it is subjected to bending moment, torque & axial load.

Column & Struts: - Analysis of long & short column by Euler's formula, Rankine's formula.

Unit –VI:

Deflection of beams: - Derivation of differential equation of elastic curve. Relation between slope, deflection & radius of curvature. Double integration method, Macaulay's method, area moment method to determine deflection of beam. Castingliano's theorem.

Stresses in thin and thick cylinders.

Tutorials: Students will have to solve two problems on each unit.

Text Books:

1. Strength of Materials by S.S. Rattan, McGraw-Hills Education (India) Publication, India.
2. Strength of Materials by S.S. Bhavikatti, Vikas Publishing house, Noida, India.
3. Strength of Materials by S. Ramamruthm & R. Narayanan, Dhanpat Rai Publishing Company, New Delhi, India.
4. Strength of Materials by S. Timoshenko, D. Van Nostrand Company.

Reference Books:

1. Strength of Materials by F. L. Singer, Harper and row Publication.
2. Strength of Materials by R. Subramanian, Oxford University Press, USA.
3. Engineering Mechanics of Solid by Egor P. Popov, Prentice Hall of India Publication.
4. Mechanics of Materials by Beer, Johnson, Dewolf, Mc Graw Hill Publication.
5. Mechanics of materials by Timoshenko and Gere, CBS Publisher.

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET207 **Course: Engineering Thermodynamics**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course outcomes

The expected learning outcome is that the students will be able to:

1. Define Thermodynamics laws, identify processes and compute associated heat and work transfer
2. Apply laws of thermodynamics to devices viz. engines, refrigerators etc.
3. Understand the application of steam table, Mollier chart and estimate the properties of steam
4. Analyze and compare air standard, steam power cycles
5. Describe the basics of compressible fluid flow

Syllabus

Unit –I:

Introduction To Thermodynamics: Basic concepts of Thermodynamics, Zeroth Law of Thermodynamics, Introduction to First Law of Thermodynamics, Heat and Work, The Ideal Gas equation of state, Internal energy and specific heats of gases, Universal Gas Constants.

Unit –II:

First Law of Thermodynamics: Closed Systems, Work done, Change in Internal energy, Heat transferred during various thermodynamic processes, P-V diagrams, Flow work and enthalpy, Steady flow process.

Unit –III:

Second Law of Thermodynamics: Introduction, Kelvin-Plank & Clausius statements, Heat engines, Refrigerator and Heat pump, Perpetual motion machines, Reversible and Irreversible processes, Carnot cycle, Thermodynamic temperature scale. Entropy: The Clausius inequality, Entropy, Principle of increase of entropy, Change in entropy for Closed and Steady flow open systems.

Unit –IV:

Properties of Steam: Formation of Steam, Application of Steam Table, Dryness fraction, Internal energy of steam, T-S diagram, Mollier chart. Work and Heat transfer during various Thermo dynamics processes with steam as working fluid. Determination of dryness fraction using various calorimeters

Unit –V:

Air Standard Cycles: Otto and Diesel cycle, Vapour Cycles: Simple and Modified Rankine cycle with reheat & regeneration, Binary cycle.

Unit –VI:

Compressible Flow: Stagnation properties, Speed of sound wave, Mach number, One dimensional isentropic flow, Stagnation properties, Isentropic flow through convergent divergent nozzles.

Text Books:

1. Engineering Thermodynamics: P. K. Nag, Tata Mc-Graw Hill publication
2. Thermodynamics - An Engineering approach: Yunus A. Cengel, Michael A. Boles, Mc-Graw Hill publication
3. Thermal Engineering: R.K. Rajput, Laxmi publications.

Reference Books:

1. Thermal Engineering: P.L. Balaney, Khanna Publisher.
2. Fundamentals of Engineering Thermodynamics: Michael J. Moran, Howard N. Shapiro, Mc-Graw Hill publication
3. Thermal Engineering: V.M. Domkundwar , Dhanpat Rai & Sons.
4. Basic Engineering Thermodynamics: Rayner Joel, Longman Publication.

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET208 **Course : Dynamics of Machinery**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand the function, analysis of flywheel in an IC engine and Punching machines
2. Demonstrate the gyroscopic effect on airplane, ship, four wheeler, two wheeler and Exhibit skills towards application of dynamic force analysis
3. Explain the balancing of the rotating elements in machines, distinguish and describe different types of speed governors
4. Examine the balancing of the rotating and reciprocating elements to avoid the failure
5. Analyze the free and forced vibrations in SDOF and TDOF

Syllabus

Unit - I

Turning moment Vs crank angle diagram for single cylinder and multiple-cylinder engines, Punching machines, riveting machines etc. concept of Flywheel and its selection, Cam dynamics and jump-off phenomenon

Unit - II

Rigid body motion in space, Euler's equation of motion, simple precession and gyroscopic couple, Gyroscopic effect on airplane, ship, vehicles and grinding mills, D'Alembert's principle, Dynamic force analysis of planar linkages such as four bar chain and reciprocating mechanism by graphical method

Unit - III

Static & Dynamic balancing in rotating machines. Balancing machines and field balancing by vector diagram, Speed governors, centrifugal and inertia type, Watt, Portal, Proell, Hartnell governors, operating characteristics of governors

Unit - IV

Balancing of Reciprocating masses: Partial balancing concept, balancing of uncoupled and coupled locomotives, balancing of Inline engines, Multi cylinder radial engines and V engines

Unit - V

Derivation of equation of motion for vibratory system, Free vibration of single-degree of freedom system with and without damping. Logarithmic decrement and damping estimation. Forced vibration of single degree of freedom and vibration isolation, whirling of shaft and critical speed of rotors.

Unit - VI

Equation of motion for two-degree-of-freedom system. Natural frequencies and mode shapes vibration absorber. Torsional oscillation of two-disc and three disc rotors, with varying cross-section and gear ratio

Text Books:

1. Theory of Machines: S. S. Rattan, Tata McGraw Hill
2. Kinematics & Dynamics of Machinery by R L Norton, Tata McGraw Hill
3. Theory of Machines and Mechanisms: Uicker and Shigley, Tata McGraw Hill
4. Mechanical vibrations: Grover, Nem Chand & Brothers

Reference Books:

1. Mechanism and Machine Theory: J.S. Rao & R.V. DukkiPati, New Age International
2. Theory of Machines: Thoman Bevan CBS publications
3. Kinematics & Dynamics of Machinery: Wilson & Sadler, HarperCollins Publishers, 1983
4. Theory of Vibrations: W. T. Thomson, CBS Publishers & Distributors

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP208 **Course: Dynamics of Machinery**

L: 0 Hrs., T:0 Hrs., P:2 Hrs., Per week **Total Credits: 02**

Course Outcomes

The expected learning outcome is that the students will be able to :

1. Demonstrate the importanc eof gyroscopic couple and balancing of rotary and reciprocating machine components.
2. Determine the frequency of longitudinal, transverse and torsional vibrations.
3. Understand the effects of jumping phenomenon in cams and effect of whirling speed of shaft.

List of Practical

1	Simple and Compound Pendulum
2	Bi-filar Suspension
3	Motorized Gyroscope
4	Cam Dynamics
5	Whirling of Shaft
6	Balancing of Rotary Masses
7	Balancing of a Single Reciprocating Mass
8	Natural Vibrations of a spring mass system
9	Free Vibrations of an equivalent spring mass system
10	Forced Vibrations of an equivalent spring mass system
11	Free Torsional Vibrations of single Rotor system
12	Free Torsional Vibrations of two Rotor system

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code : MET209 **Course: Hydraulic Machines**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able :

1. To apply knowledge of fluid mechanics, and understand effect of hydrodynamic force on various types of vanes.
2. Applying acquired knowledge to design and performance characteristics of hydraulic turbines.
3. To design and evaluate performance characteristics of centrifugal and reciprocating pump
4. To describe working of miscellaneous water lifting devices
5. Make use of concept of similitude and model testing for hydraulic machine
6 Understand the hydraulic and pneumatic circuits

Syllabus

Unit –I:

Impact of Jet and Jet propulsion: Momentum principle, Dynamic action of jet on fixed & moving flat plates and curved vanes, Series of plates and vanes, Water wheels, Velocity triangles and their analysis. Jet propulsion of ships. Principles & Classification of Hydraulic Machines, Theory of turbo machines and their classification, Elements of hydel power plant. Impulse Turbines: Principle, Constructional details of Pelton turbine, Velocity diagram, Design parameters, Performance characteristics, Governing and selection criteria.

Unit – II:

Reaction turbine: Principles of operation, Degree of reaction, Comparison over Pelton turbine, Development of reaction turbines, Classification, Draft tubes, Cavitation in turbine. Francis turbine, Propeller turbine, Kaplan turbine: Types, Constructional features, Installations, Velocity diagram and analysis, Working proportions, Design parameters, Performance characteristics, Governing, Selection of hydraulic turbines, Bulb turbines.

Unit – III:

Hydrodynamic pumps: Classification and Applications. Centrifugal Pumps: Principles of operation, Classification, Components of centrifugal Pump installation, Priming methods, Fundamental equation, Various heads, Velocity triangles and their analysis, Slip factor, Effect of outlet blade angle, Vane shapes, Losses & efficiencies of pumps, Multi staging of pumps, Design considerations, Working proportions, N.P.S.H, Cavitations in pumps, Installation and operation. Performance characteristics, Introduction to axial & mixed flow Pumps, Self priming pumps.

Unit – IV:

Positive displacement Pumps: Basic principle, Classification. Reciprocating Piston / Plunger Pumps: Types, Main components, Slip, Work done, Indicator diagram, cavitation, Air vessels, Hand pumps. Rotary Displacement Pumps: Introduction to gear pumps, Sliding vane pumps, Screw pumps.

Unit – V:

Similitude: Types of similarities, Dimensionless number and their significance, Unit and specific quantities. Model Testing: Application to hydraulic turbines and hydrodynamic pumps. Miscellaneous and Water Lifting Devices: Air lift pump, Hydraulic ram, Vertical turbine or Bore hole pump, Submersible pump, Jet pump, Regenerative pump.

Unit – VI:

Essential Elements of Hydraulic System: Flow actuators, Directional control valves, Pressure control valves, Flow control valves, Basic hydraulic circuit, Meter in & Meter out circuit. Use of single & double acting actuators, Hydraulic accumulator and intensifier. Pneumatic Systems: Principle of pneumatics, Introduction to air compressors, Comparison with hydraulic power transmission, Air preparatory unit, basic valves & industrial pneumatic circuits etc.

Text Books:

1. Fluid Mechanics & Fluid Power Engineering: D. S. Kumar -S. K. Kataria Publications.
2. Fluid Mechanics & Machines: R. K. Bansal- Laxmi publications.
3. Hydraulic Machines: Jadish Lal- Metropolitan Books.
4. Industrial Hydraulics: J. J. Pippenger- McGraw-Hill.
5. Hydraulics & Pneumatics: H. L. Stewart -T. Audel.

Reference Books:

1. Hydraulic Machines - Theory & Design: V. P. Vasandani- Khanna Publishers.
2. Theory of Turbo-Machines: A. T. Sayer- McGraw Hill.
3. Pneumatics: Gadre- Oxford University Press, New York, NY.
4. Pneumatic Systems: S R Mujumdar- Tata McGraw-Hill.

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP209 **Course: Hydraulic Machines**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Ability to perform practical on theory concepts
2. Ability perform practicals of impulse and reaction turbine.
3. Ability perform practicals of rotodyanamic pump and positive displacement pump
4. Ability to use knowledge of various discharge measuring devices, turbines and pumps for projects
5. Be able to graphically present the output of turbines and hydraulic pumps.

The laboratory will have minimum Eight Practical based on the syllabus of MET209

List of Experiments

1. Determination of coefficient of discharge for Venturi meter
2. Determination of coefficient of discharge for Orifice meter
3. Determination of hydraulic coefficients C_d and C_c for orifice
4. Determination of hydraulic coefficients C_d and C_c for mouthpiece
5. Determination of Darcy Friction factors for different pipes
6. To calculate efficiency of Pelton turbine
7. To calculate efficiency of Francis turbine
8. To calculate efficiency of Centrifugal pump
9. To calculate efficiency of Reciprocating pump
10. To determine minor losses in pipe flow

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MAT246 **Course: Engineering Mathematics-IV**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

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

1. Understand method for solving differential equation using series solution. Understand Calculus of Variation to extremise Functional for Solving Optimization problem.
2. Use numerical methods to solve algebraic equations and differential equations.
3. Understand Probability Theory and use it for analysis of data.

Syllabus

Unit – I:

Special Functions and Series solution: Series solution of differential equation by Frobeniu's method, Bessel's Function, Legendre's Polynomials, Recurrence Relations, Rodrigue's Formula, Generating function, Orthogonal properties of $J_n(x)$ and $P_n(x)$.

Unit – II:

Numerical solution of algebraic and transcendental equations: Iteration method, Regula falsi method, Newton Raphson method, Convergence / rate of convergence of iterative methods, Solution of system of non linear equations. Solution of system of linear equations: Gauss Elimination, Gauss Seidal method, Crout's method.

Unit – III:

Numerical methods for Differential Equations: Numerical solution of ordinary differential equations by Picards method, Taylor's series method, Euler's method, Modified Euler's method, Runge Kutta methods, Milne's Predictor corrector method, Solution of second order differential equation.

Unit – IV:

Probability distribution: Random Variables, Discrete and continuous, Probability density function, Distribution functions of continuous and discrete random variables, Joint distributions, Mathematical Expectation, Variance and standard deviation, Moment and Moment generating function.

Unit – V:

Special Probability Distribution: Geometric, Binomial Poisson's, Normal, Exponential, Uniform and Weibull Probability distributions.

Unit – VI:

Calculus of variation: Functional, Extremals of Functionals, variational principle, Euler's Equation, Constrained extremals, Hamilton principle and Lagrange's equation in solid mechanics.

Text Books:

1. Higher Engineering Mathematics: B. S. Grewal, Khanna Publishers, Delhi.
2. Theory and Problems of probability and statistics: J. R. Spiegal, 2ed, TMH, New Delhi.

Reference Books:

1. Advanced Engineering Mathematics 8th ed: Erwin Kreyszig, Wiley, India, Delhi.
2. Introductory method of numerical analysis, 4th ed: S. S. Sastry, PHI, New Delhi
3. Advanced Engineering Mathematics, 2nd ed : Jain ,Iyengar , Narosa publication.

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: CHT202 **Course: Environmental Studies-II**

L: 2 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 00**

Course Outcomes

1. Students will get the wealth of information that will clearly clarify modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
2. Students will realize the need to change the way in which we view our own environment, using practical approach based on observation and self learning.
3. Students will be aware about the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.
4. By studying environmental science, students may develop a breadth of the interdisciplinary and methodological knowledge in the environmental fields that enables them to facilitate the definition and solution of environmental problems.
5. At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and understand what it is to be a steward in the environment, studying how to live their lives in a more sustainable manner.

Syllabus

Unit – I:

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, and Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution, Pollution case studies; Diaster management: floods, earthquake, cyclone and landslides.

Unit – II:

Social Issues and the Environment: From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns, Case Studies; Environmental ethics: Issues and possible solutions; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case Studies; Wasteland reclamation; Consumerism and waste products; Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation; Public awareness.

Unit – III:

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programme; Environment and human health; Human Rights; Value Education; HIV/AIDS; Women and Child Welfare; Role of Information Technology in Environment and human health, Case Studies.

Field work

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain; Visit to a local polluted site-Urban/Rural/Industrial/Agricultural; Study of common plants, insects, birds; Study of simple ecosystems-pond, river, hill slopes, etc.

Text Books:

1. Environmental Chemistry and Pollution Control: N. W. Ingole, D. M. Dharmadhikari, S. S. Patil, Das Ganu Prakashan, Nagpur.
2. Environmental Chemistry: K. Bhute, A. Dhamani, A. Lonkar, S. Bakare, Celebration Infomedia, India.

Reference Books:

1. Text Book of Environmental Chemistry and Pollution Control:S. S. Dara; S. Chand and Company Ltd., New Delhi.
2. Environmental Studies-From Crisis to Cure, Second Edition:R. Rajagopalan, Oxford University Press, New Delhi.
3. Text Book of Environmental Studies: E. Bharucha, University Press (India) Private Ltd., Hyderabad, India.

Syllabus of Semester IV, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP210 **Course: Mini Project**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Ability to develop the habit to work in a group.
2. Ability to relate the theory knowledge to the fabrication work.
3. Students shall know the basic principles & their applications to mechanical engineering.

A group of students (not more than 5 students in a group) should fabricate a working model of any mechanical or electro-mechanical system.

Computer / mathematical model or simulation is not acceptable.

Students should submit (at least) one page abstract and a photograph of the model.

V SEMESTER

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET301 **Course: Design of Machine Elements-I**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand the need, steps of machine design, Design consideration for various process.
2. Design of various temporary and permanent joints as well as various types of lever.
3. Evaluate life of machine components against static loads and fluctuating loads
4. Design Power screw and springs for various applications.
5. Design the transmission shafts, pressure vessels and flywheel.

Syllabus

Unit – I:

Introduction to Machine Design: Definition of Machine Design, types of Machine Design, Basic procedure of design process. Failure of machine elements due to deformations, wear, corrosion. Design consideration in casting & forging. Mechanical properties of materials, Designation of steel, selection of material, preferred number. Aesthetic and ergonomic considerations in design. Theories of failure.

Unit – II:

Design against static loads: Design of cotter and Knuckle joint. Design of Riveted joints and Eccentric loaded riveted joint. Design of Welded joint, Eccentrically loaded welded joints. Design of Bolted joint, bolted joints under eccentric loading.

Unit – III:

Design against fluctuating loads: Stress concentration, Fluctuating stresses, Fatigue failure, Notch sensitivity, Soderberg and Goodman criterion, Design of mechanical components subjected to dynamic loading.

Unit - IV:

Design of Power Screw: Terminology of power screw, types of power screw, Design of screw and toggle jack. Simple applications of power screw.

Design of Mechanical Spring: Terminology of spring and its types. Design of helical compression and tension spring. Design of Leaf Spring.

Unit - V:

Design of Rotating Disc: Rotational stresses, Design of Disc Flywheel & Rim Flywheel.

Design of pressure vessels, heads and cover plates.

Unit - VI:

Design of transmission Keys and Shafts: Design of shaft on the Basis of Strength, rigidity and critical speed. ASME Code for shaft Design, Design of splines and keys.

Text Books:

1. Design of Machine Elements by V.B. Bhandari, Tata Mc-Graw Hill publications.
2. Mechanical Engineering Design by J. E. Shigley, Tata Mc-Graw Hill publications.
3. Machine Design by R.K. Jain, Khanna Publisher, Delhi.

Reference Books:

1. Maleeve and Hartmans Machine Design, Fifth Edition, By Dr. O. P. Grover, CBS Publisher and distributers PVT. LTD.
2. Machine Design by P. H. Black, Mc-Graw Hill publications.
3. Machine Design by Norton, Pearson publication.
4. PSG- Design Data Book.
5. Design Data for Machine Elements by B. D. Shiwalkar, Central Techno Publication.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET302 **Course: Heat Transfer**

L: 3 Hrs. , T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

1. Understand and analyze basic modes of heat transfer.
2. Analyze heat conduction with and without internal heat generation, critical thickness of insulation and extended surfaces with the practical utilities.
3. Demonstrate the concept and mechanism of forced convection, natural convection and radiation.
4. Apply a mathematical approach to analyze and solve the numerical on heat transfer phenomena's.
5. Explain the design, performance analysis and practical applications of heat exchangers.

Syllabus

Unit –I:

Introduction, Basic modes of Heat Transfer, Conduction, Convection and Radiation, Laws of Heat Transfer, General Heat conduction equation in Cartesian, Cylindrical and Spherical Co-ordinates, Thermal conductivity and diffusivity, One dimensional steady state conduction equation for the plane wall, Cylinder and Sphere, Thermal resistance of composite structures, Contact resistance, overall heat transfer coefficient, critical thickness of insulation.

Unit – II:

Conduction with internal heat generation for plane wall, Cylinder and sphere, Extended Surfaces, Types of Fins, Fins of uniform cross section area, temperature distribution and their heat transfer rate, Fin efficiency and effectiveness, Error in temperature measurement, Unsteady state Heat transfer, Lumped Heat Capacity analysis, Heisler charts, Biot number, Fourier number and their significance.

Unit – III:

Forced convection, physical significance of non dimensional parameters, Flow of high, moderate and low Prandtl number fluid over flat surface, Concept of velocity and thermal boundary layer thickness, Local and average Heat Transfer coefficient, empirical co-relation for external, internal flow, Laminar and turbulent flow through conduits.

Unit – IV:

Free or Natural Convection, Grashoff number, Rayleigh number, horizontal and vertical plate, empirical co-relations for Cylinders and sphere, Heat transfer with phase change, pool boiling curve and regimes of pool boiling, film and drop wise condensation, Laminar film condensation on vertical surface, Film condensation on horizontal tubes, effect of superheated and non condensable gases on condensation heat transfer, Introduction to heat pipe.

Unit - V:

Radiation, nature of thermal radiation, black body radiation, radiation intensity, laws of radiation-Kirchoffs, Planks, Weins displacement, Stefen-Boltzmann and Lamberts Cosine law, Emissivity, absorptivity, transmissivity, reflectivity, radiosity, emissive power, irradiation, Radiation network, radiation exchange between surfaces, idea of shape factor and reciprocity theorem, radiation between parallel plates, Cylinder and sphere, radiation shields, effect of radiation on temperature measurement.

Unit – VI:

Heat exchanger : classification, overall heat transfer coefficient, Fouling factor, LMTD method of heat exchanger analysis, Analysis for parallel, counter flow and cross flow arrangement, effectiveness-NTU method, heat exchanger analysis by NTU method , design aspects of heat exchangers, introduction to compact heat exchanger.

Text Books:

1. Introduction to Heat Transfer by Incropera & Dewitt J. Wiley, John Wiley & Sons
2. Elements of Heat Transfer: M.N.Ozisik, Mc Graw Hill
3. Heat Transfer: S.P.Sukhatme, Universities Press

Reference books:

1. Heat Transfer: Yunus A Cengel, Mc Graw Hill
2. Fundamentals of Heat & Mass Transfer, M Tirumaleshwar, Pearson
3. Heat Transfer by J P Holman, Mc Graw Hill
4. Engineering Heat Transfer: Suryanarayana, Penram Publication
5. Heat Transfer by D. S. Kumar , S K Kataria & Sons
6. Fundamentals of Heat & Mass Transfer, C P Kothandaraman , New Age Techno Press

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP302 **Course: Heat Transfer**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Ability to understand the conduction phenomena thoroughly, in objects of different geometries they can determine the thermal conductivity of composite wall, lagging material and critical heat flux.
2. Ability to understand the concept and mechanism of forced, natural convection taking place in objects of different geometries, the various empirical correlations used in different fluid flow situations.
3. Ability to learn an approach to analyze and solve the numerical on heat transfer phenomena's.
4. Ability to learn the thermal performance analysis of heat exchangers their practical application, and design.

Exp. No	Name of Experiment
1	To determine thermal conductivity of composite wall.
2	To determine thermal conductivity of insulating powder.
3	To determine thermal conductivity of lagging material.
4	To determine thermal conductivity of metal rod.
5	To determine the critical heat flux.
6	To determine heat transfer coefficient in natural convection.
7	To determine heat transfer coefficient in forced convection.
8	To determine heat transfer coefficient for a pin fin in natural and forced convection.
9	To determine effectiveness of heat pipe.
10	To determine emissivity of a test plate.
11	To determine Stefan Boltzman constant.
12	To determine the effectiveness of a concentric tube heat exchanger.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET303 **Course: Mechanical Measurements**

L: 3 Hrs. T: 1 Hrs, P: 0 Hrs, per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand measurement systems; apply principles of error reductions in measurement systems.
2. Identify the characteristics of instruments and analyze the response of instruments to different types of inputs
3. Explore different transducers and sensors with their working principle; apply the principles of signal conditioning.
4. Understand different instruments for the measurement of displacement, speed, pressure, temperature, force, strain, flow, etc .
5. Analyse measurement and to use software & hardware for acquisition of data.

Unit - I

Measurement system: Introduction, Generalized model of measurement system and its elements, types of instruments, calibration, measurements error, sources and types of error, statistical analysis of data, Error reduction, Noise in measurements, analytical treatment.

Unit - II

Static and Dynamic characteristics of Instruments : Introduction, Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Dead Band, Backlash, Drift, Formulation of Differential Equations for Dynamic Performance- Zero Order, First Order and Second order systems, Response of First and Second Order Systems to Step, Ramp, Impulse and Harmonic Functions, analytical treatment.

Unit – III

sensors & transducer elements: Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric, Inductive Self Generating and Non-Self Generating Types, Electromagnetic, Electrodynamic, Eddy Current, Magnetostrictive, Variable Inductance, LVDT,,RVDT, Variable Capacitance, Piezo-Electric Transducer and Hall effect transducers, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Single Double and Four Active Arm Bridge Arrangements, Temperature Compensation, Balancing and Calibration, Mechano Electronic Transducers, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Voltaic Transducers, Digital Transducers, Frequency Domain Transducer, Vibrating String Transducer, Binary codes, Digital Encoders, Analytical treatment.

Unit – IV:

Classification, Principle, Sensing elements, signal conditioning elements, construction, Range and working of instruments for measurement of displacement, speed, strain, Weight, force, Torque, Power, vibration, sound, analytical treatment.

Unit – V:

Classification, Principle, Sensing elements, signal conditioning elements, construction, Range and working of instruments for measurement of pressure, temperature, flow, analytical treatment.

Unit - VI

Signals processing: Analogue to digital conversion with emphasis on quantization and encoding, Introduction to data acquisition systems, Single and multi channel systems, Microprocessors and PC based data acquisition systems. Input – output devices signal transmission and Processing, Devices and systems.

Text Books:

1. Measurement systems Application and Design. Ernest O. Doebelin, Tata McGraw Hill Edition.
2. Instrumentation, Measurement and Analysis – B.C. Nakra and K.K. Chaudhary, Tata McGraw Hill.
3. Mechanical Measurements by D. S. Kumar, Kataria & Sons.

Reference Books:

1. Principles of Measurement and Instrumentation – Alan S. Morris Prentice Hall of India.
2. Measurement and Instrumentation in Engineering, Francis S. Tse and Ivan E. Morse, Marcel Dekker.
3. Mechanical measurement and instrumentation K. Sawhney, Dhanpat Rai & Company.
4. Mechanical Measurements by R. S. Sirohi, H. C. Radha Krishna, New age publication.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code : MEP303 **Course: Mechanical Measurements**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes :

The expected learning outcome is that, the students will be able to

1. Perform laboratory experiments for the measurement of quantities such as pressure, temperature, flow, load, strain, angular and linear displacement, speed, light intensity etc.
2. Identify, formulate, and solve signal conditioning problems by applying principles of different measurement system.
3. Estimate the uncertainty of an experimental result from the experimental errors associated with the data and find out the accuracy of the instruments and write the conclusions about the experiments using the obtained result.
4. Delegate task among team members and work efficiently under constrained time limit.

The laboratory will have minimum Eight Practical based on the syllabus of MET303

List of Experiments:

Sr. No.	Name of the experiment
1	Calibration Of Pressure Gauges Using Dead Weight Pressure Gauge Tester
2	Angular Displacement Measurement Using Variable Capacitive Transducer
3	Linear Displacement Measurement Using Inductive Pick Up
4	Force Measurement Using Load Cell
5	Speed Measurement Using Inductive And Optical Transducer
6	Pressure Measurement Using Piezo-Resistive Pressure Sensor
7	Displacement Measurement Using Lvdt
8	Level Measurement Using 2 Wire Pressure Transducer
9	Pressure Measurement Using Bourdon Tube 'C' Type With LVDT
10	Vibrations Measurement Using Piezo-Resistive Transducer
11	Temperature Measurement Using Transducers Like Rtc Pt-100, Al-Cr Tc & Ptc Thermistor
12	Light Intensity Measurement Using LDR
13	Torque Measurement Using Strain Gauges And Cantilever Jig
14	Sound Level Measurement Using Capacitive Transducer
15	Strain/Force Measurement Using Strain Gauge Mounted On Cantilever Beam
16	Temperature Measurement Using Radiation Pyrometer
17	Humidity Measurement Using Capacitive Transducer For 90% R H Non Condensed
18	Measurement Of Speed Of Wind Using Digital Anemometer
19	Introduction To Data Acquisition System
20	Introduction to Sound and vibration suit with portable DAQ.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET304 **Course: Production Technology**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes:

The expected learning outcome is that the students will be able to:

1. Develop and apply knowledge of engineering metrology and measuring equipment's.
2. Develop conceptual understanding of tolerance systems and design assembly gauges.
3. Interpret different production operations and prepare the tolerance chart.
4. Analyze and interpret technical data through Quality Control techniques.
5. Learn standardization norms like ISO and Six sigma for system improvement.

Syllabus

UNIT – I

Metrology: Definition, Standard of measurements, Methods of measurement, Simple gauging instruments for linear and angular measurements, Measurement of straightness and flatness, Measurements of thread, Measurements of gear tooth, Characteristics of surface finish Comparators – Mechanical, Electrical and Pneumatic, Precautions while using an instruments for getting higher precision and accuracy.

UNIT – II

Tolerances and limits, Types of fits, Types of allowances, Shaft basis system and hole basis system, Selective assembly, Interchangeability, Tolerance analysis of limit & fits, Taylor's principle, Design of limit gauges.

UNIT – III

Preparation of tolerance chart, interpretation of production process planning, Classification of operations –basic and principle operations, critical operations, qualifying operations, auxiliary and supporting operations, sequencing of operations, steps in process planning, significance of process planning. Break- even analysis.

UNIT – IV

Quality and Quality Control: Definition, function, objective and characteristics. Quality of design and conformance, Statistical Quality Control(SQC) – Meaning and importance of SQC, Process capability and Control limits, Control charts – causes of variation, Control charts for variables - X & R charts, Control charts for attributes- P, nP & U charts.

UNIT – V

Acceptance Sampling – Concept, Comparison with 100% inspection, Different types of sampling plans with comparison, OC curve- importance and significance, Producers risk, Consumer's risk, AQL, AOQL, IQL, LTPD.

UNIT –VI

Introduction to ISO 9000, BIS 14000 series - evaluation and need of standardization, necessity of ISO certification, Total Quality Management, Quality audit, Quality circle, Six sigma: meaning, methodology for system improvement.

Text Books:

1. Engineering Metrology: R.K. Jain- Khanna Publications, Delhi
2. Engineering Metrology: I.C. Gupta- Dhanpat Rai Publications, Delhi
3. Statistical Quality Control: M. Mahajan- Dhanpat Rai Publications, Delhi

Reference Books:

1. Production Engineering: P.C. Sharma- S. Chand Publications, Delhi
2. Statistical Quality control: E. L. Grant, Mc Grow-Hill, Delhi (Noida)
3. Production Technology: O. P. Khanna, Dhanpat Rai Publications, Delhi

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code : MEP304 **Course: Production Technology**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

(The laboratory will have minimum Eight Practical based on the syllabus of MET304)

Practical Outcomes:

1. Ability to understand the knowledge of engineering metrology, its working principles and various measurement practices.
2. Learn to handle the various modern engineering tools and equipments for linear and angular measurements.
3. Ability to interpret technical data of the various precise instruments Tool Maker's Microscope, Profile projector, etc.
4. Analyze and interpret technical data through Quality Control techniques.
5. To learn from case study approach.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Exp. No.	Name of Experiments
1	Measurement of linear dimensions with Vernier Caliper.
2	Measurement of linear dimensions with Vernier height gauge & depth gauge.
3	Measurement of linear dimensions with Micrometer screw gauge.
4	Measurement of angular dimensions with bevel protector.
5	Measurement of angular dimensions with sine bar and slip gauges.
6	Measurement of straightness with Autocollimator.
7	Study and use of Optical flat.
8	Measurement of screw dimensions using Tool Maker's Microscope.
9	Measurement of screw dimensions using Profile projector.
10	Study on floating gauge micrometer for thread measurement.
11	Case study.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: INT313 **Course: Operation Research**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Convert given situation to mathematical form and determine optimal settings.
2. Use sequential optimization approach to find optimal setting in many real life situations.
3. Manage projects for minimum total cost and smooth level of resources.
4. Make decisions related to age of replacement of equipments
5. Develop simulation of real life system to analyse and optimize system concerned.

Unit – I:

Introduction to OR & Basic OR Models, Definition Characteristics and limitations of OR linear programming solutions of LPP by graphical methods and simplex method. Sensitivity analysis & formulation of Dual of LPP

Unit – II:

Assignment Model, Travelling Salesman Problem by branch and bound method, Transshipment model, Transportation Model

Unit – III:

Dynamic programming structure and characteristics of Dynamic programming application of Dynamic programming to resource allocation

Unit – IV:

Project Management: Drawing of Network, CPM & PERT, probability of completion of project, cost analysis, Allocation and updating of Networks.

Unit – V:

Replacement Models: Concept of equivalence, Interest Rate, Present worth, economic evaluations of Alternatives, Group replacement models.

Unit – VI:

Inventory control models, Simulation, concepts and its application in inventory control, and in waiting line situations (queuing situations) and other applications.

Text Books:

1. Operation Research Heera & Gupta S Chand Publications
2. Operation Research JK Sharma, McMillian Publications
3. Operation Research Askhedkar & Kulkarni, Dhanpat Rai Publications

Reference books:

1. Operation Research, Hamdy Taha, Prentice Hall
2. Operation Research Liberman, McGraw Hill Publications
3. Operation Research by S D Sharma, Kedarnath Ramnath & Co.
4. Operation Research by V K Kapoor, S.Chand Publications
5. Operations Research: Models and Methods by Paul A. Jensen and Jonathan F. Bard, John Wiley and Sons.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP305 **Course: Technical Seminar**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Identify the theme/topic for the Technical Seminar
2. Review the literature online/offline of the selected theme/topic from Journals/ Conferences/ reference books
3. Compile the reviewed literature in viewpoint with topic selected.
4. Interpret the topic of technical seminar including application, merits & limitations
5. Improve confidence in presentation skills and techniques.

The seminar topic should be latest and ahead of the scope of curriculum. The student, as a part of the term work, should submit the report of the seminar in duplicate, typed on A4 size sheet in a prescribed format. The performance of the student will be evaluated on the basis of the contents, the presentation and discussion during the delivery of seminar before the evaluation committee appointed by the Department.

Syllabus of Semester V, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP312 **Course: Solid Modeling**

L: 0 Hrs., T: 0 Hrs., P:02 Hrs., Per week **Total Credits: Nil**

Course Outcomes

1. Student will be able to model machine components using geometric modeling software.
2. Student will be able to construct detailed draft views of part or assembly.

UNIT-I: Part modeling and assembly (10-12 Hrs)

Module-1 Introduction to modeling and basic concepts
Module-2 Using solid modeling software interface
Module-3 Selecting and Editing
Module-4 Sketcher geometry
Module-5 Creating datum Features: Planes and Axes
Module-6 Creating extrudes, Revolves and Ribs
Module-6 Creating sweeps and blends (geometric features)
Module-7 Creating holes, shells and drafts, Creating rounds, chamfers
Module-8 Copy and mirror tools (Editing features))
Module-9 Creating patterns
Module-10 Assembling with constraints
Module-11 Exploding assemblies

UNIT-II: Surface modeling (5-7 Hrs)

Module-1 Surface modeling overview
Module-2 Advance selection
Module-3 Basic Surfacing tools
Module-4 Helical Sweep

UNIT-III: Detailing of Drawings (5-7 Hrs)

Module-1 Introduction to drawings
Module-2 Creating new drawings and views
Module-3 Adding details to drawings
Module-4 Adding notes to drawings
Module-5 Adding tolerance and symbols

Practical List:

1. Sheet on solid modeling using basic commands.
2. Sheet on assembly of solid models.
3. Sheet on surface modeling.
4. Sheet on detail drawing of components.

Text Books:

1. Parametric Modeling with Creo Parametric 2.0 by Randy Shih, SDC Publications.
2. Parametric Modeling with Creo Parametric 2.0 by Shridhar Condoor, SDC Publications.
3. Designing with creo parametric 2.0 by Michael J. Rider, SDC Publications.

Reference Books:

1. Advanced tutorial for creo parametric Releases 1.0 and 2.0 by Roger Toogood, SDC Publications.
2. Reference manuals for Creo 2.0 of PTC University.

VI SEMESTER

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code : MET306 **Course : Thermal Engineering-I**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand the principle of steam generation system and devices used in steam power plant.
2. Compute the performance of boiler and drought requirment.
3. Apply the conservation laws to engineering components involving energy transformation in steam power plants.
4. Use of thermodynamic tables and charts for engineering calculations to estimate the performance of various components.
5. Understand and analyze the condensation process equipment & their performance parameters.
6. Understand working principle and performance evaluation of various compressor.

Syllabus

Unit – I:

Principle of Steam Generation , Classification of Steam Generators, Fire Tube and Water Tube Steam Generators, High Pressure Steam generators, Supercritical steam generators, Boiler Mountings and Accessories

Draught and Its Classification, Chimney Height, Chimney Diameter, Chimney Efficiency, Condition for Maximum Discharge. Performance of Steam Generators: Evaporation Capacity, Equivalent Evaporation, Boiler Efficiency.

Unit – II:

Fluidized Bed Boiler: Bubbling Fluidized Bed Boilers, Circulating Fluidized Bed Boilers (Elementary Treatment Expected) Fuel for Steam Generators, Gradation & Analysis of Coal, Coal Handling System, Ash Collection and Handling System, Flue Gas Analysis, Feed Water Supply System.

Unit – III:

Steam Nozzles: Adiabatic Expansion in Nozzles, Maximum Discharge Critical Pressure Ratio and effects of Friction, Calculation of Throat and Exit Areas, Super saturation Flow, Wilson Line Steam Turbines Principle of Working of Steam Turbines, Classification of Steam Turbines, Comparison of Impulse and Reaction Turbines, Compounding of Steam Turbines.

Unit - IV

Energy Losses in Steam Turbines, Flow of Steam Through Turbine Blades, Ideal and Actual Reheat Factors, Velocity Diagrams, Graphical and Analytical Methods, Work, Done, Thrust and Power, Dimensions and Proportioning of the Blades, Steam Turbine Efficiencies, Condition for maximum efficiencies, Reheat and Regenerative Cycles, Governing of steam Turbines.

Unit – V:

Introduction to Steam Condensers: Types of Condensers, Classification of Condensers Quality of cooling water required, Design calculations for surface condenser, Dalton's Law of partial Pressures, Sources of Air leakages and Air Removal, Air Ejectors. Cooling Towers: Wet Cooling Towers, Dry Cooling Towers, Cooing Ponds.

Unit – VI:

Rotary compressors: Rotary & vanes blower and screw compressor: **-** Principle, operation, parts, indicator diagram, work done, Roots efficiency, vane efficiency.

Centrifugal compressor:-Principle, operation, parts, velocity diagram, static & total head quantities, work done by impeller, isentropic efficiency of compressor, slip factor, pressure coefficient, power input factor.

Axial flow compressor: Principle, operation, parts. velocity diagram, work done, Degree of reaction stage efficiency compressor characteristics, surging &chocking, Polytropic efficiency.

(No analytical treatment expected)

Text Books:

1. Thermal Engineering by R K Rajput, Laxmi Publications
2. Turbines, Compressors and Fans by S.M. Yahya, TMH Education Pvt. Ltd.
3. Thermal Engineering by M. M. Rathore, Tata McGraw Hill Education Pvt. Ltd.

Reference Books:

1. Power Plant Engineering by V.M. Domkundwar ,, Dhanpat Rai and Co.
2. Thermodyanamics and thermal engineering by J. Selwin Rajadurai, New Age International
3. Heat Engineering by Vasandani and Kumar, Metropolitan
4. Thermal Engineering by P.L. Ballaney, Khanna Publications

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET307 **Course: Automatic Control**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand fundamentals of control system and control system representation through Block Diagram and Signal Flow Graph.
2. Develop Mathematical Models for various Physical Systems.
3. Describe quantitatively about transient response, steady state errors and stability of control system.
4. Apply classical method of Root Locus Technique for analysis of control systems.
5. Frequency analysis of control system using Bode plot,Polar Plot, Nyquist Plot.
6. Understanding of application of state variable analysis for control system representation.

Syllabus

Unit – I:

Introduction of control Systems and Concept of Transfer Function, system Representation through Block Diagram and Signal Flow Graph. Transfer function through Block Diagram simplification and Mason's Gain Formula.

Unit – II:

Mathematical Modeling of Physical System, Mechanical Systems, Electrical systems, Hydraulic systems, Pneumatic Systems, Thermal systems.

Unit – III:

Time Domain Response Analysis under transient input, steady stare error analysis and error constants, types of controllers: P, PI, PD and PID controller and its applications, Routh criterion of stability.

Unit – IV:

Frequency Domain analysis : Root - Locus technique, Bode plot, gain Margin and phase margin, transportation lag, System Identification from Bode plot.

Unit – V:

Polar Plot, Nyquist Plot and Stability criterion, Introduction to control system design, lag-lead compensation, Feed Back Compensation and Pole -Zero placement.

Unit – VI:

State Variable approach and state equations, Transfer function from state models, state transition matrix and solution of state equations, controllability and observability test through test model.

Text Books:

1. Modern Control Engineering by Ogata, PHI Publications
2. Control System Engineering by Nise, Willey Publications
3. Control system by Nagrath & Gopal, TMH Publications
4. Linear control system by B.S. Manake, Khanna Publisher

Reference Books:

1. Modern Control System by Dorf, Pearson Publications
2. Automatic control system by B.C. Kuo, PHI Publications
3. Control Systems by Goyal & Baxi, Technical Publications
4. Automatic Control Engineering by F H Raven, TMH Publications

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code : MET308 **Course: Manufacturing Science – II**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:-

1. Select a suitable pattern making and moulding processes for manufacturing engineering products/components
2. Select and apply appropriate hot and cold working method for manufacturing metal components.
3. Distinguish the principles, operations and capability of different joining processes.
4. Select an appropriate grinding and super finishing operation to obtain required precision and accuracy.
5. Select an appropriate press and press working operations for manufacturing sheet metal components.
6. Distinguish the principles, operation and capabilities of different nonconventional machining processes.

Syllabus

Unit – I:

Casting Process: Introduction, Pattern making- Types, materials used, Pattern making allowances, colour codes. Core making: - Types, core material & its properties. Moulding-Types of sand moulds, moulding sand composition, moulding sand properties, moulding machines. Gating design – Elements of gating systems, pouring time, riser design (Analytical treatment), Casting Defects, Special casting processes- investment casting, centrifugal casting, Die casting.

Unit – II:

Mechanics of forming processes (including analytical treatment), Determination of rolling pressure & roll separation force, driving force & torque, power loss in bearing. Determination of forging forces & stresses, equipment (Hammer/Press) capacity required. Sheet Metal forming processes, Rolling, Forging, Extrusion & Wire Drawing.

Unit – III:

Joining processes: Introduction -Welding, Soldering, and Brazing Processes. Types of Welding, Arc Welding & Gas Welding Processes, Defects & Inspection of Welding Joints, Electrodes, Weldability of Metals. Advance Welding Methods: Introduction to TIG, MIG, Spot welding, Plasma Arc welding, Electron Beam welding, Laser Beam welding.

Unit – IV:

Grinding operations, grinding wheel, specifications & selection, cylindrical & centreless grinding operation, surface grinding, tool & cutter grinding, time estimation for grinding operations.

Super finishing process: Honing, Lapping, super finishing, polishing, buffing. Process parameters and attainable grades of surface finish.

Unit – V:

Press working: Die cutting operation, Classification, Types of Presses, Press terminology, Shearing action, shearing operations, drawing, draw die design, spinning, bending, bend allowance, bending force computation, stretch forming, embossing, coining.

Processing of Plastics: Types of plastics, general properties & applications of Thermosetting & Thermo Plastics. General Plastic Processes: Extrusion, Injection Moulding, Compression Moulding, Transfer Moulding, Blow Moulding, Calendering, Wire Drawing and Embossing.

Unit – VI:

Nonconventional Machining Processes: Characteristics, Operation, applications, Limitation and selection of process parameters of the processes; Abrasive Jet Machining, Ultrasonic Machining, Water Jet Machining, EDM, ECM and LBM.

Text Books:

1. Manufacturing Technology (Foundry Forming & Welding) – P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
2. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi.
3. Workshop Technology (Volume-I & II) - By Hajra Choudhary, Media Promoters & Publishers Pvt. Ltd.
4. Production Engineering –P.C. Sharma, S. Chand and Company Ltd., New Delhi.

Reference Books:

1. Manufacturing Engineering & Technology – S. Kalpakjian & S.R. Schmid
2. Workshop technology by B.S. Raghuvanshi, Dhanpat Rai & Co.
3. Production Technology- R. K. Jain, Khanna Publishers,New Delhi

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code : MEP308 **Course: Manufacturing Science – II**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course outcomes

The expected learning outcome is that the students will be able to :

1. Identify specific types of pattern required to make a sand mould for casting a particular component.
2. Prepare a casting using sand mould and identify casting defects.
3. Distinguish and apply appropriate welding method for specific application.
4. Understand working principle of unconventional mchining process like EDM.

List of Experiments

Sr. No.	List of Practical
1	To study types of patterns & properties of moulding sand.
2	To carry out moulding for the single piece pattern.
3	To carry out moulding for the split pattern.
4	To carry out moulding for Solid pattern & Core making.
5	To carry out casting in the mould using Pit Furnace.
6	Study of various casting defects & observations of the actual casting.
7	Demonstration of gas welding.
8	To study constructional details and working of Power Press.
9	Demonstration of EDM.
10	To carryout manual tube bending
11	To carryout hydraulic tube bending

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET309-1 **Course: Automobile Engineering (Open Elective)**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Recognize the fundamentals and applications of various types of automobiles and its major components
2. Identify engine components and subsystems; explain working of engine, formation and control of pollutants.
3. Illustrate the importance and working of transmission and driveline components
4. Explore components and working of steering, braking and suspension system and various types of tyres.
5. Demonstrate the importance and functioning of various electrical, electronic devices and recent trends in automobiles
6. Express the need and functioning of passenger safety equipment in automobiles and vehicle aerodynamics

Syllabus

UNIT I:

Introduction: Classification of automobiles, Major components and their functions. Chassis Different vehicle layout.

Powertrain: Engine, Basic Components, Classification, Two Stroke, Four Stroke, Petrol Engine, Diesel Engine, Fuel Supply systems: Necessity, Introduction to Carburetor and Fuel Injection system, CRDi, GDI.

UNIT II:

Clutch: Necessity, requirements of a clutch system. Types of Clutches, Gear box - Necessity of transmission, principle, types of transmission, Automatic Transmission.

Transmission system: Propeller shaft, Universal joint, constant velocity joint, Differential, 2 Wheel Drive, 4Wheel drive.

Steering systems: Principle of steering, steering geometry and wheel alignment, Power Steering. Under steer, Over steer.

UNIT III:

Tyres: tyres specification, types, factors affecting tyre performance, Special tyres, tyre treads, Hydroplaning., tyre Rotation.

Suspension systems: Need, Function of spring and shock absorber, conventional suspension, Independent suspension System, Active suspensions.

Brakes: Function, Classification, Basic Components. Drum Brakes, Disc Brakes, Hydraullic brakes, Air Brakes, ABS

UNIT IV:

Electrical Systems: Operation and maintenance of Batteries, Alternator, and Starter motor, Ignition systems. DTSi, Electronics ignition, horn, windshield wiper, wiring harness.

Automotive Electronics: Dashboard instrumentation, Sensors used in automobiles, ECU

Automotive Lighting: Importance, types and specifications, LEDs, Reflectors, Intelligent lighting, EMS

UNIT V:

Vehicle Aerodynamics: Basics, Drag, Lift, Aerodynamic Structures, Spoilers. Etc.

Vehicle Safety: Necessity, active and passive safety, Restrain Systems (seatbelts), Air Bags, structural components for Safety. Safety Glasses, Crumple Zone, antiroll bars.

Vehicle Pollution Control: cause and types of Emissions from Vehicle, Euro and Bharat Stage norms, Methods to reduce vehicular pollution, after treatment devices, Catalytic Converter.

UNIT VI :

Recent Advances in automobile technology: Electric Vehicle, Hybrid Cars, types of hybrids, Micro Hybrid. Traction control, intelligent highway system, Collision avoidance system, Automatic Cruise Control, Navigational aids, Parking Assistance system.

Vehicle maintenance and troubleshooting.

Text Books:

1. Automobile Engineering Vol. 1 & Vol. 2 by Kirpal Singh, Standard Publishers.
2. Automobile Engineering by G.B.S. Narang, Khanna publisher
3. Motor Vehicle Technology -- J.A. Dolan, Heinemann Educational Books

Reference Books:

1. Automotive Mechanics -- W.H. Crouse, D.L Anglin, Tata McGraw Hill Education.
2. Motor Vehicle -- K. Newton and W. Seeds, T.K. Gawet, Butterworth, Limited, London, England,
3. Automotive Machanics -- Joseph Heitner, Van Nostrand Reinhold

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET309-2 **Course: Robotics (Open Elective)**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Survey the historical background of robots and its recent development.
2. Develop kinematics of manipulators.
3. Identify various components of a robotic system
4. Describe various control strategies used in robotic systems
5. Evaluate common industrial and non-industrial applications of Robots.

Syllabus

Unit -I:

Introduction to robots and their evolution, mobile, fixed base, humanoid robots, what is and what is not a robot, progressive advancements in robots.

Unit- II:

Design and control issues, actuators, sensors and vision, image processing and image acquisition, smart sensors, programming.

Unit -III:

Coordinate frames, mapping and transformation, modelling of robot, DH notations, manipulator transformation matrix, jacobians, singularity, dexterity

Unit IV:

Mobile robot, control, sensing, navigation, path planning algorithms (holonomic, non-holonomic)

Unit V:

Industrial application of robots: material handling, processing, assembly, inspection, welding, and painting

Unit VI:

Non industrial applications: domestic, medical, military operations, children toys, humanoids

Text Books:

1. Robotics and Control, R.K. Mittal, and I.J. Nagrath , McGraw Hill, New Delhi, 2011
2. Robotics: control, sensing, vision and intelligence, Fu, Gonzalez, Lee, McGraw Hill, 2012
3. Introduction to Robotics, Saha S.K., Tata McGraw-Hill, New Delhi, 2008

Reference Books:

1. Theory of Applied Robotics, Raza N. Jazar, Springer
2. Introduction to Robotics (Mechanism and Control), John J. Craig, Pearson education Inc.

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code : MCT321 **Course: Computer Applications**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

1. To learn arrays, pointers, structures and graphics in C language and to write C programs efficiently for engineering applications.
2. To learn network essentials, file processing and database management system for current technologies.
3. To provide a sound foundation to design, normalize and implement database schema and query writing using SQL for problem solving.
4. To elaborate SCILAB features, basic programming, graphical plotting to solve engineering problems.

Course Outcomes

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

1. Learn current computing requirements and to write equivalent C programs efficiently so as to solve problems.
2. Conceptualize various constructs such as arrays, structures, pointers, graphics and implement them in accordance with current technologies.
3. Learn characteristics and architecture to design, normalize and implement database schema and query writing using SQL to meet real world problems.
4. Demonstrate SCILAB features to graphically present the output of computer programs to solve engineering problems.

Syllabus

Unit – I :

Arrays and applications : Introduction to arrays, Types of arrays, arrays and functions, Searching : linear and binary. Sorting : bubble insertion, selection, quick and merge.

Pointers : Introduction (declaration and initialization), address arithmetic, Pointers to pointers, Pointers and multidimensional arrays, Concept of dynamic memory allocation.

Unit - II :

Structure and Union : Structure declaration and initialization, structure within structure, self referential structures, structures and functions, Union, typedef.

Introduction to Graphics : Graphics initialization, Graphical functions, Graphics Programming.

Unit - III :

Introduction to Networks : Introduction, Communication Media, Topologies, Protocols, Network Model.

Database Management System : Introduction-Data, Information and Metadata, Conventional File Processing System, Components of DBMS, Advantages and Disadvantages, the Three level Architecture proposal for DBMS, Abstraction and Data Integration, Data Independence, System Structure.

Unit - IV :

Data Models : Introduction, Types of Data Models and Entity-Relationship Model, Entity Relationship Diagram, Reducing E-R- Diagrams to Table, Generalization, Aggregation. The **Relational Model :** Structure of relational database, keys, Relationship, Mapping

Unit - V :

Integrity Constraints and Relational Database Design : Domain Constraints, Referential Integrity, Functional Dependencies, Normalization, Assertions, Pitfalls in relational Database.

SQL : Basic structure of SQL, Set operations, Aggregate Functions, Nested sub Queries.

Unit - VI :

Introduction to Scilab : Introduction, command line, basic mathematics operations, matrix operations, basic plotting, Matrices, strings, lists, rational frations, linear state space, overloading, cells and structs, Introduction to scripts and functions writing, control structures, iteratives loops and conditional instructions, testing and debugging of the programs, 2-D graphics : Graphic window, graphic handles and their properties, 2-D plot functions, graphics export. 3-D graphics and GUI : 3-D plot functions, dialog boxes, input and control boxes, GUI creation and development, uicontrol and uimenu functions.

Text Books :

1. Mastering C : K.R. Venugopal and S.R.Prasad, Tata McGraw Hill
2. Programming in ANSI C, 5th ed. : E. Balguruswami McGraw Hill
3. Database Systems Concepts, Silberschatz, Korth, Sudarshan, McGraw-Hill.
4. Computer Networks, Andrew Tanenbaum, PHI Publication.
5. Scilab by Example, Dr. M. Affouf, CreateSpace Independent Publishing Platform

Reference Books :

1. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
2. C Programming with problem solving, J.A. Jones & K. Harrow, dreamtech Press.
3. An Introduction to Database Systems, C.J.Date, Narosa.
4. An Introduction to Database Systems, by Bipin C. Desai, Galgotia.
5. PL/SQL, Ivan Bayross.
6. Engineering and Scientific Computing with Scilab, Claude Gomez, Springer Science & Business Media.

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code: MCP321 **Course: Computer Applications**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes :

Students will be able to :

1. Perform practicals using C language for engineering applications.
2. Perform practicals using DDL, DML and DCL commands. Also use SQLin project development.
3. Formulate computer algorithms and implement those algorithms in SCILAB to solve engineering problems.
4. Graphically present the output of computer programs using SCILAB for engineering applications.

List of Practical

The laboratory will have minimum Eight Practical based on the syllabus of MCT321.

Syllabus of Semester VI, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP311 **Course: Industrial Case Study**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Identify suitable Industry to carry out the case-study
2. Discover a specific case/issue/problem from the industry
3. Formulate the problem definition and select appropriate methodology to address it.
4. Analyze the problem and recommend the solutions.
5. Demonstrate the presentation and technical report writing skills
6. Improve the interpersonal skills and team work co-ordination.

Industrial case study should be based on the study of some specific case / issue/ problem related to any industrial / business establishment. Data should be collected from Industry with the objective of studying some specific case / issue / problem. The Collected data should be analysed using one or more theories studied in the curriculum. The Result should be worked out and conclusion should be drawn. A group of four/five students should be formed for one case study.

The report should be submitted in the prescribed format, consisting of the problem / issues identified, methodology of data collection, method of analysis, results and conclusion.

Minimum two presentations should be made as a part of internal evaluation.

VII SEMESTER

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET401 **Course: Thermal Engineering II**

L: 4 Hrs, T: 0 Hrs, P: 0 Hrs. Per week **Total Credits: 08**

Course Outcomes:

The expected learning outcome is that the students will be able to:

1. Understand the thermodynamics and various efficiencies of reciprocating air compressors.
2. Ability to analyze air standard cycles and fuel air cycles and compute the performance parameters for I.C. Engines.
3. Evaluate the coefficient of performance of various refrigeration systems.
4. Ability to understand the psychometric processes for air conditioning systems.
5. Analyze the gas turbine oycles and understand the working of various jet engines.

Syllabus:

Unit - I

Positive displacement Compressors:-Reciprocating compressors:- Parts, Operations, Work done during isothermal, polytropic & adiabatic compression process, isothermal efficiency, Effect of clearance, volumetric efficiency, Mechanical efficiency, Multistage compressor, condition for minimum work input, capacity control, Actual indicator diagram.

Unit - II

I.C. Engines: Air standard &fuel air cycles, parts of I.C. Engines, working of I.C. Engines, Two stroke & four stroke I.C. Engines SI & CI engines, Introduction to combustion in SI & CI engine, carburetion & fuel injection. (Analytical treatment not expected)

Unit - III

I.C. Engine Testing:-Measurement of power: indicated, friction &brake power, measurement of speed, fuel & air consumption, calculation of indicated &brake thermal efficiency, volumetric efficiency, mechanical efficiency, percentage of excess air, Heat balance sheet, performance characteristics &factors influencing the performance of I.C. Engines.

Unit - IV

Refrigeration: Introduction, unit of refrigeration, simple vapour compression refrigeration system. Vapor absorption refrigeration system (concept only) refrigerants, Alternative refrigerants, introduction to cryogenics and application of cryogenics, simple Linde-Hampson system.

Unit - V

Air conditioning: Introduction, psychrometric properties and processes, human comfort and factors affecting comfort, Bypass factor, application of Psychrometrics to simple air conditioning systems, Typical summer and winter air conditioning system (concept only), Evaporative cooling, working of Air washer.

Unit - VI

Gas Turbines:-Ideal cycles, isentropic and small stage efficiency, application of gas turbines, pressure losses, effect of inter-cooling, reheat & regeneration, fuel-air ratio, combustion efficiency, performance calculation, open cycle &closed cycle gas turbine plants, cogeneration & combined power cycles.

Jet Propulsion:-principles &working of turbojet, turbo-prop, Ramjet &pulse jet. Simple turbojet cycle, Thrust power, propulsive power. Thermal efficiency, propulsive efficiency. Overall efficiency.

Text Books

1. Thermal Engineering by R. K. Rajput, Laxmi publications.
2. Thermal Engineering by Mahesh Rathore, Mc-Graw Hill publications.
3. Internal Combustion Engines by V.Ganesan, Mc-Graw Hill publications.

Reference Books

1. Gas Turbine Theory by Cohen & Rogers, Longmans Green publications.
2. The Internal Combustion Engine in Theory and Practice Volume I & II by Charles Fayette Taylor, MIT Press
3. Gas turbine & Jet Propulsion by Khajuria & Dubey, Dhanpatrai & sons.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP401 **Course: Thermal Engineering II**

L: 0 Hrs, T: 0 Hrs, P: 2 Hrs. Per week **Total Credits: 02**

Course outcomes:

1. Ability to analyse the various performance parameters and volumetric efficiency of a reciprocating compressor.
2. Ability to know the performance characteristics by testing the S.I. and C.I.
3. Ability of Computing COP of computer based vapour compression refrigeration system.
4. Demonstrate the various air conditioning processes on computerized air conditioning tutor.
5. Understand the gas turbine and various jet propulsion systems with the help of fabricated models.

List of Practical based on the syllabus of MET401

1. To determine the volumetric efficiency of a reciprocating air compressor test rig.
2. Study of components of internal combustion engines and to study the detailed comparison of S.I. and C.I. engines and 2-stroke and 4-stroke engines.
3. To conduct the performance test and study the p-V and p-ϴ diagrams for computerized single cylinder petrol engine test rig.
4. To conduct the performance test and study the p-V and p-ϴ diagrams for computerized single cylinder diesel engine test rig.
5. To study the effect of variation in compression ratio on various operating parameters of a variable compression ratio petrol engine set up.
6. To determine the C.O.P. of computerized vapour compression refrigeration test rig.
7. To demonstrate the various psychrometric processes on computerized air conditioning tutor.
8. Study of various gas turbine plants.
9. Study of various jet propulsion systems.
10. Report on visit to a cold storage/refrigeration plant.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET402 **Course: Design of Machine Elements II**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. design and analyze shaft couplings for power transmission.
2. understand kinematics of clutches & brake.
3. Select and design rolling contact bearings and sliding contact bearings.
4. design and analyze belt drive and chain drive.
5. design and analyze spur & helical gear drives.
6. Design and alalyze bevel, worm gear drives and wire ropes.

Syllabus

Unit – I:

Coupling: Types of shaft couplings, components, and applications, design of flange coupling, design of flexible bush pin type coupling. Selection of electric motors.

Unit – II:

Kinematics and design of Friction Drives such as Brakes, Clutches. Friction Clutch: Single Plate, Multiple Plate, Cone, Centrifugal Clutch. Brake: Shoe Brake, Band Brake, Internal Expanding brake, disc brake.

Unit – III:

Design and Selection of rolling-contact bearing: Types of rolling contact bearings, selection of ball and roller bearing for radial and thrust loads, design for cyclic loads, lubrication, bearing failure, and mounting of bearings.

Design of sliding-contact bearing: Modes of lubrication, Petroff's equation, Reynold's equation, selection of parameters and design of journal bearings for radial and thrust loads, bearing construction, selection of lubricating oils, bearing failure.

Comparison of rolling and sliding contact bearings.

Unit – IV:

Design of Flat belt drive: Types of belts & belt material, analysis of belt tension, condition for transmitting maximum power, design of flat belt and flat belt pulley.

Design of V belt drive: Types of V-belts, analysis of V-belt tension, selection of V-belt, design of V belt pulley.

Roller chain drive: Types of chains, geometric relationship, power rating, design of chain drive, dimensions of tooth profile, sprocket.

Unit – V:

Design of Spur and Helical gear drive: Review of Kinematics of gears & terminology, tooth proportions, Force Analysis, Buckingham equation, beam strength of gear teeth, dynamic tooth load, wear load, fatigue load, formative number of teeth, gear tooth failure, design of gear blank, gear lubrication.

Unit – VI:

Design of Worm gear drive: Types and proportion of worm and worm gear, force analysis, beam strength of worm gear teeth, dynamic tooth load, wear load, thermal rating of worm gear, design of worm and worm gear.

Design of Bevel gear drive : Types of bevel gear, terminology and proportions of bevel gear, force analysis of bevel gear drive, design of bevel gear drive.

Design of wire rope: types of wire ropes, stresses in wire ropes.

Text Books :

1. Design of Machine Elements by V.B. Bhandari, Tata Mc-Graw Hill publications.
2. Mechanical Engineering Design by J. E. Shigley, Tata Mc-Graw Hill publications.
3. Design of Machine Elements, Spotts, M. F.; Shoup, Terry E.; Prentice Hall publication
4. Design of Machine Elements by C.S. Sharma and Kamlesh Purohit, PHI Learning Pvt. Ltd.
5. Design of Machine Elements by B. D. Shiwalkar, Central Techno Publication.
6. Machine Design by R.K. Jain, Khanna Publisher, Delhi.

Reference Books :

1. Maleeve and Hartman's Machine Design, Fifth Edition, by Dr. O. P. Grover, CBS Publisher
2. Machine Design by P. H. Black, Mc-Graw Hill publications.
3. Machine Design by Norton, Pearson publication.
4. PSG- Design Data Book, published by Kalaikathir Achchagam Coimbatore.
5. Design Data for Machine Elements by B. D. Shiwalkar, Central Techno Publication.
6. Machine Design Data Book by V. B. Bhandari, Mc-Graw Hill publications.
7. Hand book of Machine Design by Shiglay & Mischke
8. Kent's Mechanical Engineering Hand book (Vol 1 & 2) by Kent, john Wiley & sons

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP402 **Course: Design of Machine Elements II**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Design practice of various types of mechanical drives.
2. Design practice of complete drive system.
3. Assembly of the mechanical drive system and component drawing

Lab Practice based on the syllabus of MET402

1. Design and Assembly of coupling.
2. Design and modeling of one complete transmission system along with part drawings of the components.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course CodeMET403-1 **Course: Advanced Manufacturing Techniques**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes :

The expected learning outcome is that students will be able to:

1. Describe working principles of different plastic processing machines.
2. Explain different forms of glass and principle of processing glass and ceramics
3. Illustrate different joining processes, their working principles and applications.
4. Elucidate Unconventional Machining Method, their working principle and applications.
5. Understand micromachining and nano fabrication their principle of operations and applications in micro parts manufacturing such as electronic chip.
6. Explain rapid prototyping, its types, their working principle and applications.

Syllabus

Unit – I:

Forming and shaping of plastic and composite materials: extrusion, injection molding, blow, rotational, thermoforming, hydroforming. Processing of elastomers, reinforced plastics, Metal matrix composites, ceramic matrix composites.

Unit – II:

Processing of ceramics, glass and superconductors: shaping ceramics, forming and shaping glass, techniques for strengthening and treating glass, design consideration for ceramics and glasses, processing of superconductors.

Unit – III:

Unconventional joining processes: TIG, MIG, Atomic hydrogen, GMAW, Electro slag, EBW, LBW, Thermit, Plasma Arc.

Unit – IV :

Characteristics, Operation, applications, Limitation and selection of process parameters of the following processes: Abrasive water jet machining, AJM, USM, EDM, LBM (analytical treatment), ECM, ECG, Wire EDM.

Unit – V :

Micromachining, Nanofabrication: Principles, MRR, tooling, material, machine selection, processes, applications, advantages, limitations.

Unit – VI :

Rapid Prototyping operations: subtractive and additive processes, FDM, Stereo lithography, Selective laser sintering, 3D printing, Laminated object manufacturing, Rapid tooling, applications, advantages, limitations.

Text Books:

1. Production Technology : P.C. Sharma, S. Chand and company Ltd, New Delhi
2. Modern Machining Processes : Pandey and Shan, Tata McGraw-Hill Education
3. Manufacturing Science : A. Ghosh& A. Mallik, Affiliated East-West press pvt.ltd.

Reference Books:

1. Manufacturing Engineering Technology: S. Kalpakjian and S.R. Schmid, Pearson
2. Additive Manufacturing Technologies: Ian Gibson, David W. Rosen, Brent Stucker
3. Fabricated: The New World of 3D Printing by Hod Lipson, Melba Kurman, Wiley India pvt ltd.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET403-2 **Course : Synthesis of Mechanisms**

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 08**

Course Outcomes :

The expected learning outcome is that, the students will have

1. Ability to understand various methods of synthesis of mechanisms
2. Ability to understand position generation problems
3. Ability to understand function generation problems
4. Ability to understand path generation problems.
5. Ability to understand synthesis for infinite simally seperated position and optional synthesis.
6. Ability to understand various spatial Mechanisms and applications

Syllabus

UNIT-I

Introduction to kinematics, types of mechanism, kinematics synthesis, science of relative motion, tasks of kinematic synthesis with practical applications, Degree of freedom, class-I, class-II chain, Harding's notation, Grashof criterion, Grubler's criterion.

UNIT-II

Introduction to position generation problem, concept of pole, two &three position generation synthesis, pole triangle, Relationship between moving & fixed pivots, Four position generation, opposite pole quadrilateral, center point &circle point curve, Burmester's point. Matrix method for position generation problem, rotation matrix, displacement matrix

UNIT-III

Introduction to function generation problem, co-ordination of input-output link motion, relative pole technique, inversion technique, overlay technique, graphical synthesis of quick return mechanisms for optimum transmission angle. Types of errors, accuracy points, chebyshev's spacing, Frudenstein's equation

UNIT-IV

Introduction to path generation problem, synthesis for path generation with and without prescribed timing using graphical method. Coupler curves, cognate linkages, Robert's law of cognate linkages.

Complex number method for path generation problem 3 precision points

UNIT-V

Synthesis for infinitesimally separated position, concept of polode and centroid, Euler's savery equation, inflection circle, Bobbilier and Hartman's construction.

UNIT-VI

Optimal synthesis of planer mechanisms, Powell's search method, least square method, penalty function Introduction to spatial mechanisms

Text Books:

1. Advanced Mechanism Design: Analysis and synthesis Volume-II, G.N. Sandor & A.G. Erdman, Prentice-Hall Englewood
2. Theory of Machines and Mechanisms: Uicker and Shigley, Tata McGraw Hill
3. Theory of Machines: S. S. Rattan, Tata McGraw Hill
4. Kinematics & Dynamics of Machinery by R. L. Norton, Tata McGraw Hill
5. Mechanism and Machine Theory: J.S. Rao & R.V. DukkiPati, New Age International

Reference Books:

1. Applied Linkage Synthesis by Tao D.C.
2. Kinematics & Dynamics of Machinery: Wilson & Sadler, Harper Collins Publishers
3. Kinematics and Mechanism Design by C.H. Sue & C.W. Radchiffe, John Wiley & Sons.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET403-3 **Course: Internal Combustion Engines**

L: 4Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Classify various types of engines and explain the working of engine, its cooling and lubrication system
2. Distinguish between different types of fuels and describe the various fuel supply system for I.C engine
3. Elaborate the combustion process in S.I and C.I engine and illustrate the various factors affecting combustion
4. Express the causes of pollution formation in I.C engines and discuss various measures and devices to control the same
5. Interpret the effects of various performance parameters on engine performance and evaluate engine parameters.

Syllabus

UNIT - I

Introduction and Historical Perspective, Engine classifications, Engines types and their operation, Engine Operating & Working Cycle, structural components and its material. Engine friction, Frictional losses, blow by losses, pumping loss, lubrication systems. Factors affecting mechanical friction, Engine Cooling System.

UNIT - II

AUTOMOTIVE FUELS: Engine fuels characteristics, C.I. Engine fuels characteristics Rating of engine fuels, I.C. engine fuels - petrol, diesel, CNG, LPG, Alcohols, Vegetable oils. Fuel Supply System in S.I. Engine; Carburetors, SPFI, MPFI, GDI, Fuel injection pump: reciprocating &rotary, fuel injector, High pressure D.I. systems, fuel distribution systems, CRDI.

UNIT - III

Combustion in S.I. Engine: Valve timing diagram combustion stages, flame propagation ,cyclic variations in combustion, abnormal combustion, knock fundamentals, Octane , turbo charging, supercharging and scavenging in engines, ignition fundamentals, conventional ignition system.

UNIT - IV

Combustion in C. I. Engines: Combustion in direct and indirect injection, fuel spray behavior, combustion in C. I. Engines, Ignition delay, auto ignition. Factors affecting delay. Charge motion within the cylinder swirl, squish. Effects of fuel properties, abnormal combustion, supercharging and turbo charging, Stratified charged engines, Engine management system.

UNIT – V

Automotive Emissions and its effects, Emission Norms, Pollutant formation: Nitrogen oxides Kinetics of NO formation, formation of NO_2, NOx formation in S. I. Engines &C. I. Engine Carbon monoxide and unburned hydrocarbon emissions in S.I. and C.I. engines, EGR Particulate emissions, measurement technique, Catalytic converters, particulate traps, Specific emission and emission Index. On Board Diagnosis.

UNIT - VI

Engine Design and Operating Parameters, Important engine characteristics, Geometrical properties of Reciprocating engines, Brake Torque & Power, Indicated work per cycle, Mechanical efficiency, Mean effective pressure, Specific fuel consumption and efficiency, Air/Fuel and Fuel/Air ratios, Volumetric efficiency, Engine specific weight and specific volume, Correction factors for power & efficiency, Relationship between different performance parameters, Measurement of friction power indicated power, Brake power, Fuel consumption, Air consumption, Performance parameters and characteristics: Engine Power, Engine efficiencies, Engine performance characteristics, Variables affecting performance characteristics.

Text Book:

1. Internal Combustion Engines - V. Ganesan, Tata McGraw Hill Education.
2. Internal Combustion Engines - M. C. Mathur, R.D. Sharma, Dhanpat Rai Publications.
3. Internal Combustion Engine Fundamentals - John B. Heywood, Tata McGraw Hill Education.

Reference Books :

1. Internal Combustion Engines - V. M. Domkundwar, Dhanpat Rai Publications.
2. Internal Combustion Engines and Air pollution - Edward F. Obert, Intex Education Publication.
3. Internal Combustion Engines-Shyam K Agrawal, New Age International Publishers

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET403-4 **Course: Advanced Material Handling Systems**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

1. Ability to understand importance of material handling in a plant
2. Demonstrate the understanding of mechanism and working of various materials handling systems.
3. Exhibit skill towards selection and design of material handling system according to the type of material to be conveyed.
4. Study various components of material handling system
5. Ability to understand new material handling devices

Syllabus

Unit – I:

Importance of material handling, characteristics and classification of materials, Unit load, Bulk load, Principals of material handling, classification of material handling equipments, economics of material handling.

Unit – II:

Unit load handling, Pallets, skids, containers, packaging for materials handling.

Industrial trucks, hand trucks, power trucks, fork lift trucks, tractors, common designs, and standards.

Bulk material handling equipments,

Unit – III:

Conveyors: Belt conveyors, chain conveyors, screw conveyors, roller conveyors, vibrating and oscillating conveyors; types, construction, power calculations and design practice.

Unit – IV:

Cable conveyors, bucket conveyors, haulage conveyors: types, components, construction. Pneumatic and hydraulic conveyors: types, components, construction, capacity.

Unit – V:

Hoisting equipments: components of hoisting equipment, pulley systems, arresting gears and brakes, load handling attachments, hoists, winches, constructional features.

Cranes: stationary, stationary revolving, mobile, derricks, components, constructional details

Elevators: bucket elevators- type, buckets, capacity calculations, freight elevators.

Unit – VI:

Auxiliary equipments, hoppers, gates, feeders, positioners, ball tables, pallet loader and unloader, weighing and control equipments.

New material handling devices: AGV's, and robots; classification, construction, applications.

Maintenance and safety in material handling.

Text Books:

1. Introduction to Materials Handling, Siddhartha Ray, New Age International Publishers, India.
2. Aspects of Materials Handling, Dr. K. C. Arora , Vikas and V. Shinde, Laxmi Publications, India.
3. Plant layout and material handling , G K *Agarwal, Jain Book Depot*
4. Materials handling: principles and practice, Theodore Henry Allegri , CBS Publishers, New Delhi

Reference Books:

1. Plant layout and material handling, James MacGregor Apple, Wiley
2. Materials Handling Handbook, David E. Mulcahy, McGraw-Hill
3. Material Handling, Immer, J.R., McGraw-Hill
4. Material handling systems design by James MacGregor Apple, Ronald Press Co.
5. Materials Handling Equipment- N. Rudenko , Peace Publication.
6. Materials Handling Equipment, M. P. Aleksandrov, Central Books Limited

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET403-5 **Course: Composite Materials**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to :

1. Understand Define and classify composite materials.
2. Develop and analyze relationships for a unidirectional / bidirectional lamina.
3. Understand concepts of quantification of physical parameters (such as density, volume and weight fraction, void etc.) of composites.
4. Establish the failure criteria for laminates and design laminated structures.
5. Explain testing procedures and applications of composite materials.

Syllabus

Unit - I

Introduction to composites basic definitions and classification of composites classification based on matrix material, classification based on reinforcements. Comparison with Metals, advantages & limitations of composites.

Unit - II

Basic constituent: Types of reinforcements/fibers, role and selection of reinforcement materials, mechanical properties of fibers. Matrix materials, functions of a matrix, desired properties of a matrix. fiber - reinforce composite materials, fiber-reinforced polymer (FRP) Laminated composites, Lamina & Laminate Lay-up.

Unit – III

Macro-mechanical analysis of a Lamina: Introduction, Review of definitions, Hooke's Law for different types of materials such as anisotropic material, monoclinic material, orthotropic material, transversely isotropic material, isotropic material. Hooke's Law for a two-dimensional unidirectional lamina, Hooke's Law for a two-dimensional angle lamina, invariant form of stiffness and compliance matrices for the same.

Unit – IV

Macro-mechanical failure theories, comparison of failure theories. Micro-mechanical Analysis of a Lamina: Volume and mass fractions, density, and void content, evaluation of the four elastic moduli by strength of materials approach, semi-empirical models, elastic moduli of lamina with transversely isotropic fibers. Ultimate strengths of a unidirectional lamina.

Unit – V

Laminate code, stress–strain relations for a laminate, in-plane and flexural modulus of a laminate, hygrothermal effects in a laminate, warpage of laminates. Failure analysis, and design of laminates: special cases of laminates, failure criterion for a laminate, design of a laminated composite.

Unit – VI

Special Topics: Testing of composites for mechanical properties, environmental effects on composites. Engineering Applications: General engineering applications of FRP, applications related to aerospace, automobile, bridge and other civil engineering structures. Case studies.

Text Books:

1. Autar K. Kaw, “Mechanics of Composite Materials”, 2nd Ed., CRC Press.

Reference Books:

1. Agarwal, B.D. and Broutman, L.J., “Analysis and Performance of Fibre Composites”, 3rd Ed., John Wiley & Sons.
2. Srinivasan, K., "Composite Materials : Production, Properties, Testing and Applications", Narosa Publishing House, new Delhi.
3. Jones, R.M., " Mechanics of Compostie Materials", 1st Ed, Taylor & Francis.
4. Daniel, I.M. and Ishai, O., “Engineering Mechanics of Composite Materials”, 2nd Ed., Oxford University Press.
5. Christensen, R.M., “Mechanics of Composite Materials”, 1st Ed., Dover Publications.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET403-6 **Course: Energy Conservation & Management**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

1. Ability to understand and identify areas of energy conservation in industries.
2. Know the duties and responsibilities of an energy manager and energy auditor.
3. Ability to analyze working of the energy utilizing and generating machines.
4. Practice and utilize the instruments in energy audit process.
5. Ability to understand and implement proper energy saving techniques in boiler, furnaces, compressors and heavy machineries.

Syllabus

Unit I : Energy Scenario: Basics of Energy and its various forms, Energy management and audit, Material and Energy balance, Facility as an energy system, methods for preparing process flow, material and energy balance diagrams. Global environmental concerns.

Unit II : Financial Management : Investment need, appraisal and criteria, financial analysis techniques-simple payback period, return on investment, net present value, internal rate of return, financing options, Energy Monitoring and Targeting: CUSUM.

Unit III : Energy efficiency and Energy performance in thermal utilities :

Boilers, FBC boilers, Furnaces, Steam systems, Heat exchangers, Insulation and refractories, cogeneration, Classification of cogeneration systems, benefits of waste heat recovery, commercial waste heat recovery devices.

Unit IV : Compressed Air System and HVAC system: Types of air compressors, compressor efficiency, efficient compressor operation, Heating, ventilation, air conditioning and Refrigeration System, Fans and blowers, Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Unit V : Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Energy conservation in boiler feed water pump, pumping systems for municipal drinking water, and sewerage, agriculture pump sets.

Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Unit VI : Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, Electric motors, energy saving opportunities, energy efficient motors, soft starters with energy saver, variable speed drives. Electronic ballasts, Lighting System, Light source, choice of lighting, luminance requirements and energy conservation avenues.

Text Books :

1. Archie, W Culp. Principles of Energy Conservation: McGraw Hill, 1991.
2. P. O'Callaghan: Energy Management: McGraw - Hill Book Company, 1993.
3. Thuman A and Mehta D Paul, Handbook of Energy Engineering: The Fairmount Press.

Reference books :

1. Energy Management Principles, C.B. Smith, Pergamon Press
2. Energy Management, Trivedi. P.R., Jolka K.R., Common wealth Publication.
3. Industrial Energy Management and Utilization, Witte, Larry C., Hemisphere Publisher
4. Amit Kumar Tyagi, Handbook on Energy Audits and Management: TERI
5. Majumder Milli, Energy Efficient Buildings: TERI
6. Paul O'Callaghan, Energy Management: McGraw Hill
7. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 404-1 **Course: Finite Element Method**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Learn the basic concept and applications of FEM and demonstrate the various approaches to find the field variable.
2. Able to analyze the 1-D bar and 2-D trusses by the FEA method.
3. Able to investigate plain stress, plain stain and axi-symmetric problems by using CST element.
4. Able to analyze the beam and analysis structure subjected to free vibration using finite element method.
5. Able to perform the analysis of 1-D and 2-D steady state heat conduction problems.

Syllabus

Unit – I:

Fundamental concepts of FEM, Historical background, Scope of FEM in Engg. Applications, Fundamentals of stress & strain, stress & strain components, stress-strain relationship, Elastic constants, plane stress, plane strain condition, differential equation of equilibrium, compatibility equations, boundary conditions, Saint Venant's principle, sky line approach.

Unit – II:

Comparison of FEM with other approaches like Galerkin, Petro-Galerkin, Least square and Sub-domain method. Raleigh-Ritz method

Principle of minimum potential energy, Basic steps in FEM, Methods for solution of simultaneous equations like Gauss elimination, Concept of discritization of body into elements, types of coordinate system degrees of freedom, bandwidth, Basic types of 1-D, 2-D & 3-D elements, displacement models, convergence requirements.

Unit – III:

Analysis of one-dimensional and spring element, significance of shape function, Derivation of stiffness matrix, load vector, stress and strain calculation, temperature effects. Analysis of one-dimensional subjected to torsion, Analysis of two dimensional trusses.

Unit – IV:

Two dimensional problems using CST (Constant Strain Triangle), elemental stiffness matrix, global stiffness matrix, stress and strain calculation.

Analysis of axi-symmetric solid subjected to axi-symmetric loading using CST element.

Unit – V:

Finite element modeling of Beam element, derivation of stiffness matrix and load vector, boundary conditions.

Introduction to dynamic analysis, formulation of mass matrix for one-dimensional bar element, free vibration analysis using one-dimensional bar element.

Unit – VI:

Steady state one dimensional and two dimensional heat conduction problems using I-D and triangular element respectively.

Introduction to Iso-parametric & Higher order elements. Preprocessing, solution & Post-processing stages in FEM.

Text Books:

1. Theory of Elasticity -S.P. Timoshenko (McGraw Hill)
2. Introduction to Finite Elements in Engineering -T.R. Chandrupatla & A.D. Belegundu (PHI)
3. Finite Element Methods: Basic Concepts and Applications- C. R. Alavala(PHI)

Reference Books:

1. Finite Element Method- Daryl L. Logan (Cengage Learning)
2. Finite Element Analysis- Saeed Moaveni (Pearson)
3. Finite Element Analysis- S. S. Bhavikatti (New Age International)

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP 404-1 **Course: Finite Element Method**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Ability to analyze the various structures like trusses, beams, frames by analysis software.
2. Ability to perform thermal, modal and fluid flow analysis by analysis software.
3. Develop the expertise in selecting suitable material and elements as per the application.
4. Develop the expertise in applying suitable boundary condition and loading to the structure.
5. Understand the stages of analysis i.e. preprocessing, processing and post-processing.

List of Practical

1. Finite element analysis problem of1- dimensional bar element subjected to axial loading.
2. Finite element analysis problem of1- dimensional bar element considering self weight.
3. Finite element analysis problem of1- dimensional bar element subjected to torque.
4. Finite element analysis problem of 2-dimentional trusses (Two problems).
5. Finite element analysis problem of plain stress condition using CST element.
6. Finite element analysis problem of axi-symmetric condition using CST element.
7. Finite element analysis problem of free vibration.
8. Finite element analysis problem on steady state heat conduction.

Note: Students should verify the result obtained by software with algebraic method.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET404-2 **Course: Stress Analysis**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes :

The expected learning outcome is that the students will be able to:

1. Apply the fundamentals of Theory of Elasticity.
2. Use and solve 2-D problems in polar coordinate system.
3. Apply the principles and techniques of 2-D and 3-D photo-elastic stress measurement.
4. Apply the principles and techniques of strain gauge measurement.
5. Apply the principles and techniques of brittle coating and moiré analysis.

Syllabus

UNIT I : Two Dimensional Problems in Cartesian Coordinate system

Fundamentals of stress & strain, stress-strain relationship, Elastic constant, plane stress, plane strain., differential equation of equilibrium Boundary conditions, Saint Venant's principle, compatibility equation, Airy's stress function. Stress analysis of cantilever subjected to concentrated load at its end and simply supported beam subjected to uniformly distributed load.

UNIT II : Two dimensional Problems in Polar coordinate system

General equations of equilibrium in polar coordinate, compatibility equations, stress distribution about symmetric axis, stress analysis of cylinder subjected to internal & external pressure, Pure bending of curved beams, effect of hole on the stress distribution in plates, Stress analysis of rotating circular disk.

UNIT III : Two Dimensional Photo-elasticity

Introduction to basic optics related to photo-elasticity, stress optic law, plane & circular polariscope arrangements, effect of stressed model in plane & circular Polariscope, Isoclinic & Isochromatics, stress trajectories, calibration of photoelastic material (determination of fringe constant). Various photoelastic materials and their properties, Casting of photoelastic models, Tardy's compensation technique, Separation techniques like, shear difference, oblique incidence

UNIT IV :Three Dimensional Photo-elasticity

Phenomenon of Stress freezing, Method of stress freezing, slicing techniques, determination of material fringe constant at critical temperature Scaling Model- Prototype relations.

Bi-refringerent coating method, Reflection Polariscope, Introduction to fringe sharpening & fringe multiplication.

UNIT V: Strain Gage Technique For Stress & Strain Analysis

Introduction to electrical resistance strain gages, Guage factor, bridge circuit, bridge balance, output voltage of Wheatstone bridge, balancing of bridge, temperature compensation, various bridge configurations, bonding of strain gages to the specimen, determination of principal strains & stresses using strain rosettes. Environmental effects on performance of strain gages, Strain gage response to dynamic strains, Effect of lead wires. Introduction to Strain measurement on rotating components, Static & Dynamic Strain Measurement introduction to semiconductor gages, high temperature strain gages & self-temperature compensated gages.

UNIT VI : Grid Technique of Strain Analysis

Brittle coating method for stress & strain analysis, Moire fringe method for stress & strain analysis

Text Books :

1) Theory of Elasticity -S.P. Timoshenko & J.N. Goodier, Tata McGraw Hill
2) Experimental Stress Analysis –J.W. Dally &W.F. Riley, McGraw Hill
3) Experimental Stress Analysis, Dr. Sadhu Singh, Khanna Publishers

Reference Books :

1) Experimental Stress Analysis -T.K. Ray, S. Chand and Company
2) Experimental Stress Analysis -L.S. Srinath, Tata McGraw Hill
3) Advanced Strength and Applied Stress Analysis -Richard G Budynas, Tata McGraw Hill
4) Experimental Stress Analysis -G.S. Holister, Cambridge Univ. Press

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP 404-2 **Course: Stress Analysis**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes :

The expected learning outcome is that the students will be able to:

1. Understand the characteristics of photoelastic material
2. Determine the fringe constant of a material
3. Understand and separate the Principal stresses
4. Handle different types of gauges for strain measurement
5. Measure stress and strain at a point of interest in a material.

The laboratory will have minimum Eight Practical's based on the syllabus of MET404-2

List of Practicals:

1) Casting of Photoelastic Sheet
2) Preparation of Circular Disk or any model from photoelastic sheet
3) Determination of fringe constant using circular disk.
4) Determination of stresses using at least three photoelastic models
5) Separation of Principal Stresses using any method of stress separation
6) Stress freezing of photoelastic model
7) Fixing of strain gages to the specimen
8) Stress & strain measurement in cantilever beam using strain gages.
9) Study & demonstration of Reflection Polariscope
10) Study & demonstration of Fringe sharpner& multiplier

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET404-3 **Course: Refrigeration and Air Conditioning**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand the old and eco-friendly refrigerants for their selection in refrigeration and air conditioning systems.
2. Understand and apply the principles of thermodynamics to refrigeration and cryogenics systems.
3. Explain the components of refrigeration and air conditioning systems
4. Recognize the psychrometry and design the air conditioning system using heat load calculations.
5. Design of air distribution system for air conditioning system

Syllabus

Unit – I :

Refrigeration: Introduction, history & applications, reversed Carnot cycle.

Refrigerants: Classifications, refrigerant properties, nomenclature of refrigerants, alternate refrigerants, global warming potential & ozone depletion potential, Montreal & Kyoto protocol.

Vapour compression refrigeration system: cycle and its analysis, effect of sub cooling, superheating, polytropic compression & pressure drops on the performance of the system.

Vapour absorption refrigeration system: Introduction, principle, ammonia-Water& lithium bromide-water & three-fluid systems, performance.

Unit – II :

Multistage Vapour Compression Refrigeration Systems: Multiple compressor & multiple evaporator systems, cascade refrigeration system.

Refrigeration equipments: Compressors, evaporators, condenser and expansion device & control (types & principle only).

Defrosting methods, Testing & charging of refrigeration systems.

Unit – III :

Other Refrigeration Techniques: Air refrigeration system-Introduction, *bell-Coleman cycle, simple, boot-strap and regenerative systems. vortex tube, steam jet and thermoelectric refrigeration systems.*

Cryogenics: Introduction, application of cryogenics, Joule-Thomson coefficient & inversion curve, air liquefaction methods.

Unit – IV :

Psychrometry: Introduction, psychometric properties of air and their relations, psychometric chart, psychometric processes, by-pass factor of coils, air washer, adiabatic saturation temperature, apparatus dew point temperature, Sensible heat factor

Human Comfort: Thermodynamics of human body, factors affecting human comfort, effective temperature, comfort chart.

Unit – V :

Summer, winter, and Year round air conditioning systems.

All-air, all-water, & air-water systems. Evaporative air cooling system.

Design of various air-conditioning systems, RSHF, GSHF, ESHF.

Heat Load Calculations: Data collection for load calculation, various components of heat load estimate, method of cooling load calculation.

Unit – VI :

Air Transmission & Distribution: Principle of air distribution, types of grills & diffusers & their selection criteria, air alteration, types of air filters, distribution of air through ducts, Duct types & materials, pressure losses in ducts, equivalent diameter of circular duct for a rectangular duct, duct design methods, duct friction chart, duct arrangement systems.

Air conditioning controls.

Text Books :

1) Refrigeration and Air-conditioning by Dr. Manohar Prasad, New Age Int. Pub
2) A Textbook of Refrigeration and Air-Conditioning by **R. K. Rajput,** S.K.Kataria & Sons
3) Refrigeration and Air-conditioning by C.P. Arora, TMH Pub.
4) Domkundewar & Arora, 'A Course in Refrigeration & Air conditioning', Dhanpat Rai & Co.

Reference Books :

1) Refrigeration & Air-conditioning by Dr. P.L. Ballaney – Khanna Publication.
2) Refrigeration & Air-conditioning by Stocker & Jones – McGraw-Hill Publication.
3) Principle of Refrigeration & Air-conditioning by Roy J. Dossat - Pearson Education.
4) Refrigeration & Air-conditioning by Jordon & Priestar – PHI Publication.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP404-3 **Course: Refrigeration and Air Conditioning**

L:0Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes :

The expected learning outcome is that the students will be able to:

1. Identify the Refrigeration and air conditioning components; understand their principle and appropriate selection.
2. Conduct the experiments for performance evaluation of computerized refrigeration and air conditioning test-rigs and comparison with theoretical results.
3. Develop a skill to operate various tools for the repair and maintenance of air conditioning and refrigeration system.
4. Understand the various instrumentation and controls of refrigeration and air conditioning.
5. Understand the recent developments in the area of refrigeration and air conditioning.

List of Practicals:

1. Study of various types of refrigerant compressors.
2. To perform experiments on vapour compression test-rig.
3. Study of miscellaneous refrigeration systems such as vortex tube, thermoelectric, cascade and steam jet.
4. Study of various condensers, evaporators and expansion devices used in refrigeration systems.
5. To perform experiments on air-conditioning test-rig.
6. Study and demonstration of various tools and equipments used by a refrigeration mechanic.
7. Study of window air conditioner, packaged air conditioning and automotive air conditioning Systems.
8. Report on visit to air-conditioning or cold storage plant or ice plant or Milk chilling plant.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET404-4 **Course: Modeling and Simulation**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

1. Ability to recognize modelling and identification concepts as related to mechanical systems.
2. Make use of modern modelling tools to represent mechanical systems
3. Understand various techniques of simulation
4. Apply modeling and simulation techniques to simulate industrial systems using software packages.

Syllabus

Unit I

Modeling Basics: Models and modeling, purpose and objectives of modeling, examples of models. Principles of Physical Modeling: Concept of System and environment, basic relationship, Continuous and discrete systems, Linear and non-linear systems, Stochastic activities, Bond Graphs.

Unit II

Computer Aided Modeling: solid modeling of component using Creo, finite element modeling using ANSYS. Static and Dynamic models, Estimating Transient Response, Spectra and Frequency Functions, Parameter Estimation in Dynamic Models, System Identification as a Tool for Model Building.

Unit III

Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation. System Simulation: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques.

Unit IV

Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages. System Dynamics: Growth and Decay models, Logistic curves, System dynamics diagrams.

Unit V

Simulation of Mechanical Systems: Building of Simulation models, simulation of translational and rotational mechanical systems. Modelling systems for control strategies and design of control strategies in physical domain.

Unit VI

Simulation of electro mechanical, thermo - mechanical, hydraulic & pneumatic elements. Case studies related to industrial problems.

Text Books

1. Gordon, G., "System Simulation", Prentice Hall.
2. Jain , Modeling and simulation using MATLAB- SIMULINK, Wiley Press
3. Lennart, L. and Torkel, G., "Modeling of Dynamic Systems" Prentice Hall.
4. Bhonsle, S.R. and Weinmann, K.J., "Mathematical Modeling for Design of Machine Components", Prentice Hall.
5. Mukherjee, A., Karmaker, R. and Samantaray, A.K., "Bond Graph in Modeling, Simulation and Fault Identification", I & K International.
6. I.J. Nagarath& M. Gopal Systems Modelling & Analysis, Tata Me Graw Hill.

Reference Books

1. D'Souza, A.F., and Garg, V.K., "Advanced Dynamics: Modeling and Analysis", Prentice-Hall.
2. George Pelz, "Modeling and Simulation with HDL" John Wiley & Sons Ltd.
3. W.J. Palm, "Modelling Analysis and Control of Dynamic Systems", John Wiley.
4. Manual ofParametric Modelling with CREO.
5. *Rudra Pratap,* "Getting Started with MATLAB" *Oxford University Press.*
6. Nitin S. Gokhale, Sanjay S. Despande, Dr. Anand N. Thite,"Practical Finite Element Analysis" Finite to infinite.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP404-4 **Course: Modeling and Simulation**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

1. Ability to get hands on experience on modeling software's such as CREO & Autocad.
2. Ability to simulate the physical behavior of systems using ANSYS, MATLAB & Simulink.
3. Ability to analyze results obtained from these simulation tools.

The laboratory will have minimum Eight Practical based on the syllabus of MEP404-4

1. Solid modeling of structural components in CREO.
2. Finite element modeling of structural component in ANSYS.
3. Static structural analysis of machine component in ANSYS.
4. Nonlinear structural analysis using ANSYS.
5. Static thermal analysis using ANSYS.
6. Transient thermal analysis using ANSYS.
7. Transient analysis of vibrating system ANSYS.
8. MATLAB and SIMULINK tutorial for simulation of various mechanical systems.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 404-5 **Course: Mechatronics**

L: 3 Hrs., T: 1 Hr., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes:

The expected learning outcome is that the students will be able to:

1. Understand and appreciate synergistic combination of Mechanical Engineering with other branches of engineering.
2. Analyze the major components i.e. sensors, actuators and controllers of any Mechatronic system.
3. Explain construction and working of industrial and non- industrial Mechatronic system.
4. Explore a wide range of technologies (including Modeling and simulation) to provide the most economic, elegant and appropriate solution for the problem.
5. Demonstrate desire to remain abreast with the fast changing technology in all walks of life.

Syllabus:

Unit – I:

INTRODUCTION

Origin and evolution, Role in industrial automation, Role in non-industrial/office automation, Multi-disciplinary nature, Electrical components and electronic devices, Basic solid state components and devices.

Unit – II:

SENSORS AND TRANSDUCERS

Performance Terminology, Sensors for motion, force and torque. Various transducers- Inductive, Capacitive, Pyroelectric, Piezoelectric, Ionisation, Photoelectric.

MEMS and Microsystems: Introduction, working principle, Materials for MEMS and Microsystems, Introduction to micro-manufacturing and Micro system design.

Unit – III:

ACTUATORS

Elements of electromechanical energy conversion, DC & AC motors, Different types of stepper motors, hold on torques and position control of stepper motors. Starting, inversion and control of electrical drives, coupling of mechanical loads to DC and AC electrical drives.

Pneumatic and Hydraulic systems, Process control valves, Rotary actuators, Mechanical Actuation systems. Piezoelectric actuators..

Unit – IV:

SIGNALS AND CONTROLLERS

Signal Conditioning, Amplification, Protection, Filtering, Bridge Circuits, Comparator, Digital signals, Introduction to digital system Processing, Pulse Modulation.

Data Acquisition and Controlling, Micro controllers and PLCs, direction and speed control of electric motors, PID controls.

Unit – V:

MODELING AND SIMULATION

Modeling and simulation of physical systems- Mechanical, Electrical, Fluid and Thermal systems. Virtual Instrumentation and Computer Monitoring and control, modeling of the sensors, modeling of the Actuators. Techniques of interfacing mechanical devices with computer hardware and development of software for driving them (Computer Integration of Electro-Mechanical System)

Unit – VI:

APPLIED MECHATRONICS

Case studies in: Mechatronics in Home appliances, Medical Devices, Defense, Automobiles and office automation. Industrial Automation.

Design for manufacturing. Future of Mechatronics.

Text Books:

1. Mechatronics System Design, Shetty, D. and Kolk, R. A., Cengage Learning India Pvt. Ltd., Delhi
2. Mechatronics: A Multidisciplinary Approach,Bolton, W., 4th Ed., Pearson Education
3. Mechatronics: Principles, Concepts and Applications, Mahalik N.P., Tata McGraw Hill

Reference Books:

1. Understanding Electro-Mechanical Engineering : an Introduction to Mechatronics, Kamm, PHI
2. Introduction to Mechatronics and Measurement Systems, David Alciators& Michael B. Histand, Tata McGraw Hill, India , 2001.
3. Mechatronics, HMT, Tata McGraw Hill, India.

Syllabus of Elective-II, Bachelor of Engineering (Mechanical Engineering))

Course Code: MEP404-5 **Course: Mechatronics**

L: 0 Hrs. T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes :

The expected learning outcome is that the students will be able to:

1. Identify various sensors and transducers used in automated systems.
2. Interpret common circuits in automation
3. Explore use of available simulation softwares
4. Understand and test interfacing of ICs

Term work shall consist of 8 to 10 experiments on-

1. Detailed report on identification and demonstration of different sensors and actuators.
2. Demonstration of the working of various digital to analog and analog to digital converters.
3. Simulation and programming for systems like- Measurement of speed of a motor, Motor start and stop by using sensors, Lift / elevator control, Washing machine control, Tank level control, Tea/coffee dispenser.
4. Field study to locate and demonstrate working of at least one electro pneumatic system and one electro hydraulic system.

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: INT413 **Course: Productivity Improvement Techniques**

L: 3Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes :

The expected learning outcome is that the students will be able to :

1. Define and recognize the concept of Productivity, Work study and Method study.
2. Use various techniques of work measurement and calculate the standard time.
3. Understand human factor in engineering in the context of man machine system.
4. Know types of plant layouts and know the principles of material handling.
5. Understand the concept of value engineering and be aware of other productivity improvement techniques.
6. Understand various types of maintenance and the concept of reliability and maintainability.

Syllabus

Unit – I:

Productivity –Concept and objectives of Productivity, Types of Productivity, factors affecting Productivity. Tools & Techniques for Productivity Improvement, Measurement of Productivity, OMAX, Concept of work content, ineffective time. Work study and Method study : Definitions, objectives, steps in method study, process charts, string diagram, motion study, micro motion study, SIMO Chart.

Unit – II :

Work Measurement : Techniques of work Meassurement including Estimating, Stopwatch Time Study, Predetermined Time Standards, Synthetic Estimates of Work Times, MOST, Activity Sampling, Computation of Standard Time, Performance Rating, Allowances, Need for Allowances, Types of Allowances.

Unit – III :

Ergonomics : Objectives, Human factors in Engg. Man machine system, Display design, design controls. Principles of motion economy, work place design. Human factors in Mechanization, Automation and Automated Systems, Anthropometry.

Unit – IV :

Plant layout : Objectives, Principle, Types of plant layout, Material handling, Objectives, Principles and selection of material handling equipments, Unit load concept, material low pattern. Materials management.

Unit – V :

Value Analysis and Value Engineering, Introduction to quality circles, 5S, Lean manufacturing, Kanban, Kaizen.

Unit – VI:

Maintenance Management - Objectives, Types of maintenance, preventive, predictive, break down maintenance. Reliability and maintainability analysis Failure data analysis, reliability, MTBT, MTTR, Bathtub curve, series parallel and stand by system.TPM

Text Books :

1. Industrial Engg and Production management – Martand Telsang, S. Chand & Company Ltd.
2. Production Planning Control - Jain & Agrawal, Khanna Publisher
3. Human Factors Engineering, McCormic, Sanders, McGraw Hill Publication.
4. Value Engineering, Iyer S.S. , New Age International Publisher
5. Industrial Engineering, N.J. Manek, Laxmi Publications Pvt. Ltd.
6. Plant Layout and Material Handling, S.C. Sharma, Khanna Publisher

Reference Books :

1. Work study by ILO, Oxford and IBH Publishing
2. Motion and Time study – R M Barnes, Wiley Press
3. Plant layout and Material Handling - James Apple

Syllabus of Semester VII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP405 — **Course : Project Phase-I**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week — **Total Credits : 04**

Course Outcomes:

The expected learning outcome is that the students will be able to:

1. Apply knowledge, professional approach for solving specific cases/problems in engineering field.
2. Work effectively as an individual and member of a multidisciplinary team.
3. Review articles published in technical literature and information integration skills.
4. Demonstrate effective presentation and communication skills.
5. Illustrate a thorough understanding of techniques and processes.

General Guidelines:

1) The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry. It is expected to select project topic as per the guidelines of the project to be undertaken and the students may also preferably select the project works from their opted elective subjects.
2) The number of students in a group (as per the norms decided by the competitive authority) will work under the guidance of the faculty member, on the project work undertaken by them. Allotment of guide and group will be done as per the department policy.
3) A synopsis of the selected project work (3-5 pages typed on A4 size sheets) certified by the project guide, should be submitted within two month from the beginning of the semester.
4) The project work may consist of, a comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
5) The students should submit the Seminar report in a prescribed format before the end of semester. Term work will be assessed by the project guide along with project evaluation committee appointed by the Department.

VIII SEMESTER

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET406 **Course: Automation in Production**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes:

The expected learning outcome is that the students will be able to:

1. Understanding of automation knowledge, in terms of production line analysis and logics.
2. Familiarity with CNC technology and robotic areas, thereby achieve multidisciplinary integration of components, equipment.
3. Recognize material handling systems performance using analytical methods.
4. Apply manufacturing methodology to design and improve the manufacturing flexibility.
5. Awareness of the modern methods and techniques in the automation field.

Syllabus

Unit - I

Automation- Definition, types, reasons for automating, arguments for and against automation. Automation Principles and Strategies Types of production, Automated Flow Lines- Methods of workpart transport, Transfer mechanisms, parts delivery system, Analysis of flow lines- General terminology and analysis, analysis of transfer lines without storage, automated flow lines with storage buffers, Line Balancing, methods of line balancing and algorithms.

Unit - II

Numerical Control Production Systems- Machine control unit and other components, Tape and tape readers, ISO and EIA punch tapes, DNC and CNC, Adaptive control.

NC Basic concepts, Types and classifications of NC systems, coordinate system and machine motion, NC part programming, manual part programming, applications and economics of NC.

Unit - III

Industrial Robotics- Introduction, robot anatomy, robot control systems, accuracy and repeatability and other specifications, robot manipulator configurations, SCARA, wrist configurations, types of end effectors, types of sensors, types of power drives.

Different types of robot applications on shop floor, work cell layout, introduction to robot programming.

Unit - IV

Automated material handling & storage-Conveyor systems

Automated Guided Vehicle Systems, Types, Vehicle guidance & Routing, Traffic control & safety, System management, Analysis of AGVS systems, AGVS applications.

Automated Storage & Retrieval System, Analysis of AS/ RS, Carousel storage systems.

Unit - V

Automated inspection and types, methods -100% automated inspection, coordinate measuring, operation & benefits; Machine system and applications.

Group Technology, Part families, parts classification & coding, Opitz and Multiclass classification systems, Production flow analysis, types of Machine cell design, benefits of group technology.

Flexible manufacturing systems - Components, Types of systems, FMS layout configuration data files, system reports, FMS planning and benefits.

Unit - VI

Product Design and CAD,CAD/CAM, and CIM, Computer aided process planning (CAPP), Retrieval and generative CAPP systems, benefits of CAPP.

Shop floor control (SFC),Material Requirements Planning (MRP), Capacity Planning (CP), Just-in-Time Production Systems (JIT), Quality Function Deployment (QFD)

Text Books:

1. Automation, production System & CIMS: M. P. Groover, Prentice Hall of India, New Delhi
2. Industrial Robotics: M. P. Groover, Roger N. Nagel, Mc Grow-Hill, New Delhi
3. CNC Machines: M. Adithan& B. S. Pabla, New Age International Publications New Delhi

Reference Books:

1. CAD/CAM: M. Groover& E. Zimmers , Pearson Education, Delhi
2. Industrial Engg. & Production Management : Martand Telsang, S. Chand Publications, Delhi
3. Computer Control of Manufacturing Systems: Yoram Koren, Mcgraw Hill, Delhi

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP 406 **Course: Automation in Production**

L: 0 Hrs., T: 0Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes:

1. Understand and analyze the automated flow line and buffer storage algorithm.
2. AFamiliarity with CNC machines, programming & analysis of CMM data.
3. Study of robotic concepts, thereby achieve multidisciplinary integration approach.
4. Plan and recognize material handling systems performance using analytical methods.
5. Apply manufacturing methodology to design & improve the manufacturing flexibility.

(The laboratory will have minimum Eight Practical based on the syllabus of MET406)

Exp. No.	List of Experiments
1	To study automated flow line (AFL) & transfer line mechanism.
2	To Study Line Balancing Algorithms.
3	To study robot basic components and different robot configurations.
4	To study the methods of programming and applications of robots.
5	Performance on Coordinate Measuring Machine (CMM)
6	To study automated material handling and storage systems.
7	To study Group Technology.
8	To study NC component and Program of instructions.
9	To perform CNC - Lathe Programming.
10	To perform CNC - Milling Programming.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET407 **Course: Computer Aided Design**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

1. Ability to understand the basic concept of computer aided design and computer graphics.
2. Able to develop the programs to generate the line and circle as well as to realize the importance of 2-D transformation to manipulate a geometrical entity.
3. Able to comprehend the concept of 3-D transformation and various techniques of modeling
4. Learn the basic concept and applications of FEM to analyze the 1-D bar and 2-D trusses.
5. Able to analyse the structure by CST elements and to understand the various optimization techniques.

Syllabus

Unit – I :

Definition of CAD and its application, CAD Softwares modules (Operating System, Graphics, Applications, Programming, Communication). Product life cycle, Various techniques to generate the images, Rasterization Principle, Rasterization of line, frame buffer, N-bit plane buffers, simple color frame buffer.

Unit – II :

Generation of line, circle and ellipse using Bresenham's and DDA algorithms. Two dimensional geometric and co-ordinate transformations like scaling, translation, rotation, reflection, and shear. Concept of homogeneous representation and concatenated transformations. Inverse transformations. (Enumeration of entity on graph paper)

Unit – III :

Three dimensional geometric and co-ordinate transformation like scaling, translation, rotation and reflection. Bezier Curve (for 4 Control points).Introduction to surfaces, surface of revolution. Wire frame modeling, solid modeling of basic entities like box, cone, cylinder. CSG & B-rep technique.

Unit – IV :

Fundamental Concept of Finite Element Method, historical background and applications. Concept of stress analysis, Plain Stress and Strain, Compatibility condition, Minimum potential energy principle.Raleigh-Ritz method, Saint Venant's principle, sky line approach.

Unit – V:

Analysis of one dimentional bar and spring element, Displacement function, shape functions for linear & quadratic bar element. Stiffness matrix, Force Matrix. Analysis of two-dimensional trusses.

Unit – VI:

Analysis of Plain stress condition problems using Constant strain triangle elements.

Optimization: Optimal Problem Formation, Engineering optimization problems. Optimization Algorithms: Single Variable optimization algorithm using Golden search method, Bisection method.

Text Books:

1. CAD/CAM, Theory & Practice: Ibrahim Zeid (McGraw Hill)
2. Procedural elements for computer Graphics: D Rogers (McGraw Hill)
3. Introduction to Finite Elements in Engineering: Chandrupatla & A.D. Belegundu(PHI)
4. Optimization for Engineering Design: Kalyanmoy Deb (PHI)

Reference Books:

1. Computer Graphics: D. Hearn & M.P. Baker (Pearson Education)
2. Mathematical Elements for Computer Graphics Dravid F Rogers, J. Alan Adams (McGraw Hill)
3. Schaum's Outline Series: Theory & Problems of Computer Graphics Roy A. Plastock, Gordon Kalley

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP407 **Course: Computer Aided Design**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Able to understand the software and hardware required for computer graphics.
2. Able to develop the c-programs to generate the line and circle
3. Able to understand the concept of 2-D and 3-D geometrical transformation.
4. Able to analyze the various 1-D & 2-D structures like bar & trusses etc by analysis software.
5. Able to understand the process of additive manufacturing.

List of Experiments

1. Study of Computer Aided Design (CAD) softwares.
2. C-Program of DDA line algorithm.
3. C-program of Bresenham's line algorithm
4. C-program of Bresenham's circle algorithm
5. Generation of at least two solid models showing geometric properties using any CAD software.
6. Numerical examples of two dimensional transformations.
7. Numerical examples of three dimensional transformations.
8. One dimensional problem of finite element method.
9. Finite element method problem on truss.
10. Finite element method problem using two dimensional elements.
11. 3-D printing of geometrical model.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 408-1 **Course: Tool Design**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes :

The expected learning outcome is that the students will be able to:

1. Understand basic principle of metal cutting theory.
2. Describe design criterion for designing single point and multipoint cutting tools.
3. Describe tool design methods for forging and sheet metal processes.
4. Explain the principles of clamping, jigs and designing fixtures for machining and joining operations.

Syllabus

UNIT - I

Theory of metal Cutting: Introduction, Mechanics of chip formation, Cutting tool materials, Single point cutting tool, Designation of cutting tools, ASA system, Importance of Tool angles, Orthogonal rake system, Classification of cutting tools, Types of chips, determination of shear angle, velocity relationship , force relations, Merchant's Theory, Cutting power, Energy consideration in metal cutting, Tool wear, Tool life, Tool life criteria, variable affecting tool life, Machineability.

UNIT-II

Design of single Point Cutting Tool: Form tools- Introduction, Types, design of form tools.

Drills- Introduction, Types, Geometry, Design of drill.

Milling cutters - Introduction, Types, Geometry, and Design of milling cutters.

Reamers, Taps & Broaches - constructional features only

UNIT-III

Introduction, Press operations - Blanking, piercing, Notching, Perforating, Trimming, Shaving, Slitting , Lancing, Nibbling , Bending, Drawing , Squeezing . Press working equipment - Classification, Rating of a press, Press tool equipments , arrangement of guide posts . Press selection, press working terminology , Working of a cutting die , Types of dies - Simple dies, inverted die, compound dies, combination dies, progressive dies, Transfer dies, multiple dies Principle of metal cutting, strip layout, clearance, angular clearance, clearance after considering elastic recovery, cutting forces, method of reducing cutting forces, Die block, Die block thickness, Die opening, Fastening of die block, back up plate, Punch, Methods of holding punches, Strippers. Stoppers, Stock stop, Stock guide, Knock outs, Pilots. Blanking & Piercing die design - Single & progressive dies.

UNIT-IV

Bending Forming & Drawing dies, Bending methods - Bending Terminology, V- Bending, Air bending, bottoming dies, Wiping dies, spring back & its prevention, channel dies. Design Principles - Bend radius, Bend allowance, Spanking, width of die opening, Bending pressure.

Forming Dies- Introduction, Types - solid form dies, pad type form dies, curling dies, Embossing dies, coining dies , Bulging dies, Assembly dies.

Drawing Dies - Introduction, Difference between blending, forming & drawing, Metal flow during drawing, Design, Design consideration - Radius of draw die, Punch radius, Draw clearance, Drawing speed, Calculating blank size, Number of draws, Drawing pressure, Blank holding pressure.

UNIT-V

Forging Die Design & mould Design: Introduction, Classification of forging dies, Single impression dies, Multiple Impression dies. Forging design factors - Draft, fillet & corner radius, parting line, shrinkage & die wear, mismatch, finish allowances, webs & ribs.

Preliminary forging operation - fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design for machine forging - determination of stock size in closed & open die forging. Tools for flash trimming & hole piercing, materials & manufacture of forging dies .

Mould Design: of Simple Blow Moulds for Articles such as bottles, cans Design of simple two plate injection moulds , Mould Materials.

UNIT-VI

Design of jigs & fixture :- Introduction, locating & clamping - principle of location, principle of pin location, locating devices, radial or angular location, V - location, bush location. Design principle for location purpose, principle for clamping purposes, clamping devices, design principles common to jigs & fixtures.

Drilling Jigs :- Design principles, drill bushes, design principles for drill bushings, Types of drilling jigs - Template jig, plate type jig, open type jig, swinging leaf jig, Box type jig, channel type jig . Jig feet.

Milling Fixtures :- Essential features of a milling fixtures, milling machine vice, Design principles for milling fixtures, Indexing jig & fixtures, Automatic clamping devices.

Text Books:

1. Production Engineering ,P.C. Sharma, S. Chand Publication
2. Tool Design, Donaldson, Tata McGraw Hill, New Delhi
3. Jigs and Fixtures, Joshi, Tata McGraw Hill, New Delhi.

Reference Books:

1. Fundamentals of the Tool Design, ASTME, Prentice-Hall of India Private Ltd., New Delhi.
2. Manual of Jigs and Fixtures Design, Henrickson, Industrial Press Inc., New York.
3. Theory and Application of Metal Cutting, Juneja, Wiley Eastern Ltd., New Delhi.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET408-2 **Course: Automobile Engineering**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Recognize the fundamentals and applications of various types of automobiles and tyres.
2. Illustrate the importance and working of transmission components and evaluate the torque transmission capacity and gear ratios.
3. Describe the driveline components and various braking systems.
4. Explore components and working of steering and suspension system and indicate their effect on vehicle handling and stability.
5. Demonstrate the importance and functioning of various electrical and electronic devices used in automobiles.
6. Express the need and functioning of safety equipment and recent trends in automobiles.

Syllabus

Unit – I

Introduction, Automobile history and development, Chassis, articulated and rigid vehicles and vehicles layout. Vehicle body types, Prime mover, cooling and lubrication systems. Tyres: types of tyres, tyres specification, factors affecting tyre performance, Special tyres, hydroplanning.

UNIT - II

Clutch – Necessity, requirements of a clutch system. Types of Clutches, centrifugal clutch, single & multi plate clutch, fluid Clutch. Gear box - Necessity of transmission, principle, Gear Ratios, types of transmission, Sliding mesh, constant mesh, synchromesh, Transfer gear box, Gear Selector mechanism, lubrication and control. Torque Converter, Automatic Transmission.

UNIT - III

Transmission system: Propeller shaft, Universal joint, constant velocity joint, Hotchkiss drive, torque tube drive. Differential - Need and types, Rear Axles and Front Axles, transaxle, differential locking. Brakes - Need, types Mechanical, hydraulic, Pneumatic brakes, Electrical Brakes, Engine Exhaust brakes, Drum and Disc brakes, Comparison. Details of components, Brake adjustment, ABS.

UNIT – IV

Steering systems, principle of steering, center point steering, Steering linkages, steering geometry and wheel alignment, power Steering, special steering systems, Electronic Power Steering, under steer over steer, wheel balancing, suspension systems - Function of Spring and shock absorber, conventional and Independent suspension System, Telescopic shock absorber, linked suspension systems. Antiroll bars, Active suspension

UNIT - V

Electrical systems–construction. Operation and maintenance of Batteries, Alternator, starter motor, Battery Ignition and magneto ignition systems, Electronic ignition, Lighting, Horn, Side indicator wiper. Automobile air-conditioning, Panel board instruments. Maintenance & trouble shooting. Automotive Lighting, Parking Assistance, Navigational aids, Intelligent Lighting.

UNIT - VI

Driver safety, Occupant safety, restrains system, safety glasses, Air bags collision, crumple zone, Pedestrian safety, collision avoidance system, intelligent vehicle highway system. Electric and Hybrid vehicle.

Text Books:

1. Automobile Engineering Vol 1–Kirpal Singh, Standard Publishers.

Reference Books:

1. Advance Automotive Technology, Heniz Hitner, SAE International.
2. Automotive Mechanics – W.H.Crouse, D.L Anglin, Tata McGraw Hill Education.
3. Automobile Engineering by G.B.S. Narang, Khanna Publisher.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET408-3 **Course: Vibrations in Mechanical Systems**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand concepts of linear mechanical vibrations through analysis of the free and forced responses of single and multiple degree-of-freedom (DOF) systems.
2. Demonstrate the ability to apply the energy method, Lagrange's equation to solve MDOF systems for transverse and torsional vibratory systems
3. Illustrate the applications of numerical techniques to determine response of beam and rotor systems
4. Analyse the vibrations in continuous systems with introductory nonlinearity.
5. Apply FEM knowledge of variational formulations including Rayleigh-Ritz method to rod and beam for modal analyses.
6. Exhibit skills towards vibration measurement and condition monitoring of mechanical systems.

Syllabus

Unit – I :

Free body diagram, free & forced vibration, undamped and damped single degree of freedom systems subjected to harmonic and other periodic excitations. Impulse response, and response to arbitrary excitation. Vibration isolation and transmissibility.

Unit – II :

Energy method applied to multi degree freedom system. Lagrange's equation. Generalized mass formulation of mass, damping and stiffness matrix and its numerical solutions. Vibration absorber, torsional vibration of two and three disc system. Influence Coefficients and flexibility matrix of bending vibration of beam and multi-disc rotor. Mode shapes and orthogonality principle.

Unit – III :

Numerical techniques for M.D.O.F. systems. Matrix iteration method. Holzer's method for torsional vibration. Dunkerleys method and Rayleigh's method for determination of all the natural frequencies and modes shapes.

Unit – IV:

Vibration of continuous system. Axial vibration of rod, bending vibration of beam and torsional vibration of shaft. Rayleigh quotient. Modal co-ordinates and modal forces. Free and forced response through modal analysis.

Unit – V:

Finite element method in vibration of continuous system. Variational functional formulation for axial element and Rayleigh - Ritz method. Shape function for rod and beam elements. Derivation of mass and stiffness matrix. Natural frequencies and mode shape computation for simple rod and beam problem.

Unit – VI:

Vibration pickup, seismometers, accelerometer, proximity probe spectrum analyzer, FFT torsional vibration measurement, vibration measurement, philosophy of vibration condition monitoring.

Text Books:

1. Mechanical Vibrations: S S. Rao, Prentice Hall Publishing Co.
2. Mechanical vibrations : V.P. Singh
3. Mechanical vibrations : Graham Kelly, Schaum's series.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET408-4 **Course: Power Plant Engineering**

L: 3 Hrs, T: 1 Hrs, P: 0 Hrs, Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Investigate the flunctuating loads and probe into economic analysis of power plants.
2. Understand Hydrology; express the working principles, analytical treatment and governing of Hydro turbines.
3. Analyze the steam power cycle & explore the major equipments of a Steam power plant along with coal handling and ash disposals.
4. Explore components, working principles of a gas turbine & diesel electric power plant.
5. Demonstrate various energy storage/recovery systems and abstract of renewable solar, wind energy etc.
6. Explain nuclear energy conversion process; describe various types of nuclear reactors and recognize nuclear waste disposal issues.

Syllabus

Unit – I :

ECONOMICS OF POWER GENERATION

Indian Energy scenario, Load curves, various terms & definition, effect of fluctuating load. Power plant economics, Tariffs, load division, and cost of electric energy.

Unit – II :

HYDROELECTRIC POWER PLANTS

Hydrology : Rainfall, Runoff, Hydro graph, flow duration curve. Plant capacity estimation.

Hydroelectric power plant : Site selection, classification of hydroelectric power plant, different components, prime movers, governing, models & model testing, advantages.

Unit – III :

STEAM POWER PLANTS

Introduction, Power plant layouts, Analysis of Steam Cycles, Coal : Properties, handling & storage, fuel firing methods, ash & dust handling. Steam generators, steam turbine, condenser and cooling towers.

Unit – IV :

Gas Turbine Power Diesel Power Plants : Introduction, classification, various components, different arrangement, governing, methods to improve efficiency.

Diesel Electric Power Plant : Introduction, Outline, type of engines, different components, performance, plant layout, comparison with other power plant.

Unit – V :

Energy storage systems & renewable sources of energy

Peak Load plants, waste heat recovery system. Various energy storage - systems viz. pumped hydro, compressed air, flywheel, battery storage etc. Introduction to unconventional power sources : Solar, wind, Tidal, geothermal etc.

Unit – VI:

Nuclear Power Generation

Introduction to Nuclear Engineering : Nuclear reactions & its initiation, fission, component of nuclear reactors. Nuclear Reactors :Types of reactors, PWR, BWR, CANDU etc. Nuclear Waste Disposal : Effects of nuclear waste on environment, its disposal to soil, water, air, sea etc.

Text Books :

1. Power Plant Engineering - P. K. Nag, Tata Mc- Graw Hill Publications, Third Edition
2. Power Plant Engineering - S. Domkundwar, Dhanpatrai & sons.
3. Power Plant Engineering - R.K. Rajput, Laxmi Publications, Fifth Edition

Reference Books :

1. Power Plant Engineering - M.M.Wakil, Mc-Graw Hill.
2. Power Plant Engineering - Black and Veatch, CBS Publisher and Distributors.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET408-5 **Course: Optimization Techniques**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Gets optimal solution using classical technique.
2. Get inter optimal solution to LPP and do optimal setting of variable to 0 or 1 in binary programming situation.
3. Get optimal solution to nonlinear optimization problem using digital techniques or geometric programming.
4. Determine optimal solution in uncertain situation and to predict future values of various states undergoing transition.
5. Determine shortest path between two points, maximizing flow in network.

Syllabus

Unit - I

Classical optimization techniques: Single variable optimization – Multivariable optimization with no constraints – Hessian matrix – Multivariable saddle point – Optimization with equality constraints – Lagrange multiplier method- Multivariable optimization with inequality constrains – Kuhn-Tucker conditions.

Unit - II

One-dimensional unconstrained minimization

Elimination methods – Dichotomous method, Golden section method, Fibonacci method, Interpolation methods – Quadratic interpolation and cubic interpolation methods.

Unit - III

Multivariate Unconstrained minimization

Univariate method, Powells method, Hooke and Jeeve's method, Simplex method.

Unit - IV

Linear Integer programming problem, branch and bound method

Gomery's method, zero-one programming problem.

Unit - V

Network Technique, Shortest path model – Dijkstra's Algorithm, Floyd's Algorithm – minimum spanning tree problem, PRIM algorithm – Maximal Flow Problem algorithm

Unit - VI

Geometric Programming, Stochastic Programming.

Text Books:

1. Optimization theory and application – S.S. Rao, New Age International P. Ltd.
2. Operation Research an introduction – H. A. Taha, Eastern Economy Edition.
3. Operation Research – R. Pannerselvam, PHI

Reference books:

1. Optimization Concepts and applications in Engineering – A. D. Belegundu, T.R. Chandrupatla, Pearson Education Asia.
2. Principles of Operations Research for Management – F. S. Budnick, D. McLeavey, R. Mojena, Richard D. Irwin, INC.

Principles of Operations Research with Applications to Managerial Decisions – Wagner Harvey M - (Prentice-Hall international series in management)

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 408-6 **Course: Cryogenics**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand gas liquefaction, gas separation & purification systems
2. Evaluate the performance of cryogenic systems
3. Choose different working fluids & materials in cryogenic systems.
4. Select low temperature systems for various applications.

Syllabus

Unit-I :

Introduction

Limitations of Carnot cycle, vapor compression cycle and air refrigeration cycle. Production of low temperature by reversible and irreversible adiabatic expansion of a gas; Joule Thomson effect; Joule Thomson co-efficient, Inversion curve.

Unit-II :

Gas Liquefaction Systems

Linde-Hampson, Linde dual pressure, Claude, Heylandt and Kapitza systems; Systems for liquefaction of Neon, Hydrogen and Helium; Collins and Simon systems for helium liquefaction

Unit-III :

Gas Separation and Purification Systems

Ideal system, Gas separation by simple condensation or evaporation, principles of rectification, Air separation systems: Linde single column and double column, Linde–Frankl, Heylandt, Argon separation system; Neon separation system; Linde – Bronn system for hydrogen separation, Hydrogen – deuterium separation system; Helium separation from natural gas; Physical adsorption for gas purification

Unit-IV :

Gas Refrigeration Systems

Joule Thomson refrigeration system, Pre cooled Joule Thomson refrigeration system, Expansion engine refrigeration system, Cold gas refrigeration system, Stirlingcryocooler

Unit-V :

Material and fluid properties

Thermal and Mechanical properties of engineering materials at cryogenic temperatures, Properties of cryogens, Cryogenic insulations

Unit-VI :

Cryogenic Applications

Applications in space, on-ground, medical, electronic cooling, manufacturing processes, preservation and bio-technology.

Text Books :

1. Cryogenic systems, R. Barron, McGraw–Hill Company
2. Fundamentals of Cryogenics Engineering, Mamata Mukhopadhyay, PHI Learning Pvt. Ltd.
3. Cryogenic Fundamentals, G.G.Hasseldon, Academic Press
4. Advanced Cryogenics, Bailey, Plenum Press

Reference Books :

1. Industrial Refrigeration Handbook, W.F. Stoecker, McGraw-Hill Publication.
2. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 409-1 **Course: Industrial Robotics**

L: 3 Hrs., T: 1 Hrs., P: 0Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Survey the historical background of Industrial robots and recent developments.
2. Develop kinematics and apply basics of dynamics to industrial manipulators.
3. Identify various components of a robotic systems.
4. Describe various control strategies used in robotic systems
5. Evaluate various work cell layouts and common industrial situations for robotic applications.

Syllabus

Unit – I:

Automation and introduction to robotics, structure of robot system, configuration, degree of freedom, specifications, accuracy, end effectors.

Robotic evolution, advanced features of modern robot, Industrial robotics scenario in India, advantages and disadvantages, cost effectiveness.

Unit- II

eIntroduction to manipulator kinematics, position representation, forward and reverse transformations of a 2-DoF arm, a 3-DoF arm in two dimension, a 4-DoF arm in three dimension, homogeneous transformations in robot kinematics, D-H notations, solving kinematic equations.

Introduction to robot arm dynamics.

Unit – III:

Basic control system models, slew motion, joint-interpolated motion and straight line motion, controllers like on/off, proportional, integral, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative.

Robot actuation and feedback components, hydraulic, pneumatic, and electric actuators. Various sensors in robotics and robot vision

Unit – IV:

Robot motion analysis: Differential motion of robot and it's hand frame, Jacobian, for 4-DOF manipulator.

Trajectory planning: path control modes, joint interpolated trajectory, linear, parabolic, polynomial path.

Unit – V:

Robot programming methods: Lead through programming, programming languages. General considerations in robotic material handling, material transfer applications, pick and place operations, palletizing and related operations, machine loading and unloading, die casting, plastic molding, forging, machining operations, stamping press operations using robots. Use of robot in spot welding, continuous arc welding, spray coatings,

Unit – VI:

Robot cell layouts, multiple robots and machine interface, other considerations in work cell design, work cell control, interlocks, error detection and recovery, workcell controller, robot cycle time analysis.

Mobile robots in manufacturing, AGVs, types of wheels and other items for AGVs, wheel layouts and control strategies. Robots in Assembly operations. Design considerations for robotic assemblies in mass manufacturing.

Text Books:

1. “Industrial Robotics: Technology, Programming and Applications”; Groover, Weiss, Nagel, Odrey; Tata McGraw-Hill
2. “Robotics and Control”, R.K. Mittal, and I.J. Nagrath , McGraw Hill, New Delhi
3. "Introduction to Robotics”, Saeed B. Niku, Pearson Publication
4. “A text book on Industrial Robotics”, Ganesh S. Hegde, Laxmi Publications Pvt. Ltd.

Reference Books:

1. "Robotics: control, sensing, vision and intelligence”, Fu, Gonzalez, Lee, McGraw Hill.
2. "Theory of Applied Robotics”, Raza N. Jazar, Springer
3. "Introduction to Robotics (Mechanism and Conntrol)”, John J. Craig, Pearson education Inc.
4. "Introduction to Autonomous Mobile Robots”, R. Siegwart, I.R. Nourbaksh, PHI.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP 409-1 **Course: Industrial Robotics**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs. Per week **Total Credits: 02**

Course Outcome:

The expected outcome is that the students will

1. Understand and apply techniques of Forward & inverse Kinematic modeling.
2. Apply techniques to real life industrial situations for competent solutions.
3. Initiate a thought process for introduction of robots in manufacturing critical components.
4. List & describe various options for AGvs in different situations.

List of experiments:

1. Determination of Transformation Matrix for a 2 DOF manipulator by DH notation.
2. Forward Kinematics of *n*- DOF manipulator. (Divide the batch in groups).
3. Inverse Kinematics of *n*- DOF manipulator. (Divide the batch in groups).
4. Determination of Jacobian Matrix for *n*- DOF manipulator.
5. Dynamic analysis of *n*- DOF manipulator by Newton-Euler's approach.
6. Dynamic analysis of *n*- DOF manipulator by Lagrangian-Euler's approach.
7. Trajectory planning.
8. Robot simulation using MATLAB software.
9. Design of PI controller.
10. Design of AGV for obstacle avoidance.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET409-2 **Course: Renewable Energy Systems**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits: 07**

Course Outcomes :

The expected learning outcomes is that, the students will be able to

1. List and describe the primary renewable energy sources, their feasibility and challenges.
2. Describe main features of solar thermal and photovoltaic systems
3. Perform elementary mathematical analysis for designing of different solar thermal collectors
4. Describe different types and components of wind energy conversion systems and can analyze wind speed data and wind turbine performance in a given wind regime
5. Describe components and principles of other renewable systems like biomass, biogas, ocean energy conversion systems, geothermal systems etc

Syllabus

Unit – I :

Introduction to renewable energy sources: Global energy scenario, conventional and non conventional sources of energy, merits and challenges.

Solar Energy: solar radiation geometry, measurement of solar radiations, estimation of average solar radiations on horizontal and tilted surfaces.

Unit – II :

Solar Energy Collectors: conversion of solar radiation into heat, liquid flat plate collectors, analysis of flat plate collector, various performances indicating parameters, novel designs of flat plate collectors. Concentrating collectors: line focusing, point focusing and non focusing type, central receiver concept of power generations compound parabolic collector, comparison of flat & concentrating collectors.

Unit – III :

Applications of solar energy: Water heating - Space-heating and cooling, distillation, solar air-heaters, solar chimney, solar thermal-electric conversions.

Solar energy storage: sensible, latent and thermo chemical storage, solar ponds.

Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells, Photovoltaic system components and different applications.

Unit – IV :

Wind and Ocean energy:**-** Power in wind, forces on blades, wind energy: Basic principle of wind energy conversion site selection consideration wind data and energy estimation, basic components of WECS Classification of WEC systems, savonius and darrieus roters, and applications of wind energy.

Ocean energy: Introduction: - ocean thermal electric conversion open and closed cycle of OTEC, hybrid cycle, energy from tides basic principles of tidal power & components of tidal power plants, single & double basin arrangement estimation of tidal power and energy. Energy from ocean waves -energy availability, wave energy conversion devices

Unit – V:

Biogas: - Introduction, bio gas generation, fixed dome & floating drum biogas plants their constructional details, raw material for biogas production, factors affecting generation of biogas and methods of maintaining biogas, production, digester design considerations, fuel properties of biogas and utilisation of biogas

Bio Mass :- Introduction, methods of obtaining energy from biomass, Incineration, thermal gasification, classification of gasifiers & constructional details chemistry of gasification fuel properties, applications of gasifiers

Unit – VI :

Geothermal and MHD power generation :Geothermal energy: Introduction, classification of geothermal systems vapour dominated, liquid dominated system, total flow concept, petro-thermal systems, magma resources, applications of geothermal operational & environmental problems. Magneto Hydro Dynamic power generation: Introduction, principles of MHD, power generation, MHD open and closed systems, power output from MHD generators, design problems of MHD generation, gas conductivity, seeding.

Text Books:

1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi.
2. S. Rao And B.B. Parulekar, Energy Technology :Nonconventional, Renewable And Conventional Khanna Publisher, New Delhi.
3. G. N. Tiwari And M. K. Ghoshal, Renewable Energy Sources Basic Principles And Applications, Narosa Publishing House, New Delhi.
4. S.P. Sukhatme, Solar Energy: Principles Of Thermal Collection And Storage, Tata Mcgraw-Hill

Reference Books:

1. John Twidell , Tony Weir , Renewable Energy Resources, Taylor & Francis; 2nd edition, 2005
2. Duffie, J. A. & W. A. Beckman.Solar Engineering of Thermal Processes, 3rd ed. John Wiley & Sons, Inc., 2006
3. Boyle, G.. Renewable energy: Power for a sustainable future. Oxford University press, Oxford, UK., 2004
4. C. S. Solanki, "Solar Photovoltaics: Fundamental Applications and Technologies, Prentice Hall of India, 2009.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP409-2 **Course : Renewable Energy Systems**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 02**

Course Outcomes

1. Able to measure and estimate the solar radiations in different situations.
2. To understand construction and working of various devices in renewable energy systems.
3. Ability to design and analyze solar photovoltaic and thermal systems for given requirements.
4. Knowledge of miscellaneous renewable energy systems.

List of practicals :

1. Measurement of solar radiations using pyranometer in different conditions.
2. To study construction and working of various solar photovoltaic (PV) systems.
3. To study the performance of PV module with varying radiation intensities and module temperature.
4. To study the series and parallel combination of PV modules.
5. To study the effect of tilt angle and shading on the PV output.
6. To study the role of by pass and blocking diodes in photovoltaics.
7. Design of photovoltaic system for various applications.
8. Performance analysis of liquid flat plate collector in the thermosiphon mode of flow with fixed input parameters.
9. Performance analysis of liquid flat plate collector in the thermosiphon mode of flow with varying tilt angles, radiation intensity and wind speed.
10. Performance analysis of liquid flat plate collector in the forced circulation mode of flow with varying tilt angles, mass flow rates, radiation intensity and wind speed.
11. To study construction and working of various solar collectors.
12. To study construction and working of various renewable energy systems.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET409-3 **Course: Mechanical System Design**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Demonstrate an understanding of various systems and mechanisms used for single / special purpose machines.
2. Demonstrate ability to design the various components of speed drives and gear boxes
3. Illustrate designs of spindles, their support and guide ways
4. Analyse the force and motion in mechanisms of actual systems
5. Apply knowledge to select hydraulic / pneumatic drive
6. Exhibit skills towards selecting electrical control system

Syllabus

Unit -I:

Principles of Machine tool design, Machine structures: Construction, Materials, Design Criteria,

Unit –II:

Regulation of speeds & feeds, Design of Speed drives, feed drives, gear boxes.

Unit –III:

Design of Spindles, Design of Spindle Supports, Design of Guide ways.

Unit –IV:

Force and motion analysis of mechanisms in actual system: Linkages, power screws, gears, Chains, Cams.

Unit –V:

Hydraulic System Design: Circuits, Power packs, Cylinders, Regulators, Valves. Pneumatic System Design: Circuits, Compressors, Cylinders, Regulators, Valves. Functions of above components.

Unit –VI:

Control System in machines: Electrical circuits for A/C single phase & three phase, Electrical circuits for DC supply, Arrangement of starters, switches, relays, limit switches, contactors, Drives, interlocking of components for safety in operations, Functions of above components.

Text Books:

1. Machine Tool Design and Numerical Control– N. K. Mehta, Tata McGraw Hill Publication.
2. Pneumatic Systems: S R Mujumdar- Tata McGraw Hill Publication.
3. Industrial Hydraulics: J. J. Pippenger-McGraw-Hill
4. Fluid Power wit Applications: A. Esposito- Pearson Education
5. Mechanical System Design: Mishre & Simant- PHI Learning

Reference Books:

1. Machine Tools Hand Book – P. H. Joshi, – Tata McGraw Hill Publication
2. Machine Tools Design Handbook Central Machine Tool Institute - Tata McGraw Hill Publication.
3. PSG- Design Data Book, published by Kalaikathir Achchagam Coimbatore
4. Design Data for Machine Elements by B. D. Shiwalkar, Central Techno Publication.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP409-3 **Course: Mechanical System Design**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Outcomes

1. Ability to construct the system required for operation of a machine.
2. Ability to design a control system for a machine.
3. Ability to coordinate various types of systems in practice.

The laboratory will consist of project work to be performed by the group of students on a mechanical system based on the MET203 syllabus.

The practical will consist of CAD drawing of components of a system, assembly of components, simulation of the system, design considerations and process, control circuit design.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 409-4 **Course: Simulation of Manufacturing Systems**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes:

The expected outcome is that the students will have -

1. Ability to imitate real systems like manufacturing, production, banking, hospital etc. on computer.
2. Ability to alter the settings in simulation model so that behavior of model built is close to real system.
3. Ability to assess the effect of implementation of certain proposal in simulation model on system performance.

Syllabus:

Unit I

Principle of computer modeling and simulation: Monte Carlo simulation. Nature of computer modeling and simulation. Limitations of simulation, areas of application.

Unit II

System and environment: Components of a system – discrete and continuous systems.

Models of a system – a variety of modelling approaches.

Random number generation: Techniques for generating random numbers – Mid square method – The mid product method – Constant multiplier technique – Additive congruential method – Linear congruential method – Test for random numbers – The Kolmogorov –Smirnov test – the Chi-square test.

Unit III

Random variable generation: Inverse transform technique – exponential distribution–uniform distribution – Weibull distribution Emprical continuous distribution–generating approximate normal variants – Erlang distribution.

Unit IV

Empirical discrete distribution: Discrete uniform distribution – Poisson distribution –geometric distribution – acceptance – rejection technique for Poisson distribution –gamma distribution.

Unit V

Design and evaluation of simulation experiments: Variance reduction techniques –antithetic variables – verification and validation of simulation models.

Unit VI

Discrete event simulation: Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue – two server queue, simulation of inventory problem.

Text books

1. Jerry Banks & John S. Carson II, "Discrete Event System Simulation" Prentice Hall Inc.
2. Gordon G, " System Simulation", Prentice Hall Ltd.
3. Modeling and Simulation by Law and Kelton.

Reference Books

1. Narsingh Deo, "System Simulation with Digital Computer" Prentice Hall
2. Francis Neelamkovil, "Computer Simulation and Modeling", John Wiley & Sons
3. Ruth M. Davis & Robert M.O'Keefe, "Simulation Modeling with Pascal", Prentice Hall Inc.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP 409-4 **Course: Simulation of Manufacturing Systems**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 02**

Course Outcomes

The expected out come is that the students will have

1. Ability to imitate real systems like manufacturing, production, banking, hospital etc. on computer
2. Ability to alter the settings in simulation model so that behavior of model built is close to real system.
3. Ability to assess the effect of implementation of certain proposal in simulation model on system performance.

List of Practicals:

1. 2 or 3 sessions for comparison of various available simulation softwares like- TECHNOMATICS, SIMUL8 and ARENA.
2. Minimum 3 real life situations to be simulated with one each for these softwares.
3. Survey of present day trend in simulation of systems to be completed

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MET 409-5 **Course: Industrial Fluid Power**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 07**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Identify the hydraulic fluids, their properties and various seals used in fluid power systems with their applications.
2. Understand the construction and working of various types of hydraulic accumulators, intensifiers and valves.
3. Understand the various methods of actuation for Direction Control valves and Flow Control valves.
4. Compute the pressure drop and design parameters for hydraulic piping and actuators.
5. Design a hydraulic circuit for a given application.
6. Understand the various components, working and applications of pneumatic systems.

Syllabus

UNIT I

FLUID POWER SYSTEMS: Components, advantages, applications in the field of M/c tools, material handling, hydraulic presses, mobile & stationary machines, clamping &indexing devices etc. Transmission of power at static & dynamic states. Types of Hydraulic fluids like petroleum based, synthetic & water based. Properties of fluids, Selection of fluids, additives, effect of temperature & pressure on hydraulic fluids. Seals, sealing materials, selection of seals, Filters strainers, sources of contamination of fluid & its control.

UNIT-II

ACCUMULATORS & INTENSIFIERS: Types & functions of accumulators, Intensifiers, applications, selection & design procedure.

CONTROL OF FLUID POWER: Necessity of pressure control directional control, Flow control valves, Principle of pressure control valves, direct operated, pilot operated, Relief valves pressure reducing valve, sequence valve & methods of actuation of valves.

UNIT-III

FLOW CONTROL VALVES: Principle of operation, pressure compensated, temp. Compensated flow control valves, meter in & meter out flow control circuits, bleed off Circuits.

DIRECTION CONTROL VALVES: Check valves, types of D.C.Valves: Two way two Position, four way three position, four way two position valves, open center, close center Tandem center valves, method of actuation of valves, manually operated solenoid Operated, pilot operated etc.

UNIT-IV

ACTUATORS: Linear & Rotary actuators, Hydraulic motors, - Types, vane, gear Piston, radial piston. Calculations of piston velocity thrust under static & dynamic applications. Design Consideration for cylinders.

Hoses & Pipes: Types, Materials, pressure drop in hoses/pipes.

Hydraulic piping connections.

UNIT-V

DESIGN OF HYDRAULIC CIRCUITS:

Circuit illustrating use of pressure reducing valves, sequencing valve, counter balance Valves, unloading valves with the use of electrical controls, accumulators etc. Maintenance, trouble shooting & safety precautions of Hydraulic Circuits.

Methods of control of acceleration

UNIT-VI

PNEUMATICS: Introduction to pneumatic power sources, e.g. reciprocating & rotary Compressors, roots-blower etc. Comparison of pneumatics with Hydraulic power Transmission. Air preparation units, filter, regulators & lubricators. Actuators, linear Single & double acting rotary actuators, air motors, pressure regulating valves. Directional control valves two way, three way & four way valves, solenoid operated, Push button; & lever control valves. Flow control valves. Check valves methods of Actuation, mechanical, pneumatic & electrical etc. Pneumatic circuits for industrial applications & automation. e.g. Feeding clamping, Indexing, picking & placing etc.

Text Books:

1. Introduction to Fluid Power, N.V. Sahashtrabudhe, Nirali PrakashanPune
2. Industrial Hydraulics, J.J. Pipenger, McGraw Hill Co,
3. Pneumatics circuits, S.R. Mujumdar.

Reference Books:

1. Industrial Fluid Power, Pinches, Prentice Hall
2. Manuals on Industrial Hydraulics, Vickers
3. Hydraulics & Pneumatics, H.L. Stewart, Industrial Press
4. Fluid Power Design Handbook, Yeaple.

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP409-5 **Course: Industrial Fluid Power**

L: 0 Hrs. T:0 Hrs. P: 2 Hrs. Per week **Total Credits: 02**

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand the basic function, construction and working of the various components of hydraulic and pneumatic systems.
2. Ability to compute the power and capacity requirement of actuators for a given application.
3. Design and demonstrate the hydraulic and pneumatic circuits for various industrial applications.
4. Thorough knowledge of repair and maintenance of hydraulic and pneumatic systems.

The laboratory will have minimum Eight Practical based on the syllabus of MET409-5

List of practicals:

[1] Study and demonstration of working of various actuators used in hydraulic and pneumatic systems.

[2] Study and demonstration of construction and working of various pumps and valves used in hydraulic systems.

[3] Demonstration of various pneumatic circuits on pneumatic circuit trainer.

[4] Demonstration of various hydraulic circuits on hydraulic circuit trainer.

[5] Study of hydraulic and pneumatic circuits used in

(i) CNC Lathe machine

(ii) CNC milling trainer

(iii) Universal Testing Machine

[6] Design of hydraulic circuits for industrial applications.

[7] Design of pneumatic circuits for industrial applications.

[8] Report on visit to an industry (automation plant using hydraulic and pneumatic systems).

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: INT414 **Course : Industrial Management & Entrepreneurship Development**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 08**

Course Outcomes

The expected learning outcome is that the students will be able to:

1) Get knowledge about evolution of management thoughts and the principles of scientific management.
2) Understand the functions of personnel management and the related legislations
3) Know the different types of production system and the concept of production planning and control
4) Get knowledge about entrepreneurship, traits and competencies for the same and the factors affecting entrepreneurial growth.
5) Get knowledge about the steps involved in setting up a business.
6) Get overview of the marketing function and the various sources of finance.

Syllabus

Unit – I:

Principles of management: Concepts of management, development of scientific Management, Principles of Frederick Taylor & Henry Fayol, Management functions – Viz, Planning, Organizing, Staffing, Leading, Motivating, Communicating, Controlling, Decision Making, Span Of Control.

Unit – II:

Managing People: Meaning, functions of personnel management, manpower planning, collective bargaining, wages & salary administration, labor welfare, training, trade unions, Industrial Disputes Act, Factories Act, Industrial Boilers Act, Trade union act.

Unit – III:

Production Systems, Overview of Types of Production, Capacity Planning, Production Planning & Control, Material & Inventory management, Introduction to Supply Chain Management.

Unit – IV:

Overview of Entrepreneurship, Entrepreneurial Functions, Personality Traits and Competencies of Entrepreneurs, Achievement, Motivation. Types of Enterprises, Policies Governing small scale Industries, Procedure to set up small scale Industries Unit, Advantages and Limitations of SSI, Factors Affecting Entrepreneurial Growth.

Unit – V:

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Statutory agencies and government organizations in Industrial Sector, Role of Consultancy Organizations.

Unit – VI:

Marketing Function- Overview, 4 Ps of Marketing, Product Life Cycle, Factors Governing Product Selection, Product Design, Sales Forecasting.

Financing & Accounting Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis.

Text Books:

1. Industrial Engineering & Management: O P Khanna, Dhanpat Rai Publication, India
2. Industrial Management , I.K. Chopde, A.M. Shaikh, S. Chand Publisher
3. Entrepreneurship Development: S. S. Khanka, S. Chand Publisher
4. Essentials of Entrepreneurship and Small business Management: Zimmerer, PHI Learning

Reference Books:

1. Principles of Management: Harold Koontz & Cyril O'Donnell
2. Industrial Engineering and organizational Management, S.K. Sharma, S.K. Kataria and sons
3. Industrial Management, D.K. Bhattachcryya, Vikas Publishing House
4. Entrepreneurship and Development, R.K. Singal , S.K. Katariya and sons

Syllabus of Semester VIII, Bachelor of Engineering (Mechanical Engineering)

Course Code: MEP410 **Course: Project Phase-II**

L: 0 Hrs., T: 0 Hrs., P: 6 Hrs., Per week **Total Credits: 12**

Course Outcomes:

The expected learning outcome is that the students will be able to:

1. Plan and design experiments, tests for problems solving in projects.
2. Critically analyse, interpret data, and effectively disseminate the results.
3. Assess integration in mechanical applications with multi-disciplinary areas of mechanics, automation, electronics, and computing.
4. Project management skill, report organization and writing skills.
5. Understand the role of mechanical engineer in society for ethical, environmental and safety issues.

General Guidelines:

This project work execution phase may conform to the below stated types of broad based work.

1. Detailed design of some mechanical system. This may comprise of machines, thermal, hydraulic / pneumatic system & design of some small industry and like.
2. Detailed study of the literature on a normal topic along with the comparative study of various approaches studied under literature from time to time.
3. Detailed experimental / practical verification of some mechanical engineering systems.
4. Detailed study of some industry manufacturing some product. This study may comprise of various aspects such as plant layout, mechanical handling systems, assembly shop, quality control system, and maintenance system, various service systems, design, development and planning functions, techno-economic studies etc.
5. Study may also comprise of in-depth and exhaustive analysis of any one or all above combinations of the abovementioned systems. Detailed experimental/ Practical verification of some mechanical engineering, systems must be carried out and the end of the project.

On the completion of work, the submission of the Project report and assessment should be done before the end of semester. The students should submit the final report in a prescribed format as per the guidelines before the end of semester. Term work will be assessed by the project guide along with project evaluation committee appointed by the Department, as the internal examiner(s) and the external examiner (s).

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR

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