SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR - 440 013

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

PROGRAMME SCHEME & SYLLABI
2019 - 2020

B. E. (MECHANICAL ENGINEERING)

Published by
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ISO 9001 : 2015 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 stand for design, production and operations in core mechanical domain and management of interdisciplinary applications.
2) Graduates will be capable of carrying out the analysis of mechanical and allied systems and provide numerical and computer based solution.

TEACHING SCHEME FOR FIRST YEAR (SEMESTER I & II) BACHALOR OF ENGG
GROUP 1: SEMESTER-I/ GROUP 2: SEMESTER-II

Sr. No.	Code	Course	Branches	Hours/week L	T	P	Credits	Maximum Marks: Continual Assessment	End Sem Examination	Total	ESE Duration (Hours)
1.	PHT151	Mechanics	Civil; Industrial	3	1	0	4	40	60	100	03
	PHT152	Oscillations, waves & Optics	Electrical								
			Mechanical								
	PHT153	Semiconductor Physics	Electronics; EDT; Electronics & Comm								
			Computer Science Engg; Information Tech.								
2.	PHP151	Mechanics Lab	Civil; Industrial	0	0	3	1.5	25	25	50	–
	PHP152	Oscillations, Waves & Optics Lab	Electrical								
			Mechanical								
	PHP153	Semiconductor Physics Lab	Electronics; EDT; Electronics & Comm.								
			Computer Science Engg; Information Tech.								
3.	MAT152/ MAT151	Differential Equations, Linear Algebra, Statistics & Probability / Calculus	All Branches	3	0/1	0	3/4	40	60	100	03
4.	MAP151	Computational Mathematics Lab	All Branches	0	0	2	1	25	25	50	–
5.	EET151	Basic Electrical Engineering	All Branches	3	1	0	4	40	60	100	03
6.	EEP151	Basic Electrical Engineering Lab	All Branches	0	0	2	1	25	25	50	–
7.	MET151	Engineering Graphics & Design	All Branches	1	0	0	1	40	60	100	03
8.	MEP151	Engineering Graphics & Design Lab	All Branches	0	0	4	2	50	50	100	–
9.	HUT152	Constitution of India	All Branches	2	0	0	0	–	–	--	–
10.	PEP151	Yoga/Sports	All Branches	0	0	2	0	–	–	--	–
			Total	12	2/3	13	**17.5/18.5**			**650**	

GROUP 2: SEMESTER-I / GROUP 1: SEMESTER-II

Sr. No.	Code	Course	Branches	Hours/week L	T	P	Credits	Maximum Marks: Continual Assessment	End Sem Examination	Total	ESE Duration (Hours)
1.	CHT151	Chemistry	All Branches	3	1	0	4	40	60	100	03
2.	CHP151	Chemistry Lab	All Branches	0	0	3	1.5	25	25	50	–
3.	MAT151/ MAT152	Calculus / Differential Equations, Linear Algebra, Statistics & Probability	All Branches	3	1/0	0	4/3	40	60	100	03
4.	CST151	Programming for Problem Solving	All Branches	4	0	0	4	40	60	100	03
5.	CSP151	Programming for Problem Solving Lab	All Branches	0	0	2	1	25	25	50	–
6.	IDT151	Creativity, Innovation & Design Thinking	All Branches	1	0	0	1	20	30	50	1.5
7.	INT151	Workshop/Manufacturing Practices Lab	All Branches	1	0	0	1	20	30	50	1.5
8.	INP151	Workshop/Manufacturing Practices Lab	All Branches	0	0	2	1	25	25	50	–
9.	HUT151	English	All Branches	2	0	0	2	40	60	100	03
10.	HUP151	English Lab	All Branches	0	0	2	1	25	25	50	–
			Total	14	2/1	9	**20.5/19.5**			**700**	

Scheme of Teaching & Examination of Bachelor of Engineering
III Semester B.E. (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET251	Materials Engineering	3	0	0	3.00	40	60	100	3 Hrs.
2	MEP251	Materials Engineering	0	0	1	0.50	25	25	50	-
3	MEP252	M/C Drawing & Solid Modeling	0	0	2	1.00	50	50	100	-
4	MET253	Engineering Mechanics	3	0	0	3.00	40	60	100	3 Hrs.
5	MET254	Manufacturing Processes	3	0	0	3.00	40	60	100	3 Hrs.
6	MEP254	Manufacturing Processes	0	0	2	1.00	25	25	50	-
7	MAT257	Mathematics III (Mech.Engg.)	3	1	0	4.00	40	60	100	3 Hrs.
8	IDT251	Biology	2	0	0	2.00	40	60	100	3 Hrs.
9	MEP260	Industry Visit	0	0	2	0.00	-	-	-	-
		Total	**14**	**1**	**7**	**17.5**			**700**	

Scheme of Teaching & Examination of Bachelor of Engineering
IV Semester B.E. (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET261	Kinematics & Dynamics of Machinery	3	1	0	4.00	40	60	100	3 Hrs.
2	MEP261	Kinematics & Dynamics of Machinery	0	0	2	1.00	25	25	50	-
3	MET262	Thermodynamics	3	1	0	4.00	40	60	100	3 Hrs.
4	MET263	Strength of Materials	3	1	0	4.00	40	60	100	3 Hrs.
5	MET264	Fluid Mechanics & Hydraulic Machines	3	1	0	4.00	40	60	100	3 Hrs.
6	MEP264	Fluid Mechanics & Hydraulic Machines	0	0	2	1.00	25	25	50	-
7	MEP265	Mech Engg. Software Lab	0	0	2	1.00	25	25	50	-
8	MET266	**Open Elective - I**	3	0	0	3.00	40	60	100	3 Hrs.
9	CHT252	Environmental Science	2	0	0	0.00	-	-	-	-
10	MEP270	Mini Project	0	0	2	0.00	-	-	-	-
		Total	**17**	**4**	**8**	**22.00**			**650**	

Open Elective - I	
Course Code	**Course Name**
MET266-1	Basic Mechanical Engineering
MET266-2	Non Conventional Energy Sources

Scheme of Teaching & Examination of Bachelor of Engineering
V Semester B.E. (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET351	Applied Thermodynamics-I	3	1	0	4.00	40	60	100	3 Hrs.
2	MET352	Heat Transfer	3	0	0	3.00	40	60	100	3 Hrs.
3	MEP352	Heat Transfer	0	0	2	1.00	25	25	50	3 Hrs.
4	MET353	Design of Machine Elements-I	3	1	0	4.00	40	60	100	3 Hrs.
5	MET354	Manufacturing Technology	3	0	0	3.00	40	60	100	3 Hrs.
6	MEP354	Manufacturing Technology	0	0	2	1.00	25	25	50	-
7	MET355	Operations Research	3	0	0	3.00	40	60	100	3 Hrs.
8	MET356	**Open Elective - II**	3	0	0	3.00	40	60	100	3 Hrs.
9	HUT353	Essence of Indian Traditional Knowledge	2	0	0	0.00	-	-	SF/USF	-
10	MEP360	Project-I	0	0	2	1.00	50	-	50	-
		Total	**18**	**2**	**8**	**23.00**		**750**		

Open Elective - II	
Course Code	**Course Name**
MET356-1	Project Management
MET356-2	Automobile Engineering

Scheme of Teaching & Examination of Bachelor of Engineering
VI Semester B.E. (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET361	Applied Thermodynamics-II	3	0	0	3.00	40	60	100	3 Hrs.
2	MEP361	Applied Thermodynamics-II	0	0	2	1.00	25	25	50	-
3	MET362	Instrumentation & Control	3	0	0	3.00	40	60	100	3 Hrs.
4	MEP362	Instrumentation & Control	0	0	1	0.50	25	25	50	-
5	MET363	Finite Element Analysis	3	0	0	3.00	40	60	100	3 Hrs.
6	MEP364	Design of Machine Elements-II	0	0	2	1.00	25	25	50	-
7	MET365	Elective-I	3	0	0	3.00	40	60	100	3 Hrs.
8	MEP365	Elective-I Lab	0	0	1	0.50	25	25	50	-
9	MET366	Elective-II	3	0	0	3.00	40	60	100	3 Hrs.
10	NET367	**Open Elective - III**	3	0	0	3.00	25	25	50	-
11	MEP368	Comprehensive Viva Voce	0	0	2	1.00	25	25	50	-
12	MEP370	Project-II	0	0	2	1.00	50	-	50	-
Total			**18**	**0**	**10**	**23**			**800**	

Elective I			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET365-1	Introduction to Computational Fluid Dynamics	MEP365-1	Introduction to Computational Fluid Dynamics
MET356-2	Internal Combustion Engines	MEP365-2	Internal Combustion Engines
MET365-3	Computer Graphics	MEP365-3	Computer Graphics
MET365-4	Synthesis of Mechanisms	MEP365-4	Synthesis of Mechanisms
MET365-5	Soft Computing Techniques in Mechanical Engineering	MEP365-5	Soft Computing Techniques in Mechanical Engineering
MET365-6	Additive Manufacturing	MEP365-6	Additive Manufacturing

Elective II			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET366-1	Advanced Manufacturing Techniques	MET366-2	Industrial Fluid Power
MET366-3	Automobile Engineering	MET366-4	Machine Dynamics
MET366-5	Failure Analysis and Design	MET366-6	Numerical Methods for Mechanical Engineering
MET366-7	Production Planning and Control	MET366-8	Geometric Dimensioning and Tolerance
MET366-9	Biomechanics		

Open Elective - III	
Course Code	**Course Name**
MET367-1	World Class Manufacturing
MET367-2	Safety and Hazard Analysis
MET367-3	Energy Auditing

Scheme of Teaching & Examination of Bachelor of Engineering
VII Semester B.E. (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET451	Elective-III	3	0	0	3.00	40	60	100	3 Hrs.
2	MEP451	Elective-III Lab	0	0	1	0.50	25	25	50	-
3	MET452	Elective-IV	3	0	0	3.00	40	60	100	3 Hrs.
4	MET453	Elective-V	3	0	0	3.00	40	60	100	3 Hrs.
5	MET454	Elective-VI	3	0	0	3.00	40	60	100	3 Hrs.
6	MET455	**Open Elective - IV**	3	0	0	3.00	40	60	100	3 Hrs.
7	MEP456	Internship Evaluation (6 to 8 Week)	0	0	2	0.00	-	-	-	-
8	MEP460	Project-III	0	0	10	5.00	100	100	200	-
Total			**15**	**0**	**13**	**20.5**			**750**	

Elective III			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET451-1	Stress Analysis	MEP451-1	Stress Analysis
MET451-2	Advanced Finite Element Methods	MEP451-2	Advanced Finite Element Methods
MET451-3	Industrial Robotics	MEP451-3	Industrial Robotics
MET451-4	Engineering Economics and Cost Estimation	MEP451-4	Engineering Economics and Cost Estimation
MET451-5	Refrigeration and Air-conditioning	MEP451-5	Refrigeration and Air-conditioning
MET451-6	Solar Energy Utilization	MEP451-6	Solar Energy Utilization
MET451-7	Design of Transmission Systems	MEP451-7	Design of Transmission Systems
MET451-8	Mechatronic Systems	MEP451-8	Mechatronic Systems
MET451-9	Modeling and Simulation of Production Systems	MEP451-9	Modeling and Simulation of Production Systems
MET451-10	CAD/CAM/CIM	MEP451-10	CAD/CAM/CIM
MET451-11	IoT & Industry 4.0	MEP451-11	IoT & Industry 4.0

Elective-IV			
Course code	**Course name**	**Course code**	**Course name**
MET452-1	Mechanical Vibrations	MET452-2	Power Plant Engineering
MET452-3	Vehicle Dynamics	MET452-4	Supply Chain Management
MET452-5	Energy Conservation and Management	MET452-6	Alternate Fuels
MET452-7	Micro and Nano-machining	MET452-8	Maintenance Engineering

Elective-V			
Course code	**Course name**	**Course code**	**Course name**
MET453-1	Microprocessors in Automation	MET453-2	Principles of Management
MET453-3	Total Quality Management	MET453-4	Renewable Sources of Energy
MET453-5	Composite Materials	MET453-6	Advanced Heat Transfer
MET453-7	Super-finishing and Grinding		

Elective-VI			
Course code	**Course name**	**Course code**	**Course name**
MET454-1	Design of Mechanical Systems	MET454-2	MEMS
MET454-3	Auto Mechatronics	MET454-4	Material Handling Systems
MET454-5	Product Design	MET454-6	Vehicle Body Engineering and Aerodynamics
MET454-7	Project Management	MET454-8	Introduction to Aerospace Engineering

Open Elective - IV	
Course Code	**Course Name**
MET455-1	Mechatronics
MET455-2	Industrial Robotics
MET455-3	Functional Safety
MET455-4	Condition Monitoring
MET455-5	Steam and Hydro Turbines

Scheme of Teaching & Examination of Bachelor of Engineering
VIII Semester B.E. (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET461	Industrial Management & Entrepreneurship Development	3	0	0	3.00	40	60	100	3 Hrs.
2	MET462	Productivity Improvement Techniques	3	0	0	3.00	40	60	100	3 Hrs.
3	MET463	Automation in Manufacturing	3	0	0	3.00	40	60	100	3 Hrs.
4	MEP463	Automation in Manufacturing	0	0	2	1.00	25	25	50	-
5	MEP470	Project - IV / One Semester Industry Project / Incubation	0	0	12	6.00	150	150	300	-
		Total	**9**	**0**	**14**	**16.00**			**650**	

SEM	III	IV	V	VI	VII	VIII	Total
Credits	17.5	22	23	23	20.5	16	122

Scheme of Teaching & Examination of Bachelor of Engineering
Honors Scpecialization (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET267	Digital Manufacturing	4	0	0	4.00	40	60	100	3 Hrs.
2	MET357	Tool Design	4	0	0	4.00	40	60	100	3 Hrs.
3	MET371	Turbo Machinery	4	0	0	4.00	40	60	100	3 Hrs.
4	MET457	Design of Heat Exchangers	4	0	0	4.00	40	60	100	3 Hrs.
5	MET464-1	Tribology	4	0	0	4.00	40	60	100	3 Hrs.
6	MET464-2	Robotics	4	0	0	4.00	40	60	100	3 Hrs.

Scheme of Teaching & Examination of Bachelor of Engineering
Minors Scpecialization (Mechanical Engineering)

Sr. No.	Course Code	Course Name	Hours/ Week			Credits	Maximum Marks			ESE Duration (Hrs.)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MET268	Automotive Engineering	4	0	0	4.00	40	60	100	3 Hrs.
2	MET358	Computer Aided Design	4	0	0	4.00	40	60	100	3 Hrs.
3	MET372	Automation and Robotics	4	0	0	4.00	40	60	100	3 Hrs.
4	MET458	Solar Energy Technology	4	0	0	4.00	40	60	100	3 Hrs.
5	MET466-1	Manufacturing Engineering	4	0	0	4.00	40	60	100	3 Hrs.
6	MET466-2	Mechanical Engineering Design	4	0	0	4.00	40	60	100	3 Hrs.

Syllabus for Semester I / II

(Civil Engineering, Industrial Engineering)

Course Code: PHT151 **Course : PHYSICS : Mechanics**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits: 4**

Course Objectives:

1. To develop working knowledge of methods to treat particle and rigid body motions;
2. To introduce kinematics and dynamics of general rigid body motions.

Course Outcomes:

After successful completion of the course students will

1. be able to understand and work with free, damped and forced oscillations;
2. be able to recognize and work problems with conservative as well as non-conservative forces ;
3. be able to use vector dierential operations in solving mechanics problems;
4. understand how to describe and solve simple general rigid body motions.

Module 1: Forces, Newton's Laws (8L)

Coordinate frames, change of frames as linear transformation, rotation matrix, Scalars and vectors - Denition based on their transformation under change of frames; Examples and problems; Newton's Laws of Motion, First law (law of inertia), inertial frame; Second law, concept of force; Third law; Forces in Nature, derived forces; friction, pressure in a fluid; Examples and problems including friction and constraints.

Module 2: One, and Two-dimensional Motion (7L)

One-dimensional harmonic oscillator, damped oscillator, over, critical and under damping; Forced oscillator, undamped and damped cases; Examples, resonance and Q factor; Projectile motion with drag; Two-dimensional oscillator; Charged particle in constant magnetic field.

Module 3: Conservative Forces (5L)

Work and kinetic energy: work-energy theorem, scalar and vector fields, Work done by a force field; Conservative and non-conservative forces, Potential energy function for conservative forces; Gradient of potential energy, F = - V; Curl of a vector field, test of conservation character of a force; Potential near equilibrium point.

Module 4: Angular Momentum, System of Particles (6L)

Angular momentum of a particle, torque of force; Radial-polar coordinates, Planetary orbits and Kepler's laws; elliptical, parabolic and hyperbolic trajectories; **' L'** of a system of particles, torque of external forces,

Module 5: Rigid Body Dynamics-1 (5L)

Denition of a rigid body, rotation in a plane, angular momentum about a point of rigid body in planar motion about a fixed axis, Kinematics, concept of moment of inertia; The physical pendulum.

Module 6: Rigid Body Dynamics-2 (7L)

General rotation of a rigid body, Euler angles, angular velocity; Kinetic energy, moment of inertia tensor, examples, parallel axis theorem, angular momentum of a rigid body; Euler's equations of rigid body dynamics (statement and meaning without derivation), simple examples: rotating rod, torque-free precession.

Text Book(s):

1. Introduction to Mechanics (Second Edition), M. K. Verma, Universities Press 2016.

References:

1. An Introduction to Mechanics, Daniel Kleppner and Robert Kolenko, Cambridge University Press 2010.
2. Online course: Engineering Mechanics (Modules 1, 2,5, 6, 7, 8) by M K Harbola on NPTEL
3. Engineering Mechanics (Second Edition), M K Harbola, Cengage publications, New Delhi, 2013.

Syllabus for Semester BE I / II

Bachelor of Mechanical Engineering, Electrical Engineering

Course Code: PHT152 **Course: Oscillations, Waves, Optics**

L:3 Hrs.,T:1Hrs.,P:0Hrs.,Per week **Total Credits:4**

Course Objectives:

1. To train the student to work with oscillatory phenomena in electrical, mechanical and optical systems;
2. To introduce fundamental concepts and laws as relevant to electromagnetic waves and matter waves.

Course Outcomes:

After successful completion of the course students will understand and be able to work with

1. Free, damped and forced oscillations;
2. Fundamental properties of mechanical waves and their propagation across material boundaries;
3. Basics of electromagnetic waves and optical media, phenomena of interference, diffraction of optical waves
4. Elementary understanding of quantum behavior of electrons in solids.

Module 1: Oscillations (8L)

Quick review of simple harmonic motion, mechanical and electrical oscillators, vector and complex number (phasor) representation, superposition of many SHMs of equal amplitude and equal successive phase difference; Damped oscillations, under, critical and over-damping with stress on mechanical oscillators, problems; Forced oscillations with focus on electrical/mechanical oscillations, impedance of a electrical/mechanical circuit, forcing frequency dependence of velocity, displacement in a forced oscillator, two components of displacement, energy and power supplied by driving force, Q factor.

Module 2: Waves - 1 (5L)

Correlated harmonic oscillations in space and time, statement and meaning of the wave equation, general solution, concept of polarization of waves- transverse and longitudinal waves; Transverse wave on a string, characteristic impedance, reflection and transmission at a string-string boundary, impedance matching, insertion of quarter-wave element.

Module 3: Waves - 2 (5L)

Group of waves, group velocity, meaning of dispersion, causes of dispersion; Standing waves, normal modes of vibrating string, energy in modes, standing wave ratio; Longitudinal waves: sound waves in gases, statement and meaning of expressions for energy distribution and intensity.

Module 4: Wave Optics - 1 (6L)

Light as a transverse polarized electromagnetic wave in vacuum and in homogeneous isotropic dielectric, impedance $|\mathbf{E}|/|\mathbf{H}_{perp,E}|$, Poynting vector, energy; Reflection and refraction of em wave at dielectric-dielectric boundary, parallel and perpendicular polarizations, boundary conditions on E and H components, Fresnel equations, Brewster's angle.

Module 5: Wave Optics - 2 (6L)

Huygens' principle, superposition, interference by division of amplitude and wavefront, Young's double-slit, Newton's rings, Michelson interferometer; Single-slit Fraunhofer diffraction, Rayleigh criterion for resolution, grating and its resolving power.

Module 6: Matter Waves (8L)

Plank's energy packets, Wave-particle duality of de Broglie, Heisenberg uncertainty relations; Wave function for matter waves and its interpretation, position and momentum operators, Hamiltonian operator, Schrodinger's equation; One-dimensional single particle systems: Particle in a infinite square well potential (rigid box), Finite square well potential; Quantum tunneling.

Text Book(s):

1. The Physics of Vibrations and Waves (Sixth Edition), H J Pain John-Wiley 2005.
2. Optics, Ajoy Ghatak, Tata McGraw Hill Education 2005

References:

1. Online course: Oscillations and Waves by S Bharadwaj on NPTEL
2. Engineering Physics (Second Edition), Sanjay Jain and Girish Sahasrabudhe, Universities Press 2016.

Syllabus for Semester I / II

(Electronics Engineering, Electronics Design Technology, Electronics and Communication Engineering, Information Technology, Computer Science Engineering)

Course Code : PHT153 **Course: Semiconductor Physics**

L: 3 Hr., T: 1 Hrs., P : 0 Hrs., Per week **Total Credits : 4**

Course Objectives:

1. To introduce ideas of quantum mechanics necessary to begin understanding semiconductor devices;
2. To familiarize prospective engineers with fundamental concepts of semiconductors and their interaction with light and resulting devices

Course Outcomes:

After successful completion of the course students will

1. have an elementary understanding of quantum behavior of electrons in solids;
2. have a grasp of band structure and its consequences for semiconductors;
3. should be able to use band structure to explain effects of doping, properties of junctions between semiconductors and metals;
4. have an elementary understanding of working of optoelectronics devices

Module 1: Quantum Mechanics Introduction (6L)

Wave-particle duality, Heisenberg uncertainty relations, the quantum state wave function and its probability interpretation, Schrodinger's equation, Energies and wave functions of a single electron in one-dimensional infinite potentials: formulae, function graphs, number of bound states, tunneling

Module 2: Electronic Materials (8L)

Free electron theory, Extension of idea of energy level splitting in molecules to bonding in solids, Energy bands in solids, Kronig-Penny model (to better demonstrate origin of band gaps), Band gap based classification of electronic materials: metals, semiconductors, and insulators, E-k diagram, Direct and indirect bandgaps, Valence and conduction bands, Density of states, Fermi-Dirac statistics: Occupation probability of states, Fermi level, Effective mass.

Module 3: Intrinsic and Extrinsic Semiconductors (10L)

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier transport: diffusion and drift, Carrier generation and recombination, Continuity equation, Ambipolar transport.

Module 4: Junction Physics (8L)

p-n junction, Zero applied bias, forward bias, reverse bias, Metal-semiconductor junction, Shottky barrier, Ideal junction properties, Ohmic contacts, ideal non-rectifying barrier, tunneling barrier, Heterojunctions, Materials, Energy band diagram.

Module 5: Light - Semiconductors Interaction (6L)

Optical transition in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states in bulk semiconductors, density of states for photons, semiconductor materials for optoelectronic devices, electron hole pair generations, Photovoltaic effect, Solar cells, Light emitting diodes, population inversion, Optical loss and gain, Semiconductor Laser.

Module 6: Engineered Semiconductor Materials (6L)

Low-dimensional systems such as quantum wells, wires, and quantum dots: design, fabrication, and characterization techniques. Energies and wave functions in three dimensions with one, two, or all three dimensions of nano-sizes, Density of states for 2D, 1D and 0D electron gases, Heterojunctions and associated band-diagrams.

Text Book(s):

1. Semiconductor Physics and Devices (Fourth Edition), Donald A Neamen, McGraw-Hill 2012.

References:

1. Online course: Semiconductor Optoelectronics by M R Shenoy on NPTEL
2. Online course: Optoelectronic Materials and Devices by Monica Katiyar and Deepak Gupta on NPTEL
3. Principles of Electronic Materials and Devices (Third Edition), S. O. Kasap, McGraw-Hill 2006.
4. Engineering Physics (Second Edition), Sanjay Jain and Girish Sahasrabudhe, Universities Press 2016.

Syllabus of Physics Lab for Semester II, Bachelor of Industrial, Civil Engineering

Course Code : PHP151 **Course : Mechanics Lab**

L:0 Hr., T:0Hrs., P:3 Hrs., Per week **Total Credits : 1.5**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

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

1. Error analysis and graph plotting
2. g by free fall
3. To determine acceleration due to gravity by compound pendulum
4. To determine the moment of inertia of a body using torsion pendulum
5. Young's modulus by bending of beam
6. Young's modulus by vibrational method
7. To study damping of a bar pendulum
8. Fixed pulley, loose pulley, and block and tackle as simple machine
9. Static friction, sliding friction, and rolling friction
10. Force oscillation and resonance
11. To study the oscillation of a mass in combinations of two springs and hence determination of force constant
12. Measurement of linear expansion of solid as a function of temperature
13. Determination of thermal conductivity of building materials using single plate model or heat flux plate principle
14. Thermal diffusivity Used for measuring the thermal diffusivity and thermal conductivity of brass.
15. Thermal conductivity of a bad conductor by Lee's disc method.
16. Data analysis using Mathematica.

Suggested References:

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

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

Syllabus of Physics Lab for Semester I/II,

(Semester-I: Electrical Engineering, Semester-II: Mechanical Engineering)

Course Code : PHP152 **Course : Oscillations, Waves , Optics lab**

L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week **Total Credits : 1.5**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

In addition to the demo experiments, the Lab turns will be utilized for performing the experiments based on the following lists as specific to Program:

1. Error analysis and graph plotting
2. Wave length, frequency and phase velocity of travelling wave.
3. Wavelength of source of light using Newton's rings
4. To study the oscillation in bifilar suspension arrangement
5. Determination of velocity of sound in liquid–standing ultrasonic waves as optical grating
6. Kundt's tube – Determination of the wavelength of sound with the cork powder method
7. Determination of velocity of sound in solid
8. Beating of ultrasonic waves
9. Investigation of Doppler effect with ultrasonic waves
10. Refractive Index of prism
11. Frequency, amplitude and phase determination using C.R.O.
12. Study of surface flatness using interference phenomena
13. To determine the resolving power of grating
14. Study of Polarizers and Analyzers
15. Study of total internal reflection using Laser source
16. Data analysis using Mathematica

Suggested References:

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

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

Syllabus for Semester I/II, B.E. (2018-19)
(Semester I: Electronics, Electronics Design Technology, Electronics & Communication Engineering)
(Semester II: Computer Science Engineering and Information Technology)

Course Code : PHP153 **Course : Semiconductor Physics Lab**
L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week **Total Credits : 1.5**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

In addition to the demo experiments, the Lab turns will be utilized for performing the experiments based on the following lists as specific to Program

1. Error analysis and graph plotting
2. Energy gap of semiconductor/thermister
3. Study of Hall Effect
4. Parameter extraction from I-V characteristics of a PN junction diode
5. Parameter extraction from I-V characteristics of a zener diode
6. Study of diode rectification
7. Parameter extraction from I-V characteristics of a transistor in common-emitterconfiguration.
8. Determination of Planck's constant
9. Determination of time constant of RC circuit
10. V-I Characteristics of Light Emitting Diodes
11. Study of a photodiode
12. Solar Cell (Photovoltaic cell)
13. Resistivity measurement by Four Probe method
14. Van der Pau and conventional techniques for resistivity measurement (LCR meter)
15. Study of R-C filters using C.R.O.
16. Data analysis using Mathematica.

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

Syllabus for B.E. Semester I

Course Code: MAT151 **Course: Mathematics-I: Calculus**
L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 04**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in Calculus and multivariate analysis. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics & applications that they would find useful in their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
2. The tool of power series and Fourier series for learning advanced Engineering Mathematics.
3. To deal with functions of several variables that are essential in most branches of engineering.

Syllabus

Module 1 Calculus: (6 hours)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3:Sequences and series: (10 hours)

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4:Multivariable Calculus (Differentiation) (10 hours)

Limit, continuity and partial derivatives, Jacobians, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl & divergence.

Module 5: Multivariable Calculus (Integration) (10 hours)

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune - 411030 (India).

Syllabus for B.E. Semester II

Course No. MAT152 — **Course : Mathematics-II: Differential Equations, Linear Algebra, Statistics & Probability**

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

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equation, statistics, probability and Matrices. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
2. The essential tool of matrices in a comprehensive manner.
3. The ideas of probability and various discrete and continuous probability distributions and the basic ideas of statistics including measures of central tendency, correlation and regression.

Syllabus

Module 1:First order ordinary differential equations(7 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2:Ordinary differential equations of higher orders (8 hours)

Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3: Basic Statistics: (7 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, correlation and regression – Rank correlation, Multiple regression and correlation.

Module 4: Basic Probability: (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 5: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Theory & Problems of probability and statistics : 2nd ed :J. R. Spiegal, Schaum series
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune - 411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Syllabus of Mathematics Computational Lab for Semester I/II, B.E. (2018-19)

Course Code : MAP151 **Course : Computational Mathematics Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 1**

Course Outcomes

The Computational Mathematics Lab course will consist of experiments demonstrating the principles of mathematics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in mathematics and compare the results obtained with theoretical calculations.
3. Understand basics of mathematics, and report the results obtained through proper programming.

The Lab turns will be utilized for performing the experiments based on the following list:

1. Calculus
2. Ordinary Differential Equations
3. Statistics
4. Linear Algebra

Suggested References:

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

A minimum of 8 experiments to be performed based on the above list.

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

Course Code : EET151 **Course : Basic Electrical Engineering**

Course Outcomes:

At the end of this course, students will demonstrate the ability

CO1: To understand and analyze basic electric and magnetic circuits.

CO2: To study the working principles of electrical machines and power converters.

CO3: To study the working principles of power converters.

CO4: To introduce the components of power systems and low-voltage electrical installations.

Module 1: Introduction to Power system (2 hours)– CO4:

Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind, and Solar) with block schematic presentation only. Single line diagram for Generation, Transmission & Distribution through different voltage levels.

Module 2 : DC Circuits & Magnetic Circuits(8 hours) - CO1:

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation, Time-domain analysis of first order RL and RC circuits, Magnetic materials, BH characteristics, Basics of Magnetic circuits.

Module 3: Single Phase AC Circuits (6 hours) - CO1:

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.

Module 4: Three Phase AC Circuits (4 hours) - CO1:

Three phase Ac generation, Three phase balanced circuits, voltage, and current relations in star and delta connections. Power factor improvement.

Module 5: Transformers (6 hours) - CO2:

Ideal and practical transformer, Equivalent circuit, losses in transformers, regulation, and efficiency. Auto transformer and three-phase transformer connections.

Module 6: Electrical Machines (8 hours) - CO2:

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components, efficiency, starting of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic, and speed control of separately excited dc motor.

Module 7: Power Converters (4 hours) - CO3:

Block schematic introduction to power converters and its practical applications (DC-DC, DC-AC, AC-DC, AC-AC), Types of Batteries, Important Characteristics for Batteries and battery backup.

Module 8: Electrical Installations (4 hours) - CO4:

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption, energy tariff.

Text / References:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
6. Electrical Technology: B. L. Thereja, S. Chand Publications.
7. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

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

Course Code : EEP151 **Course: Basic Electrical Engineering Lab.**

Laboratory Outcomes: The students are expected to

CO1: Get an exposure to common electrical components and their ratings.

CO2: Make electrical connections by wires of appropriate ratings.

CO3: Understand the usage of common electrical measuring instruments.

CO4: Understand the basic characteristics of transformers and electrical machines.

CO5: Get an exposure to the working of power electronic converters.

List of Laboratory Experiments/Demonstrations:

1. Basic safety precautions. Introduction & use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
   Observation of phase differences between current and voltage.
3. Transformers : Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-toneutral voltage, line and phase currents). Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of dc shunt motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

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

Course Code : MET151 **Course: Engineering Graphics and Design**

L:1 Hr., T:0Hrs., P:0 Hrs., Per week **Total Credits : 01**

Course Outcomes

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

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

UNIT 1 : Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of drawing instruments, Lettering and dimensioning.

UNIT 2 : Orthographic Projections

Principles of Orthographic Projections -Conventions : Projections of Points and lines (line inclined to both planes) Projections of planes (inclined to both the planes), Introduction to Auxiliary Planes;

UNIT 3 : Projections of Solids

Inclined to both the Planes - Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include : windows, doors, and fixtures such as WC, bath, sink, shower, etc.

UNIT 4 : Sections and Sectional Views of Right Angular Solids

Prism, Cylinder, Pyramid Cone-Auxiliary Views; Development of surface of Right Regular solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT 5 : Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; Conversion of Orthographic views to Isometric Views / Projection.

Suggested Text / Reference Books :

i) Bhatt N. D. Panchal V.M. & Ingle P.R., (2014) Engineering Drawing, Charotar Publishing House.

ii) Jolhe D. A. (2016) Engineering Drawing with an Introduction to Auto CAD", Tata McGraw- Hill Publishing Co. Ltd., New Delhi.

iii) Narayan K. L. & P. Kannalah (2008), Text book on Engineering Drawing, Scitech Publishers.

iv) Shah, M. B. & Rana B. C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.

v) Agrawal B & Agrawal C. M. (2012), Engineering Graphic, TMH Publication.

vi) Corresponding set of CAD Software Theory and User Manuals.

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

Course Code : MEP151 **Course: Engineering Graphics & Design Lab**

L:0 Hr., T:0Hrs., P:4 Hrs., Per week **Total Credits : 02**

Course Outcomes

Students are prepared for actual work situations through practical training in a new state of the art computer designed CAD laboratory using engineering software. The student will learn to :

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

UNIT 1 : Introduction to Engineering Drawing

Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and involutes; Introduction to Scales.

UNIT 2 : Orthographic Projections

Principles of Orthographic Projections -Conventions - Projections of Points and lines inclined to both planes; Projections of planes - Auxiliary Planes.

UNIT 3 : Projections of Solids

Inclined to both the Planes Auxiliary Views; Draw simple annotation, dimensioning and scale, Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

UNIT 4 : Sections and Sectional Views of Right Angular Solids

Prism Cylinder, Pyramid, Cone - Auxilary Views; Development of surfaces of Right Regular Solids Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT 5 : Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; conversion of Orthographic views to Isometric views / Projection

UNIT 6 : Overview of Computer Graphics

Demonstrating knowledge of the theory of CAD software such as (the Menu System Toolbars Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, crosshairs, Coordinate Systems), Dialog boxes and windows, Shortcut menus (Button Bars), The command Line (wherever applicable), The Status Bar, Different methods of zoom as used in CAD, select and erase objects; Isometric Views of lines, Planes, Simple and compound solids);

UNIT 7 : Customization & CAD Drawing

Setting up drawing page and the printer, including scale settings, Setting up of units and Drawing limits; ISO and ANSI standards for coordinate dimensioning; Orthographic constraints, map to objects, manually and automatically, Producing drawings by using various coordinate input entry methods to draw straight lines,

Applying various ways of drawing circles;

UNIT 8 : Annotations Layering & Other Functions

Applying dimensions to objects, applying annotations to drawings; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques.

UNIT 9 : Demonstration of a simple team design project that illustrates

Geometry And Topology Of Engineered Components Creation Of Engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed toplogies for engineering, Introduction to Building Information Modeling (BIM)

List of sheets

1. Curves (ellipse, Parabola, hyperbola, Cycloid, involute)
2. Line, Planes, Solids
3. Application of Section and development of solids
4. Orthgraphic Projection
5. Isometric
6. Auto CAD practic sheet 1
7. Auto CAD practice sheet 2
8. Blueprint sheet

Suggested Text/ Reference Books :

i) Bhatt N.D. Panchal V.M. & Ingle P.R., (2014), Engineering drawing, Charotar Publiishing house

ii) Jolhe D.A., (2016) Engineering drawing with an Introduction to Auto CAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

iii) Shah M.B. & Rana B.C. (2008), Engineering drawing and Computer Graphic, Pearson Education.

iv) Agarwal B & Agarwal C.M. (2012), Engineering Graphics, TMH PUBLICATION

v) Narayana, K.L & P Kannaiah (2008), Text Book on Engineering Drawing, Scitech Publishers.

vi) (Concesponding set of) CAD Software Theory and USER Manuals.

Syllabus for B.E. Semester I Department of Humanities

Course Code : HUT152 **Course : Constitution of India**

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

Course outcome

1. Students will understand the role of constitution in democratic India
2. Students will be responsible students by knowing their fundamental rights and duties
3. Students will develop better understanding of democratic functions of the government of India
4. Students will form better understanding of system of governance for effective participation

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the Fundamental Rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Union Executive: structure, functions
10. Judiciary: Structure, role with special reference to PIL, writ petitions, strengthening of democracy & social justice
11. Amendment of the Constitutional Powers and Procedure
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government – Constitutional Scheme in India
14. Provisions of civil services: Characteristics, functions, merits and demerits
15. Democratic principles in industry

Book

1. Durga Das Basu "An Introduction to Constitution of India" 22nd Edition, LexisNexis

Syllabus for B.E. Semester I Department of Humanities

Course Code : PEP151 **Course : Yoga / Sports**

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

Course outcome

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

1. Understand fundamental skills and basic rules of games offered by the Physical Education Department of RCOEM.
2. Obtained health related physical fitness.
3. Develop body-mind co-ordination through games and yoga.
4. Changed sedentary life styles towards active living.

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 to make the all-round development with team spirit, social values as well as to identify and develop leadership qualities in students through various sports activities. Sports activities would also be conducted with the objective to provide better interaction and recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate the health related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline:

Sports :

1. Introduction to sports, offered by the department.
2. Health and safety issues related to sports; knowledge, recognition and ability to deal with injuries and illness associated with sports.
3. Practicing the fundamental skills and bringing awareness of basic rules and regulations.
4. Conduction of small recreational games and activities.

Yoga : Includes various sitting, standing and lying Asanas, Suryanamaskars and Pranayamas.

Physical Efficiency Tests : This includes 6 health related physical fitness tests.

Components	Name of Tests
Speed	50 mts Dash
Agility	Shuttle run
Cardiovascular Endurance	8 mins Run/Walk
Test Flexibility	Sit and Reach Test
Abdominal Strength (M) / shoulder strength (F)	Bent Knee Sit-ups (M)/ Modified Pull-ups (F)
Yogic exercises	Suryanamaskars

Syllabus for B.E. Semester I / II

Course Code : CHT151 **Course : Chemistry**

L: 3 Hrs, T: 1 Hr, P : 0 Hr., Per week **Total Credits : 4**

Course Outcomes

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

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

(i) Chemistry-I (Concepts in Chemistry for Engineering)

(i) Atomic and molecular structure (12 lectures)

Schroedinger equation. Particle in box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

(v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry & chirality, enantiomers, diastereomers, optical activity, absolute configurations & conformational analysis. Isomerism in transitional metal compounds.

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

(i) University chemistry, by B. H. Mahan
(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) Organic Chemistry: Structure & Function by K. P. C. Volhardt & N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp
(vii) Selected topics in Inorganic Chemistry by Malik, Madan & Tuli.

Syllabus for B.E. Semester I / II

Course Code : CHP151 **Course : Chemistry Lab**

L: 0 Hrs., T: 0 Hrs., P: 3 Hrs., Per week **Total Credits : 1.5**

Laboratory Outcomes

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

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials and impurities in water etc.
- Synthesize a polymer or drug molecule or nano-material.

List of Experiments for Chemistry Lab

1. Determination of Surface tension and Viscosity of a given liquid.
2. Determination of total hardness and alkalinity of a given water sample.
3. Synthesis of a polymer.
4. Determination of Cu and Zn in a brass sample.
5. Determination of partition coefficient of a substance between two immiscible liquids.
6. Study of chemical oscillations or iodine clock reaction.
7. Estimation of acid value and saponification value of oil.
8. Determination of cell constant and conductometric titration of strong acid vs. strong base.
9. Colligative properties using melting point.
10. Determination of rate constant of a reaction.
11. Ion Exchange column for removal of hardness.
12. Synthesis of nanoparticles.
13. Adsorption of acetic acid by charcoal.
14. Demonstration of UV-Visible spectrophotometer and FTIR

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

Course Code: CST151 **Course : Programming for Problem Solving**

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

Course Outcomes :

On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays, pointers, structures and I/O operations for the formulation of algorithms and programs.
4. To apply programming to solve matrix addition, multiplication problems and searching & sorting problems.

UNIT-I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm : Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops and Writing and evaluation of conditionals and consequent branching.

UNIT-III: Arrays and Basic Algorithms

Arrays: 1-D, 2-D, Character arrays and Strings.

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

UNIT-VI: File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using fflush().

Text Books:

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

Reference Books:

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

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

Course Code: CSP151 **Course : Programming for Problem Solving Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 1**

Course Outcomes :

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision making statements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem using C programming.
3. Understand pointers, structures, unions and apply them to develop programs.
4. Implement file Operations in C programming for a given application.

CREATIVITY INNOVATION AND DESIGN THINKING
COURSE SYLLABUS

Course Code : IDT151 **Credits:1**

L:1Hrs., T:0Hrs., P:0Hrs., Per week

Course Outcomes

C1: Be familiar with processes and methods of creative problem solving

C2: Enhance their creative and innovative thinking skills

C3: Practice thinking creatively and innovative design and development

Detailed Topics

UNIT I. Introduction: Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

UNIT 2. Pattern Breaking: Thinking differently , Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brainwriting, The SCAMPER methods, Metaphoric thinking, Outrageous thinking , Mapping thoughts, Other (new approaches)

UNIT 3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

UNIT4. Systematic Inventive Thinking: Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats , Ethical considerations

UNIT 5. Design for Innovation: Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT 6.Intellectual Property: Introduction to intellectual property: Patents, Copyrights©, Trademarks ®, Trade Secret, Unfair Competition.

Reference Books and Text Book :

1. Creative Problem Solving for Managers - Tony Proctor - Routledge Taylor & Francis Group
2. 101 Activities for Teaching creativity and Problem Solving - By Arthur B Vangundy - Pfeiffer
3. H. S. Fogler and S.E. LeBlanc, Strategies for Creative Problem Solving, Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill,
5. J. Goldenberg and D. Mazursky, Creativity in product innovation. Cambridge University Press, 2002.

Course Assignments for internal continuous assessment of 20 Marks (NO T1 and T2)

- Brain teasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)
- TRIZ, a systematic ideation method, reading (individual)
- Book readings and discussions (small teams)
- Small teams presentations on innovation: (1) innovative individual, (2) innovative company, (3) innovative movie / game, (4) sustainable innovation, (5) innovation in business, (6) innovation in art, (7) innovation in architecture, (8) innovative nation, (9) innovation in science, and (10) innovation in engineering.
- Large groups hands-on projects
- Eight-dimensional (8D) ideation method examples
- Large teams videos

Syllabus Department of Industrial Engineering

Course Code : INT151 **Course : Workshop / Manufacturing Practices (Theory)**

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

Course Outcomes

1. Identify the different manufacturing process commonly employed in Industry along with prevailing safety practices.
2. Identify the various tools and equipments to carry out different manufacturing processes accompanied by the inspection of the work part.

Syllabus

Unit-1 Fundamentals of metal cutting, single point cutting tool, fundamental mechanics of metal cutting, fitting operations, and associated measuring and marking tools

Unit-2 Introduction to pattern making for metal casting, different types of carpentry tools, measuring tools and marking tools, holding devices, different types of carpentry joints.

Unit-3 Smithy and Forging, Forging tools like chisels, hammers, types of furnaces, types of coal, Forming operations, Hot working and Cold working of metals.

Unit-4 Metal joining Process, mechanics of welding, types of welding, soldering and brazing, types of joints

Unit-5 Introduction to foundries, Metal Casting, types of sand, Introduction to Molding tools & casting process.

Unit-6 Introduction to Plastic Injection Molding

Suggested Text Book

1. "Elements of Workshop Technology" Hajra S.K, Choudhury A. K , Roy Nirjhar Vol. I and Vol .II, Media Promoters and Publishers Private Ltd. Mumbai.

Reference Books

1. Kalpakjian S. and Schmid S. "Manufacturing Engineering and Technology"4th Edition, Pearson India Education 2008
2. Roy A. and Lindberg, "Process and Materials of Manufacture"4th Edition, Prentice Hall India 1998.

Syllabus Department of Industrial Engineering

Course Code : INP151 **Course : Workshop/Manufacturing Practices Lab (Practical)**

L:0Hrs.,T:0Hrs.,P:2Hrs.,Per week **Total Credits:1**

Laboratory Outcomes

On the completion of the course the students shall be able to;

1. Recognize the different manufacturing process commonly employed in the Industry
2. Make the components using required manufacturing process, inspection methods while practicing the requisite safety precautions

Contents

1. Fitting Practice
2. Welding and Soldering Practice
3. Pattern Making Practice
4. Metal Casting Practice
5. Smithy and Forging Practice
6. Machining Practice
7. Plastic Molding Process
8. Glass Cutting Process

Suggested Text Book

1. "Elements of Workshop Technology'" Hajra S.K, Choudhury A.K , Roy Nirjhar Vol. I and Vol .II, Media Promoters and Publishers Private Ltd Mumbai.

Reference Books

1. Kalpak Jain S. and Schmid S. "Manufacturing Engineering and Technology"4th Edition, Pearson India Education 2008
2. Roy A. and Lindberg, "Process and Materials of Manufacture", Prentice hall India 1998.

Syllabus for B.E. Semester I / II Dept of Humanities
Humanities and Social Sciences

Course Code: HUT151 **Course : English**

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

Course Objectives

The main objective of the subject is to enhance the employability skills of engineering students as well as communication skills at work place. The sub-objectives are:

1. To develop vocabulary of students.
2. To orient students in basic writing skills.
3. To orient students in functional grammar.
4. To orient students in the process of effective writing.
5. To provide practice and improve students' oral communication skills.

Course Outcomes

1. Students will have good word power.
2. Students will acquire basic writing skills.
3. Students will understand functional grammar and its usage.
4. Students will organize and express their thoughts effectively through written communication.
5. Students will learn oral communication skills in order to handle themselves effectively in an interview and group discussion

SYLLABUS

1. Vocabulary Building
- 1.1. The concept of Word Formation
- 1.2. Root words from foreign languages and their use in English
- 1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives
- 1.4. Synonyms, Antonyms and standard abbreviations

2. Basic Writing Skills
- 2.1 Sentence Structures
- 2.2 Use of phrases and clauses in sentences
- 2.3 Importance of proper punctuation
- 2.4 Creating coherence
- 2.5 Organizing principles of paragraphs in documents
- 2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing
- 3.1 Subject-verb agreement
- 3.2 Noun-pronoun agreement
- 3.3 Misplaced modifiers
- 3.4 Articles
- 3.5 Redundancies
- 3.6 Cliches

4. Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence

5. Writing Practices

5.1 Comprehension
5.2 Precis Writing
5.3 Essay Writing
5.4 Letter Writing
5.5 Email Writing

6. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations : Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Books

1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Syllabus for B.E. Semester I

Course Code: HUP151 | **Humanities and Social Sciences including Management courses** | **Course : English Lab**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week | **Total Credits: 1**

Course objective :

1. To enhance competency of communication in English among learners.

Course outcomes:

1. Students learn presentation and public speaking skills
2. Students learn to practice effective strategies for Personal Interview and Group Discussions
3. Students learn and effectively apply language skills – listening, speaking, reading and writing

List of Practical (2 hours each for each batch) based on unit 6 (oral communication).

1. Common Everyday Situations: Conversations and Dialogues
2. Pronunciation, Intonation , Stress, and Rhythm
3. Formal Presentations: Orientation
4. Formal Presentations : Practice Session
5. Interviews: Orientation
6. Interviews: Practice Session
7. Communication at Workplace: Group Discussion- Orientation
8. Communication at Workplace: Practice Session

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MET251 **Course : Materials Engineering**

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

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. Compute the mechanical properties of engineering materials using various testing methods
3. Interpret and explain the phase diagram and make use of this knowledge to illustrate the Iron-Iron carbide equilibrium diagram.
4. Realize the significance and general procedure of heat treatment processes.
5. Understand the composition, microstructure, properties and application of alloy steels, cast-iron and non metal alloys.
6. Understand composite material, ceramics, polymers and powder metallurgy.

Syllabus

Unit I:

Classification and properties of engineering materials.
Structure of materials: crystal structure – grouping of atoms, binding in solids, space lattice and unit cell, indexing of lattice planes and directions, atomic packing factor.
Mechanism of crystallization, polymorphism.
Imperfection in crystals: Point, line, interfacial and volume defects.
Dislocations, strengthening mechanisms and slip systems, critically resolved shear stress. (8)

Unit II:

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery.
Hardness test : Rockwell, Brinell and Vickers tests and their relation to strength.
Impact tests: Izod and Charpy.
Fracture with fatigue, Fatigue test, S-N curve, creep test.
Introduction to nondestructive testing (NDT) (8)

Unit III:

Alloys, solid solutions, compounds, Hume-Rothery's rules of solid solubility, Gib's phase rule.
Solidification of pure metal, critical size of nucleus, shape of crystals, dendritic growth.
Types of cooling curves, non equilibrium cooling.
Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. (6)

Unit IV:

Solidification of pure iron, Iron Iron-carbide phase diagram and microstrctural aspects of austenite, ferrite **and**

cementite, pearlite and ledeburite. Critical temperatures, invariant reactions.
Solidification and transformation of steel and cast-iron.
Classification of steel, Heat treatment of Steel, Isothermal transformation (TTT) diagrams for Fe-C alloys and microstructure development. Continuous cooling curves (CCT) and interpretation of final microstructures and properties.
Annealing, tempering, normalizing and hardening. Austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. (8)

Unit V:

Alloying of steel, properties of stainless steel and tool steels, maraging steels.
Cast irons; grey, white, malleable and spheroidal cast irons.
Copper and copper alloys; brass, bronze and cupro-nickel. Bearing Materials.
Aluminium and Al-Cu – Mg alloys, Nickel based super alloys and Titanium alloys. (8)

Unit VI:

Introduction to composite materials, Ceramics, Polymers.
Introduction to Powder metallurgy, smart materials. (7)

Text Books:

1. V. D. Kodgire & S. V. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House.
2. Sindney H Avner , Introduction to Physical Metallurgy, Mc-Graw Hill Education (India) Pvt. Ltd.
3. L. Krishna Reddy, Principles of Engineering metallurgy , New Age International Publishers

Reference Books:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering', Prentice Hall of India Private Limited,1999.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MEP251 **Course : Materials Engineering**

L: 0 Hrs. T: 0 Hrs. P: 01 Hrs. Per week **Total Credits : 0.5**

Course Outcomes

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

The laboratory will have minimum Ten Practical based on the syllabus of MET251

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 for B.E. Semester III (Mechanical Engineering)

Course Code: MEP252 **Course : M/C Drawing & Solid Modeling**

L: 0 Hrs. T: 0 Hrs. P: 02 Hrs. Per week **Total Credits : 01**

Course Outcomes

1. Ability to draw and read production drawings. & ability to convert 3D object to its 2D representation.
2. Ability to select standard machine elements as per the standards.
3. Ability to use the Drafting and Design package e.g. CREO 2.0.
4. Ability to model machine components using geometric modeling software and able to construct detailed draft views of part or assembly

Syllabus

UNIT 1: 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.

UNIT 2: Limits: Terminology Fits: Types & Applications of fits. Dimensional Tolerance, Geometrical Tolerance. Tolerance Grades & Tolerance Charts, calculations of dimensional tolerance.

UNIT 3: Assembly and Dismantling Principles: Study of some Standard Assemblies. Subassembly Drawing, Full Assembly Drawing, Exploded Views. Preparation of Bill of material. Production drawing preparation.

UNIT 4: Part modeling and assembly
Module-1 Introduction to modeling and basic concepts , Using solid modeling software interface Selecting and Editing , Sketcher geometry , Creating datum Features: Planes and Axes , Creating extrudes, Revolves and Ribs ,Creating sweeps and blends (geometric features),Creating holes, shells and drafts, Creating rounds, chamfers ,Copy and mirror tools (Editing features)),Creating patterns
Module-2 Assembling with constraints, exploding assemblies

UNIT 5: Surface modeling, Surface modeling overview, Advance selection, Basic Surfacing tools

UNIT 6: Detailing of Drawings, Introduction to drawings, Creating new drawings and views, Adding details to drawings, Adding notes to drawings, Adding tolerance and symbols

Text Books:

1. Machine Drawing by N. D. Bhat, Charotar Publications
2. Machine Drawing by K.L.Narayan, R. Kannaiah, K.V.Reddy, New Age Int. Publishers
3. Parametric Modeling with Creo Parametric 2.0 by Randy Shih, SDC Publications.

Reference Books:

1. Machine Drawing by R. K. Dhawan, S. Chand Publications
2. Machine Drawing by P. S. Gill, S. K. Kataria & Sons
3. Engineering Drawing Practice for Schools & Colleges (SP-46:1988): Bureau of Indian Standards.
4. Reference manuals for Creo 2.0 of PTC University

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MET253 **Course : Engineering Mechanics**

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

Course Outcomes

Upon successful completion of the course, student should be able to:

1. Understand basic force system and determine the resultant force and moment for given system of forces.
2. Understand friction terminology and determine the problems related to friction.
3. Understand to determine the centroid and Second moment of Inertia.
4. Understand basic dynamics concepts – force, momentum, work and energy
5. Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse -Momentum principle and the coefficient of restitution;
6. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);

Unit 1:

Introduction to Engineering Mechanics covering, Force Systems, Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

Unit 2:

Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction.

Unit 3:

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia.

Unit 4:

Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom.

Unit 5:

Review of particle dynamics - Kinetics of Particles - Forces & Acceleration, Work- energy, Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit 6:

Introduction to Kinetics of Rigid Bodies ; Kinetics of rigid body rotation, Circular motion of rigid bodies, Kinetics of rolling bodies.

Text Books:

1. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
2. S.S. Bhavikatti (2017), Engineering Mechanics, New Age Publications
3. A.K. Sharma, Fundamental of Engineering Mechanics, Sai Publications

Reference Books

1. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, Pearson Educations, Forth edition, 2003.
2. Beer and Johnston, Vector Mechanics for Engineers, Vol.1 "Statics" and Vol.2 "Dynamics, McGraw Hill International Edition, 1995.
3. Suhas Nitsure, Engineering Mechanics, Technical Publications, Pune, 2007.
4. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
5. S.S. Deo, (2017), Engineering Mechanics, Nirali Publications.

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MET254 **Course : Manufacturing Processes**

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

Course Outcomes

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

1. Select a suitable pattern and casting method for manufacturing of casted components.
2. Select a suitable hot/cold working method to manufacture metal components.
3. Select a suitable joining processes for fabrication work of ferrous and non ferrous metals.
4. Identify the machining parameters, cutting tool materials and cutting fluids for different machining operations.
5. Understand concept of rapid prototyping, its types, their working principle and applications
6. Distinguish and select appropriate unconventional machining process for manufacturing complex shape component.

Syllabus

Unit-I :

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(7)**

Unit-II :

Forming Processes: Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), Principles of powder metallurgy.**(5)**

Unit-III :

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding. **(5)**

Unit-IV :

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.**(8)**

Unit-V :

Additive manufacturing: Rapid prototyping and rapid tooling**(4)**

Unit-VI :

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters **(5)** Electrical Discharge Machining, **Unit**

Unit - VII

Electrical Discharge Machining : principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. **(8)** Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining **(3)**

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

Reference Books:

1. Manufacturing Technology (Vol I & II) – 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.
5. Computer Graphics including CAD, Autocad and "C" - A. M. Kuthe, S. Chand Publication (2005)

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MEP254 **Course : Manufacturing Processes**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 01**

Course Outcomes

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

1. Perform different operations on lathe, shaper, milling and drilling machine.
2. Understand the basic components and working of CNC machines.
3. Understand working principle of unconventional machining process like EDM.
4. Prepare a casting using sand mould and identify various casting defects.

List of Experiments

About 10 experiments will be carried out from-

1. Taper turning and external thread cutting using lathe.
2. Contour milling using vertical milling machine.
3. Spur gear cutting in milling machine.
4. Measurement of cutting forces in Turning process.
5. Precision drilling on Radial Drilling Machine.
6. To perform various operations on Shaper machine.
7. CNC: Demonstration and part programming
8. EDM-Demonstration
9. To study different types of melting furnaces.
10. To carry out moulding and casting using pit furnace for different patterns.
11. Study of various casting defects & observations of the actual casting.
12. 3D printing: Demonstration
13. To study constructional details and working of Power Press.

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MAT257 **Course : Mathematics-III**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

After studying the course, the student will be able to:

1. Solve field problems in engineering involving PDEs.
2. Formulate and solve problems involving random variables
3. Apply statistical methods for analyzing experimental data
4. Understand complex variable.

Syllabus

MODULE I: (17Hrs) : Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane and cylindrical coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

MODULE II: (13Hrs) : Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities.

MODULE III: (12Hrs) : Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

MODULE IV(8Hrs) : Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions
Contour integrals, Cauchy Integral formula (Without proof), Taylor's series, zeros of analytic functions, singularities; Residues, Cauchy Residue theorem (without proof).

Text Book:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna publishwers 43rd edition (2015)

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: IDT251 **Course : Biology**

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

Course Outcomes

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

1. Understand biological sciences and levels of organization of life.
2. Identify biomolecules and enzymes.
3. Apply principles of energy transactions in Metabolism / Bioenergetics.
4. Classify Nervous and immune system in context to cell signaling.
5. Analyze basic concepts in genetics.
6. Explore the concept of growth kinetics with reference to Microbiology.

Syllabus

MODULE I: (6 Hrs) Introduction: Engineering perspective of Biological Sciences, Fundamental differences between science and Engineering- case studies; Hierarchy and classification of life forms, Levels of organization of life- cell, tissues, organs, system and organism, Anatomy and physiology.

MODULE II: (6 Hrs) Biomolecules and Enzymes: Biomolecules as basic building block of all forms of life, structure and function of carbohydrates, proteins and Amino acids, Lipids, Nucleic acids, Vitamins and Minerals, Enzymology- Introduction, classification and mechanism of action

MODULE III: (6 Hrs) Metabolism /Bioenergetics: Fundamental principles of energy transactions (Thermodynamics) as applied to biology, Entropy changes in biological systems, free energy, equilibrium, process of synthesis and breakdown of glucose.

MODULE IV(5Hrs) Nervous System, Immune System, and Cell Signaling: Nervous System-Immune System-General principles of cell signaling

MODULE V: (6 Hrs) Genetics: Introduction to Genetics, genetic codes, Expression and Transmission of genetic Information, concept of DNA cloning, single gene disorders in humans**.**

MODULE VI. (4Hrs) Microbiology: Concept of single celled organisms. Concept of species and strains. Identification andclassification of microorganisms. Microscopy. Ecological aspects of single celledorganisms. Sterilization and media compositions. Growth kinetics.

Text Book:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd

Reference Books:

1) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
2) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
3) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
4) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Syllabus for B.E. Semester III (Mechanical Engineering)

Course Code: MEP260 **Course : Industrial Visit**

L: 3 Hrs. T: 0 Hrs. P: 02 Hrs. Per week **Total Credits : 00**

Course Outcomes

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

Syllabus

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 / equipments.
10. List of raw material used.

Syllabus for B.E. Semester IV (Mechanical Engineering)

Course Code: MET261 **Course : Kinematics and Dynamics of Machinery**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To classify and synthesize the cams for different follower motions
4. Demonstrate the understanding of successfully addressing issues related to kinematics of Spur gears and gear trains
5. Examine the balancing of the rotating and reciprocating elements to avoid the failure and analyze the free and forced vibrations in SDOF systems
6. Demonstrate the gyroscopic effect on airplane, ship, four wheeler, two wheeler and Exhibit skills towards application of dynamic force analysis

Syllabus

Unit-I:

Basics of Mechanisms and Machines

Basic concept of mechanism, link, kinematics pairs, kinematics chain, mechanism, machine, simple & compound chain, Degree of freedom, Kutzbach's theory, Grubber's criterion. Harding's notations, Class-I & Class-II mechanisms, Inversions of four bar chain and slider crank chains, Limit positions- Mechanical advantage- Transmission angle, various types of mechanism such as Geneva wheel, Pawl and ratchet mechanism. **(8)**

Unit-II:

kinematic analysis of Mechanisms

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism coincident points- Coriolis component of acceleration **(8)**

Unit-III:

Cams and Followers

Classification of cams and followers- Terminology and definitions- Displacement diagrams-uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- pressure angle and undercutting, Introduction to linkage synthesis three position graphical synthesis for motion and path generation **(8)**

Unit-IV:

Kinematics of Gear and Gear Trains

Involute and cycloidal gear tooth profiles, gear terminologies, fundamental law of gearing and conjugate action, spur gear, length of path of contact, length of arc of contact, contact ratio and interference/undercutting,

kinematics of regular and epicyclic gear trains **(8)**

Unit-V:

Balancing of Masses

Inertia forces and their balancing for rotating and reciprocating machines. Balancing of Inline engines, radial engines, Free and forced vibration of SDOF system, whirling speed of shaft, Introduction to 2 DOF systems, vibration absorbers **(9)**

Unit-VI:

Gyroscopic Motion and Static Force Analysis

Rigid body motion in space, Euler's equation of motion, simple precession and gyroscopic couple, Gyroscopic effect on airplane, ship, vehicles and grinding mills, Dynamic force analysis of planar linkages such as four bar chain and reciprocating mechanism by graphical method **(9)**

Text Books:

1. Theory of Machines: S.S. Rattan, Tata McGraw Hill Publishers, 3rd edition onwards

Reference Books:

1. Kinematics & Dynamics of Machinery: R. L. Norton Tata McGraw Hill Publishers
2. Mechanism and Machine Theory: J. S. Rao & Rao V. Dukkipati, New Age International
3. Theory of Mechanisms and Machines: Ghosh& Mallik, Tata McGraw Hill
4. Theory of Machines: Thoman Bevan, CBS publication
5. Theory of Machines and Mechanisms: Uicker and Shigley, Tata McGraw Hill

Syllabus for B.E. Semester IV (Mechanical Engineering)

Course Code: MEP261 **Course : Kinematics and Dynamics of Machinery**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 01**

Course Outcomes:

Students shall be able to

1. Demonstrate the importance of 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 whirling speed of a shaft
4. Understand and examine the balancing of the rotating and reciprocating elements to avoid the failure.

Objectives of this lab are to impart practical knowledge on design and analysis of mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces for the transmission systems, machine kinematics and dynamics can be well understood.

Mechanisms form the basis of any machine and it is an assemblage of rigid bodies so that they move upon each other with definite relative motion.

Demonstration exercises are provided with wide varieties of transmission element models to understand machine kinematics. Various experiments with gyroscopes, balancing machines, cam dynamics, governors, whirling of shaft and vibrations of a spring mass system are available to understand machine dynamics.

List of Practicals

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 for B.E. Semester IV (Mechanical Engineering)

Course Code: MET262 **Course : Thermodynamics**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

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

1. Understand Engineering approach of thermodynamics and identify processes and compute associated heat and work transfer.
2. Learn balance of energy between system and its surroundings and apply laws of thermodynamics to thermal utilities.
3. Understand the concept of Heat engine, Refrigerator & Heat Pumps.
4. Understand the II law limitations on energy conversion and concept of entropy.
5. Analyze steam power cycles and thermodynamic relations.
6. Evaluate the changes in properties of substances in various processes.

Syllabus

UNIT 1

Fundamentals-Approaches of Thermodynamics, System & Control volume, Concept of Continuum, Property of system ,State Postulate, State and Equilibrium, Process, Path and Cycle; Forms of Energy, Concept of total energy E, Work-Thermodynamic definition of work; examples on Displacement work; Path dependence of displacement work and illustrations for simple processes: electrical, magnetic, gravitational, spring and shaft work, Temperature, Definition of thermal equilibrium and Zeroth law, Temperature scales and various Thermometers Definition of heat; examples of heat/work interaction in systems, Exact & Inexact differentials.**(8)**

UNIT2

Joules Experiment and Introduction to First Law, First Law applied to closed systems, Energy as a property; Internal Energy and Joule Law, Specific heat and Enthalpy. First Law applied to Open Systems, Derivation of general energy equation for open systems; Steady state steady flow processes including throttling and examples of steady flow devices. **(8)**

UNIT3

Limitations of First Law, Thermal Energy Reservoir, Heat Engines, Refrigerator and Heat Pumps, Definitions of thermal efficiency and COP, Kelvin-Planck and Clausius statements, Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.**(8)**

UNIT4

Clausius inequality, Definition of entropy, Entropy as a property; Evaluation of Entropy for solids, liquids, ideal gases undergoing various processes; Determination of Entropy from steam tables- Principle of increase of entropy, Illustration of processes on Ts coordinates. Definition of Isentropic efficiency for compressors, turbines and nozzles **(10)**

UNIT5

Irreversibility and Availability, Availability Function for Systems and Control volumes undergoing different processes, Thermodynamic Relations, Maxwel Equation, Clausius-Clapeyron Equation.

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle, Otto cycle & diesel cycle. **(8)**

UNIT 6

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. **(8)**

Text Books:

1. Engineering Thermodynamics: P. K. Nag, Tata Mc-Graw Hill publication
2. Thermal Engineering: R.K. Rajput, Laxmi publications.

Reference Books:

1. Thermodynamics - An Engineering approach: Yunus A. Cengel, Michael A. Boles, Mc-Graw Hill publication
2. Thermal Engineering: P.L. Balaney, Khanna Publisher.

Syllabus for B.E. Semester IV (Mechanical Engineering)

Course Code: MET263 **Course : Strength of Materials**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

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

1. Understand basic concept of stress, strain and their relations based on linear elasticity, material behavior due to different types of loading.
2. Learn analytical and graphical analysis of compound stresses and analysis of strain energy.
3. Develop shear force – bending moment diagram of beams under different loading conditions & support conditions and analyze bending & shear stresses in beams.
4. Analyze torsional shear stresses in circular shafts.
5. Analyze deflection of beams, columns & struts.
6. Analyze stresses in cylinders, spherical shells and rotating discs.

Syllabus

Unit- I:

Concept of simple stresses and strains: Deformation in solids- Hooke's law, stress and strain diagram, tension, compression and shear stresses, saint-venant's principle; poisson's ratio; volumetric, linear, and shear strains; principle of superposition, statically indeterminate systems, compound bars; elastic constants and their relations; Factor of safety (8)

Thermal stresses and strain. (2)

Unit- II:

Compound stresses and strain: normal and shear stress on inclined plane, principal stresses and principal planes, maximum shear stresses, Mohr's circle.

Normal and shear strain, principal strain, principal shear strain, strain rossets, determination of principal stresses from principal strains. (5)

Strain energy: Strain energy stored in a body when subjected to axial loading, & impact loading, strain energy in three dimensional system. (3)

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. (5)

Bending and shear stresses in beams:

Theory of simple bending**,** bending equation, section modulus, bending stresses in symmetrical and unsymmetrical sections, composite beams, beam of uniform strength.

Shear stress equation, shear stresses across standard sections and built up sections.

Compound stresses in beam. (5)

Unit –IV:

Torsion of circular shafts: Derivation of torsion equation, Strength and rigidity criterion for design of shaft; torque transmitted by solid and hollow shafts; stepped shafts, composite shafts, tapering shafts. Comparison of solid and hollow shafts; Compound stresses in shaft, Derivation of principal stresses and maximum shear stress induced in shaft subjected to bending moment, torque & axial load, Torsional strain energy.(8)

Unit –V:
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, bending strain energy.(6)
Column & Struts: - Analysis of long & short column by Euler's formula, Rankine's formula.(4)

Unit –VI:
Stresses in cylinders and spherical shells: - Stresses in cylinders & spheres subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure, Compound cylinders. (5)

Stresses in Rotating Disc: Stresses in thin rotating ring, disc of uniform thickness. (3)

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.

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 for B.E. Semester IV (Mechanical Engineering)

Course Code: MET264 **Course : Fluid Mechanics & Hydraulic Machines**
L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

The expected learning outcome is that the students will be able to:
1. Understand the different types and properties of the fluid and learn various methods to measure pressure.
2. Evaluate the fluid flow kinematics for fluids in motion and apply basic principles of fluid dynamics.
3. Apply flow theories to engineering flow systems also understand flow through different pipes.
4. Understand effect of hydrodynamic force on various types of vanes.
5. Apply acquired knowledge to design and performance characteristics of hydraulic turbines.
6. Design and evaluate performance characteristics of centrifugal and reciprocating pump.

Syllabus
UNIT-1 : Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow,**(8)**

UNIT-2 : Continuity equation in one & three dimensions, differential velocity field Stream function, stream line, type of flow, kinematics flow (introductory treatment).Dynamics of flow -. Eulers equation of motion. Bernoulli's equation & its limitation. Application of Bernoulli's theorem,:- Venturimeter, orifice meter, pitot tube. **(9)**

UNIT -3 : Introduction to laminar and turbulent flow, Reynolds number and its Significance. Flow of viscous fluids through pipe .Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness Boundary layer Theory, Flow through pipes, losses in the pipes, Flow Through Pipes: Losses in pipes. Darcy Weisbach equation, friction factor, Moody's diagram. **(9)**

UNIT-4 : Impact of jet and jet propulsion: Momemtum principle, Dynamic action of jet on fixed and moving plates, curved vanes, series of plates and vanes, velocity triangles and their analysis, Introduction to hydroelectric power plant **(8)**

UNIT-5 : Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles –draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines. **(8)**

UNIT-6
Theory of Rotodynamic machines – Various efficiencies , velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves ,Cavitation in pumps, Reciprocating pump – working principle. **(8)**

Text Books:
1. Fluid Mechanics & hydraulic machines, R.K. Bansal, Laxmi Publications.
2. Fluid Mechanics & Fluid Power Engineering, D. S. Kumar -S. K. Kataria Publications.
3. Fluid Power with Applications, Anthony Esposito, 7th edition, Pearson Publication.

Reference Books:
1. Fluid Mechanics: Som & Biswas - Tata McGraw-Hill.
2. Hydraulic Machines - Theory & Design: V. P. Vasandani- Khanna Publishers.
3. Theory of Turbo-Machines: A. T. Sayer- McGraw Hill.
4. A text book of Fluid Mechanics : R.K. Rajput, S.Chand Publication.

Syllabus for B.E. Semester IV (Mechanical Engineering)

Course Code: MEP 264 **Course : Fluid Mechanics & Hydraulic Machines Lab**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 01**

Course Outcomes

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

1. Use knowledge of various discharge measuring devices such as orifice, mouthpiece and venturimeter for determining Cd,Cc,Cv.
2. Determine the major and minor losses in the various pipes
3. Graphically present the output of Impulse and Reaction turbines
4. Ability to perform practicals of rotodyanamic pump and positive displacement pump

The laboratory will have minimum Eight Practical based on the syllabus of MET-264

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 and C for orifice d c
4. Determination of hydraulic coefficients C and C for mouthpiece d c
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 for B.E. Semester IV (Mechanical Engineering)

Course Code: MEP265 **Course : Mechanical Engineering Software Lab**

L: 3 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 01**

Course Outcomes:

Upon successful completion of the course, student should be able to:

1. Explore and understand the modeling of machine components using geometric modeling software.
2. Program, understand importance and implementation Software languages for Mechanical applications.
3. Understand and implement the Project planning and Business analytics tools.
4. Understand Data Science and Data Analytics tools.

Syllabus:

Module 1 Solid Modeling Software's

Machining simulation using CAM software (CREO 2.0, Solid Works)

Web based Software- OnShape.

Module 2 Programming

MatLAB

SciLAB

Module 3 Project Planning / Business Analytics

Exposure to Project Planning and Business Analytics Tools.

Financial Decision support systems.

Module 4 Data Analytics

Python, Introduction to NumPy , SciPy, Pandas, Stats Models, Matplotlib

Introduction to R Programming.

Text Books :

1. Parametric Modeling with Creo Parametric 2.0 by Randy Shih, SDC Publications.
2. Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, RudraPratap, Oxford University.

Reference Books :

1. Reference manuals for Creo 2.0 of PTC University
2. Reference Manual For OnShape of Onshape domain.

Syllabus for B.E. Semester IV (Mechanical Engineering)

Course Code: CHT252 **Course : Environmental Science**

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

Course Outcomes

On successful completion of the course, the students:

1. Will get sufficient knowledge regarding different types of environmental pollutions, their causes, detrimental effects on environment and effective control measures.
2. Will realize the need to change an individual's outlook, so as to perceive our environmental issues correctly, using practical approach based on observations and self learning.
3. Will become conversant with recent waste management techniques such as E-wastes, its recycling and management.
4. Will gain knowledge about the modes for sustainable development, importance of green energy and processes.
5. Will be able to identify and analyze environmental problems as well as risks associated with these problems and greener efforts to be adopted, to protect the environment from getting polluted.

Syllabus

Principle of contaminant behaviour and recent trends in environmental pollution control

I- Air pollution and its control techniques: (4 lectures)
Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution
Natural pathways for degradation: Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle.
Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs).
Techniques to control Air pollution, ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

II- Noise pollution and its control techniques: (2 lectures)
Introduction to noise pollution and its causes
Noise pollution control: Recent advances in noise pollution control and benefits.

III- Soil pollution and its control techniques: (5 lectures)
Soil pollution: Soil around us, Soil water characteristics, soil pollution.
Solid waste management: Composting, vermiculture, landfills, hazardous waste treatment, bioremediation technologies, conventional techniques (land farming, constructed wetlands), and phytoremediation.
Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals

IV-Water pollution and its control techniques: (8 lectures)
Major sources of water pollution: Eutrophication, acid mine drains, pesticides and fertilizers, dyeing and tanning, marine pollution, microplastics
Techniques to control water pollution: Conventional waste water treatment-types of sewage, sewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal.

Case studies:
Treatment schemes for waste water from dairy, textile, power plants, pharmaceutical industries, and agro based industries such as rice mills

V- E-wastes (2 lectures)
Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

VI- Environmental Sustainability: Role of Green technology (5 lectures)
Concept of green technologies, categories, goals and significance, sustainability
Green energy, green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation
Different government initiatives (2 lectures)

Books suggested:

1) Benny Joseph, Environmental Studies, Mc Graw Hill Education (India) Private Limited
2) B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3) P Aarne Vesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth -Heinemann
4) D. D. Mishra, S. S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S. Chand & Company Ltd. Sultan Chand & Company
5) Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer-Verlag Berlin Heidelberg
6) P.T. Anastas & J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press
7) P. Thangavel & Sridevi, Environemental Sustainability: Role of Green technologies, Springer publications.

Syllabus for B.E. Semester IV (Mechanical Engineering)

Course Code: MEP270 **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.
4. Ability to convert the innovative or recent technologies in the form of working model.

Syllabus

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.

Syllabus for B.E. Semester IV (Mechanical Engineering), Honors Specialization

Course Code: MET267 **Course : Digital Manufacturing**

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

Course Outcomes

Upon successful completion of the course, student should be able to:

1. To understand basic Conventional and Modern Machining Processes and Advanced Material and their properties.
2. Students should able to understand the 2D and 3D Machining operations and Manual CNC Programming.
3. Model machine component using geometric modeling software, & Interpreter software.
4. Understand the Subtractive technology/ Additive Manufacturing.
5. Understand the Micro fabrication process MEMS
6. Understand the Micro fabrication process & Thin film deposition for MEMS

Unit 1.

Overview of digital manufacturing processes: and Material properties: What makes a manufacturing process "digital", The 10 disruptive principles of digital manufacturing processes. And Mechanical properties of printed materials, Post processing, Empirical and data-driven models (Polymers, Metals, Ceramics, and Resins).

Unit 2.

CNC Machining and Programming: 2D Lathe machining and different operations, 3D Milling machining and different operations.

Unit 3.

CAD / CAM Modeling and Machine control: Design process and role of CAD, Types and applications of design models, Solid modeling - Parametric modeling, CAM Feature, Tool path generation for Lathe and milling operation. STL file generation; file verification & repair, STL/AMF Slicing CURA / Ultimaker, preprocessing and post processing techniques

Unit 4. Additive Manufacturing processes:-

Liquid based processes, Powder based processes & Solid based processes, RP Processes: Process overview, Direct digital tooling, direct digital manufacturing, system classification, Stereo lithography, SL with photo polymerization, SL with liquid and thermal polymerization, Selective laser Sintering, Fused deposition modeling, Laser Powder forming.

Unit 5. Micro Fabrication Processes and Materials for MEMS-

Substrate and wafers, Silicon as Substrate material, crystal structure, single crystal and polycrystalline, Mechanical properties, Silicon compound, silicon piezo- registers, gallium arsenide, quartz, Poezo-electric crystals, Polymers and Packaging materials. Fabrication Processes:- Bulk and Surface micro manufacturing, Photolithography, photo resists, structural and sacrificial material, x-ray and electron beam lithography.

Unit 6. Thin film deposition for MEMS-
Spin coating, thermal oxidation, chemical vapour deposition (CVD), Electron beam evaporation, sputtering, Etching- Wet eatching and Dry eatching, Wafer bounding- glass-frit, anodic fusion bonding, LIGA Process and applications.

Text Books:

1. "Fundamentals of Digital Manufacturing Science" by Zhou, Zude, Xie, Sheng, Chen, Dejun, eBook, Springer publication ISBN 978-0-85729-564-4
2. "CNC Technology and Programming",Tilak Raj,Dhanpat Rai Publication Company.
3. "Micro and Smart Systems", G. K. Anantsuresh. K.j.Binoy, Willey India.

Reference Books:

1. Rapid Manufacturing: An Industrial Revolution for the Digital Age – Editors N. Hopkinson, R.J.M. Hague and P.M. Dickens, (2006) John Wiley & Sons, Ltd., ISBN-10 0-470-01613-21. T. A. Grimm & Associates, Users Guide to Rapid Prototyping, Society of Manufacturing Engineers (SME) ISBN 0872636976
2. Frank W. Liou, Rapid Prototyping & engineering applications, CRC Press, ISBN 978-0-8493-3409-2
3. Rapid Prototyping theory & practice, Manufacturing System Engineering Series, Ali K. Kamarani, Springer Verlag
4. Rapid Prototyping- case book, J. A. McDonalds, C. J. Ryall, Wiley Eastern
5. "Computer Numerical Control",Jon Stenerson and Kelly Curran, Prentice-Hall of India Pvt. Ltd. New Delhi, 2008

Syllabus for B.E. Semester V (Mechanical Engineering), Honors Specialization
Course Code: MET357 **Course : Tool Design**
L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

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. Understand press working operations in die design.
4. Understand working of bending, forming and drawing dies.
5. Describe forging die design and mould design.
6. Understand the principles of clamping, jigs and designing fixtures for machining.

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, Machinability. **(7)**

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. **(6)**

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.
Principle of metal cutting, clearance, angular clearance, 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, Blanking & Piercing die design - Single & progressive dies. **(7)**

UNIT-IV
Bending Forming & Drawing dies, Bending methods - Bending Terminology, V- Bending, Air bending, bottoming dies, Wiping dies, spring back & its prevention, channel dies.
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 and design considerations. **(7)**

UNIT-V

Forging Die Design & mould Design: Introduction, Classification of forging dies, Single impression dies, Multiple Impression dies and Forging design factors.
Preliminary forging operation - fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design for machine forging in closed & open die forging, materials of forging dies .
Mould Design: of Simple Blow Moulds for Articles such as bottles, cans Design of simple two plate injection moulds , Mould Materials. **(6)**

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.
Milling Fixtures:- Essential features of a milling fixtures, milling machine vice, Design principles for milling fixtures. **(7)**

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 for B.E. Semester VI (Mechanical Engineering), Honors Specialization

Course Code: MET371 **Course : Turbo Machinery**

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

Course Outcomes: Students will be able to

1. Apply thermodynamic concepts to understand the working of turbo machines.
2. Differentiate ideal and practical gas turbine cycles.
3. Understand the working of compressors and analyze their performance.
4. Understand the gas turbine combustion system.
5. Analyze the steam power plant cycles.
6. Design steam nozzles and steam turbines.

Syllabus

Unit I : Review of Basics: Introduction to Prime Movers, Gas Turbines, Review of Basic principles - Thermodynamics, Review of Basic principles - Fluid Dynamics and Heat Transfer, Fundamentals of Rotating Machines - Energy Equation, Dimensional Analysis, Airfoil Theory.

Unit II : Ideal Gas Turbine Cycles: Analysis of Ideal Gas Turbine Cycles, Simple Cycle, Regeneration Cycle, Reheat Cycle, Inter cooling Cycle. Practical Gas Turbine Cycles: Analysis of Practical Gas Turbine Cycles, Methods of accounting for component losses, changes in the composition of the working fluid. Working of Turbojet, Turbofan, Turboprop, Ramjet, Scramjet and Pulsejet Engines and cycle analysis –thrust, specific impulse, specific fuel consumption, thermal and propulsive efficiencies.

Unit III : Centrifugal Compressors: Centrifugal Compressors- Principle of Operation, T-s diagram, Energy equation, velocity triangles, types of blades. Analysis of flow, Performance characteristics.
Axial Flow Compressors: Axial Flow Compressors - Construction, Principle of Operation, T-s diagram, Energy equation, velocity triangles. Analysis of flow. Work done factor, Stage efficiency, Degree of reaction, Performance characteristics.

Unit IV : Combustion Chambers: Gas turbine combustion systems - Introduction, Geometry, Factors affecting Design & Performance, Requirements of the Combustion Chamber, Gas Turbine Combustion Emissions.

Unit V : Rankine Cycle: Properties of Pure Substances, Property diagrams, Steam Power plant Layout, Rankine Cycle- Analysis, Modified Rankine Cycle, and Combined Cycle.

Unit VI : Steam Nozzles: Steam Nozzles- Introduction, Area- velocity relationship, Mass flow rate, Choking of Nozzles, Performance characteristics of Nozzles.
Steam Turbines: Steam Turbines - Impulse and Reaction Turbines, Compounding of steam turbines, Multistage reaction Turbines, Reheat factor and Efficiency.

Text Books:

1. Ganesan, V., Gas Turbines , Tata McGraw Hill Book Company, New Delhi, 2011.
2. Vasandani, V.P. and Kumar, D.S., Treatise on Heat Engineering, Chand and Co Publishers, New Delhi, 2011.
3. Saravanmuttoo, H.I.H., Rogers, G.F.C. and Cohen H., Gas Turbine Theory, Pearson Prentice Education, 2008.

Reference Books:

1. Khajuria P.R and Dubey S.P, Gas Turbines and Propulsive Systems, Dhanpat Rai Publications, 2003
2. Hill P G and Peterson C R, Mechanics and Thermodynamics of Propulsion, Addition-Wesley, 1970.
3. Mattingly J D, Elements of Gas turbine Propulsion, McGraw Hill, 1st Edition. 1997

Syllabus for B.E. Semester VII (Mechanical Engineering), Honors Specialization

Course Code: MET457 **Course : Design of Heat Exchangers**

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

Course Outcomes

1. Understanding Classifications & Applications of Heat Exchangers.
2. Apply Principles of Fluid Mechanics & Heat Transfer to the Design of Heat Exchanger.
3. Understanding the Basic Design Aspects of Heat Exchangers.
4. Understanding the Design of Shell & Tube Heat Exchangers.
5. Understanding the Selection Criteria & Maintenance of Industrial Heat Exchangers.
6. Understanding of Design Considerations & Performance Enhancement Techniques for Practical Heat Exchangers.

Syllabus

Unit I:
Classification of Heat Exchangers, Constructional Details of Shell & Tube Heat Exchangers, Counter Flow Exchanger & Parallel Flow Exchanger, Industrial applications.

Unit II:
Fluid & Heat Transfer Aspects, Basic Thermal Design: LMTD Method, LMTD Correction Factor, Effectiveness of Heat Exchanger, Heat Capacity Rate Ratio, - NTU Method.

Unit III:
Heat Exchanger Design Methodology, Process and Design Specifications, Thermal, Hydraulic & Mechanical Design, Manufacturing Considerations, Heat Exchanger Design Sheets.

Unit IV:
Design of Shell & Tube Heat Exchanger: Preliminary Analysis, Sizing Analysis, Rating Program, Kerns Method, Pressure Drop Analysis.

Unit V:
Selection of Heat Exchangers & their Components, Selection Criteria Based on Operating Parameters, Operating Pressures and Temperatures, General Selection Guidelines for Major Exchanger Types, Quantitative Considerations, Fouling and Corrosion, Testing & Maintenance.

Unit VI:
Heat Exchanger Surface Geometrical Characteristics, Design Considerations for Tube-Fin Heat Exchangers, Plate-Fin Heat Exchangers, Condensers, Evaporators, Cooling Tower, Compact Heat Exchangers etc. Heat Transfer Enhancement Techniques.

Text Books:

1. Fundamentals of Heat Exchanger Design, John Wiley & Sons Ltd.
2. Heat Exchanger Design, P. O. Fraas, John Wiley & Sons, 1988
3. Process Heat Transfer, Donald Q. Kern, McGRAW Hill Book Company

Reference Books:

1. Heat Exchangers: Theory & Practices, T. Taboreck, G. F. Hewitt & N. Afgan, TMH,1980
2. Industrial Heat Exchanger: A Basic Guide, Walkar, TMH Book co,1980
3. Heat Exchangers: Basics Design Applications, Edited by Jovan Mitrovic, InTech Publisher
4. Tubular Exchanger Manufacturers Association, Manual

Syllabus for B.E. Semester VIII (Mechanical Engineering), Honors Specialization

Course Code: MET464-1 **Course : Tribology**

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

Pre-Requisites: TOM and Machine design.

Course Objectives: After successful completion of this course, students will be able

1 To know about properties of lubricants, modes of lubrication, additives etc.
2 To select suitable/proper grade lubricant for specific application.
3 To select suitable material combination for tribological contact.
4 To apply the basic theories of friction, wear and lubrications about frictional behavior commonly encountered sliding surfaces.
5 To suggest an explanation to the cause of tribological failures.
6 To design bearing, friction, wear test rig for laboratory purposes.

Unit 1: (8 hrs)
Tribology in design - bearing material its properties and construction Tribological design of oil seals and gasket. Tribology in industry (Maintenance).
Basic modes of lubrication, properties of lubricants, additives, EP lubricants,
Recycling of used oil, oil conservation, oil emulsion.
Bearing Terminology -Types of Sliding contact, rolling contact bearings. Comparison between sliding and rolling contact bearing. (Theoretical treatment only)

Unit 2: Friction and wear (8 hrs)
Friction- classification, causes of friction, Theories of dry friction, Friction measurement, Stick-slip motion and friction instabilities.
Wear - classification, wear between solids, wear between solid and liquids, factors affecting wear, Theories of wear, Wear measurement.
Approaches to friction control and wear prevention.(Numericals)

Unit 3: Hydrodynamic lubrication (10 hrs)
Theory of hydrodynamic lubrication, mechanism of pressure development in oil film.
Two dimensional Reynold's equation and its limitations, Petroff` 's equation.
Infinitely long journal bearing, infinitely short journal bearing and finite bearing, Designing journal bearing using Raimondi and Boyd approach.
Hydrodynamic thrust bearing-Introduction, types.
Flat plate thrust bearing-Pressure equation, load, centre of pressure, frictional force equation.
Tiltling pad thrust bearing – bearing-Pressure equation, load, centre of pressure, frictional force equation.(Numericals on Raimondi and Boyd approach and thrust bearing only)

Unit 4: Hydrostatic lubrication (8 hrs)
Hydrostatic lubrication- viscous flow through rectangular slot, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, optimum design of stepped bearing, compensators and their actions.
Squeeze film lubrication-Basic concept, circular and rectangular plate approaching a plane (Numericals on hydrostatic bearing, Squeeze film lubrication).

Unit 5: Elasto hydrodynamic lubrication and Gas (Air) lubrication (8 hrs)
Elasto-hydrodynamic lubrication-Principle and applications, pressure viscosity term in Reynold's equation, Hertz theory, Ertel-Grubin equation, lubrication of spheres.
Gas(air) lubricated bearings-Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication, Active and passive magnetic bearings(working principle, types and advantages over conventional bearing).(Theoretical treatment only)

Unit 6: Tribological Aspects
Lubrication in rolling, forging, drawing and extrusion.
Mechanics of tyre road interaction, road grip, wheel on rail road.
Surface engineering for wear and corrosion resistance-diffusion, plating and coating methods, selection of coatings, properties and parameters of coatings.
Other bearings-porous bearing, foil bearing, Lobe, hybrid bearing.(Theoretical treatment only)

Text Books:
1. Principles and Applications of Tribology, Bharat Bhushan, 2nd Edition, Wiley India
2. Introduction to Tribology and Bearings, Mujumdar B. C., S. Chand and Company Ltd., New Delhi.

Reference Books:
1. Fundamentals of Tribology, R. Gohar and Homer Rahnejat, Imperial College Press, London.
2. Engineering Tribology, G.W. Stachowiak & A. W. Batchelor, Elsevier Science Publisher, Amsterdam.

Syllabus for B.E. Semester VIII (Mechanical Engineering), Honors Specialization

Course Code: MET464-2 **Course : Robotics**
L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes
The expected learning outcome is that the students will be able to:
1. Understand the basic of Robotics.
2. Understand the functional elements of Robotics.
3. Understand the direct and inverse kinematics solution for manipulator
4. Understand the velocity analysis of manipulator
5. Understand the dynamic analysis of serial manipulator
6. Understand the Motion planning and control.

Syllabus
Unit 1: Introduction : Brief history- Types of Robot–Technology-Robot classifications and specifications -Design and Control issues -Various manipulators –Sensors -work cell -Programming languages.

Unit 2: Elements of robots – joints, links, actuators, and sensors : Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Unit 3: Kinematics of serial robots : Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots.

Unit 4: Velocity and statics of robot manipulators : Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial manipulators, Singularity analysis for serial manipulators

Unit 5: Dynamics of serial robots : Mass and inertia of links, Lagrangian formulation for equations of motion for serial manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics.

Unit 6: Motion planning and control : Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator.

Text Books:
1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
2. Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.
Reference Books:
1. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
2. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
3. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
4. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
5. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008

Syllabus for B.E. Semester IV (Mechanical Engineering), Minors Specialization

Course Code: MET268 **Course : Automotive Engineering**

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

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 I.C engines.
2. Identify various fuels for I.C engine, fuel supply system and formation and control of emissions.
3. Illustrate the importance and working of transmission, driveline components including tyres.
4. Explore components and working of steering, braking and suspension system and their importance.
5. Demonstrate the importance and functioning of various electrical, electronic devices and safety systems.
6. Express the need and functional requirements of Electric and hybrid vehicles and latest trends in Automobile.

Syllabus

UNIT I:

Introduction and Classification of automobiles, Chassis types and construction, I.C Engines, Lubrication and Cooling. 08 hr

UNIT II:

Fuels for I.C Engines, Alternate Fuel, Fuel Supply systems: Carburetor and Fuel Injection system, CRDi. Emissions and its Control. 07hr

Unit III

Transmission and Drive Line Components: Clutches, Gearbox, Driveline Components, Differential. Axles, wheels and Tyres. 08 hr

UNIT IV:

Steering, Suspension and Braking system: Need, classification, working, latest trends. 07 hr

UNIT V:

Auto Electricals and Electronics, Automotive Lighting, Safety. 08 hr

UNIT VI:

Hybrid and Electric vehicles, Auto Mechatronics and latest trends. 07 hr

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 for B.E. Semester V (Mechanical Engineering), Minors Specialization

Course Code: MET358 **Course : Computer Aided Design**

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

Course Outcomes

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

1. Understand the basic concept of computer aided design and computer graphics.
2. Understand the technique to display of graphical entities like line, circle and ellipse.
3. Apply the knowledge of 2-D transformation to manipulate a geometrical entity.
4. Comprehend the concept of 3-D transformation and various techniques of modeling.
5. Learn the basic concept and applications of FEM to analyze the machine element.
6. Analyze the structure by one dimensional element i.e. 1-D bar and 2-D trusses.

Syllabus

Unit – I: CO1 : Definition of CAD and its application, CAD Softwares modules (Operating System, Graphics, Applications, Programming, Communication). Product life cycle, Various techniques to generate the images, frame buffer, N-bit plane buffers, simple color frame buffer.

Unit – II: CO2 : Rasterization Principle, Rasterization of line, Generation of line, circle and ellipse using Bresenham's and DDA algorithms. Windowing and clipping, Cohen-Sutherland Clipping Algorithm.

Unit-III: CO3 : 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 – IV: CO4 : 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 – V: CO5 : 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 – VI: CO6 : Analysis of one dimensional bar and spring element, Displacement function, shape functions for linear & quadratic bar element. Stiffness matrix, Force Matrix. Analysis of two-dimensional trusses.

Text Book

1. Schaum's Outline Series: Theory & Problems of Computer Graphics Roy A. Plastock, Gordon Kalley
2. Introduction to Finite Elements in Engineering: Chandrupatla & A.D. Belegundu(PHI)

Reference Book:

1. CAD/CAM, Theory & Practice: Ibrahim Zeid (McGraw Hill)
2. Procedural elements for computer Graphics: D Rogers (McGraw Hill)
3. Mathematical Elements for Computer Graphics Dravid F Rogers, J. Alan Adams (McGraw Hill)
4. Schaum's Outline Series: Theory & Problems of Computer Graphics Roy A. Plastock, Gordon Kalley

Syllabus for B.E. Semester VI (Mechanical Engineering), Minors Specialization

Course Code: MET372 **Course : Automation and Robotics**

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

Course Outcomes

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

1. Have awareness and understanding of automation knowledge, in terms of production line.
2. Understand various automated material handling systems and logics.
3. Familiarity with CNC technology, thereby achieve multidisciplinary integration.
4. Understand the functional elements of Robotics.
5. Understand the direct and inverse kinematics solution for manipulator.
6. Understand sensors, actuators and application of fixed base and mobile robots.

Syllabus

Unit I:
Fundamental of Automation
Fundamental concepts of Industrial automation and reasons for automating. Types of production and automation, automation strategies, Automated Flow Lines - Methods of workpart transport, Transfer mechanisms, Part feeding devices, Analysis of flow lines with storage buffers, Line balancing methods.

Unit II:
Automated Material Handling
Automated material handling & storage - cob\nveyor systems, Automated Guided Vehicle Systems, Types, Vehicle guidance & Routing, Analysis of AGVS systems, AGVS applications, Automated storage & retrieval system, Carousel storage system.

Unit III:
Computer Numerical Control
Numerical control production systems - NC basic concepts, Machine control unit and other components, DNC and CNC, Types and classifications of CNC systems, CNC part programming. Automated inspection and its types, Coordinate measuring machine, Industry 4.0.

Unit IV:
Introduction to Robotics
Evolution of Robots and Robotics, Law of Robotics, Progressive advancement in robots, Robot Anatomy, Classification of robots, Coordinate frame, mapping and transformation.

Unit V:
Direct and Inverse Kinematics
Mechanical structure and notations, description of link and joints, kinematic modeling if the manipulator, Denavit - Hartenberg notation, manipulator transformation matrix, solvability of inverse kinematic model, solution techniques, direct and inverse kinematic solution by MATLAB or any analytical tools, Introduction to dynamic modeling.

Unit VI:
Robotic sensors, actuators and applications
Path and Trajectory planning, meaning of sensing, various sensors and actuators in robotics, industrial applications of robots i.e. material handling, processing, assembly, inspection, etc. Mobile robots, In - pipe robot for cleaning and inspection, underwater robot, recent in robotic technology.

Text Books:

1. Automation, Production System & CIMPS : M. P. Groover, Prentice Hall of India, New Delhi.
2. R. K. Mittal and I. J. Nagrath, " Robotics and Control", McGraw hill Education (India) private limited, 2017.
3. craig. J. J. " introduction to Robotics - mechanics and control", Addison - Wesley, 1999.

Reference Books:

1. B. S. pabla and M. Adithan, " CNC Machines", New Age International, 1994.
1. S. R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
2. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
3. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
4. P. A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
5. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008

Syllabus for B.E. Semester VII (Mechanical Engineering), Minors Specialization

Course Code: MET458 **Course : Solar Energy Technology**

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

Course Outcomes

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

1. Understand the basic terminologies in solar energy technology.
2. Estimate and measure the insolations for given location and time of year.
3. Understand various ways of solar energy utilization.
4. Understand the working of different solar thermal systems.
5. Understand construction and working of different PV systems.
6. Give a preliminary design of typical solar heating and photovoltaic systems.

Syllabus

Energy Scenario and Solar Resources: Global energy scenario, status of solar energy utilization in the world, Introduction to electromagnetic spectrum, solar spectrum, estimation of extraterrestrial radiations, solar constant, air mass, attenuation of solar radiations through atmosphere, solar geometry, measurement of solar radiations, empirical equations for predicting availability of terrestrial radiations

Solar Thermal systems: Principles of solar thermal energy collection, different types of solar thermal collectors, novel designs of collectors, solar energy storage: sensible, latent and thermo chemical storage.

Solar thermal applications: Water and space heating; solar ponds; dryers, distillation, solar cookers, Solar thermal power plants, design of solar thermal systems.

Basics of solar photovoltaics: Photovoltaic effect, different types of photovoltaic cells, cell materials, Module specifications, manufacturing of PV cells and modules, PV cell characteristics, cost of PV technologies.

Components of Photovoltaic Systems: balance of PV systems, module hot spots, bypasses diodes, PV arrays and PV systems, mounting structures, series and parallel connections of PV modules, mismatch in PV connections, charge controllers, MPPT, cables, storage batteries, inverters.

Design of PV Systems: standalone PV systems, grid connected PV systems

Text Books :

1. Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme, 2nd edition, Tata McGraw Hill New Delhi, 1984.
2. Solar Photovoltaics: Fundamental Applications and Technologies, C. S. Solanki, 2nd edition, Prentice Hall of India New Delhi 2011.

Reference Books:

1. Solar Engineering of Thermal Processes, Duffie. J. A. & W. A. Beckman, 3rd edition, John Wiley & Sons, 2006.
2. Renewable Energy Resources, John Twidell, Tony Weir, Taylor & Francis; 2nd edition, 2005
Solar Energy Fundamentals and applications, H.P,Garg, J Prakash, 1st edition, Tata Mc Graw Hill, New Delhi, 1997.

Syllabus for B.E. Semester VIII (Mechanical Engineering), Minors Specialization

Course Code: MET466-1 **Course : Manufacturing Engineering**

L: 4 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

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

1. Select a suitable manufacturing process for desired components.
2. Select a suitable engineering material for a product to manufacture.
3. Select a suitable casting/forming method to manufacture metal components.
4. Select suitable joining processes for fabrication work of ferrous and non ferrous metals.
5. Identify the machine tool, cutting tool materials and cutting fluids for different machining operations.
6. Select an appropriate NTM and advanced machining process for manufacturing complex shape component.

Syllabus

Unit-I Introduction, Classification of manufacturing processes, kinds of production, computers in manufacturing, selection of manufacturing process.(3)

Unit-II Engineering materials and their properties, importance of heat treatment. **(5)**

Unit-III Primary manufacturing processes. Introduction to casting, forming ,Rolling ,forging, extrusion and sheet metal working processes, processing of plastics.(8)

Unit-IV Fabrication processes, classification of welding processes, Soldering, brazing and advanced welding processes. (6)

Unit-V Metal cutting, Single and multi-point cutting tools, Cutting tool materials, Tool life, Cutting fluids, Types of machine tools, Turning, Drilling, Milling and finishing processes, (8)

Unit-VI Unconventional and Advanced Machining Processes:
Abrasive Jet Machining, Electrical Discharge Machining, Electro-chemical machining (ECM), Laser Beam Machining (LBM), Electron Beam Machining
Introduction to CNC, FMS, GT and CIMS. (10)

Text Books:

1. Manufacturing Technology (Vol I and II) – P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
2. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
3. Production Engineering –P.C. Sharma, S. Chand and Company Ltd., New Delhi.

Reference Books:

1. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi.
2. Workshop Technology (Volume-I & II) - By Hajra Choudhary, Media Promoters & Publishers Pvt. Ltd.
3. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
4. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

Syllabus for B.E. Semester VIII (Mechanical Engineering), Minors Specialization

Course Code: MET466-2 **Course : Mechanical Engineering Design**

L: 4 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Outcomes:

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

1. Understand the basic concepts of Engineering Design.
2. Design of various types of joints.
3. Design the Helical springs and power screw.
4. Design of shafts.
5. Design the mechanical drives like belt drive and gear drive.
6. Design & selection of bearings.
7. Understand the significance of optimization in machine design.

Syllabus

Unit 1 **[10 hours]**

Fundamentals of Mechanical Engineering Design

Mechanical engineering design, Phases of design process, Design considerations, Engineering Materials and their Mechanical properties, Standards and Codes, Factor of safety, Material selection. Static Stresses: Static loads - Normal, Bending, Shear and Combined stresses. Stress concentration and determination of stress concentration factor.

Unit 2 **[08 hours]**

Temporary And Permanent Joints : Threaded fasteners – Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures – theory of bonded joints.

Unit 3 **[08 hours]**

Mechanical Springs: Compression and tension helical springs, Design of helical springs subjected to static and fatigue loading.

Power Screws: Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack.

Unit 4 **[08 hours]**

Design of Shafts: Materials for shaft, Stresses in shafts, Design of solid and hollow circular shaft subjected to torque and combined loading; Design of shaft for rigidity and stiffness.

Unit 5 **[08 hours]**

Design of Mechanical Drives

Power transmission and drives, Belt Drives: design of v-belt drives, Gear drives, Design of spur gears.

Unit 6 **[08 hours]**

Rolling Contact bearing: types, static and dynamic load carrying capacity, selection of rolling contact bearings.

Sliding contact bearings: Basic Modes of lubrication, Hydrostatic and hydrodynamic bearing, design parameters. Comparison of Rolling and Sliding contact bearings.

Text Books

1. Bhandari, V. B. Design of machine elements. Tata McGraw-Hill Education, 2010.

Reference Books

1. Shigley, Joseph Edward. Shigley's mechanical engineering design. Tata McGraw-Hill Education, 2011.
2. Aggarwal, PC Sharma DK, P. C. Sharma, and D. K. Aggarwal. Machine Design. SK Kataria and Sons, 1997.
3. Data Book of Engineers by PSG College-KalaikathirAchchagam - Coimbatore

Syllabus for B.E. Semester IV (Mechanical Engineering), Open Elective I

Course Code: MET266-1 **Course : Basic Mechanical Engineering**

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

Course Outcomes:

Students will be able to

1. Understand the mechanical properties of engineering materials and metal forming processes.
2. Understand the machine tools and various machining operations.
3. Understand the working of automobiles and power transmission system components.
4. Understand the laws of thermodynamics, thermodynamic cycles and heat transfer.
5. Understand the concept and working of refrigeration and air conditioning systems.
6. Understand the concept and working principles of energy conversion devices.

Syllabus

Unit I :

Engineering Materials: Introduction to Engineering Materials, Classification and Properties, stresses and mode of failure.

Manufacturing Processes: Castings - Patterns & Moulding, Hot Working and Cold Working, Metal Forming processes: Extrusion, Drawing, Rolling, Forging, Welding - Arc Welding & Gas Welding, Soldering, Brazing.

Unit II :

Machine Tools: Lathe - Types - operations, Drilling M/c - Types - Operations, Milling M/c - Types - Operations - Up & Down Milling, Shaping M/c –Operations, Quick Return Mechanism, Planer M/c.- Operations-Shaper Vs Planer, Grinding M/c-Operations. Introduction to NC/CNC Machines.

Unit III :

Power Transmission: Transmission of Power, Belt drives, chain drive, rope drive, Gears and Gear Trains. Automobile Engineering: Layout of an Automobile, major components and their functions (Brief description only), Transmission, Clutch, Differential, Brakes, Introduction to battery operated vehicles.

Unit IV :

Thermodynamics: Energy Sources - Conventional/Renewable, Laws of thermodynamics, significance and applications of thermodynamics, Ideal and real gas equations, Carnot cycle, Heat Pump, Refrigerator and Heat Engine, Otto, Diesel Cycle.

Heat Transfer: Modes of Heat Transfer, Thermal Resistance Concept, Composite Walls & Cylinders, and Overall Heat Transfer Coefficient.

Unit V :

Refrigeration and Air Conditioning: Vapour compression refrigeration systems, Energy efficiency rating, Psychrometry, psychrometric process, Air conditioning systems and air conditioners, Refrigerants and their impact on environment.

Unit VI :

Energy Conversion Devices: Conventional power generation, Boiler, steam turbines, gas turbines, working principle of two stroke and four stroke IC Engines (SI and CI), Fuels, CRDI, MPFI, Reciprocating pumps,

centrifugal pumps and hydraulic turbines, solar, wind, tidal, geothermal, power generation (Elementary idea only).

Text Books:

1. Elements of Mechanical Engineering – R.K.Rajput Lakmi Publications, Delhi
2. Elements of Mechanical Engineering – D.S.Kumar, S.K. Kataria and Sons
3. Engineering Thermodynamics- P.K.Nag TMH, New Delhi
4. Refrigeration & Airconditioning – Arora & Domkundwar, Dhanpat Rai & Co. Pvt. Ltd
5. Workshop Technology Volt.I & II – Hazra & Chaudhary, Asian Book Company., New Delhi.

Reference Books:

1. Hydraulic Machines – Jagdish Lal, Publication, Metropolitan, Allahbad.
2. Strength of Materials – G.H. Ryder, ELBS Publications.
3. Engineering Thermodynamics – C.P. Arora, TMH Publications, New Delhi
4. Refrigeration & Airconditioning- C.P. Arora. Pub. – TMH Publications , New Delhi
5. Manufacturing Science – Amitabha Ghosh & Ashok Kumar Malik, East-West Press.

Syllabus for B.E. Semester IV (Mechanical Engineering), Open Elective I

Course Code: MET266-2 **Course : Non conventional Energy sources**

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

Course Outcomes:

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

1. Recognize the need of non conventional energy sources.
2. Describe various solar thermal energy conversion systems.
3. Understand the basics of solar photovoltaic systems.
4. Describe the working principle of wind energy conversion systems.
5. Understand the biogas and biomass energy conversion systems.
6. Describe the ocean energy conversion systems.

Syllabus

Unit – I: World energy resources: Global energy scenario, Indian energy scenario, Environmental aspects of energy utilization, conventional and non conventional sources of energy, merits and challenges, Introduction to various renewable energy sources.

Unit – II: solar thermal energy conversion: Solar radiation on the earth surface, Measurement of solar radiations, concentrating and non concentrating types of solar collectors, various solar thermal applications.

Unit – III: solar electrical energy conversion: Construction and working of solar cells and PV modules, different PV technologies, Photovoltaic system components and different applications.

Unit – IV: Wind energy: Basic principle of wind energy conversion system, site selection consideration, basic components of WECS, classification of WEC systems, applications of wind energy.

Unit –V: Biogas: - Principle of bio gas generation, constructional details of various biogas plants, factors affecting generation of biogas and methods of maintaining biogas, Bio Mass: Introduction, methods of obtaining energy from biomass, thermal gasification.

Unit – VI: Ocean energy: ocean thermal electric conversion, open and closed cycle of OTEC, basic principles of tidal power & components of tidal power plants, single & double basin arrangements, Energy from ocean waves, wave energy conversion devices.

Text Books:

1. G.D. Rai, 'Non Conventional Energy Sources', Khanna Publishers, New Delhi.
2. G. N. Tiwari and M. K. Ghoshal, Renewable Energy Sources Basic Principles and Applications, Narosa Publishing House, New Delhi.

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. C. S. Solanki, 'Solar Photovoltaics: Fundamental Applications and Technologies, Prentice Hall of India, 2009.
4. S.P. Sukhatme, Solar Energy: Principles of Thermal Collection And Storage, Tata Mcgraw-Hill