UG

Manufacturing Engineering

SYLLABUS

2016-Scheme

Vision of the department

The department shall strive to act as a podium for the development and transfer of technical competence in academics, impart appropriate skills, entrepreneurship and research in the field of Mechanical Engineering to meet the changing need of society.

Mission of the department

1. To provide modular programmes from skill development to the research level.
2. To impart technical education and training in innovative state-of-the-art technology in the field of mechanical engineering.
3. To disseminate of knowledge and information by organizing seminars/ workshops/short term courses in a planned manner.
4. To provide extension services to rural society, industry professionals, institutions of research and higher learning in the field of mechanical engineering.
5. To interact with the industry, educational and research organizations, and alumni in the fields of curriculum development, training and research for sustainable social development and changing needs of society.

Programme Outcome (PO) s: UG

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and manufacturing/welding specialisation for the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyse complex mechanical/welding engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex mechanical engineering problems or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems:** Conduct investigations of complex manufacturing/welding problems using 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:** To apply appropriate techniques, resources and engineering and IT tools for modelling of different manufacturing/welding problems 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 manufacturing/welding engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex manufacturing/welding engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of manufacturing/welding engineering and management principles and apply these to

one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Participate and succeed in competitive examination for higher studies.

Program specific outcomes (PSO)

1. Graduates having an ability to identify, analyze and solve engineering problems relating to mechanical systems together with allied engineering streams.
2. Graduates will be able to build the nation, by imparting technological inputs and managerial skills to become Technocrats and Entrepreneurs.
3. Graduates will be able to develop new concepts on various emerging fields and pursue advanced research.

Title of the course : **Engineering Mathematics**
Subject Code : **AMT - 411**

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Learn about the basic concepts of Mathematics.
CO2: Understand various rules of Mathematics and how it is applied on solve different equations.
CO3: Understand the behavior of differential equations and integration.
CO4: Learn about the mechanism different formulas derivations and theorem.
CO5: Get knowledge about complex matrix, transformations, theorem and their properties.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO 11	PO1 2	PS O1	PS O2	PS O3
CO1	3	1	3	2	2	2	2	3	2	2	2	2	-	-	-
CO2	3	1	3	1	1	3	3	3	3	2	3	3	1	-	1
CO3	3	3	3	3	1	2	1	1	3	2	3	2	-	-	-
CO4	3	1	3	1	3	2	2	2	2	2	2	2	1	2	1
CO5	3	3	3	3	1	3	1	1	3	2	2	3	-	1	1
Avera ge	3	1.8	3	2	1.6	2.4	1.8	2	2.6	2	2.4	2.4	1	1.5	1

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Matrices	Elementary transformations. Row reduced Echelon forms. Rank of a matrix. Normal form. Linearly dependent and independent vectors. System of linear equations. Linear transformations. Eigen values and eigenvectors. Properties of eigenvalues. Reduction to diagonal form. Verification of Cayley-Hamilton Theorem and its use for finding inverse of a matrix. Idempotent matrices. Complex matrices.	15
	2. Solid geometry	Cartesian co-ordinate system. Distance formula. Section formulae. Direction ratios and direction cosines. Equation of a plane. Equations of a straight line. Condition for a line to lie in a	

		plane. Coplanar lines. Shortest distance between two lines. Intersection of three planes. Equation of a sphere. Tangent plane to a sphere. Equations of a cone and a cylinder.	15
Unit-2	3. Differential equation	Solution of differential equation by variable separable method, homogeneous differential equation of first order and their solution, Exact differential equation.	14
	4. Linear differential equations	Solution of linear differential equation of first order. Reducible to linear differential equation. Higher order linear differential equation with constant coefficients, complementary function and particular integral. Method of variation of parameters. Cauchy's and Legendre's equations.	16

Total=60

Recommended Books:

1. R.K. Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishers.
2. Denial A Murray, Elementary Course in Differential Equations, Longman.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited.
4. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill.

Title of the course : **APPLIED PHYSICS**

Subject Code : **PHT-411**

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:

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

CO1: An ability to apply profound understanding of Quantum Mechanics and its applications.

CO2: An understanding of free electron gas model

CO3: An ability to design a Laser system and its component, or process to meet desired needs within realistic constraints such as health and safety, manufacturability

CO4: The broad education necessary to understand special theory of relativity

CO5: A knowledge of upcoming technologies like photonics

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO 12	PS O1	PS O2	PS O3
CO1	3	1	3	2	2	1	1	2	2	2	2	2	2	2	2
CO2	3	1	3	1	1	1	1	1	3	2	3	3	1	1	1
CO3	2	3	2	3	1	1	1	2	3	2	3	2	2	1	2
CO4	3	1	3	1	3	2	1	1	2	2	2	2	1	2	1
CO5	3	3	3	3	1	1	1	2	3	2	2	3	2	1	1
Avera ge	2.8	1.8	2.8	2	1.6	1.2	1	1.6	2.6	2	2.4	2.4	1.6	1.4	1.4

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	**RELATIVITY**	Newtonian mechanics and Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity,	12

		Lorentz transformations, time dilation and length contraction, space-time interval, twin paradox, relativistic addition of velocities, variation of mass with velocity, mass energy equivalence, relativity and Doppler effect	
	QUANTUM MECHANICS	Need of quantum mechanics, Basis of quantum mechanics, wave function, Schrödinger's time-independent and time-dependent equations, expectation values of physical quantities (position, momentum and energy), applications of time independent equation; for a particle in a box (one dimensional), step potential, finite square well potential, tunnelling effect	12
Unit-2	**RADIATION PHYSICS AND LASERS**	Elementary ideas about interaction of charged particles, electromagnetic radiations and neutrons with matter, detection of radiations by: proportional counter, GM counter, scintillation detectors, solid state detectors (basic principle only), applications of radiations in industry, agriculture and health science, radiation hazards. Principle of lasers, types of lasers : He-Ne, Ruby, CO_2 and semiconductor laser, Applications of Lasers.	12
	FIBER OPTICS	Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, Sources and sensors for optical fibers, applications of Optical fibers in communication.	06
	ELECTRODYNAMICS	Gauss's law in dielectric medium, Equation of continuity, displacement current, Maxwell's equations, wave equation for electromagnetic radiation, electromagnetic wave propagation in free space and isotropic dielectric medium, Poynting theorem &Poynting vector, vector potential, Lorentz gauge.	06

Total=48

Recommended Books:

Arthur Beiser ; Concepts of Modern Physics (McGraw Hill)

C. Kittel: Introduction to Solid Satate Physics(John-Wiley&Sons) Engineer

Serway, Moses and Moyer Modern Physics (Thomson)

Title of the course : **APPLIED PHYSICS**

Subject Code : **PHP-411**

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:

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

CO1: An ability to apply profound understanding of Quantum Mechanics and its applications.

CO2: An understanding of free electron gas model

CO3: An ability to design a Laser system and its component, or process to meet desired needs within realistic constraints such as health and safety, manufacturability

CO4: The broad education necessary to understand special theory of relativity

CO5: A knowledge of upcoming technologies like photonics

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO 12	PS O1	PS O2	PS O3
CO1	3	1	3	2	2	1	1	2	2	2	2	2	2	2	2
CO2	3	1	3	1	1	1	1	1	3	2	3	3	1	1	1
CO3	2	3	2	3	1	1	1	2	3	2	3	2	2	1	2
CO4	3	1	3	1	3	2	1	1	2	2	2	2	1	2	1
CO5	3	3	3	3	1	1	1	2	3	2	2	3	2	1	1
Avera ge	2.8	1.8	2.8	2	1.6	1.2	1	1.6	2.6	2	2.4	2.4	1.6	1.4	1.4

List of Experiments

1. To find the value of Planck's constant by using a Photoelectric cell.
2. To verify inverse square law of radiation using a photoelectric cell.

3. To determine the frequency of an unknown signal by drawing the Lissajous patterns for various frequency ratios and evaluate the face difference between two sinusoidal signals applied to X and Y input of cathode ray oscilloscope.
4. To measure the velocity of ultrasonic waves through a given liquid medium.
5. Measurement of wavelength of given He-Ne LASER by diffraction method.
6. To determine the wavelength of a sodium (Na) light by using the Michelson's Interferometer.
7. Determination of the value of e/m of an electron by helical method.
8. To determine the numerical aperture (Na) of a given multimode optical fiber by using Laser beam.
9. To determine the g – factor by using ESR Spectrometer.

Subject Code : MET-411
Title of the course : Elements of Mechanical Engineering

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Learn about the basic concepts of thermodynamics.
CO2: Understand various laws of thermodynamics and how it is applied on various engineering devices.
CO3: Understand the behavior of solids under various types of loads.
CO4: Learn about the mechanism of different machines and its applications.
CO5: Get knowledge about properties of engineering materials and its industrial applications.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.333 33	1.75	1.4

Theory

Course Description	**Lecture**
Unit-I	
Basic Concept of Thermodynamics	**06**
Definition, Thermodynamic system, boundary and surroundings, Thermodynamic property, Thermodynamic processes, Thermodynamic cycle and its concept, Energy and its forms, Ideal gas and characteristic gas equation, Zeroth law of thermodynamics.	
First Law of Thermodynamics and its Applications	**09**
Definition, Essence and corollaries of the first law, expressions for first law applicable to a process and cycle, concept of internal energy, enthalpy, total energy, specific heats, Closed and open systems, analysis of non-flow and flow processes for an ideal gas under constant volume, constant pressure, constant temperature, adiabatic and	

polytropic conditions, Analysis of free expansion and throttling processes, analysis of first law to steady flow energy equation and its applications to various engineering devices.	
Second Law of Thermodynamics	**09**
Limitations of first law, statements of second law and their equivalence, heat engine, heat pump and refrigerator. Philosophy of Carnot cycle and its consequences, Carnot theorem for Heat engine, refrigerator and heat pump, Clausius inequality, philosophy and concept of entropy, Third law of Thermodynamics.	
Unit-II	
Mechanics of Solids	**08**
Introduction, stress and strain, Hook's Law, longitudinal and lateral strain, Poisson's ratio, Stress strain diagram for ductile and brittle materials, Factor of safety, strain energy and resilience, Sudden and impact load, Stresses in bars, Thermal stresses, Elastic constants and their significance, relations between Elastic constants.	
Mechanism and Simple Machines	**08**
Introduction, Mechanisms and their concept, Definition of element, link, kinematic chain, mechanism, machine, Examples of mechanisms and their applications, Concept of Basic machines, Law of Lifting Machine, Different systems of pulleys and wheels.	
Engineering Materials	**08**
Materials and Engineering, Classification of Engineering Materials, Mechanical Properties of Engineering Materials, Various properties and Industrial applications of metals (ferrous: cast iron, tool steels, stainless steels and non-ferrous: Aluminum, brass, bronze), polymers, ceramics, composites, smart materials, Conductors, Semiconductors and insulators.	

Total=48

Referrence Books:

1. Nag P.K. Engineering Thermodynamics, Mc. Graw Hill.
2. Yadav R., Thermodynamics and Heat Engines, Central Publishing House, Allahabad
3. Singh V.P., Theory of Machines, DhanpatRai and Company, New Delhi.
4. Jindal U.C., Engineering Mechanics, Part-I, Galgotia Publications Pvt.Ltd. , New Delhi.

Subject Code : MEP-411
Title of the course : Elements of Mechanical Engineering Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Learn about the basic concepts of thermodynamics.
CO2: Understand various laws of thermodynamics and how it is applied on various engineering devices.
CO3: Understand the behavior of solids under various types of loads.
CO4: Learn about the mechanism of different machines and its applications.
CO5: Get knowledge about properties of engineering materials and its industrial applications.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.33333	1.75	1.4

List of Experiments Elements of Mechanical Engineering lab (MEP-411)

1. To verify the Zeroth law of thermodynamics.
2. To study the COP's of Heat pump and Refrigerator.
3. To study the behaviour of ductile and brittle materials under tensile load.
4. To study different types of kinematics links and kinematic chains.
5. To find out the mechanical advantage, velocity ratio and efficiency of first system of pulley.
6. To find out mechanical advantage, velocity ratio and efficiency of a simple lifting machine.
7. To study the classification and properties of various engineering materials.

Title of the course : **Elements of Electrical Engineering**

Subject Code : **EET-411**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

CO1: Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits.

CO2: Formulate and analyze electrical circuits.

CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.

CO4: Identify and select various electrical machines according to the applications.

CO5: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	1	1	2	2	1	3	1	2	2
CO2	2	3	1	1	1	1	1	1	2	1	1	2	1	1	2
CO3	3	1	1	1	1	1	1	1	2	1	1	3	3	1	1
CO4	3	2	1	1	1	1	1	1	2	2	1	1	2	1	2
CO5	1	1	1	1	1	3	1	3	2	1	1	2	2	2	1
Average	2.4	1.6	1	1	1	1.4	1	1.4	2	1.4	1	2.2	1.8	1.4	1.6

Theory:

Unit	Main Topics	Course outlines	Lecture(s)
⊃ ⊆	**Basic Concepts**	Electric Charge, Current and Electromotive force, Potential and	06

		Potential Difference; Conductor, Semiconductor Insulator and dielectric; Electrical Power and Energy; Ohm's Law, Resistance and color coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel connection, Kirchoff's Laws and Their Applications	
	AC Fundamentals	Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; RMS and Average Values, Concept of Phase and Phase Difference, Single Phase and Three Phase Supply; 3-ph Star-Delta connections, Inter-Relation between phase voltage/current & line voltage/current; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit.	08
	Measuring Instruments	Principle and Construction of Instruments used for Measuring Current, Voltage, Power and Energy, Concept and applications of digital multimeters, oscilloscopes, signal generators	03
	Electrical Safety	Electrical Shock, Safety practices to prevent Electric Shock; Concept of Fuses- Classification, Selection and Application; Concept of Earthing ,Types of Earthing, MCBs, ELCBs and their Applications.	04
Unit-2	**Electromagnetic Induction**	Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in a Magnetic Field, various losses in magnetic circuits;	04
	Electrical Machines &Transformers	Elementary concepts and classification of electrical machines, Common features of rotating electrical machines, Basic principle of a motor and a generator, Need of Starters and their classifications. Transformer- Classification, Principle of operation, Construction, Working and applications.	10
	Utilization of Electricity	Concepts of Electricity for electrolysis process e.g., Electroplating, Electro refining etc., Electrochemical Cells & Batteries; Application of Electricity for Heating, Ventilating and air-conditioning, Welding and illumination.	04
	Basic Troublshooting	Basic Testing and faults diagnosis in electrical systems, various tools and their applications, replacement of different passive components e.g. fuses, lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays.	04

Recommended Books:

Title	**Author**	**Publisher**
Electrical Technology	Edward Hugh	Pearson Education

Basic Electrical Engineering	D P Kothari & I J Nagrath	TMH
Electrical Machines	D P Kothari & I J Nagrath	TMH
Electrical Machines	S K Bhattacharya	TMH

Title of the course : **Elements of Electrical Engineering**

Subject Code : **EEP-411**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

CO1: Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits.

CO2: Formulate and analyze electrical circuits.

CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.

CO4: Identify and select various electrical machines according to the applications.

CO5: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	1	1	2	2	1	3	1	2	2
CO2	2	3	1	1	1	1	1	1	2	1	1	2	1	1	2
CO3	3	1	1	1	1	1	1	1	2	1	1	3	3	1	1
CO4	3	2	1	1	1	1	1	1	2	2	1	1	2	1	2
CO5	1	1	1	1	1	3	1	3	2	1	1	2	2	2	1
Average	2.4	1.6	1	1	1	1.4	1	1.4	2	1.4	1	2.2	1.8	1.4	1.6

List of Practicals

1. Study of various passive components and measuring instruments and their connections in electrical circuits.
2. Verification of Ohm's Law.

3. Verification of Kirchoff's laws (KCL & KVL).
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of various characteristic values of a Sinusoidal waveform with the help of CRO.
6. Measurement of voltage, current and power in RL and RLC circuits and Verification of phase angle and power factor concept.
7. Study of various types of earthings.
8. Study of various types of protection devices e.g. fuses, MCBs and ELCBs
9. Verification of Faraday's laws and Lenz's law.
10. Study of various types of DC motors and their starters.
11. Study of various types of AC motors and their starters.
12. Study of various types of transformers and Verification of turns ratio.
13. Starting and reversing various AC and DC motors.
14. Fault diagnosis and removal in general electrical connection /apparatus.

Title of the course **English Communication & Soft Skills**
Subject Code **: HUT-411**

L	T	P	Credits	Weekly Load
3	0	0	3	3

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Basic concepts of English skills and their use.
CO2: Understand various formation of sentences and how it is applied in general life.
CO3: Learn about the concepts of grammar for the formation of sentences.
CO4: Understand the behavior of words and their impact in writing.
CO5: Differentiate between tenses, voice command and phrases in sentence formation.

Pre-requisite knowledge:

CO/PO Mapping: (Strong (3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	-	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	-
CO4	3	3	2	3	1	2	1	2	1	3	1	2	1	2	1
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.33333	2	1

Course Description	**Lecture(s)**
Unit- I	
Communication Techniques	
Importance of Communication, One-way and Two-way Communication, Essentials of Good and effective Communication, Barriers to Communication, Techniques to Overcome Barriers	08
Writing Skills	
Précis- writing; Essay- writing, Official e-mail writing	08

Unit- II	
Report Writing	
Reports and their importance, Types of Routine Reports along with their formats- Annual Confidential Report, Progress Report, Inventory Report, Inspection Report, Lab Report, Structure of Reports; Bibliography & References	08
Grammar & Vocabulary	
Tenses, Change of Voice, Change of Narration, Words often confused, Correct use of Prepositions, Use of Idioms and Phrases	08

Total=32

Recommended Books:

1. Bhattacharya, Indrajit**.** *An Approach to Communication Skills.* DhanpatRai& Co.
2. Gibaldi, Joseph. *MLA Handbook for Writers of Research Papers*. MLA.
3. Sinclair, John. *Collins Cobuild English Grammar.* Collins.
4. Wren, P.C. &H. Martin. *High School English Grammar & Composition*. S. Chand & Company Ltd.
5. Sharma, R.C. & Krishna Mohan. *Business Correspondence and Report Writing*. Tata McGraw-Hill.

Title of the course **English Communication & Soft Skills lab**

Subject Code **: HUP – 411**

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Basic concepts of English skills and their use.

CO2: Understand various formations of sentences and how it is applied in general life.

CO3: Learn about the concepts of grammar for the formation of sentences.

CO4: Understand the behavior of words and their impact in writing.

CO5: Differentiatebetween tenses, voice command and phrases in sentence formation.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	1	1	2	1	1	1	1	1	1	2	1
CO2	3	1	3	1	1	1	1	1	1	1	1	1	1	-	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	-	2	1
CO4	3	1	3	1	3	1	2	2	1	1	1	1	1	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	3	-	2	1
Average	3	1.8	3	1.8	1.4	1	1.4	1.2	1	1	1	1.4	1	2	1.4

List of Experiments (1-14):

1. Introducing yourself.
2. Observing and analyzing your environment/ surroundings.
3. Collecting and Using Library Resources.
4. Giving Individual Presentations.
5. English Conversation Skills.
6. Group Discussions.
7. Extempore.
8. Debates.
9. Summarizing newspaper reports.
10. Role Plays.
11. Grammar exercises.
12. Finalization of Team Project Work.
13. Collecting Materials for Project Work & Finalization of Project.
14. Presentation of Project.

Title of the course : Workshop technology &practice-I

Sub code : MET-422

L	T	P	Credits	Weekly Load
2	0	0	2	2

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Basic concepts of workshop processes.

CO2: Understand various formation equipment and how it is applied on various engineering application.

CO3: Learn about the mechanism of different machines and its applications.

CO4: Understand the behavior of foundry, carpentry tools and their use.

CO5: Differentiate properties of engineering materials and its industrial applications

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	1	2
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	1	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.66667	1.4	1.6

Course Description	Lecture(s)
Unit -1	
Sheet Metal	
Introduction to sheet metal work; GI sheets, aluminium, tin plate, copper, brass etc, Hand tools used in sheet metal shop like steel rule, verniercalipers, micrometer, sheet metal gauge etc., scriber, divider, punches, chisels, hammers, snips, pliers, stakes, rivets etc., Operations -shearing, bending, drawing, squeezing etc.	06
Pattern making	
Introduction to pattern making, moulding and foundry practice. Pattern materials like wood, cast iron, brass, aluminium, waxes etc., different types of patterns, pattern allowances.	06
Foundry	
Introduction to casting process, core-boxes, core prints, hand tools-shovel, riddle,	08

rammer, trowel, slick, lifter, sprue pin, bellow, mallet,vent rod, pouring weights etc., moulding sands-green sand, dry sand, loam sand, facing sand etc., grain shape and size, properties of moulding sand, sand preparation and testing etc., Gating Systems- requirements and functions, Functions of risers, Riser and directional solidification. casting- permanent mould casting, centrifugal casting,etc.	
Unit-II	
Carpentry	
Introduction to wood working, Types of wood, seasoning methods, Marking and Measuring Tools-rule, try square, marking gauge, mortise gauge etc., Cutting Tools-rip saw, tenon saw, firmer chisel, mortise chisel, iron jack plane, wooden jack plane etc., Drilling Tools-braces, drill bits etc., Striking Tools-hammers, mallet etc., Holding Tools-bench vice, G-cramp etc., Miscellaneous Tools- rasps, files, screw driver, pincer etc.; Operations-marking, sawing, planning, chiseling, boring, grooving etc., Joints- Corner joints, Tenon and Mortise joint, Briddle cross-joint.	06
Fitting	
Introduction to fitting, Tools used in fitting -bench vice, hammers, chisels, files-flat file, square file, half round file, round file, knife edge file, scrapers, hacksaws, try squares, drill machine, drill bits, taps, dies etc, Operations-chipping, filing, scrapping, sawing, marking, drilling, tapping, dieing etc.;	06
	Total: 32

Recommended Books

1. HajraChoudhury, HazraChoudhary and Nirjhar Roy, 2007, Elements of Workshop Technology, vol. I, Media promoters and Publishers Pvt. Ltd.
2. W A J Chapman, Workshop Technology, 1998, Part -1, 1st South Asian Edition, Viva Book Pvt Ltd.
3. P.N. Rao, 2009, Manufacturing Technology, Vol.1, 3rd Ed., Tata McGraw Hill Publishing Company.
4. Kaushish J.P., Manufacturing Processes, 2008, Prentice Hall India

Subject Code : WSP-422
Title of the course : Workshop Technology and Practice Lab

L	T	P	Credits	Weekly Load
0	0	4	2	4

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Basic concepts of workshop processes.
CO2: Understand various formation equipment and how it is applied on various engineering application.
CO3: Learn about the mechanism of different machines and its applications.
CO4: Understand the behavior of foundry, carpentry tools and their use.
CO5: Differentiateproperties of engineering materials and its industrial applications.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	2	1	2
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	1	2
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	2	1	2
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1.66667	1.4	1.6

LIST OF PRACTICALS FOR WSP-422

CARPENTRY SHOP

Making of various joints like:

a) Cross lap joint

b) T-lap joint

c) Corner lap joint

d) Mortise and tenon joint

e) Dovetail joint

FITTING SHOP

a) Study and use of instruments in fitting shop, like, vernier calipers, micrometer, height gauge and bevel protractor

b) . Exercise on simple operation viz. cutting, chipping, sawing, filing, drilling,

FOUNDRY SHOP

a) Familiarization with different patterns and hand tools.

b) Preparations of green sand mould using single piece pattern three-four exercises.

c) Preparations of green sand mould using split pattern on bench moulding.

d) .Preparations of green sand mould using solid pattern by bedded method.

PATTERN SHOP

a) 1 Familiarization with different tools and patterns in pattern shop.

b) Exercise on making of solid piece pattern

c) Exercise on making of split piece pattern

d) Exercise on making of cored pattern.

SHEET METAL SHOP

a) Study the layout and different equipment used in sheet metal shop.

b) Familiarization with different tools and processes in sheet metal shop.

c) Exercise on sheet cutting, development, folding, bending, piercing, punching, parting, notching and slitting.

d) Profile and circle cutting exercise.

Title of the course : Engineering Drawing
Subject Code : MEP-423

L	T	P	Credits	Weekly Load
0	0	4	2	4

COURSE OUTCOMES:

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

CO1: Understand the universally accepted conventions, symbols and the methods of engineering drawing such as line, lettering, dimensioning, scales etc.

CO2: Draw dimensioned orthographic and isometric projections of engineering objects.

CO3: Develop and interpret the projection of planes, regular & sectioned solids, solids, surfaces.

CO4: To translate geometric and topological information of common engineering object.

CO5: To understand and visualize geometric objects more clearly by using AutoCAD.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	2	3	2	2	1	3	3	2	2	1	2	2
CO2	3	2	3	3	1	2	3	2	1	2	2	2	1	-	2
CO3	2	3	2	1	2	2	2	3	2	3	3	3	-	2	1
CO4	3	2	2	1	2	1	2	3	2	2	3	3	2	1	2
CO5	3	2	3	2	3	2	3	2	3	3	3	2	-	2	1
Average	2.4	2.2	2.6	1.8	2.2	1.8	2.4	2.2	2.2	2.6	2.6	2.4	1.33333	1.75	1.6

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	**04**
Introduction, Objectives, applications. Fundamentals of engineering drawing, Use and handling of different drawing instruments, title block, sheet sizes, first and third angle projections, orthographic projections.	
Lettering and Dimensioning	**04**
Free hand sketching of different types of lines in engineering drawing as per IS specifications, Free hand lettering (alphabet and numerals) - lower case and upper case, vertical and inclined	

at 75^0 in the ratio of 7:4, Notation of dimensioning, size and location dimensions, aligned and undirectional systems of dimensioning, general rules for dimensioning, unit of dimensioning.	
Scales	**06**
Uses of scales, sizes of scale, representative fraction, construction of plain and diagonal scales	
Projection of points, line	**12**
Introduction on theory of projections and orthographic projections, projection of a point in different quadrants, projection of straight lines in different positions (all possible cases)	
Unit-II	
Projection of Planes	**06**
Definition of plane, types of planes, traces of plane, projection of planes in different positions	
Projection of Solids	**08**
Types of solids, projections of solids in simple and typical positions, introduction on sectioning of solids	
Development of surfaces	**08**
Introduction, Development of a right prism, cylinder, pentagonal prism, and a right pyramid, truncated pentagonal pyramid.	

Total = 48

Recommended Books

Title	*Author(s)*	*Publisher*
Engineering Drawing	P S Gill	Kataria and Sons, New Delhi
Engineering Drawing	R.K.Dhawan	S. Chand & Co, New Delhi
Engineering Drawing	N.D,Bhatt	Charotar Publishing House

Title of the course : **Engineering Economics and Entrepreneurship**

Subject : **HUT-422**

L	T	P	Credits	Weekly Load
3	1	0	4	4

CO-1 Understand the identify the type of interest simple, compound, preset worth comparison equivalent, annual worth comparison with interest tables

CO-2 Knowledge of obtaining annual payment monthly payment cash flow diagram depreciation.

CO-3 Able to acquire skills regarding direct costs components of costs financial statement profit and loss account,

CO4 :Analyse the stability of profit planning balance sheet scope of finance functions.

CO5: Understand shrinking fund application concepts using formulas compound interest tables.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	1	1	1	1	2	2	2	1	2	2
CO2	1	1	1	1	1	2	2	2	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	2	2	1	1	3	1	2	2
CO4	1	1	1	1	1	2	2	2	1	1	1	2	1	1	1
CO5	1	1	1	1	1	1	1	2	2	1	1	3	1	2	2
Average	1	1	1.2	1.2	1	1.4	1.4	1.8	1.4	1.2	1.2	2.4	1	1.6	1.6

Theory:

Course Description	Lectures
UNIT- I	
Introduction	
Engineers and Economics, Utility of its study, Managerial Economics, Nature and scope, basic terms and concept of economics like goods, kinds of goods.	02

Theory of Demand and Supply	
Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, The meaning of Supply, Supply function, Law of supply- Explanation of law of supply.	08
Environment Analysis	
Concept of National income- GDP, GNP, Monetary policy, Fiscal Policy.	05
Entrepreneurship-Enterprise	
Conceptual issues, Entrepreneurship vs. Management, Concept of Social Entrepreneurship and Women Entrepreneurship, Roles and functions of engineer in relation to the enterprise and in relation to the economy.	07
Business Excellence	
Role of creativity and innovation and business research, Sources of business idea, TQM,Six Sigma	02
UNIT- II	
The process of setting up a small business	
Preliminary screening and aspects of the detailed study of the feasibility of the business idea , Preparation of Project Report and Report on Experiential Learning of successful and unsuccessful entrepreneurs..	04
Communication skills	
Introduction, process of communication, barriers to communication, Removal of barriers, channels of communication, Verbal and non-verbal communication.	03
Issues in small business marketing.	
The concept and application of product life cycle ,Advertising and publicity, sales and distribution management, National, state level and grass-root level financial and non-financial institutions in support of small business development, MSME Act	09
Human Resource Management	
Introduction, definition, types, tools of motivation,Theories of motivation- Alderfer's ERG theory, Herzberg's theory of motivation, McClelland theory. Introduction , objectives, scope, functions. Introduction to concept of IR.Regulation and abolition of Contract Labour Act 1970	08

Total= 48

RECOMMENDED BOOKS:

1. Economics – Samuelson, Pauls& W.D. Nordhan – McGraw Hill
2. Engineering Economics, R.Panneerselvam
3. Advanced Cost Accounting – Nigam, Sharma – Himalaya Publishing House
4. Managerial Economics – Mote and Paul – TMH
5. Macro Economics for management Students – A. Nag – Macmillan India Ltd

6. Dynamics of entrepreneurial development & Management, Vasant Desai/Himalaya Pub.House.
7. Entrepreneurship New venture creation, David H.Holt, PHI
8. Entrepreneurship & Small Business Management, Nicholas, Siropolis Houghton Mifflin company, Boston-Newyork
9. Management, Stephen P. Robbins, Mary(Pearson education Asia)

Title of the course : Elements of Computer Programming
Subject Code : CST-421

L	T	P	Credits	Weekly Load
2	0	0	2	2

COURSE OUTCOMES:
After successful completion of course, the students should be able to
CO1: Get acquainted with basics of computer system along with its various components

CO2: Know about various operating systems and memory

CO3: Study the C programming basics and learn the concept of operators

CO4: Understand the concept of decision statements and loops

CO5: Learn the use of functions, pointers, arrays, structures, union etc. for modular programming

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	1	2	3	2	3	1	1	1	3	3	2	2	1	2	2
CO2	3	2	3	3	1	1	1	1	1	2	2	2	1	2	2
CO3	2	3	2	1	2	1	1	1	2	3	3	3	2	1	1
CO4	3	2	2	1	2	1	1	1	2	2	3	3	1	2	2
CO5	3	2	3	2	3	1	1	1	3	3	3	2	2	3	1
Average	2.4	2.2	2.6	1.8	2.2	1	1	1	2.2	2.6	2.6	2.4	1.4	2	1.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Introduction	Elements of computer processing, Hardware and software, Introduction and feature wise comparison of various Operating Systems, Including DOS, Windows and Linux, Problem solving-algorithms and flowcharts. Structured Programming vs. Object Oriented Programming.	04

	2. C Programming Basics	Basic program construction, Structure of a C program, Compilation process, preprocessor directives, Comments, Data types, Type conversions, Operators - arithmetic, Relational, Logical, Conditional, Increment/decrement, Library functions, Header files.	04
	3. Loops and Decision Statements	*for* loop, *while* loop, *do* loop, Various forms of *if* statement,*switch* statement, *break* statement, *continue* state ment, *go to* statement.	03
	4. Arrays	arrays and strings, Declaring an array, Initializing arrays, Accessing the array elements, Working with multidimensional arrays, Declaring and initializing string variables, Arithmetic operations on characters, String handling functions.	04
Unit-2	5. Functions	Defining functions, Passing arguments to functions, Returning values from functions, Reference arguments, Variables and storage classes, Static functions.	05
	6. Pointers	Pointers, Pointers to pointers, Declaring and initializing pointers, Pointer expressions, Pointer increment and scale factor, Pointers and arrays, Pointers and strings.	05
	7. Structures and Union	Declaring and initializing a structure, Accessing the members of a structure, Nested structures, Array of structures, Using structures in functions, Pointers and structures, Declaring and initializing a union.	03
	8. Files	Reading and writing to text and binary files, Character I/O, String I/O, File pointers, Error handling, Redirection, Command line arguments.	04

Total=32

Recommended Books:

1. Kernighan Brian W. and Ritchie, Dennis M, The C Programming language, Dorling Kingsley.
2. Balagurusamy, E., Programming in ANSI C, TMH Publications

Title of the course : **Elements of Computer Programming Lab**
Subject Code : **CSP-421**

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:
After successful completion of course, the students should be able to
CO1: Get acquainted with basics of computer system along with its various components

CO2: Know about various operating systems and memory

CO3: Study the C programming basics and learn the concept of operators

CO4: Understand the concept of decision statements and loops

CO5: Learn the use of functions, pointers, arrays, structures, union etc. for modular programming

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	1	2	3	2	3	1	1	1	3	3	2	2	1	2	2
CO2	3	2	3	3	1	1	1	1	1	2	2	2	1	2	2
CO3	2	3	2	1	2	1	1	1	2	3	3	3	2	1	1
CO4	3	2	2	1	2	1	1	1	2	2	3	3	1	2	2
CO5	3	2	3	2	3	1	1	1	3	3	3	2	2	3	1
Average	2.4	2.2	2.6	1.8	2.2	1	1	1	2.2	2.6	2.6	2.4	1.4	2	1.6

LIST OF PRACTICALS

1. WAP to find multiplication of two numbers.
2. WAP to swap two numbers without using third variable.
3. WAP to calculate temperature in Fahrenheit to Celsius using formula C= (F- 32)/1.8.
4. WAP to calculate Sum and Average of N numbers using sequence of statements.
5. WAP to convert integer arithmetic to a given number of day and month using switch case.

6. WAP to find maximum out of 3 numbers a, b &c using Control Statements (if, else, nested if, nested else).
7. WAP to find minimum out of 3 numbers a, b & c using Control Statements (if, else, nested if, else)
8. WAP to find whether entered number is palindrome or not.
9. WAP to check entered number is even or odd .
10. WAP to find whether entered year is leap year or not.
11. WAP to find factorial of positive integer using for loop.
12. WAP to print all the number between 1 to 100 which are divisible by7 using the concept of loops.
13. WAP to generate Fibonacci series up to n using loops.
14. Write a program to calculate area of circle using function.
15. Write an iterative function to calculate factorial of given number.
16. Write a recursive function to calculate factorial of given number
17. WAP to find even & odd up to a given limit using the concept of array and loops.
18. WAP to reverse a string.
19. WAP to find addition of two matrix of n*n order using the concept of 2 dimensional array
20. WAP to find multiplication of two matrix of n*n order using the concept of 2 dimensional array.
21. WAP program to study the concept of structure.
22. WAP to implement the concept of switch and break statements.
23. WAP to implement the concept of continue statements.
24. WAP to create a data file, retrieve data from the file.

Title of the course : Applied Chemistry
Subject Code : CYT-421

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:
After successful completion of course, the students should be able to
CO1: Learn about the basic concepts of Chemistry.
CO2: Understand various materials and their properties.
CO3: Understand the behavior of different salt solution.
CO4: Learn about the mechanism of using different chemistry testing equipment's.
CO5: Get knowledge about electrolyte behaviour and their properties.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	1	2	1
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1	2	1

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	**Electro-analytical Chemistry**	Conductivity of electrolytes- Specific, molar and equivalent conductivity, Nernst equation for electrode potential, EMF series, hydrogen electrode, calomel electrode, glass electrode, Electrolytic and galvanic cells, cell EMF, its measurement and applications, reversible and irreversible cells, concentration cell, electrode (hydrogen gas electrode) and electrolyte concentration cell, concentration cell with and without transference. Potentiometry: Principle, instrumentation and applications.	**09**
	Fuels	Classification, examples, relative merits,Solid Fuels: Coal, Proximate and Ultimate analysis of coal. Gross and Net Calorific Value, Determination of calorific value by Bomb Calorimeter Carbonization	**10**

		process, Low and High Temperature Carbonization. Liquid fuels: Cracking, Thermal and Catalytic Cracking, Synthetic petrol, Knocking, Antiknocking, Octane number, Cetane Number. Antiknocking agents. Gaseous fuels: Biogas, LPG and CNG. Determination of calorific value by Junker's Calorimeter. Flue gas analysis by Orsat's apparatus, problems.	
	Surface Chemistry	Adsorption, chemisorption and physisorption, application of adsorption of gases on solids. Langmuir's adsorption isotherm, Freundllch's adsorption isotherm, BET theory of multi-layer adsorption (qualitative), adsorption chromatography. Colloidal particles, surfactants, micelles. Enzyme catalysis, Criteria for choosing catalyst for industrial processes.	**09**
Unit-2	**Engineering Materials**	Abrasives – Moh's scale of hardness – natural abrasives (diamond, corundum, emery, garnets and quartz) – synthetic abrasives (silicon carbide, boron carbide) – refractories – characteristics – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina magnesite and zirconia bricks.	**10**
	Lubricants	Classification of lubricant, lubricating oils, semisolid lubricants, solid and synthetic lubricants. Properties of lubricating oils (viscosity, flash and fire points, cloud and pour point, Iodine Value, Acid Value, R. M. Value, mechanical stability and saponification number).	**07**

Total=45

Recommended Books:

Text Books

1. P. C. Jain & M. Jain, Engineering Chemistry, DhanpatRai Publishing Company, New Delhi, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
3. F.W. Billmayer. Textbook of Polymer Science. 3rd Edn, Wiley. N.Y. 1991.
4. C. N. Banwell& E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn, Tata McGraw-Hill Edition, 1995.
5. S. S. Dara, S. S. Umare, A Text Book of Engineering Chemistry, S. Chand Publishing, 2011.
6. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Chapman and Hall, London, 1996.
7. Engineering Chemistry by B. Sivasankar, Tata Mcgraw Hill
8. Engineering Chemistry by A. Mallick, Viva Books, 2008.
9. Organic Chemistry by J. Clayden, Nick Greeves, S. Warren, Oxford Press 2012.
10. Levine, Physical Chemistry, 5/e (7th reprint), Tata McGraw Hill, 2006.
11. Inorganic Chemistry, Principle, structure and reactivity, J.E. Huheey, E.A. Keitler, R.L. Keita, O.K. Medhi, Pearson Education, 4th Ed.
12. Chemistry, J.E. Mcmerry and R.C. Fay, 5th Ed., Pearson Education, 2008

Title of the course : **Applied Chemistry**

Subject Code : **CYP-421**

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Learn about the basic concepts of Chemistry.

CO2: Understand various materials and their properties.

CO3: Understand the behavior of different salt solution.

CO4: Learn about the mechanism of using different chemistry testing equipment's.

CO5: Get knowledge about electrolyte behaviour and their properties.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSO)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	2	1	2	2	2	1	3	2	2	1	2	1
CO2	2	3	3	3	2	1	2	1	1	1	3	1	1	-	1
CO3	3	3	2	3	2	2	1	1	2	3	2	2	-	2	1
CO4	3	3	2	3	1	2	1	2	1	3	1	2	1	2	1
CO5	3	3	2	2	1	1	1	2	2	2	2	2	-	2	1
Average	2.8	3	2.2	2.6	1.4	1.6	1.4	1.6	1.4	2.4	2	1.8	1	2	1

List of Experiments (CYP-421)

1. Determination of strength of unknown solution of Mohr's salt using $KMnO_4$ and standard oxalic acid solution.
2. Determination of ferrous, ferric and total iron in a given sample using standard $K_2Cr_2O_7$
3. Determination of copper in a given solution by iodometric method using $Na_2S_2O_3$ and standard $K_2Cr_2O_7$
4. To find out the cell constant of a conductivity cell.
5. To find out the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide using pH meter.
6. To prepare and describe a titration curve for phosphoric acid-solution hydroxide titration using pH-meter.
7. Determine the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide conductometrically.

8. Determination of EMF/oxidation/reduction potential of a given metal/metal ion in different conditions.
9. Determination of equilibrium constant of a reaction by potentiometric method.
10. To determine moisture and volatile contents in a given coal sample by proximate analysis.
11. To determine fixed carbon and ash contents in a given coal sample by proximate analysis.
12. To study the adsorption of acetic acid on active charcoal and to verify the Freundlich and Langmuir isotherm.
13. To study the adsorption of Iodine from alcoholic solution by charcoal.
14. Determination of viscosity of heavy oil by means of Redwood Viscometer.
15. Determination of coefficient of viscosity of the given liquids by Ostwald's Viscometer method.
16. Determination of Flash point of a given sample.
17. Determination of Fire point of a given sample.
18. Determination of acid value and saponification value of an oil.
19. Determination of aniline point of a lubricating point.
20. Determination of Iodine value of oil.
21. To determine the cloud and pour point of a lubricating oil.

(Any twelve to be performed)

Title of the course : **Elements of Electronics Engineering**

Subject Code : **ECT-421**

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:

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

CO1: Design simple combinational and sequential logic circuits.

CO2: Characterize semiconductors, diodes and transistors.

CO3: Apply the basics of diode and transistor to analyse the operation of electronic devices.

CO4: Design electronic circuits such as rectifiers, filters, voltage regulators, transistor amplifiers and operational amplifiers.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	1	1	1	2	2	1	2	2	1	2	1	3
CO2	3	1	3	1	1	1	1	3	2	2	1	2	1	-	1
CO3	3	3	3	3	1	1	2	1	3	2	2	1	-	2	-
CO4	3	1	3	1	3	1	2	2	2	3	3	1	1	2	1
Average	3	1.5	3	1.5	1.5	1	1.75	2	2	2.25	2	1.25	1	1.25	1.25

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Semiconductors	Semiconductors p-type, n-type, pn junction diodes, pn junction as a circuit element, its characteristics, half wave and full wave and bridge type rectifier circuits basic filter circuits, Doide as voltage multiplier, clipper & clamper circuit. Zener diode as a voltage regulator. LED its characteristics construction & applications	12
	2. Amplifiers	Concept of d.c. and a.c. load line and operating point selection. Various amplifiers configurations their h-parameter equivalent circuits determination of voltage gain current gain input resistance and output resistance & power gain. Concept of feedback in amplifiers, different oscillators circuits (without analysis) Differential amplifier and its transfer characteristics.	12
Unit-2	3. Operational Amplifiers	IC Op-Amps, its ideal & practical specifications and measurement of parameters. Op-Amp in different modes as inverting amplifier	12

		non inverting amplifier scale changer, differentiator & integrator.	
	4. Transistors	Characteristics of JFET, MOSFET, Various amplifier configurations using FET. Characteristics and Construction of SCR, TRIAC, UJT. Their basic areas applications.	12

Total=48

Recommended Books:

1. Electronic Devices & Circuits - Boylstad&Nashelsky
2. Integrated Electronics ByMillman&Halkias
3. Electronic Principles – Malvino
4. Principles of Electronics – V.K. Mehta, ShaluMelta
5. Electronic Circuits – Donald L. Shilling & Charles Belowl

Title of the course : Elements of Electronics Engineering Lab

Subject Code : ECP-421

L	T	P	Credits	Weekly Load
0	0	2	1	2

COURSE OUTCOMES:

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

CO1: Design simple combinational and sequential logic circuits.

CO2: Characterize semiconductors, diodes and transistors.

CO3: Apply the basics of diode and transistor to analyse the operation of electronic devices.

CO4: Design electronic circuits such as rectifiers, filters, voltage regulators, transistor amplifiers and operational amplifiers.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	1	1	1	2	2	1	2	2	1	2	1	3
CO2	3	1	3	1	1	1	1	3	2	2	1	2	1	-	1
CO3	3	3	3	3	1	1	2	1	3	2	2	1	-	2	-
CO4	3	1	3	1	3	1	2	2	2	3	3	1	1	2	1
Average	3	1.5	3	1.5	1.5	1	1.75	2	2	2.25	2	1.25	1	1.25	1.25

List of Experiments

1. To study single stage amplifiers and calculate its gain
2. To study the two stage R-C coupled amplifiers and calculate its gain
3. To study the two stage R-C coupled amplifier's frequency response
4. To study the frequency response of single stage amplifier
5. To study the voltage feedback amplifiers
6. To study the Wein bridge oscillator
7. To study the Hartley oscillator
8. To study the class-B push pull amplifier
9. To study the tuned collector oscillator
10. To study the crystal oscillator
11. To study the basic principles of R-C oscillator i.e. phase oscillator
12. To study the negative feedback, its merits, demerits and calculate its gain

Title of the course : **HigherEngineeringMathematics**
Subject Code : **AMT–511**

L	T	P	Credits	Weekly Load
3	1	0	4	4

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Learn about the basic concepts of Mathematics.

CO2: Understand various rules of Mathematics and how it is applied on solve different equations.

CO3: Understand the behavior of differential equations and integration.

CO4: Learn about the mechanism different formulas derivations and theorem.

CO5: Get knowledge about complex matrix, transformations, theorem and their properties.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
CO1	3	1	3	2	2	2	2	3	2	2	2	2	-	-	-
CO2	3	1	3	1	1	3	3	3	3	2	3	3	1	-	1
CO3	3	3	3	3	1	2	1	1	3	2	3	2	-	-	-
CO4	3	1	3	1	3	2	2	2	2	2	2	2	1	2	1
CO5	3	3	3	3	1	3	1	1	3	2	2	3	-	1	1
Avera	3	1.8	3	2	1.6	2.4	1.8	2	2.6	2	2.4	2.4	1	1.5	1

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Laplace transforms	Laplace transforms of elementary functions. Properties of Laplace transform. Transform of derivatives and integrals. Evaluation of integrals by Laplace transforms. Inverse Laplace transforms. Convolution theorem. Solution of ordinary differential equations. Unit step function and unit impulse function. Engineering applications.	7
	2. Fourier series	Fourier series. Change of interval. Even and odd functions. Half-range series.	5
	3. Partial derivatives and expansions	Functions of two or more variables. Partial derivatives. Homogenous functions. Euler's Theorem. Total derivative. Derivative of an implicit function. Tangent and normal to a	9

		surface. Change of variables. Jacobians. Taylor's and Maclaurin's series expansions for a function of two variables.	
Unit-2	4. Complex functions	Limit of a complex function. Differentiation. Analyticity. Cauchy-Riemann equations. Harmonic functions. Conformal mapping. Some special transformations- translation, inversion and rotation. Bilinear transformation.	7
	5. Multiple integral	Double integral. Change of order of integration. Triple integral. Change of variables. Applications to area and volume. Beta and Gamma functions.	8
	6. Vector Calculus	Differentiation of a variable vector. Scalar and vector point functions. Vector operator - Del. Gradient, curl and divergence - their physical interpretation and applications. Directional derivative. Line, surface and volume integrals. Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.	9

Total=45

Recommended Books:

1. R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishers.
2. G.B. Thomas & R.L. Finney, Calculus: Analytical Geometry, Addison Wesley.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern.
4. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill.

Subject Code : MET-511
Title of the course : ENGINEERING MECHANICS

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the basic laws of Engineering Mechanics
CO2: Calculate and analyze the various forces acting on engineering component
CO3: Solve complex Engineering problems by applying mechanics laws
CO4: Analyze various forces acting on elements of truss
CO5: Understand and analyze the kinetics of particle

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3	3	2	3	2	2	2	3	2	3	2	2	2	1	-
CO2	2	3	3	2	3	3	3	2	3	2	3	3	1	-	1
CO3	2	2	3	3	2	2	2	3	2	3	2	2	1	2	2
CO4	2	3	3	3	3	3	2	3	3	2	3	2	2	1	-
CO5	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
Average	2.4	2.6	2.8	2.6	2.6	2.4	2.2	2.6	2.6	2.4	2.4	2.2	1.4	1.5	1.333 33

Theory

Course Description	Lecture(s)
Unit-I	
Fundamentals of Mechanics	
Fundamental concept of mechanics and applied mechanics, idealization of mechanics, Basic dimensions and units of measurements, concept of rigid bodies, Laws of Mechanics	**04**
Laws for Forces	
Control Scalars and Vectors, Vector operations, Vector addition of forces, Force and its effects, characteristics of force vector, Bow's notation Force systems: Coplanar and space force systems. Coplanar concurrent and non-concurrent forces. Free body diagrams,	**04**
Resultant and components of forces	
concept of equilibrium; parallelogram law of forces, equilibrium of two forces; super position and transmissibility of forces, Newton's third law, triangle law of forces, different cases of concurrent, coplanar two forces systems, extension of parallelogram law and triangle law to many forces acting	**04**

at one point	
Polygon law of forces	
Triangle law to many forces acting at one point - polygon law of forces, method of resolution into orthogonal components for finding the resultant, graphical methods, special case of three concurrent, coplanar forces, Lami's theorem	**04**
Moments & Couples	
Concept of moment, Varignon's theorem, Principle of moments, Moment of forces about a specified axis, concept of couple - properties and effect, Moment of couple, Movement of force on rigid body, Resultant of force and couple system, Reduction of force and couple system, Parallel forces - like and unlike parallel forces, calculation of their resultant	**03**
Trusses	
Simple trusses, analysis of simple truss, Method of Joints, Method of sections	**05**
UNIT II	
Friction	
Concept of friction, Characteristics of Dry friction, Laws of Coulomb friction, limiting friction, coefficient of friction; sliding friction and rolling friction, Belt friction, Ladder friction.	**05**
Centre of Gravity	
Concept of gravity, gravitational force, centroid and centre of gravity, centroid for regular lamina and centre of gravity for regular solids. Position of centre of gravity of compound bodies and centroid of composite area. CG of bodies with portions removed.	**06**
Simple Lifting Machines	
Concept of machine, mechanical advantage, velocity ratio and efficiency of a machine, their relationship, law of machine, Simple machines : lever, wheel and axle, differential wheel & axle, pulley systems, simple screw jacks, winch crab (single & double	**06**
Kinetics of particle	
Types of motion, linear motion with uniform velocity, uniform & varying acceleration, motion under gravity, motion of projectiles, relative motion of a particle. Newton's laws of motion, equation of motion, equation of motion for system of particles, D' Alembet's Principle, Motion of connecting bodies. Concept of momentum, Impulse momentum principle, Conservation of momentum, Principle of work and energy.	**07**

Total=48

Recommended Books:

1. J. L. Mariam & L. G. Kraige , Engineering Mechanics. John Wiley & Sons
2. R. C. Hibbeler, Engineering Mechanics (Static & Dynamics), Prentice Hall
3. Beer & Johnston, Engineering Mechanics (Static & Dynamics), McGraw Hill
4. Boresi&Schimidt, Engineering Mechanics (Static & Dynamics), Cengage Learning
5. R. K. Rajput, Engineering Mechanics, DhanpatRai Publication, New Delhi
6. S. Rajshekharan, Engineering Mechanics, VIkas Publishing House , New Delhi

Subject Code : MEP-511
Title of the course : ENGINEERING MECHANICS

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the basic laws of Engineering Mechanics
CO2: Calculate and analyze the various forces acting on engineering component
CO3: Solve complex Engineering problems by applying mechanics laws
CO4: Analyze various forces acting on elements of truss
CO5: Understand and analyze the kinetics of particle

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3	3	2	3	2	2	2	3	2	3	2	2	2	1	-
CO2	2	3	3	2	3	3	3	2	3	2	3	3	1	-	1
CO3	2	2	3	3	2	2	2	3	2	3	2	2	1	2	2
CO4	2	3	3	3	3	3	2	3	3	2	3	2	2	1	-
CO5	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
Average	2.4	2.6	2.8	2.6	2.6	2.4	2.2	2.6	2.6	2.4	2.4	2.2	1.4	1.5	1.333 33

List of experiments ENGINEERING MECHANICS LAB (MEP-511)

L	T	P	Credits	Weekly Load
0	0	2	1	2

1. To verify parallelogram law of forces addition.
2. To verify triangular law of forces addition.
3. To verify Lamis theorem.
4. To determine efficiency of screw jack.
5. To determine coefficient of friction on horizontal surface.
6. To determine coefficient of friction on inclined plane.
7. To calculate moment of inertia of a body.
8. To determine center of gravity of a 3 dimensional body.
9. To determine efficiency of wheel and Axle.

Subject Code : MET-512
Title of the course : BASIC ENGINEERING THERMODYNAMICS

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Able to identify the various types of engines along with their working.

CO2: Able to conduct experiments on performance analysis of engines.

CO3: Develop the basic knowledge the steam engines/ steam nozzle/ steam turbine.

CO4: Able to conduct experimentation on performance analysis of jet propulsion/ compressors.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	3	2	3	2	3	2	2	2	2	1	1
CO2	3	3	3	3	1	3	2	3	2	3	2	3	1	2	1
CO3	3	3	3	2	2	3	2	2	2	2	3	2	1	2	2
CO4	3	3	3	2	2	3	2	3	3	3	2	2	2	1	2
Avera ge	3	3	2.7 5	2	2	2.7 5	2.2 5	2.5	2.5	2.5	2.25	2.25	1.5	1.5	1.5

Theory

Course Description	**Lectures**
Unit-I	
Internal Combustion Engines	
Introduction to I.C. Engines and their classification, Engine components, Nomenclature, Comparison of S.I. & C.I. engine, Working principles of 2-stroke and 4-stroke engine, Comparison of 2-stroke and 4-stroke engine, Gas power cycle, Introduction of different cycles, Carnot cycle, Otto, Diesel cycle, Dual cycle. Analysis of Otto cycle, Diesel cycle & Dual cycles.	**7**
Combustion in S.I. Engine	
Introduction, Combustion in S.I. engine, Flame front propagation, Factor influencing flame speed, pre-ignition, abnormal combustion, Phenomena of knock in S.I. engine, Effect of engine variables on knocking.	**7**
Combustion in C.I. Engine	

Stages of Combustion in C.I. engine, Factors affecting delay period, Phenomena of knocking in C.I. engine, Comparison of knocking in S.I. & C.I. engine	**6**
Steam Engines:	
Parts of steam engine and their function, Working of steam engine, Indicator diagram (Theoretical & actual), Diagram factor, IHP, BHP, Mechanical efficiency, Compounding of steam engines.	**4**
Steam Nozzles and Steam Turbines:	
Introduction to nozzles & types, Equation of continuity, Steady flow energy equation, Momentum equation, Nozzle efficiency, Calculation of nozzle area in adiabatic and frictionless flow, Mass flow rate through nozzle. Steam Turbines:Rankine's cycle, Principle of operation of steam turbine, Types of steam turbines, Simple impulse turbine, Compounding of impulse turbine, impulse reaction turbine, Reaction turbine, Velocity diagram of impulse turbine, effect of blade friction on velocity diagram, Blade or diagram efficiency, gross stage efficiency.	
Gas Turbines:	**8**
Simple open cycle gas turbine, Actual Brayton's cycle, Rate & work ratio, Open cycle gas turbine with regeneration, Open gas turbine cycle with reheat, Open gas turbine with inter cooler, Comparison between closed cycle gas turbine & open cycle gas turbine, advantages & disadvantages of gas turbine over steam turbine, application of gas turbine.	**7**
Jet Propulsion	
Introduction to turbojet engine, Thrust power propulsive efficiency, Thermal efficiency relations, Advantages & disadvantages of jet propulsion over other system, Operation of rocket engine using solid, Liquid propellant.	**4**
Compressors	
Types of compressors, Reciprocating, centrifugal, screw comp. etc., Work done in single & multi cylinder compressor, Inter-cooling, Principle of minimum work for multi compressor, Efficiency.	**5**

Total-48

Recommended Books

Title	**Author(s)**	**Publisher**
I.C. Engine	Mathur& Sharma	DhanpatRai& Sons
Thermodynamics	P.K.Nag	TMH
Thermodynamics (Vol. I-	R.Yadav	CPH

III)

Heat Engineering	V.P.Vasandhani	KhannaPubilsher
Thermal Engineering	P.L.Ballaney	KhannaPubilsher
Engineering Thermodynamics	O.P.Single	TMH

Subject Code : MEP-512
Title of the course : BASIC ENGINEERING THERMODYNAMICS LAB

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Able to identify the various types of engines along with their working.

CO2: Able to conduct experiments on performance analysis of engines.

CO3: Develop the basic knowledge the steam engines/ steam nozzle/ steam turbine.

CO4: Able to conduct experimentation on performance analysis of jet propulsion/ compressors.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	3	2	3	2	3	2	2	2	2	1	1
CO2	3	3	3	3	1	3	2	3	2	3	2	3	1	2	1
CO3	3	3	3	2	2	3	2	2	2	2	3	2	1	2	2
CO4	3	3	3	2	2	3	2	3	3	3	2	2	2	1	2
Average	3	3	2.75	2	2	2.75	2.25	2.5	2.5	2.5	2.25	2.25	1.5	1.5	1.5

List of Experiments APPLIED THERMODYNAMICS LAB

1. Constructional details and working of 2-stroke petrol engine.
2 Constructional details and working of 4-stroke petrol engine.
3. Constructional details and working of 4-sytokr diesel engine.
4. To find the performance of a diesel engine (B.H.P, thermal efficiency, fuel consumption, air consumption.)
5. Make a heat balance sheet of 4-stroke single cylinder diesel engine.
6. Morse test on 4-stroke 4 cylinder petrol engine.
7. To Analyses the exhaust gases of a vehicle with the help of a exhaust gas analyses.
8. To find out the flash point and fire point of kerosene.
9. Constructional details and working of steam engine.
10. Constructional details and working of turbojet engine.

Subject Code : MET-513
Title of the course : MANUFACTURING PROCESS I

PROCESSES

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: select and use different cutting tools for various operations such as turning drilling etc
CO2: identify and use of various presses and related operations
CO3: understand metal finishing operations such as metal spraying & coating etc.
CO4: know basics of various powder metallurgy aspects
CO5: understand various gear manufacturing methods

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	3	2	3	2	2	1	1	1
CO2	2	3	3	2	3	3	3	2	3	2	3	3	2	2	1
CO3	2	2	3	3	2	2	2	3	2	3	2	2	1	2	3
CO4	2	3	3	3	3	3	2	3	3	2	3	2	2	1	2
CO5	3	2	3	2	3	2	2	2	3	2	2	2	2	1	3
Average	2.4	2.6	2.8	2.6	2.6	2.4	2.2	2.6	2.6	2.4	2.4	2.2	1.6	1.4	2

Theory

Course Description	**Lecture(s)**
Unit-I	
Cutting Tools	**08**
Types of cutting tools, cutting tool materials and their properties, illustration of different cutting tools, design and manufacturing of a single point cutting tool, a twist drill and milling cutters.	
Press Working	**08**
Types of presses, press working operations; shearing, blanking, piercing, coining, swaging, embossing and upsetting. Types of dies, punches. punch holders & strip Layout	
Metal Finishing and Coating	**08**

Purpose of grinding, surface grinding, cylindrical grinding, centre-less grinding, specifications of grinding wheel, super finishing, introduction to Honing, Lapping Polishing, Buffing and super-finishing. Metal Spraying. Metal Coating; galvanizing, electro-plating and anodizing.	
Unit-II	
Powder Metallurgy	**06**
Principle. Methods of making powder from metal. Processes involved; Compacting, Sintering and finishing operations. Advantages and Disadvantages of powder metallurgy	
Thread Manufacturing	**08**
Introduction, types of threads, threads making techniques, thread cutting on a lathe, threads finishing.	
Gears and Gear Manufacturing	**10**
Gear nomenclature, types of gears and their applications, gear manufacturing methods, gear cutting on a milling machine, gear hobbing, gear shaping and gear finishing	

Total = 48

Recommended Books

Title	***Author(s)***	***Publisher***
Manufacturing Science	Malik & Ghosh	EWP
Production Engineering Science	Pandey & Singh	Standard Publishers
Metal cutting Theory	A.Bhattacharya	Central Book publishers

Subject Code : MET-514
Title of the course : Fluid Mechanics

L	T	P	Credits	Weekly Load
3	0	0	3	3

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

CO1: To learn fluid properties, types of fluid and to apply this knowledge for understand of static fluid behaviour.
CO2: To understand the properties of the moving fluid and different equations like Euler's equation of motion and Bernoulli's theorem and their applications
CO3: To find out the pressure drop inside the pipes
CO4: To understand the Dimensional Analysis and Model Similitude and its applications, also understand the boundary layer theory
CO5: Apply the basic knowledge of fluid on flow over free surface and also work on introduction of compressible flow.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	3	2	3	2	1	3	1	2	2
CO2	3	2	3	3	3	2	3	3	2	3	2	3	2	3	1
CO3	2	3	3	2	2	1	2	2	2	3	2	3	3	1	2
CO4	3	3	3	3	3	3	2	3	2	2	1	2	1	2	3
CO5	2	1	2	3	3	3	2	2	2	2	2	3	1	2	2
Average	2.6	2.4	2.8	2.6	2.6	2.2	2.4	2.4	2.2	2.4	1.6	2.8	1.6	2	2

Course Description	**Lectures**
Unit-I	
Fundamental concepts	
Definition of fluid, distinction between solid and fluid, fluid properties: viscosity, surface tension, capillarity, vapour pressure; types of fluid	**02**
Fluid statics	
Control volume, forces on fluid element, fundamental equation of fluid statics, pressure and devices for its measurement, centre of pressure, buoyancy, centre of buoyancy, metacentre, metacentric height, hydrostatic thrust on submerged bodies	**04**

Kinematics of fluid	
Scalar and vector fields, flow field and methods of describing fluid motion, classification of fluid flow, motion of fluid particle along a curved path, velocity and acceleration of fluid particle, rate of discharge, continuity equation in differential form in different co-ordinate systems, velocity potential, rotation, circulation, vorticity, stream lines, path lines, streak lines, stream function, flow net, conservation of momentum- equation of motion and momentum theorem	**06**
Dynamics of fluid flow	
Fluid dynamics, control volume and control surface, energy and its different form used in fluid mechanics, Euler's equation of motion, Bernoulli's theorem, application of Bernoulli's theorem, Euler's equation along a streamline, Application of Bernoulli's theorem.	**06**
Viscous incompressible flow	
General viscosity law, Navier –Stokes equations, exact solutions of Navier –Stokes equations as applied in parallel flow in a straight channel, Couette flow and Hagen Poiseuille flow, kinetic energy correction factor, momentum correction factor, theory of hydrodynamic lubrication	**06**
UNIT II	
Dimensional Analysis and Model Similitude	
Systems of dimensions, Dimensional homogeneity and its applications. Dimensional analysis, Rayleigh's method, Buckingham's π-theorem, model similitude, Dimensionless numbers and their significance, distorted model.	**06**
Boundary Layer Theory	
Description of boundary layer, boundary layer parameters, Prandtl's boundary layer equations, Blasius solution for laminar boundary layer flows. Von-Karman momentum integral equation, Laminar boundary layer, laminar –turbulent transition, turbulent boundary layer flow, boundary layer separation, Prandtl's mixing length hypothesis, fully developed turbulent flow in a pipe	**06**
Flow through pipes	
Concept of friction factor in a pipe flow, variation of friction factor, flow potential and flow resistance, flow through pipes jointed together either in series or in parallel or in combination of both of them, losses in pipe bends and pipe fittings, flow through orifice	**06**
Flow with a free surface	
Flow in open channels, flow over a weir and notch, flow in a closed circular conduits only partly full, hydraulic jump	**06**
	Total=48

Recommended Books:

3. White, Fluid Mechanics, ,McGraw Hill
4. Munson , Fundamentals of Fluid Mechanics, John Wiley & Sons
5. Cenegal, Fluid Mechanics, McGraw Hill
6. Modi & Seth, Fluid Mechanics & Fluid Machines, Standard Publishers
7. D. S. Kumar, Fluid Mechanics & Fluid Machinery, Kataria& Sons
8. A.K Jain, Fluid Mechanics, Khanna Publishers
9. Om & Biswas, Fluid Mechanics & Fluid Machines, Tata McGraw-Hill.
10. J. Lal, Fluid Mechanics, Metropolitan.

Subject Code : MEP-514
Title of the course : Fluid Mechanics

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO1: To learn fluid properties, types of fluid and to apply this knowledge for understand of static fluid behaviour.
CO2: To understand the properties of the moving fluid and different equations like Euler's equation of motion and Bernoulli's theorem and their applications
CO3: To find out the pressure drop inside the pipes
CO4: To understand the Dimensional Analysis and Model Similitude and its applications, also understand the boundary layer theory
CO5: Apply the basic knowledge of fluid on flow over free surface and also work on introduction of compressible flow.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	3	2	3	2	1	3	1	2	2
CO2	3	2	3	3	3	2	3	3	2	3	2	3	2	3	1
CO3	2	3	3	2	2	1	2	2	2	3	2	3	3	1	2
CO4	3	3	3	3	3	3	2	3	2	2	1	2	1	2	3
CO5	2	1	2	3	3	3	2	2	2	2	2	3	1	2	2
Average	2.6	2.4	2.8	2.6	2.6	2.2	2.4	2.4	2.2	2.4	1.6	2.8	1.6	2	2

Experiments of Fluid Mechanics Lab

1. Determination of Viscosity of a Liquid by Redwood viscometer.
2. Verification of Bernoulli's Theorem.
3. To determine Coefficient of Discharge of Venturimeter.
4. To determine Coefficient of Discharge of orifice meter.
5. To determine Coefficient of Discharge of Weir.
6. Pressure measurement using Bourdons Tube Pressure Gauge.
7. To determine C_c,C_v,C_d for Vena-Contracta.
8. Computation of Reynolds Number for different types of flow.

9. Computation of losses in Pipe bends/Fittings/Geometrical changes.
10. To determine coefficient of friction in a pipe flow.

Subject Code : MET-515
Title of the course : Industrial Engineering and Management

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: understand the basic concept of Production and Industrial engineering.

CO2: Develop and prepare various recording techniques associate with work study/ method study.

CO3: able to apply various techniques for optimum utilization of resources.

CO4: Able to practical apply inventory control model.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	1	1	1	1	2	1	1	3	2	1	1
CO2	3	3	2	2	3	1	1	1	2	3	1	3	2	3	1
CO3	3	2	2	1	3	1	1	1	1	3	2	2	1	3	2
CO4	2	2	3	2	1	1	1	1	2	1	2	2	2	1	2
Average	2.75	2.25	2.25	1.75	2	1	1	1	1.75	2	1.5	2.5	1.75	2	1.5

Theory

Course Description	**Lecture(s)**
Unit-I	
Introduction	8
Industrial Engineering, Definition and Evolution, Understanding Industrial System Focus: Production/Service System. Performance measures of a Production System -Production, Productivity, Efficiency, Effectiveness, Classical Industrial Engineering -Work Study: Method Study and Time Study, Human Factors, Ergonomics.	
Quality Control	**8**
Quality, TQM, SQC, Control Charts, Acceptance Quality Level (AQL), Lot Tolerance Percentage Defective (LTPD), Producer's Risk, Consumer's Risk, Operating Characteristic Curve, Simple Numerical Problems	
Value Engineering	**8**
Concept of value analysis, Aim and objectives, Phases in value analysis, Test for value analysis, Difference between V.E. and Cost Reduction Techniques, Functional Analysis System Techniques	

(FAST), Principles of Value Analysis.	
Unit-II	
Production and Process Planning	**9**
Objectives of PPC, Component of PPC, Phases of PPC, Process Planning, Steps in Process Planning for Flow Shop Scheduling, Types of Scheduling Systems, Master Scheduling, Order Scheduling, Comparison between Production Planning and Production Control, Sequencing.	
Sales Forecasting Techniques	**6**
Types of forecasting, importance of demand planning, Methods of Sales forecasting, Qualitative and Quantitative methods of demand planning.	
Inventory Control & Management	**9**
Introduction, Inventory, Deterministic model of EOQ, EOQ, Selective Inventory Control, Japanese Influences: Just in Time (JIT), Kanban etc., Increasing Integration in Industrial Enterprises: From MRP to ERP to Supply Chain Management.	

Total=48

Recommended Books

Title	***Author(s)***	***Publisher***
Motion and Time Study	A. Barnes	John Wiley & sons
Work Study and Ergonomics	Dalela and Sourabh	Standard Publishers
Production Management	Ronald Mayer	TMH
Industrial Engineering & Management	MartandTelsang	S.Chand

Subject Code : MEP-515
Title of the course : MACHINE DRAWING

L	T	P	Credits	Weekly Load
0	0	4	2	4

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

CO1: Recall the concept of basicengineering drawing

CO2: Understand and represent a machine component or machine by lines according to certain set rules

CO3: Understand and apply the knowledge of machine drawing as a system of Communication in which ideas are expressed clearly and all information fully conveyed.

CO4: Use the techniques, skills and modern engineering tools necessary for creating and assembling with the concept of virtual work.

CO5: Design a system, component or process to meet desired needs within, realistic constraints such as manufacturability ,economic ,environmental, safety & sustainability etc.., to represent a part drawing and assembly drawings.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):															
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	1	1	2	2	2	3	2	1	2	1
CO2	3	3	3	2	3	1	1	3	2	2	2	3	2	2	1
CO3	3	2	2	2	3	1	1	2	2	3	3	3	1	3	2
CO4	3	3	3	2	2	1	2	3	2	2	3	3	1	1	2
CO5	3	3	3	2	2	2	2	2	2	2	2	3	1	1	3
Avera ge	3	2.6	2.6	2	2.4	1.2	1.4	2.4	2	2.2	2.6	2.8	1.2	1.8	1.8

Theory

Course Description	**Lecture(s)**
Unit-I	
Basics of Machine Drawing	**04**
Machining symbols, surface finish characteristics, surface roughness symbols, limits, fits and tolerances.	
Screw Threads	**06**

Screw thread nomenclature, thread designation, conventional representation of screw threads, different types of threads and their representation.	
Fastenings	**08**
Nut, bolt and washer; types of nuts, types of bolts, Welding; types of welded joints, representation of a weld, welding symbols according to B.I.S.	
Unit-II	
Keys, Cotters and Joints	**08**
Introduction, proportions of a key, types of keys and their applications. A Cotter and a Gib with their uses. Types of joints used for connecting rods.	
Rivets and Riveted Joints	**08**
Types of rivets, types of riveted joints, general terms/rules used for riveted joints.	
Assembly and detail drawings	**14**
One assembly drawings of a Tail stock, details (drawings of different elements) of a screw jack assembly.	

Total = 48

Recommended Books

Title	*Author(s)*	*Publisher*
Machine Drawing	N D Bhatt	Khanna
Machine Drawing	P S Gill	Standard
Machine Drawing	R.K. Dhawan	S. Chand
Machine Drawing	GoutamPohit& GoutamGhosh	Pearson Education

Subject Code : MET-521
Title of the course : Physical Metallurgy and Heat Treatment

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understanding crystal structure, solid solutions and its types, component, solubility limit, diffusion in solids.

CO2: Learning about the Crystal defects and their classifications, edge and screw dislocations, stress strain relationship, plastic deformation by slip & twinning, review of strengthening mechanisms.

CO3: Need and importance of phase diagram, unary & binary phase diagrams, Allotropic transformation of iron and steel, analysis of phase diagrams, Iron carbon equilibrium diagram.

CO4: Select a suitable heat treatment process for a given application.

CO5: Understand various hardening process.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	1	2	2	1	2
CO2	3	2	3	2	2	2	2	2	3	2	2	2	2	2	1
CO3	3	3	3	3	2	2	3	2	2	3	2	2	1	2	3
CO4	3	2	3	2	3	2	2	3	2	3	1	2	2	1	2
CO5	3	3	3	3	2	2	1	3	2	2	1	3	2	1	3
Average	3	2.4	3	2.4	2.2	2	2.2	2.6	2.2	2.4	1.4	2.2	1.8	1.4	2.2

Theory

Course Description	Lecture(s)
Unit-I	
Structure of solids	**06**
Introduction to metals, non metals and alloys, crystal structure, solid solutions and its types, component, solubility limit, diffusion in solids.	
Plastic deformation and work hardening	**08**
Crystal defects and their classifications, edge and screw dislocations, stress strain relationship, plastic deformation by slip & twinning, review of strengthening mechanisms.	
Phase Transformation I	**10**
Phase diagram: Introduction, importance and objectives of phase diagram, unary & binary phase	

diagrams, Allotropic transformation of iron and steel, cooling curves, Gibbs's phase rule, Lever rule, common types of phase diagram: eutectic and eutectoid systems, peritectic and peritectoid systems, Properties of austenite, ferrite, pearlite, martensite.	
Unit-II	
Phase Transformation II	**10**
Introduction, Nucleation and Growth, Ingot structure, solidification and crystallization, recovery, re-crystallization and grain growth, Iron carbon equilibrium diagram, Transformation of austenite to pearlite , Transformation of austenite at constant temperature: time temperature transformation (TTT), continuous cooling transformation (CCT).	
Heat Treatment:	**08**
Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering. harden ability.	
Surface Hardening	**06**
Carburizing: Gas, Pack, Liquid, Nitriding, cyaniding, flame and induction hardening. Surface hardening applications	

Total=48

Recommended Books:

	Title	***Author(s)***	***Publisher***
1.	Engg. Phy. Metallurgy &Heat Treatment	Yuri Lakhtin	Mir Publishers
2.	Physical Metallurgy	Donalk S Clark	East West Press
3.	Material Science and Engineering	Raghvan	PHI
4.	Heat treatment principles and applications	Rajan and Sharma	PHI
5.	Physical metallurgy handbook	McGRAW Hill	Anil Kumar Sinha

Subject Code : MEP-521
Title of the course : Physical Metallurgy and Heat Treatment Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understanding crystal structure, solid solutions and its types, component, solubility limit, diffusion in solids.

CO2: Learning about the Crystal defects and their classifications, edge and screw dislocations, stress strain relationship, plastic deformation by slip & twinning, review of strengthening mechanisms.

CO3: Need and importance of phase diagram, unary & binary phase diagrams, Allotropic transformation of iron and steel, analysis of phase diagrams, Iron carbon equilibrium diagram.

CO4: Select a suitable heat treatment process for a given application.

CO5: Understand various hardening process.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	1	2	2	1	2
CO2	3	2	3	2	2	2	2	2	3	2	2	2	2	2	1
CO3	3	3	3	3	2	2	3	2	2	3	2	2	1	2	3
CO4	3	2	3	2	3	2	2	3	2	3	1	2	2	1	2
CO5	3	3	3	3	2	2	1	3	2	2	1	3	2	1	3
Average	3	2.4	3	2.4	2.2	2	2.2	2.6	2.2	2.4	1.4	2.2	1.8	1.4	2.2

List of Experiments

1. Introduction to the crystal lattice of solids.
2. Familiarization and specimen preparation with the following examinations
   i. Macro examination of specimens of ferrous materials.
   ii. Micro examination of specimens of ferrous materials
   iii. Macro examination of specimen of non-ferrous material.
   iv. Micro examination of specimen of non-ferrous material.
3. To carry out microstructural studies on different steel specimens e.g. cast specimens, welded specimens etc.
4. Study the effect of varying cooling rate on the microstructure of steel and comparing in terms of grain size and mechanical properties.
5. To carry out following heat treatments of the given steel specimen
   i. Annealing.,
   ii. Normalizing

iii. Hardening

6. To conduct following case hardening treatment of the given specimen.
   i. Carburizing.
   ii. Flame hardening.
7. Analysis of the microstructural changes in the specimens after giving different heat treatments as above.
8. Familiarization with the codification of steels and other alloys.

Subject Code : MET-522
Title of the course : Fluid Machinery

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Identify and assess the usefulness of dynamic action of a fluid in scientific way.
CO2: Analyze parameters using scientific approach for assessing need of efficiency in fluid energy utilization.
CO3: Investigation for design and development of fluid based energy conversion devices, appliances and machinery.
CO4: Analyze environment and sustainability

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	1	2	2	1	2
CO2	3	2	3	2	2	2	2	2	3	2	2	2	2	2	1
CO3	3	3	3	3	2	2	3	2	2	3	2	2	1	2	3
CO4	3	2	3	2	3	2	2	3	2	3	1	2	2	1	2
Average	3	2.25	3	2.25	2.25	2	2.5	2.5	2.25	2.5	1.5	2	1.75	1.5	2

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	
Dynamic action of fluid, Newton second law of motion, application of linear momentum equation, Limitation.	**02**
Impact of jet and Jet propulsion	
Dynamic force exerted by fluid jet on stationary/ moving, vertical, inclined, flat and curved plates. Jet propulsion- Principle and propulsion of ship. Rocket mechanics and angular momentum equation	**06**
Whirling fluids	
Types of fluid motion ,rectilinear motion, radial motion, radial flow, rotary motion. Free and Forced vortex motion.	**02**
Pelton Wheel and impulse turbine	
Element of hydroelectric power plant, efficiencies of hydraulic turbines; Classification of turbines. Pelton wheel turbine , main component and their function, turbine power, nozzle and jet diameter, No. of jets, mean diameter of a pelton runner, selection of a speed, jet ratio, minimum no. of buckets	**08**

and other impulse turbine. Design of Pelton turbine runner. Force , power and efficiency . Unit and specific quantities, Specific speed.	
Reaction turbine	
Francis turbine, work done and efficiency of Francis turbine, Design of Francis turbine runner. Kaplan turbine,work done & efficiency of Kaplan turbine, Cavitations and its effect . Draft tube theory and it's type , efficiency of draft theory.	**06**
UNIT II	
Reciprocating pumps	
classifications, main parts of a reciprocating pumps, working principle. Discharge, work done and power requirement in a reciprocating pump. slip of a reciprocating pump. Effect of accelerating of piston on velocity and acceleration in the suction and delivery pipe. Indicator diagram. Air vessel.	**09**
Centrifugal pumps	
working principle and operation , classification , Main components , discharge , Head of a pump , power , determination loss of head in pipe line and pipe fitting. Efficiencies of Centrifugal pump. Priming of pump. Cavitations In pumps. Net positive section head. Selection of a centrifugal pump.	**08**
Hydraulic Machines	
Pascal law, Description and application of hydraulic accumulator, intensifiers, hydraulic jack, Hydraulic ram. Hydraulic press. Hydraulic crane. Gear wheel pump. Hydraulic torque convertor and hydraulic coupling. Air lift pump	**07**

Total=48

Recommended Books:

1. Modi & Seth, Fluid Mechanics & Fluid Machines, Standard Publishers
2. D. S. Kumar, Fluid Mechanics & Fluid Machinery, Kataria& Sons
3. A.K Jain, Fluid Mechanics, Khanna Publishers
4. Om & Biswas, Fluid Mechanics & Fluid Machines, Tata McGraw-Hill.
5. J. Lal, Hydraulic Machines, Metropolitan.

Subject Code : MEP-522

Title of the course : Fluid Machinery Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Identify and assess the usefulness of dynamic action of a fluid in scientific way.

CO2: Analyze parameters using scientific approach for assessing need of efficiency in fluid energy utilization.

CO3: Investigation for design and development of fluid based energy conversion devices, appliances and machinery.

CO4: Analyze environment and sustainability

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	1	2	2	1	2
CO2	3	2	3	2	2	2	2	2	3	2	2	2	2	2	1
CO3	3	3	3	3	2	2	3	2	2	3	2	2	1	2	3
CO4	3	2	3	2	3	2	2	3	2	3	1	2	2	1	2
Average	3	2.25	3	2.25	2.25	2	2.5	2.5	2.25	2.5	1.5	2	1.75	1.5	2

List of Experiments

1. To study the constructional details of a Pelton turbine and draw its fluid flow chart.
2. To draw performance characteristics of Pelton turbine.
3. To study the constructional details of a Francis turbine and draw its fluid flow chart.
4. To draw performance characteristics of Francis turbine.
5. To study the construction details of a Kaplan turbine and draw its fluid flow chart.
6. To draw the constant head, speed and efficiency curves for a Kaplan turbine.
7. To draw characteristic curves of a Centrifugal Pump .
8. To draw characteristics curves of Reciprocating Pump.
9. To determine the efficiency of a Gear oil pump.
10. To find efficiency of a Hydraulic Ram.
11. To determine the efficiency of a Centrifugal compressor.

Subject Code : MET-523
Title of the course : Strength of Materials

L	T	P	Credits	Weekly Load
3	1	0	4	4

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

CO1: Apply the basic concepts and principles of strength of materials.

CO2: Calculate stresses and deformations of objects under external loadings.

CO3: Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
CO4: Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
CO5: Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

Theory

Course Description	Lecture(s)
Unit-I	
PROPERTIES OF MATERIAL*:* Introduction, uni-axial tension test, idealized stress-strain diagrams, isotropic linear elastic, visco-elastic and plastic materials, compression test, impact test, fatigue test, torsion and bending test	**03**
SIMPLE STRESS & Strain	**05**

Concept of stresses and strains, relationship between elastic constants, Modulus of elasticity stresses and strains in bars subjected to axial loading, , stress produced in compound bars subjected to axial loading.Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls. Extension of uniform bar & tapered bar under its own weight and due to load applied,	
COMPOUND STRESSES AND STRAIN Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants. principal stresses determined from principal strain	**04**
SHEAR FORCE AND BENDING MOMENT IN BEAMS Relation between unit load, Force and Moment. Shear Force and Bending Moment diagram of beams under various types of loading for cantilevers, simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.	**08**
Theory of bending stresses simple bending theory, derivation of bending formula: its application to beams of various sections (rectangular, circular and channel, etc) Shear Stresses- Derivation of formula ,Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections, Composite beams, bending and shear stresses in composite beams	**06**
Unit-II	
Slope & DEFLECTION OF Beams Relationship between moment, slope and deflection Deflection by calculus, Macaulay's methods, Moment area method, method of deflection coefficient, deflection due to shear of various beams under the action of various loading conditions; built in and propped beam.	**06**
Torsion Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, Torsional rigidity., Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.	**04**
Thin Cylinders and Spheres Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.	**04**
Columns and Struts Definitions and examples of instability; criteria for stability of equilibrium, Euler's theory of columns, Slenderness ratio. equivalent length Columns under uni-axial load, buckling, Euler's equation for various end restraints, Rankine formula, eccentrically loaded struts, struts with initial curvature, lateral stability of beams; struts with lateral loading Buckling	**08**

of Columns,.RankineGordon‟s empirical formula	

Total=48

.

Recommended Books

Title	Author(s)	Publisher
Mechanics of Solids	Popov	PHI
Strength of Materials	Sadhu Singh	Khanna
Strength of Materials	Ryder G.H	ELBS
Mechanics of Solids	Gambhir	PHI
Strength of Materials	R. S. Lehri	Kataria
Strength of Materials	Pytel A H and Singer F L	Harper Collins, New Delhi.

Subject Code : MEP-523
Title of the course : Strength of Materials Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO1: Apply the basic concepts and principles of strength of materials.

CO2: Calculate stresses and deformations of objects under external loadings.

CO3: Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
CO4: Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
CO5: Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

List of Experiments Strength of Materials lab(MEP-523)

1. Tension test
2. Bending tests on simply supported beam / Cantilever beam.
3. Torsion test
4. Hardness tests (Brinell and Rockwell)
5. Tests on closely coiled and open coiled springs
6. Compression test on wood or concrete
7. Impact test
8. Shear test
9. Fatigue Test

Subject Code : **MET-524**

Title of the course : MANUFACTURING PROCESSES-**II**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand principle of gas welding and arc welding, TIG, MIG/MAG welding processes, select suitable (most appropriate) welding electrodes, various parameters of the process for a given job.

CO2: To study the different types of metal cutting operations and cutting parameters used in turning, study work holding and tool guiding devices.

CO3: Understand drilling, reaming, counter boring, counter sinking and tapping operations to be performed on drilling machine with its nomenclature.

CO4: To study the manufacturing processes and re-sharpening principles of multipoint cutting tool, milling cutter.

CO5: Understand the concept of jigs and fixture and locating devices

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

Theory

Course Description	Lecture(s)
Unit-I	

Welding: Principle of welding, Classification of welding processes, Advantages and limitations of welding, Industrial applications of welding, types of welding joints, Welding positions and techniques, Soldering and brazing. Gas and Arc Welding: Principle of operation, Types of gas welding flames and their applications, Gas welding equipment - Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes. Principle of arc welding, Arc welding equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes: Classification, B.I.S. specification and selection, Requirements of pre heating, post heating of electrodes and work piece. Types of Welding Processes: Spot welding, seam welding, projection welding, Shielded metal arc welding, submerged arc welding, Welding distortion, welding defects, methods of controlling welding defects and inspection of welded joints. Principle of operation, advantages, disadvantages and applications of Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electron beam welding, Ultrasonic welding, Laser beam welding.	**06**
Lathe Operations: Principle of turning, Description and function of various parts of a lathe,types of lathe machines, work holding devices, lathe operations :- plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning, machining time. lathe accessories:-centers, dogs, different types of chucks, collets, face plate, angle plate, mandrel, steady rest, follower rest, taper turning attachment, tool post grinder. brief description of capstan and turret lathe, comparison of capstan/turret lathe, work holding and tool guiding devices in capstan and turret lathe. Numerical problems on calculating machining time. Manufacturing process and re-sharpeningprinciples of single point cutting tool.	**06**
Drilling: Principle of drilling, classification of drilling machines and their description, various operations performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping, speeds and feeds during drilling, machining time, types of drills and their features, nomenclature of a drill, drill holding devices, reaming operation and types of reamers. Counter boring, counter sinking, core drilling and spot facing operations, cutting tools used in these processes. Numerical problems on calculating machining time. Manufacturing process and re-sharpening principles of drill.	**06**

Unit-II	
Milling: Specification and working principle of milling machine, classification, brief description and applications of milling machines, up milling and down milling. details of column and knee type milling machine, milling machine accessories and attachment – arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment and rotary table, work holding devices, other milling operations – face milling, angular milling, form milling, straddle milling and gang milling, cutting speed and feed, simple numerical problems.	**06**
Boring: Principle of boring, classification of boring machines and their brief description, specification of boring machines, boring tools, boring bars and boring heads, and description of jig boring machine. Numerical problems on calculating machining time.	
Shaping and Planing: Working principle of shaper and planer, type of shapers, type of planers, quick return mechanism applied to shaper and planer machine, work holding devices used on shaper and planer, types of tools used and their geometry, specification of shaper and planer, speeds and feeds in above processes. Numerical problems on calculating machining time.	
Broaching: Introduction, types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, elements of broach tool, broach tooth details – nomenclature, types, and tool material.	
Jigs and Fixtures: *Importance and use of jigs and fixture, advantages of jigs and fixtures Principle of location, locating devices, clamping devices, types of Jigs – drilling jigs, bushes, template jig, plate jig, channel jig, leaf jig, fixture for milling, turning, welding, grinding.*	

Recommended Books:

1.	Tool Design	Donaldson	McGraw Hill
2	Cutting tools	Prakash Joshi	Wheeler Publishing
3	Metal Cutting theory & practice	Arschinov&Alearoev	MIR publication
4	Jigs & Fixtures	Grant	TMH

Subject Code : **MEP-524**

Title of the course : MANUFACTURING PROCESSES LAB-**II**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand principle of gas welding processes, spot welding/seam welding select suitable (most appropriate) welding electrodes, various parameters of the process for a given job.

CO2: To study the different types of metal cutting operations and cutting parameters used in turning, study work holding and tool guiding devices.

CO3: Understand drilling, reaming, counter boring, counter sinking and tapping operations to be performed on drilling machine with its nomenclature.

CO4: To study the manufacturing processes and re-sharpening principles of multipoint cutting tool, milling cutter.

CO5: Understand the concept of jigs and fixture and locating devices.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

List of Experiments:

1. Preparing gas welding joint in vertical/Horizontal position joining M.S. Plates.
2. Exercise on spot welding/seam welding.

3. Exercises on external turning and internal turning on lathe machine.
4. Exercises on internal threading on lathe machine
5. Grinding a drill-bit on tool and cutter grinder.
6. Produce a rectangular block using a milling machine with a side and face cutter.
7. Produce a rectangular block using shaper machine.
8. Study of single ram and duplex ram horizontal type broaching.
9. Study of Jig and Fixture and locating devices.

Recommended Books:

1.	Tool Design	Donaldson	McGraw Hill
2	Cutting tools	Prakash Joshi	Wheeler Publishing
3	Metal Cutting theory & practice	Arschinov&Alearoev	MIR publication
4	Jigs & Fixtures	Grant	TMH

Subject Code : MET-525
Title of the course : Kinematics of Machines

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the working of various machines and mechanisms

CO2: Synthesize the mechanism using various mathematical techniques.

CO3: Formulate and construct the cam profile for a particular application.

CO4: Analyze and suggest the suitable power transmission mechanism between two shafts.

CO5: Distinguish the suitable gear for a particular application, Understand different motions with in a gear box and importance of different parts of a gear box.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

Theory

Course Description	Lecture(s)
Unit-I	
Review of Mechanism & Machine	
Concepts and classification of links, pairs, kinematic symbols, kinematic chains, plane motion; Constraints and degrees of freedom, mechanism and machines, inversion, conversion of mechanisms.	**08**
Kinematic Analysis	
Kinematic quantities and their relationships, absolute and relative motions and their vector representation, instantaneous centers, Kennedy's theorem; Relative velocity method, method of instantaneous centres, resolution and orthogonal velocity methods; Acceleration analysis, Coriolis acceleration, mathematical analysis of slider crank mechanism, special graphical	**10**

methods; Klein's construction, Ritterhau construction &Bennet construction for velocity & acceleration analysis of single slider crank mechanism.	
Motion Synthesis	
Graphical methods of synthesis, Chebyshev spacing, two position synthesis, application to four bar mechanism, analytical synthesis using complex algebra, Freudensteins method.	**06**
Unit-II	
Applied Linkages	
Radial engines and mater crank, straight line motion and indicator mechanisms, steering mechanisms, quick return mechanisms, intermittent motion mechanisms, Geneva mechanism, analog computing mechanisms, various types of ingenious mechanisms and their functioning.	**06**
Cams	
Classification, types of motion curves and their analytical expressions, graphical construction of cam profiles for different types of followers, pressure angle and cam size, cams with specified contours.	**08**
Belt, Rope & Belt Drive	
Introduction, flat and V-belt drive, velocity ratio, Creep, slip in belt drive, velocity law, compression in belt, tension in belt, and angle of contact, power transmission. Belt, chain and rope drive.	**06**
Gears	
Introduction, Classification. Terminology. Law of Gearing Spur Gear; velocity of sliding in mating teeth. Involute and Cycloidal teeth & their construction and comparison. Involute Profile Gears; Length of path of contact, Contact Ratio, Interference, number of teeth on wheel, pinion & rack to avoid interference. Introduction to helical and worm gears.	**04**

Total=48

Recommended Books:

1. Martin, G.H., "Kinematics and Dynamics of Machines", 3rd Ed., McGraw-Hill, 1982
2. Ghosh, A., and Mallik, A.K., "Theory of Mechanisms and Machines", 2nd Ed., Affiliated East-West Press, 2003.
3. Bevan, T., "Theory of Machines", 3rd Ed., CBS Publishers 2003.
4. Vicker, J.J., Shigley, J.E., and Penock, G.R., "Theory of Machines and Mechanisms", 3rd Ed., Oxford University Press, 2003.
5. Hannah, J., and Stephens, R.C., "Mechanics of Machines: Elementary Theory and Examples", 4th Ed., Viva Books, 2004.
6. Rattan S.S., "Theory of Machines", TMH, New Delhi, 2010.

Subject Code : MEP-525
Title of the course : Kinematics of Machines Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the working of various machines and mechanisms
CO2: Synthesize the mechanism using various mathematical techniques.
CO3: Formulate and construct the cam profile for a particular application.
CO4: Analyze and suggest the suitable power transmission mechanism between two shafts.
CO5: Distinguish the suitable gear for a particular application, Understand different motions with in a gear box and importance of different parts of a gear box.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

Cos	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

List of Experiments Kinematics of Machines lab

1. Study of kinematic pairs and kinematic chain.
2. Study of different kinds of planar mechanism; four bar mechanism, single slider crank mechanism, double slider mechanism.
3. Construction of velocity and acceleration diagram for planar mechanism.
4. Demonstration of different kinds of CAM and Follower arrangements.
5. Construction of CAM with different types of followers for various kind of motion.
    a. Knife edge follower with various kind of motion.
    b. Roller follower with various kind of motion.
    c. Flat faced follower with various kind of motion.
    d. Spherical faced follower with various kind of motion.
6. Demonstration of different types of Gears.

7. Generation of profile of Gear teeth
    a. For Involute profile
    b. For Cycloidal profile.

Title of the course : Numerical Analysis

Subject Code : AMT- 611

L	T	P	Credits	Weekly Load
3	1	0	4	4

CO1: Apply Numerical analysis which has enormous application in the field of Science and some fields of Engineering.

CO2: Familiar with numerical solutions of nonlinear equations in a single variable.

CO3: Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations.

CO4: Familiar with calculation and interpretation of errors in numerical method.

CO5: Familiar with programming with numerical packages like MATLAB.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	1	1	1	1	2	2	2	1	2	2
CO2	2	2	1	2	1	1	1	1	1	1	1	2	2	3	1
CO3	2	3	3	2	2	1	2	2	2	3	2	3	3	1	2
CO4	3	3	3	3	3	3	2	3	2	2	1	2	1	2	3
CO5	2	1	2	3	3	3	2	2	2	2	2	3	1	2	2
Average	2	2	2.2	2.4	2	1.8	1.6	1.8	1.6	2	1.6	2.4	1.6	2	2

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Errors	Errors in arithmetic operations and functions. Round-off error, truncation error. Absolute error. Relative error. Percentage error. Principles of equal effect. Significant	

		digits.	4
	2. Roots of equations	Intermediate value property. Bisection method. Method of false position. Secant Method. Newton-Raphson method. Iteration method. Convergence of these methods.	6
	3. Solution of linear equations	Gauss Elimination method (with and without partial pivoting). Gauss-Seidel, Jacobi's methods. Triangularization method.	5
	4. Eigenvalue	Rayleigh's power method for finding dominant eigenvalue.	4
	5. Finite differences	Finite differences-forward, backward and central differences. Shift and averaging operators.	4
Unit-2	6. Interpolation	Newton's forward, backward and divided difference interpolation formulae. Lagrange's formula. Gauss forward and backward difference interpolation formulae. Spline interpolation–quadratic and cubic.	7
	7. Numerical differentiation and integration	Numerical differentiation using Newton's forward and backward difference formulae. Numerical integration – Trapezoidal rule, Simpson's one third and three-eighth rules. Romberg's integration. Error in integration.	8
	8. Numerical solution of ODEs	Taylor series method. Picard's method. Euler method. Modified Euler's method. Runge-Kutta methods (upto fourth order) for solution of ODE of first order.	7
			Total=45

Recommended Books:

1. S.S. Sastry, Introductory Method of Numerical Analysis, PHI.
2. Gerald Wheatley, Applied Numerical Analysis, Pearsons Education.
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Sc. and Engg. Computation.
4. J.H. Mathew, Numerical Methods for Maths., Science and Engg., PHI.

Title of the course : **Numerical Analysis Lab**

Subject Code : **AMP- 611**

L	T	P	Credits	Weekly Load
0	0	2	1	2

CO1: Solve nonlinear equations and system of linear equations.

CO2: Find largest eigen value of a square matrix.

CO3: Use various interpolation formulae.

CO4: Find numerical differentiation and integration.

CO5: Solve numerically by using various techniques.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	1	0	0	0	0	0	1	0	2	2	3	2
CO2	3	3	2	1	0	0	0	0	0	1	0	2	2	3	2
CO3	3	3	2	1	0	0	0	0	0	1	0	2	2	3	2
CO4	3	3	2	1	0	0	0	0	0	1	0	2	2	3	2
CO5	3	3	2	1	0	0	0	0	0	1	0	2	2	3	2
Average	3	3	2	1	0	0	0	0	0	1	0	2	2	3	2

List of Programmes

1. Finding roots of the equation $f(x) = 0$ using
   i) Bisection Method ii) Secant Method iii) Method of false position

2. Finding roots of the equation $f(x) = 0$ using
   i) Iterative Method ii) Newton - Raphson's Method

3. To check consistency and finding Solution of a system of linear algebraic equations using

i) Gauss elimination Method ii) Gauss - Seidal Method iii) Jacobi Method

4. Interpolation using
   i) Newton's forward difference formula ii) Newton's backward difference formula

5. Interpolation using
   i) Newton's divided difference formula ii) Lagrange's interpolation formula

6. Numerical differentiation using
   i) Newton's forward interpolation formula ii) Newton's backward interpolation formula

7. Numerical Integration using
   i) Trapezoidal rule ii) Simpson's $1/3^{rd}$ rule
   iii) Simpson's $3/8^{th}$ rule

8. Solution of I^{st} order ordinary differential equations using
   i) Taylor's series method ii) Picard's method
   iii) Euler's method iv) Euler's modified method

9. Solution of I^{st} order ordinary differential equations using Runge-Kutta methods.

10. Fitting a curve using given data.
    i) linear curve ii) quadratic curve
    iii) cubic curve iv) any other

11. Finding the following, using given data:
    i) mean, median and mode.
    ii) standard deviation and mean deviation.
    iii) moments, skewness and kurtosis of various order.
    iv) rank correlation.

Subject Code : MET-611

Title of the course : Dynamics of Machines

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: To expand students knowledge of planar kinematic analyses of rigid body and simple, compound, reverted, epicyclical gear train systems.

CO2: To teach the student about the basic concepts of flywheel and governors and their applications to different situations.

CO3: To understand the basic laws of friction and its application to clutches, Power screws, brakes

CO4: Understandconcepts of static and dynamic mass balancing and concept of gyroscope

CO5: To understand the concepts of natural, damped and forced vibrations. Also apply it for solving complex problems of vibration

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

Course Description	**Lecture(s)**
Unit-I	
Gear Trains	
Introduction of simple, compound, reverted, epicyclic gear train & compound epicyclic gear train. Tooth load & torque in gear trains.	**04**
Force Analysis of Mechanisms	
Concept of free body and its equilibrium, static force analysis, friction effects, forces on gear teeth; D'Alembert's principle, dynamic force analysis, force	**04**

analysis of cam-follower system, equivalent dynamical systems, dynamic analysis of reciprocating engines, practical examples from actual machines.	
Flywheel	
Introduction, an approximate analysis, Fluctuation of energy and speed, energy in flywheel, calculation of flywheel size; Flywheel in punching, inertia force analysis of reciprocating engine.	**05**
Governors	
Type of governors, function of governors, Analysis of different types of governors, controlling force diagrams, sensitivity analysis, stability of governors, isochronous governors, hunting, power and efforts of governors.	**07**
Friction	
Introduction, law of friction, Coulomb friction, pivot and roller friction, flat pivot and conical pivot, flat collar pivot, single and multiple clutches, cone clutch.	**04**
Unit-II	
Friction Drives	
Introduction, Power screws, band and block brakes.	**04**
Balancing	
Balancing of rotating masses on one plane and in different parallel planes, balancing of slider crank mechanisms, balancing of in-line, V- and locomotive engines, principles of balancing machine.	**08**
Gyroscope	
Introduction. Principle of gyroscope. Gyroscopic couple. Direction of vector with forced precession. Analysis of precession due to forced precession of rotating disc mounted on shaft. Motion of rigid body with reference to Euler's equations. Effect of gyroscopic couple. Stability of two wheeler, four wheeler, sea vessels and aircraft with numerical problems.	**06**
Mechanical Vibration	
Simple harmonic motion; Conservative systems; Free vibrations of systems without damping; Equilibrium and energy methods for determining natural frequency; Rayleigh's method, free vibrations of system with viscous damping, over damped, critically and under damped systems, logarithmic decrement; Forced vibrations of systems with viscous damping, equivalent viscous damping; Impressed forces due to unbalanced masses and excitation of supports, vibration isolation, transmissibility.	**06**
	Total=48

Recommended Books:

1. Vicker, J.J., Shigley, J.E., and Pennock, G.R., "Theory of Machines and Mechanisms", 3rd Ed., Oxford University Press, 2003.
2. Vinogradov, O., "Fundamentals of Kinematics and Dynamics of Machines and Mechanisms", CRC Press, 2000.

3. Massie, H.H., and Reinholtz, C.F., “Mechanisms and Dynamics of Machinery”, 4th Ed., John Wiley & Sons, 1987.
4. Grover, G.K., “Mechanical Vibrations”, 7th Ed., Nem Chand and Brothers, 2003.
5. Thomson, W.T., “Theory of Vibration with Applications”, 3rd Ed., CBS Publishers, 2003.
6. Rattan S.S., “Theory of Machines”, TMH, New Delhi, 2010.

Subject Code : MEP-611
Title of the course : Dynamics of Machines Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: To expand students knowledge of planar kinematic analyses of rigid body and simple, compound, reverted, epicyclical gear train systems.

CO2: To teach the student about the basic concepts of flywheel and governors and their applications to different situations.

CO3: To understand the basic laws of friction and its application to clutches, Power screws, brakes

CO4: Understandconcepts of static and dynamic mass balancing and concept of gyroscope

CO5: To understand the concepts of natural, damped and forced vibrations. Also apply it for solving complex problems of vibration

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3	2	2	2	3	2	2	2	1	2	1
CO2	2	3	2	2	2	3	3	2	2	3	2	3	2	2	1
CO3	2	2	2	3	3	2	3	3	3	2	3	2	1	2	2
CO4	2	2	2	2	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	2	2	2	2	2	2	2	2	2	3	2	1	1
Average	2.4	2.4	2.2	2.2	2.6	2.4	2.6	2.2	2.4	2.2	2.2	2.4	1.6	1.6	1.4

List of Experiments Dynamics of Machineslab(MEP-611)

1. Different types of Gear train.
2. Determination of moment of inertia for flywheel.
3. Different types of Governors.
4. Determination of height of Governor for varied spindle speed.
5. Demonstration of various types of Clutches and Brakes.
6. Determination of position and orientation of masses for balancing in different planes.

7. Demonstration of Gyroscope and determination of gyroscopic couple.
8. Demonstration of whirling of shaft.

Subject Code : MET-612A
Title of the course : Advanced Manufacturing Systems

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: apply the knowledge for product development& Product lifecycle management.
CO2: select the design principle, mechanism for fit and tolerance for designing a product/components using CAQC.
CO3: use the knowledge towards Material requirement planning, ERP etc.
CO4: learn the fundamentals of Computer Integrated Manufacturing Systems,GT,CAPP
CO5: understand the concept of recent trends in manufacturing like rapid tooling, concurrent engineering, DFM, Reverse Engineering, Lean Manufacturing and its requirement

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	3	3	1	1	2	2	1	2	3	2	2	1
CO2	1	2	3	3	3	1	1	1	2	1	2	3	1	2	1
CO3	1	2	3	3	3	1	1	1	2	2	2	3	1	2	2
CO4	2	1	3	3	3	1	1	2	1	2	2	3	2	1	2
CO5	1	2	3	3	3	1	1	1	2	3	2	3	1	2	3
Average	1.4	1.8	3	3	3	1	1	1.4	1.8	1.8	2	3	1.4	1.8	1.8

Main Topics & Course Outline	*Lectures*
UNIT-I	
Product Life Cycle Management	
Product information, PLM framework, benefits, implementation, enabling technologies, example of business problems. Product Data Management (PDM): Motivation, Evolution, Scope, benefits, implementation, Software capabilities and functions.	**6**
Computer Aided Quality Control (CAQC)	

Role of computers in QC, Contact and Non-contact inspection methods, Computer aided testing, CMM, 3D scanners, Integration with CAD/CAM.	5
Material Requirement Planning	
Material requirement planning (MRP)- concepts, inputs, output, Benefits. Manufacturing Resource Planning (MRP-II). Entrepreneur Resource Planning (ERP).	5
UNIT-II	
Computer Integrated Manufacturing System	
Types of manufacturing systems, machine tools and related equipment, material handling systems, computer control systems, human labor in manufacturing systems, CIMS benefits. Robots: anatomy, configuration and control. Conveyor system, automated guided vehicle (AGV), automated storage and retrieval systems (AS/RS), flexible manufacturing systems (FMS).	6
Group Technology and CAPP	
Introduction, Part families, Coding and classification, production flow analysis, benefits of group technology, Computer aided process planning (CAPP)-variant and generative approach.	5
Recent Trends in Manufacturing	
Concurrent Engineering: concept, enabling technologies. Collaborative design. Deign for 'X', Design for Manufacturing. Reverse Engineering. Agile Manufacturing, Lean Manufacturing. Rapid Prototyping (RP).	5
Total lectures	32
Recommended Books	

Title	***Author(s)***	***Publisher***
Automation, production systems and CIM	Groover& Zimmer	PHI
CAD/CAM	McMohan& Browne	Pearson Education
Mastering CAD/CAM	Zeid, Ibraham	Tata McGraw Hill
Computer aided manufacturing	Chang, Wysk and Wang	PHI
Computer Aided Design and Manufacturing	Besant and Lui	EWP

Subject Code : MET-612B
Title of the course : Tool Design

L	T	P	Credits	Weekly Load
3	0	0	3	3

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

CO1: Understand the different types of metal cutting operations and cutting parameters used in turning, drilling and milling operations.
CO2: Identify different types of systems to represent the geometrical parameters of single point cutting tool.
CO3: Understanding of different cutting tool materials anddesired properties of cutting tool materials.
CO4: Study the design considerations and development of single point cutting tool, drill, milling cutters, broach and hob.
CO5: To select the manufacturing processfor a given application.

Pre-requisite knowledge:

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	2	2	3	2	3	2	3	2	2	1
CO2	2	3	3	3	2	3	3	2	3	2	3	2	1	2	2
CO3	3	2	3	3	2	3	3	3	2	3	2	3	1	2	1
CO4	3	3	2	3	3	2	3	2	3	2	3	2	2	1	2
CO5	3	2	2	2	3	2	2	3	2	3	2	3	1	2	1
Average	2.8	2.4	2.4	2.8	2.6	2.4	2.6	2.6	2.4	2.6	2.4	2.6	1.4	1.8	1.4

Course Description	**Lecture(s)**
Unit-I	
Classification of cutting tools principle elements of various cutting tools; single point cutting tool geometry in ASA, ORS & NRS systems **Tool Materials** Properties of various cutting tool materials, composition, production process and	**06**

application.	
Design of Single point cutting tools Cutting parameters, Classification of single point cutting tools: solid, carbide tipped tools, design of single point cutting tool, re-sharpening of single point cutting tools. Form Tools Purpose and types, design procedure and their sharpening.	**06**
Drill design Cutting parameters of drilling operations,. Types of drills, solid, carbide tipped drills, geometrical parameters of a twist drill, design of a twist drill, re-sharpening of the twist drill.	**06**
Milling Cutter Design Milling operations, cutting parameters, different milling tools for these operations. Types of milling cutters, solid, and carbide tipped cutter; geometrical parameters of a milling cutter, design procedure of a disc type milling cutter, re-sharpening of the cutters	**06**
Unit-II	
Broach design Broaching operation and cutting parameters, types of broaches, design procedure of a broach, re-sharpening of the broach. **Hob design** Gear nomenclature, construction of involutes profile, hobbing operation and its advantages, geometrical parameters of a hob, design of a hob	**06**
Jigs and Fixture	**10**
Definition, uses of jigs & Fixture, Principle of jigs& fixture design, location & clamping devices Drilling jigs , milling fixtures, lathe fixture, grinding fixture, assembly & welding fixture, broaching fixture. Economics of jigs & fixture, selection of particular types of jigs & fixture	
Press Tool and Die Design	**08**
Types of presses and selection, press accessories and attachments, Chutes, Magazines, Hoppers, Roll feeds, Dials, etc. Automatic stops, Hand feed and pin stops, Automatic Finger stops Development of blanks and scrap strip layouts, Die material, Selection between dies Die clearances and Allowances, Design for blanking dies, progressive, Bending dies, Forming dies, Drawing die	

Recommended Books:

1.	Tool Design	Donaldson	McGraw Hill
2	Cutting tools	Prakash Joshi	Wheeler Publishing
3	Metal Cutting theory & practice	Arschinov&Alearoev	MIR publication
4	Jigs & Fixtures	Grant	TMH

Subject Code : MET-612C
Title of the course : Quality Reliability & Maintainability

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Plot control charts for variables and attributes
CO2: Conduct inspection and control the process quality
CO3: Understand ISO standard & TQM approaches
CO4: Conduct reliability testing of products
CO5: Implement various types of maintenance strategies in the plant

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	1	2	1	1	1	1	1	1	2	1
CO2	3	3	3	3	3	1	2	2	1	3	2	1	3	2	1
CO3	3	3	3	3	3	1	2	1	1	1	1	1	1	1	1
CO4	3	3	3	3	3	1	2	1	1	1	1	1	1	2	1
Average	3	3	3	3	3	1	2	1.25	1	1.5	1.25	1	1.5	1.75	1

Theory

Course Description	**Lecture(s)**
Unit-I	
Quality Control Introduction, statistical control of processes, control charts for variables – X & R Charts, X & s Charts , properties of control charts, control charts for attributes – p chart, np chart, 100p chart, c chart, process capability analysis.	**08**
Quality assurance and acceptance control Objectives of acceptance control, hypothesis testing in acceptance control, average outgoing quality, lot-by-lot acceptance sampling by attributes, acceptance procedures based on AQL.	**08**
Total Quality Management Evolution of quality management, ISO standards, TQM approach, implementation of TQM, TQM critical success factors, Six Sigma implementation methodology.	**08**
Unit-II	

Reliability Introduction, failure data, mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series configuration, parallel configuration, mixed configuration, reliability improvement.	**12**
Maintainability Introduction, maintenance types- breakdown maintenance, shut down maintenance, corrective maintenance, preventive maintenance, predictive maintenance, productive maintenance, total productive maintenance, maintainability, availability, maintenance management, condition based management, Life Cycle costing.	**12**

Total = 48

Recommended Books

Title	*Author(s)*	*Publisher*
Industrial Maintenance Management	Sushil Kumar Srivastava	S Chand & Co.
Maintenance Engineering	Mishra	PHI
Reliability, Maintenance and Safety Engineering	A.K.Gupta	University Science Press
Reliability Engineering	L.S. Srinath	East-West Press

Subject Code : MET-613
Title of the course : Heat and Mass Transfer

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand fundamentals of different types of modes of Heat transfer.
CO2: Apply various mode of heat transfer to actual problems.
CO3: Understand various types of boiler.
CO4: Application of different type of Heat exchanger.
CO5: Understanding of Radiation and Mass-Transfer

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	3	2	2	2	2	2	2	2	2	2	1	1
CO2	2	3	3	3	2	2	2	2	2	2	3	2	2	3	1
CO3	2	2	2	3	2	2	2	2	3	2	2	2	1	3	2
CO4	2	3	2	2	2	2	2	2	2	2	2	2	2	1	2
CO5	3	3	3	2	2	2	3	2	3	2	2	3	1	1	1
Average	2.4	2.6	2.6	2.6	2	2	2.2	2	2.4	2	2.2	2.2	1.6	1.8	1.4

Theory

Course Description	**Lecture(s)**
Unit-I	
Introduction	
Different modes of heat transfer: conduction, convection, radiation.	**6**
Conduction	
Fourier's law of heat conduction, thermal Conductivity, effect of temperature and pressure on thermal conductivity of solid, liquid. Three dimensional general conduction equations in rectangular cylindrical and spherical coordinates. Electrical analogy for solving 1-D steady state conduction problem for slab, cylinder, sphere and influence of variable thermal Conductivity.	**6**

Application of conduction	
Straight and circular fins of rectangular cross-section, optimum design of rectangular fin, efficiency of fin, fin effectiveness for rectangular and circular cross section fins. Application of fins in temperature measurement of flow In tubes. Critical radius of insulation for pipes and electrical cables. Introduction to unsteady state heat transfer.	**6**
Convection	
Free and forced convection, derivation, mass, momentum and energy equations. Concept of boundary layer, boundary layer thickness. Heat transfer coefficient. Heat transfer in laminar and turbulent flow over plates, tubes using empirical relations. Dimensional analysis for forced and free convection	**6**
Unit-2	
Boiling and Condensation	**6**
Introduction, boiling phenomena, pool boiling regimes, condensation drop-wise and film-wise.	
Heat Exchangers	
Overall coefficient of heat transfer, different design criterion of heat exchangers (LMTD & NTU methods), calculation of number, diameter & length of tubes, mean temperature difference for parallel & counter flow heat exchangers.	**6**
Radiation	
Laws of radiation, definition of- emissivity, absorbitivty, reflectivity and transmissivity. Concept of black and grey bodies Planck's law monochromatic radiation, Kirchoff's law and the geometric factor. Lambert's cosine law, definition of intensity of radiation, radiation exchange between simple bodies, two parallel surfaces, concentric cylinders, furnace walls, using definition of radiosity and irradiation, radiation shields, simple	**6**
Mass Transfer	
Mass transfer process : classification, Concentrations, velocities and fluxes, Fick's law, General equation of mass diffusion, Steady state diffusion through a plain membrane,Equimolal diffusion.	**6**
	Total-48

Recommended Books

Title	***Author(s)***	***Publisher***
Heat and Mass Transfer	R. K. Rajput	S. Chand
Heat Transfer	J.P. Holman	TMH
Heat and Mass Transfer	R.C. Sachdeva	New Age International
Heat and Mass Transfer	R. Yadav	Central Publishing House
Heat Transfer	P.K.Nag	TMH
Heat Transfer	Domkundwar	DhanpatRai

Subject Code : MEP-613
Title of the course : Heat and Mass Transfer Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand fundamentals of different types of modes of Heat transfer.
CO2: Apply various mode of heat transfer to actual problems.
CO3: Understand various types of boiler.
CO4: Application of different type of Heat exchanger.
CO5: Understanding of Radiation and Mass-Transfer

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	3	2	2	2	2	2	2	2	2	2	1	1
CO2	2	3	3	3	2	2	2	2	2	2	3	2	2	3	1
CO3	2	2	2	3	2	2	2	2	3	2	2	2	1	3	2
CO4	2	3	2	2	2	2	2	2	2	2	2	2	2	1	2
CO5	3	3	3	2	2	2	3	2	3	2	2	3	1	1	1
Average	2.4	2.6	2.6	2.6	2	2	2.2	2	2.4	2	2.2	2.2	1.6	1.8	1.4

LIST OF EXPERIMENTS

1. To determine the Thermal Conductivity of a Metal Bar.
2. To determine the total Thermal resistance and thermal conductivity or a composite wall.
3. To find out the convective heat transfer coefficient in a vertical cylinder in nature convection mode and also compare the results while using suitable empirical relation for the given configuration.
4. To find out heat transfer coefficient in forced convection mode and also compare the results while using suitable empirical relation for the given configuration. _
5. To find the thermal conductivity of insulating powder using sphere configuration.
6. To study the parallel & counter type heat exchanger & find out overall heat transfer coefficient and effectiveness of the heat exchanger for both parallel and counter type flow of heat exchanger.
7. To study the critical heat flux at various temp. or distilled water and, compare the result of critical heat flux at saturated condition with zubcr's co-relation.
8. To verify the Stefan Boltzmann constant help or the given experimental setup.
9. To find out the emissivity of the test plate at various surface temperatures

Subject Code : MET-614
Title of the course : Advanced Strength of Materials

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Calculate the stresses and strains in various materials
CO2: Analyse the failure of curved beam.
CO3: Develop formulation/ design of various kind of cylinder.
CO4: Determine stresses in various kinds of rotating discs and cylinders.
CO5: Evaluate various failures in 3D stress systems in structural elements.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	3	2	2	3	2	3	2	3	2	2	1
CO2	2	3	3	3	2	3	3	2	3	2	3	2	1	2	2
CO3	3	2	3	3	2	3	3	3	2	3	2	3	1	2	1
CO4	3	3	2	3	3	2	3	2	3	2	3	2	2	1	2
CO5	3	2	2	2	3	2	2	3	2	3	2	3	1	2	1
Average	2.8	2.4	2.4	2.8	2.6	2.4	2.6	2.6	2.4	2.6	2.4	2.6	1.4	1.8	1.4

Theory

Course Description	Lecture(s)
Unit-I	
Strain Energy and Virtual Work Strain Energy due to various types of loading, deflection from strain energy (Castigliano's theorem), strain energy of dilation and distortion due to 3-D stress system; Virtual work methods.	**04**
Bending of Curved Bars. Introduction, Stresses in bar of small initial curvature and of large initial curvature, Deflection of beam using Castigliano's theorem, , Winker-Bach Theory, Stresses in crane hook, Ring, chain link, rings and other links of various cross section . Deflection of curved beams by Castigliano's Theorem	**06**

Cylinders and spheres. Thin cylinders and sphere, thick cylinder , Lame theory, compound cylinders, hub-shrunk on solid shaft, Comparison with thin cylinder Thick spherical shell	**06**
Centrifugal Stresses. Introduction, Stresses in rings, disc and cylinders due to rotation; Disc of uniform strength; Temperatures stresses in disc	**06**
Unsymmetrical Bending Introduction, Stress in a beam due to the unsymmetrical bending, Principal axes deflection of beam due to unsymmetrical bending, shear centre for channel and unequal I- section.	**06**
Unit-II	
Theories of Elastic Failure: Maximum principal stress theory, Maximum principal strain theory, Maximum strain energy theory, Maximum shear stress theory, Maximum distortion energy theory, Graphical representation and comparison of different theories of failure	**03**
Springs Close and open coiled helical springs, leaf spring, flat spiral spring	**03**
3-D Stress System. Differential equilibrium equations in Cartesian and cylindrical coordinate system for 3-D stress system, Mohr's circle, stress invariant, stress component on an arbitrary plane, principal stresses	**05**
Elastic Analysis of System. Two basic methods of elastic analysis, force method, flexibility coefficient reciprocity, displacement method, stiffness coefficient reciprocity.	**05**
Plastic Limit Analysis. Plastic limit analysis of beams, portal frames – collapse loads	**04**

Total=48

Recommended Books:

Title	**Author(s)**	**Publisher**
Engineering Mechanics of Solids	Popov	Pearson Education
Mechanics of Materials	Gere	Thomson Books
Advanced Strength of Materials	Ryder G.H	ELBS
An Introduction to the Mechanics of Solids	Crandall & Dahl	McGraw Hill
Advanced Mechanics of Solid	L.S. Srinath	Tata Mcgraw Hill
Mechanics of Materials by	E.J. Hearn	B & H

Subject Code : MEO-621
Title of the course : CONCURRENT ENGINEERING

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Should have basic knowledge of concurrent engineering for enhancement of product quality.

CO2: Should be able to apply the knowledge for design manufacturing assembly, quality function deployment, rapid prototyping and total design integration.

CO3: To apply concurrent technique for design inspection and testing for product design and development process.

CO4: To apply latest techniques resources engineering and IT tools for modeling and simulation of engineering systems

CO5: To demonstrate knowledge and understanding of concurrent engineering and management principle for integrating concurrent design and product development and consistent network

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2	2	1	1	1	2	1	2	1	1	1
CO2	3	3	1	2	3	2	2	1	2	1	2	2	1	1	2
CO3	3	3	3	3	3	3	2	3	3	3	1	2	1	2	1
CO4	3	3	2	3	3	2	3	2	3	1	2	1	2	2	2
CO5	3	3	3	3	3	3	3	3	3	1	3	3	1	1	1
Average	3	3	2	2.4	2.8	2.4	2.2	2	2.4	1.6	1.8	2	1.2	1.4	1.4

Theory:

Course description	***Lectures***
UNIT-I	
Introduction Concurrent Engineering Definition, Product life cycle, quality products, evaporative markets, globalization and concurrent engineering	12
Concurrent Engineering Techniques Review of concurrent engineering techniques like DFM (design for manufacture). DFA (design for assembly), QFD (quality function deployment), RP (rapid prototyping), TD	12

(total design) for integrating these technologies.	
UNIT-II	
Product Design & Development Process Product information systems and their Mechanical Engineering architecture. Information environment for Suppliers, management, testing & inspection design engineering, purchasing, process control, manufacturing, support plans, operators, quality control, servicing and maintenance.	12

Product and Process Integration Product information modeling. Integration of information models and end users applications. Computer aided simultaneous engineering systems. Integrated concurrent design and product development. Constraint networks.	12

Recommended Books		
Title	***Author(s)***	***Publisher***
Integrated Product and Process Development	John M. Usher, Utpal Roy and H. R. Parasaei	Tata McGraw Hill
Product Design and Manufacture	A. K. Chitale and R. C. Gupta	PHI
Engineering Design and Design for Manufacturing: A structured approach	John R. Dixon and CorrodoPoli	Field Stone Publishers, USA
Material Selection in Mechanical Design	M. F. Ashby	Elsevier
Concurrent Engineering	Biren Prasad	Prentice Hall
Product Design & Development	Karl T. Ulrich, Steven D. Eppinger	TMHl

Subject Code : MEO-622
Title of the course : SYSTEM DYNAMICS AND CONTROL

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Identify the Physical systems using Bond Graphs
CO2: Apply METLAB for simulation and dynamics.
CO3: Design and analysis of control system for linear and non-linear systems
CO4: Perform Stability analysis
CO5: Analyze dynamical system using bond graph.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	1	1	1	2	3	3	2	2	1
CO2	3	3	3	2	2	2	2	1	2	3	3	3	1	1	2
CO3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	1
CO4	3	2	3	2	2	2	3	2	3	3	3	3	2	2	2
CO5	3	3	3	2	2	3	3	3	3	3	3	3	1	2	1
Avera ge	3	2.8	3	2.2	2.2	2.4	2.2	2	2.4	2.8	3	3	1.6	1.8	1.4

Main Topics & Course Outline	**Lectures**
UNIT-I	
Introduction Introduction to Physical System Dynamics	12
Modeling of Physical System Dynamics: A Unified Approach Physical systems, Introduction to Bond graphs, Ports, Bonds and Power; Elements of Bond graphs:1-port elements : resistor R, Stiffness C, and Inertia I, Source of Effort Se and Flow SF; 2-port elements : Transformer TF and Gyrator GY, with modulation, Junction elements 1 and 0; Causality, Causality for basic 1-port and multi-ports. Derivation of System equations from Bond graphs in first order state space form.	
Bond Graph Modeling of Multi-energy Systems Mechanical Systems, Translation and rotation (about a fixed axis), Electrical Systems, Electromechanical Systems, Fluid systems, Transducer models–cylinder, rack and pinion, electromechanical transducers, pumps – positive displacement and centrifugal pump, gear	12

trains, etc.	
Analysis of Linear Systems Free & forced response for first and second order systems, Undamped& damped oscillator. Derivation of Signal flow graphs from Bond graphs. Derivation of Transfer functions.	
UNIT-II	
System Analysis Bode plots. State Variable Analysis. State transition matrix, Characteristic equation, Eigen values and Eigen vectors, Their impact on system response. Similarity transformations and their properties. Controllability and Observability, Canonical forms, Controllable, Observable, Diagonal.	12
Stability Criteria Routh-Hurwitz criterion	12
Controllers Proportional Integral and Derivative feedback	
Simulation Computer simulation of Dynamic Systems using Bond graphs	

Subject Code : MEO-623
Title of the course : Power Plant Engineering

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the present scenario of energy production in India and understand the different working aspects of hydro power plant

CO2: Explain the construction detail and the working of thermodynamic cycle of the thermal as well as gas power plant

CO3: To understand the power production techniques of nuclear power plant and to apply the knowledge for power plant economics for different load situations

CO4: Explore the knowledge in the field of non-conventional power generation methods and the direct energy conversion methods

CO5: Understand the pollution effects of power generation and ways to control them for the betterment of society

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	2	1	1	1	2	1	2	1	1	2
CO2	3	3	1	2	3	2	2	1	2	1	2	2	1	1	2
CO3	3	3	3	3	3	3	2	3	3	3	1	2	1	1	1
CO4	3	3	2	3	3	2	3	2	3	1	2	1	2	2	1
CO5	3	3	3	3	3	3	3	3	3	1	3	3	1	2	1
Avera ge	3	2.8	2	2.4	2.8	2.4	2.2	2	2.4	1.6	1.8	2	1.2	1.4	1.4

Theory

Course Description	Lecture(s)
Unit-I	
Introduction Energy resources and their availability, Present power position and future planning in India & World, Types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.	**03**

HYDRO ELECTRIC POWER PLANTS Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, Advantages and comparison with other types of power plants.	**05**
STEAM POWER PLANTS Flow sheet and working of modern-thermal power plants, Classification of turbine, their working and governing, analysis of Re-heat cycle, Regenerative cycle, reheat –regenerative cycle and binary cycle Turbine problems, Condenser, Cooling ponds, cooling towers, Feed water treatment, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection mechanical dust collector and electrostatic precipitator.	**08**
GAS AND STEAM TURBINE COMBINED CYCLES Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems with organic fluids, parameters affecting thermodynamic efficiency and performance of combined cycles.	**08**
UNIT II	
NUCLEAR POWER PLANTS Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Gas-cooled reactors, liquid –metal cooled reactors, organic moderated cooled reactors, fast breeder reactor, Location of Nuclear power plants, Advantages and limitations, nuclear power station, Shielding Materials, Effect of nuclear radiation, waste disposal.	**07**
POWER PLANT ECONOMICS Load curve, different terminology and definitions, cost of electrical energy, tariff methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing.	**06**
NON-CONVENTIONAL POWER GENERATION Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.	**07**
DIRECT ENERGY CONVERSION SYSTEMS Fuel cell, MHD power generation-principle, open & closed cycle systems, thermoelectric power generation, and thermionic power generation	**02**
Pollution and its control Introduction, Air and water pollution by thermal power plants, Radioactive pollution of environment by nuclear power plants, Noise pollution, Methods for reducing the pollution.	**02**

Recommended Books:

1.Power Plant Engineering — P.K. Nag
2. Power Plant Engineering — P.C. Sharma
3. Power Plant Engineering — M. Wakil
4. Power Plant Engineering — ARORA.S.DOMKUNDWAR

Subject Code : PHT-621
Title of the course : Physics of Materials-Theory

L	T	P	Credits	Weekly Load
3	1	0	4	4

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

CO1: Recognise common crystal structure and describe their symmetries.

CO2: Understand motion of electron in crystalline solids under periodic potential and able to differentiate materials on basis of band theory.

CO3: Describe nanomaterials based on their dimensionality.

CO4: To analysis the dielectric and magnetic properties of materials.

CO5: Understand the phenomenon of superconductivity and their properties in order to their applications.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	2	1	1	3	1	3	3	1	3
CO2	3	2	3	2	2	1	2	1	1	1	2	2	2	1	3
CO3	2	3	3	3	2	1	1	1	1	2	3	2	2	2	2
CO4	3	3	1	3	2	3	2	1	1	1	3	3	2	1	2
CO5	3	2	2	3	3	3	2	1	1	2	3	3	2	1	1
Average	2.8	2.6	2.2	2.8	2.2	1.8	1.8	1	1	1.8	2.4	2.6	2.2	1.2	2.2

UNIT-I

Elements of crystallography

A brief Introduction to material science Material structure, Space lattices, unit cell, primitive cell, Bravais lattice, Atomic packing factor, Miller indices, directions and planes in crystal lattice (cubic & hexagonal only), Distribution of atoms in lattice planes (in cubic crystal only), Important structures (NaCl, CsCl, diamond and ZnS), Structure determination: x-ray

diffraction,neuron and electron diffraction.

(08 Hrs)

Imperfections in crystals

Point imperfections, Frenkel and Schottky defects and their equilibrium concentration determination, Colourcentres, types of colourcentres, generation of colourcentres, Edge and screw dislocation, Berger vector, Surface and volume defects.

(5 Hrs)

Band theory of solids

Free electron theory, Concepts of energy bands, Bloch theorem, electron in a periodic field of crystal (the Kronig-Penny Model) and its applications in metal, Distinction between metal, semiconductor and insulator, Effective mass of an electron, Hall effect.

(6 Hrs)

Nano-materials

Fundamentals of nanomaterials and nanotechnology, Nano particles and Properties of nanomaterials, Synthesis, characterization & Applications of nanomaterials.

(5 Hrs)

UNIT-II

Dielectric materials

Introduction of dielectric materials, polarisation, Different types of polarization, electronic, ionic, orientational and space charge polarization, polarizability, Clausius-Mossotti relation, temperature and frequency dependence of polarizability, dielectric breakdown, measurement of dielectric properties, dielectric constant, dielectric loss, ferroelectric and piezoelectric materials examples of materials and their applications.

(8 Hrs.)

Magnetic Materials

Terminology and classification of magnetic materials, Types of magnetism (dia, para, ferro, ferri and antiferromagnetism), Theories of para, dia and ferromagnetic materials, Magnetic anisotropy and magnetostriction, magnetic domains, hard and soft magnetic materials, Ferrites and their applications.

(5 Hrs)

Superconductivity

Introduction, type I & type II superconductors, Meissner's effect and isotope effect, effects of magnetic field, London's equations and penetration depth, specific heat, BCS theory (electron-

lattice-electron interaction, cooper pair, coherence length and energy gap), High temperature superconductors, Applications of superconductivity.

(8 Hrs)

45 Hrs.

Recommended Books

Author	Title
Charles Kittel	Introduction to solid state Physics
MS Vijaya, G Rangarajan	Materials scienece
Raghvan	Materials science
Srinivasan and Srivastava	Materials science and Eng.
Callister JR	Materials science and Engg.: an introduction
Askeland and Phule	The science and engineering of material

Subject Code : PHP-621
Title of the course : Physics of Materials - Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Differentiate between macro and microstructure in the materials.
CO2: Specify the microstructure of an alloy from phase diagrams
CO3: Understand type of charge carrier, mobility and carrier concentration and band gap of semiconductor.
CO4: Understand thermal and mechanical properties of material.
CO5: To analyze the electric, dielectric and magnetic properties and related phenomenon of materials

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	1	2	1	1	3	1	3	3	1	3
CO2	3	3	3	2	2	1	2	1	1	1	2	2	2	1	3
CO3	3	3	3	3	2	1	3	1	3	2	3	2	2	2	2
CO4	3	3	3	3	2	3	3	1	3	1	3	2	2	1	2
CO5	3	2	3	3	3	3	3	1	3	2	3	3	2	1	1
Average	3	2.8	3	2.8	2.2	1.8	2.6	1	2.2	1.8	2.4	2.4	2.2	1.2	2.2

List of Experiments

1. To prepare a metallic sample and measure the grain size using the metallurgical microscope.
2. To study the creep nature in metallic wires at room temperature.
3. To find the mobility and carrier concentration in a semiconductor sample using Hall Effect experiment.
4. To study the B-H curves of different materials.
5. To determine the Stefan's constant.
6. To determine the resistivity and energy band gap by four probe method
7. To find the Curie temperature of the given ferrite material.
8. To find the Curie temperature of the given ferroelectric material.
9. To calculate the dielectric constant of the given dielectric material.

10. To find the capacitance and permittivity of the given material.
11. To study the cooling curve and phase diagram of Pb-Sn alloy.
12. Dispersion relation of monoatomic and diatomic lattice

Subject Code : MET-621
Title of the course : CAD/CAM

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Enhance the knowledge of application of computers in designing.
CO2: Know about the hardware.
CO3: Designing and analysis ability in field of modeling the parts.
CO4: Understand the knowledge related to the use of computers in manufacturing.
CO5: Use CAD software to produce 2d and 3D designs.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	2	1	1	1	2	3	3	2	2	2	1
CO2	3	2	2	2	2	2	1	2	3	3	3	1	3	2	2
CO3	2	1	3	3	3	2	3	3	3	3	3	2	2	3	3
CO4	2	2	3	2	2	3	2	3	3	3	3	2	2	2	3
CO5	3	2	3	2	3	3	3	3	3	3	3	1	2	3	3
Average	2.6	1.8	2.4	2.2	2.4	2.2	2	2.4	2.8	3	3	1.6	2.2	2.4	2.4

Course Description	
UNIT-I	***Lectures***
Fundamentals of CAD/CAM	
Introduction to CAD and CAM. Definition of CAD and CAM tools. Applications of CAD/CAM. Design process and application of computers in design. Creating Manufacturing database. Benefits of CAD/CAM.	4
CAD Hardware	
Input devices: Keyboard, Touch panel, Light pens, Graphic tablets, Joysticks, Trackball, Mouse, Voice systems. Output devices: Storage, Tube graphics display, Raster refresh graphics display, Plasma panel displays, Liquid crystal displays. Central Processing Unit (CPU).	4
CAD Software and Database Management	
Graphic Standards: GKS, IGES, PHIGS. Data Structure and Database Management of a Graphics System. Coordinate Systems: WCS, MCS, SCS. Software modules: Operating	4

System, Graphics, Application, Programming and Communication.	
Curves, Surfaces and Solids	
Analytical curves: parametric and non-parametric equations; Bezier Curves; Introduction to free form curves: B-spline and NURBS; Surfaces: plane, cylindrical, spherical, ruled, coons patch, swept, revolved, Bezier, B-spline. Ferguson and Bilinear patch. Introduction to solid models; Solid representation, B-rep. CSG, Sweep representation; CAD/CAM data exchange.	7
Geometric Transformations	
Formulation, translation, rotation, scaling, reflection, mapping of geometric models, projections. Basic concepts of hidden surface removal and shading.	5
UNIT-II	
Fundamentals of Numerical Control	
Principles of NC, Types of NC machines, Classification of NC: Motion control, control loops, positioning systems, NC, CNC, DNC, Combined CNC/DNC systems.	5
NC Machines	
Constructional details of NC machines;Components of NC machines: MCU, drives, transducers, lead screw, control loops and interpolation, guide-ways. Tooling for NC machines: automatic tool changes, multiple pallets.	5
Numerical Control Programming	
Manual part programming; Block format and codes; Tool length and radius compensation; NC programming for cylindrical and prismatic components; Multiple axis NC machines; Tool path simulation of lathe and milling; Computer assisted part programming; post processor and auxiliary statements.	10
Adaptive Control Systems	
Types, advantages, adaptive control for proper cutting speed, feed in turning operation.	4
Total lectures	48
Recommended Books	

Title	***Author(s)***	***Publisher***
CAD/CAM – Theory and Practice	Zeid, Ibraham	Tata McGraw Hill
Geometric Modeling	Mortenson	John Wiley& Sons
Automation, Production Systems and CIM	Groover& Zimmer	PHI
Computer aided manufacturing	Chang, Wysk and Wang	PHI
Numerical Control and Computer Aided Manufacture	Kundra, Rao, Tiwari	Tata McGraw Hill

Subject Code : MEP-621
Title of the course : CAD/CAM Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Enhance the knowledge of application of computers in designing.
CO2: Know about the hardware.
CO3: Designing and analysis ability in field of modeling the parts.
CO4: Understand the knowledge related to the use of computers in manufacturing.
CO5: Use CAD software to produce 2d and 3D designs.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	2	1	1	1	2	3	3	2	2	2	1
CO2	3	2	2	2	2	2	1	2	3	3	3	1	3	2	2
CO3	2	1	3	3	3	2	3	3	3	3	3	2	2	3	3
CO4	2	2	3	2	2	3	2	3	3	3	3	2	2	2	3
CO5	3	2	3	2	3	3	3	3	3	3	3	1	2	3	3
Average	2.6	1.8	2.4	2.2	2.4	2.2	2	2.4	2.8	3	3	1.6	2.2	2.4	2.4

List of Experiments

S. No.	Title
1.	Introduction to AutoCAD and drawing and drafting of a 2D component
2.	Draw orthographic projections of given 2D components using AutoCAD
3.	Draw orthographic projection from given isometric views of given 3D components using AutoCAD
4.	Draw given isometric projections using AutoCAD
5.	Introduction to CNC Star Lathe and Part Programming for a given component using Fanuc controller
6.	Part Programming for a given component for CNC lathe using Fanuc controller, simulation and machining the component.
7.	Introductions to CNC Star Mill and Part programming for a given prismatic component using Fanuc controller
8.	Part programming for a given prismatic component using Fanuc controller, Simulation and

	machining the component.
9.	Make a program for transformations like scaling, rotation, translation etc. of Line/Rectangle/Triangle in C or MATLAB
10.	Make a program for drawing analytical or parametric curves like line, circle, parabola, hyperbola and Bezier.
11.	To make 3D model of the given component and generate its drawing using ProE/CATIA
12.	To make 3D model of given components and make assembly using ProE/CATIA

Subject Code : MET-622
Title of the course : Refrigeration and Air Conditioning

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Understand the operation of vapour comperation and vapur absorption system.
CO2: Analyze the refrigeration cycles and methods of improving performance.
CO3: Familiarize the components of refrigeration systems.
CO4: Design air-conditioning system using cooling load calculations.
CO5: Identify the applications of refrigeration and air-conditioning systems.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	1	1	1	2	2	1	3	2	2	2
CO2	3	3	3	1	2	2	1	1	1	2	1	3	1	2	1
CO3	3	3	3	1	2	1	1	1	1	2	2	2	1	2	1
CO4	3	3	3	2	1	1	2	1	2	1	2	2	2	1	2
CO5	3	3	3	1	2	1	1	2	1	2	3	2	1	2	1
Average	3	3	3	1.4	1.8	1.2	1.2	1.2	1.4	1.8	1.8	2.4	1.4	1.8	1.4

Course Description	**Lecture(s)**
Unit-I	
Air Refrigeration Systems	
Introduction, types of air refrigeration systems, reversed control cycle, Bell Coleman air refrigerator, Necessity of air-craft refrigeration, regenerative and reduced ambient type cycles, compression and bootstrap cycle.	**12**
Refrigeration Systems	
Vapor compression refrigeration system,T-S,H-S,P-H diagram for VCR, COP. Performance of VCR, advantages and disadvantages, Methods for improving COP, Multiload system, Single and multi compressions. Introduction, actual aqua ammonia absorption system, electrolux refrigerator, COP Compression between VCR and absorption refrigeration system.	**12**
Unit-2	

Refrigerants and Refrigeration Equipments	
Classifications of refrigerants, properties of ideal refrigerants, anti-freeze solutions, selection of refrigerants, nomenclature of refrigerants. Ozone layer depletion, eco-friendly refrigerants. Construction details of different types of compressors, condensers, evaporator, expansion devices, dehydrators	**12**
Air Conditioning Systems	
Types of air-conditioning systems, central AC, unitary AC load circulation load calculation based on various parameters, like solar radiations, transmission through building, fresh air ventilation occupancy load, internal heat gain such as lights, appliances, machine etc, state and quantity of supply air for different type of air-conditioning system.	**12**
	Total-48

Recommended Books

Title	***Author(s)***	***Publisher***
Refrigeration and Air conditioning	C. P. Arora	TMH
Refrigeration and Air conditioning	Domkondwar	Khanna
Refrigeration and Air conditioning	Balleney	Khanna
Ref and Air Conditioning	Gupta & Prakash	New Chand

Subject Code : MEP-622
Title of the course : Refrigeration and Air Conditioning lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the operation of vapour comperation and vapur absorption system.
CO2: Analyze the refrigeration cycles and methods of improving performance.
CO3: Familiarize the components of refrigeration systems.
CO4: Design air-conditioning system using cooling load calculations.
CO5: Identify the applications of refrigeration and air-conditioning systems.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	2	2	1	3	2	2	2
CO2	3	3	3	1	2	2	1	1	1	2	1	3	1	2	1
CO3	3	3	3	1	2	1	1	1	1	2	2	2	1	2	1
CO4	3	3	3	2	1	1	2	1	2	1	2	2	2	1	2
CO5	3	3	3	1	2	1	1	2	1	2	3	2	1	2	1
Average	3	3	3	1.4	1.8	1.2	1.2	1.2	1.4	1.8	1.8	2.4	1.4	1.8	1.4

LIST OF EXPERIMENT

1. Study of a window type air-conditioner
2. To demonstrate the working of domestic refrigerator
3. To study and sketch of various types of condensers
4. Study of trouble shooting in refrigeration and air conditioning
5. To demonstrate the working of water cooler
6. To demonstrate the working of cooling tower
7. To demonstrate the working of domestic refrigerator.
8. Study of window-type air-conditioner.
9. Study of split type air-conditioner.
10. Locating leaks in refrigeration system.

Subject Code : MET-623
Title of the course : Work Study and Ergonomics

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Critical examination of existing engineering methods.

CO2: Develop and improved method of any engineering operation/process/ system .

CO3: Identify the standard time for an operation/ activity.

CO4: Describe ergonomically designed engineering system.

CO5: Able to design & development of products/systems with applications of Ergonomics

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	2	1	1	1	2	2	1	3	2	1	3
CO2	1	1	1	1	2	2	1	1	1	2	1	3	1	1	3
CO3	2	1	2	1	2	1	1	1	1	2	2	2	1	2	2
CO4	1	1	1	1	2	1	2	1	2	1	2	2	2	2	2
CO5	1	1	1	1	2	1	1	2	1	2	3	2	1	3	2
Average	1.2	1	1.2	1	2	1.2	1.2	1.2	1.4	1.8	1.8	2.4	1.4	1.8	2.4

Course Description	**Lecture(s)**
Unit-I	
Productivity	
Introduction, Types of productivity, Measurement of productivity, Productivity Index, Importance of productivity, Means of productivity improvement, Effect of productivity on society	**04**
Method Study	
Introduction to Work Study: Time study and method study, Objectives of work study, Method Study Procedure, factors for selection of Job for method study, Recording techniques: Charts, and Diagrams, Critical Examination, Principle of motion economy, Concept of Normal and maximum working area, Therbligs, Simo Chart, Micro motion study, Memo Motion Study, Cyclegraph and Chronocyclegraphs.	**16**
Unit-II	
Time Study	
Introduction to various work measurement techniques, Stop watch Time study: definition,	**16**

equipments, Types of stop watches, stop watch time study procedure: Computation of number of cycles, types of work elements, guidelines for breaking the job into various work elements, Confidence levels and permissible error. Work sampling: definition, procedure, design of work sampling plans. PMTS: various methods, MTM-1, MTM-2, work factor Rating: Definition, Types of rating Techniques, Standard Performance, Normal Time, Observed Time and Standard Time, Uses of Standard Time, Allowances.	
Ergonomics	
Definition, Components of Ergonomics: Anthropology, Physiology, Psychology and Machines, Design principles, Anthropometry: Definition, Structural Body Dimensions and Functional Body Dimensions, Seat Design, Design recommendations for seat design, Displays and controls: Types, design recommendations, design of control panels Environment: Light, ventilation, Vibration, Sound, House keeping	**12**

Total=48

Recommended Books:

1. NPC , A Manual of Method Study
2. ILO, Work Study
3. Dalela and Sharma, Work Study and Ergonomics, Standard
4. Barnes, Motion and Time Study, John Wiley

Subject Code : MEP-623
Title of the course : Work Study and Ergonomics Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Critical examination of existing engineering methods.

CO2: Develop and improved method of any engineering operation/process/ system .

CO3: Identify the standard time for an operation/ activity.

CO4: Describe ergonomically designed engineering system.

CO5: Able to design & development of products/systems with applications of Ergonomics

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	2	1	1	1	2	2	1	3	2	1	3
CO2	1	1	1	1	2	2	1	1	1	2	1	3	1	1	3
CO3	2	1	2	1	2	1	1	1	1	2	2	2	1	2	2
CO4	1	1	1	1	2	1	2	1	2	1	2	2	2	2	2
CO5	1	1	1	1	2	1	1	2	1	2	3	2	1	3	2
Average	1.2	1	1.2	1	2	1.2	1.2	1.2	1.4	1.8	1.8	2.4	1.4	1.8	2.4

List of Experiments

1. Study and Construct Operation Process Chart of Given Activity
2. Study and Construct Flow Process Chart (Man Type) of Given Activity.
3. Study and Construct Two Handed Operation Chart of Given Activity.
4. Study design features of an Ergonomic Chair
5. Construct Charts for Minimum and Maximum working areas and Therbligs
6. To obtain performance rating for given activity (Playing cards).
7. To obtain performance rating for given activity (walking).
8. To compute standard time on Dexterity Ring Apparatus
9. To Design and perform work sampling plan to compute percentage utilization of any facility
10 To Construct string diagram for the given layout problem.

Subject Code : MET-624

Title of the course : Mechanical Design - I

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: apply the theories of failure in design of machine elements.

CO2: Application of theories of failure to thedesign a of various joints viz. riveted, welded, and screwed.

CO3: Analyse the temporary and permanent joints and design joints based on applications.

CO4: Apply the theories of static and dynamic failure theories to the design of Power screws, cotter joints, knuckle joints and shafts etc.

CO5: Select appropriate rolling contact bearing, gasket and seal from the standard catalogue based on loads.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	2	2	1	1	1	2	1	2	1	1	1
CO2	3	3	1	2	3	2	2	1	2	1	2	2	1	1	2
CO3	3	3	3	3	3	3	2	3	3	3	1	2	1	2	1
CO4	2	1	2	3	3	2	3	2	3	1	2	1	2	2	2
CO5	1	2	3	3	3	3	3	3	3	1	3	3	1	1	1
Average	2.4	2.4	2	2.4	2.8	2.4	2.2	2	2.4	1.6	1.8	2	1.2	1.4	1.4

Theory

Course Description	**Lecture(s)**
Unit-I	
Introduction	
Introduction to design procedure, design requirements, review of force analysis concepts, factor of safety concepts, concept and mitigation of stress concentration, motor selection and mechanical Properties. General design considerations like fatigue, creep, fabrication methods, economic considerations, material selection and ergonomics.	**04**
Riveted and Welded Joints	
Type of riveted joints. Possible failure of riveted joints. Strength and efficiency of Butt (Single plate & double cover plate) and Lap riveted joints. Design of Boiler joints and	**07**

pressure vessels, Joint of Uniform strength. Common types of welded joints. Design for V-butt welded joints. Transverse fillet and parallel fillet welded joint. Axially and eccentrically loaded welded joint.	
Screwed Joints	
Introduction to term screw and various definitions of screw threads. Advantages and Disadvantages of screwed joints. Form of screw threads. Bolts of Uniform strength. Bolted joint for eccentric loading. Common types of screw fastening; through bolt, tap bolt, stud, cap screw, machine screw and set screw. Designation of screw threads. Stresses in screw fastening. Design of bolts for cylindrical cover	**07**
Power Screws	
Power to screw drive, efficiency of screw like square, trapezoidal threads, stresses in screw and design procedure of screw Jack. Condition for self locking.	**06**
Unit-II	
Cotter Joint and Knuckle Joint	
Design of cotter. Design of Socket. Design of Spigot. Design of knuckle joint; Design of rod. Design of Pin.	**07**
Shafts	
Design for static and dynamic loading; stresses in shaft, design of shaft subjected to bending moment or torsion moment and combined bending and torsion moments, shafts subjected to axial load in addition to combined bending and torsion moments failure theories; shafts subjected to fluctuating load conditions, cyclic loading, endurance limit, Soderberg Diagrams, fatigue strength and the S-N diagram, Design of shaft on the basis of rigidity.	**10**
Bearings	
Classification of bearing; Design, Specification and selection of Journal bearing, rolling contact bearing for given application.	**07**

Total=48

Recommended Books:

1. Shigley, J.E., and Mischke, C.R., "Mechanical Engineering Design (in S.I. Units)", 6th Ed., Tata McGraw-Hill, 2006.
2. Juvinall, R.C., and Marshek, K.M., "Fundamentals of Machine Component Design", 4th Ed., John Wiley & Sons, 2006.
3. Sharma & Aggarwal, "A Text book of Machine Design" , Katson.
4. Machine Design-An Integrated Approach, Norton, Pearson Education.
5. Mahadevan, K., and B., Reddy, "Design Data Hand Book", CBS Publishers, 2003.
6. P. S. G, "Design data handbook", P. S. G., Coimbatore.

Subject Code : MET-625

Title of the course : Metal Cutting and Forming

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: understanding of basic concepts, chip formation mechanism, cutting forces and their impact on machining, optimization of machining operations.

CO2: awareness on different cutting tool materials, tool wear and wear mechanism of cutting tools, machinability and tool life principles.

CO3: Study the design considerations and development of lathe, drilling and milling dynamometers.

CO4: Understand the theory of plasticity and its application in metal forming operations to give insight to the students on theoretical and practical applications of metal forming operations.

CO5: to evaluate and analyze the stresses produced during rolling, wire drawing and strip drawing processes.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1	1	2	2	2	2	2	2	1
CO2	3	2	3	3	3	2	1	1	2	2	2	3	2	2	3
CO3	3	2	2	2	3	2	2	1	2	3	2	2	2	1	3
CO4	3	2	3	2	2	2	2	1	2	2	2	2	2	2	1
CO5	3	3	3	3	2	2	1	1	2	3	2	2	3	1	1
Average	3	2.4	2.6	2.6	2.6	2	1.4	1	2	2.4	2	2.2	2.2	1.6	1.8

Theory

Course Description	**Lecture(s)**
Unit-I	
Metal Machining	**04**
Kinematics, Elements involved in metal cutting action, classifications of cutting tools, Single point tools, multi point tools, principle angles on a single point cutting tool, tool signature, ASA system, ORS system, NRS system, Interrelation ship between ASA, ORS & NRS Systems. Concept of oblique cutting and orthogonal cutting	
Chip Formation Mechanism	**08**
Mechanics of chip formation, types of chips, adverse effect of BUE formation, Chip reduction coefficient, cutting ratio, shear plane, shear strain, chip velocity & velocity of shear, Factors involved in chip formation analysis, effect of cutting variables on chip reduction coefficient, Chip formation in Milling & drilling	
Force System in Machining	**08**
Force system during turning, Merchant circle diagram for cutting force, Frictional force system at chip tool interface, Force system at interface, Effect of obliquity, nose radius & wear land on force system, Forces in drilling & milling. Fundamentals of dynamometry, lathe dynamometer,	

drilling & milling dynamometer.	
Thermal Aspect in Machining	**03**
Heat generation in metal cutting, tool wear & temperature, coolants & their applications.	
Tool Wear	**03**
Types of tool wear, Machine ability, Tool life analysis & tool life equation.	
Unit-II	
Metal Forming: Plastic Deformation & Yield Criterion	**06**
Plasticity, True stress, True strain, Elastic & plastic strain, Yield stress, Plastic incompressibility, Poisson's ratio for plastic deformation, Von Misses yield criterion, Tresca yield criterion, generalized strain hardening curve	
Rolling	**04**
Analysis of the processes, Roll separating force, Torque on the rolls, Effect of front & back Tension, Effect of support rolls	
Wire & Strip Drawing	**06**
Analysis of the processes	
Plain Strain Forging	**06**
Analysis of the processes, Deep drawing of circular blanks-analysis of process, Extrusion-analysis of process.	

Total = 48

Recommended Books

	Title	*Author(s)*	*Publisher*
1.	Manufacturing Science	Malik & Ghosh	EWP
2.	Production Engineering Science	Pandey & Singh	Standard Publishers
3.	Metal cutting Theory	A.Bhattacharya	Central Book Publishers

Subject Code : MEO-711
Title of the course : Properties and selection of engineering materials

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: The students will be able to display a critical awareness of the relevance of key areas, e.gmetals, alloys, properties of metals and defects in metals.

CO2: The students will be able to interpret mechanical properties, diffusion mechanism, dislocations and solidification of metals.

CO3: The students will also be able to interpret the applications of different materials used in modern industry and engineering.

CO4: The students will be able to understand composite material, polymers and smart materials and its applications.

Pre-requisite knowledge:

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):													Program Specific Outcomes (PSO)		
COs	Programme Outcomes (POs)												PSO 1	PSO 2	PSO 3
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	2	2	1
CO1	3	1	1	1	1	2	1	2	2	2	2	1	3	2	2
CO2	3	1	1	1	1	2	1	2	2	2	3	1	2	3	3
CO3	3	2	1	2	1	2	1	2	3	2	2	2	2	2	3
CO4	3	2	1	2	1	2	1	2	2	2	2	2	2	3	3
Avera ge	3	1.5	1	1.5	1	2	1	2	2.2 5	2	2.25	1.5	2.2	2.4	2.4

Unit	Course description	Lectures
	Unit 1	
1.	**Introduction:** Introduction to engineering materials, Industrial importance of common engineering materials-metals, non-metals and alloys, their properties (physical and mechanical) and applications.	4
2.	Metallic materials-Engineering Ferrous materials, Aluminium, Copper, Nickel, Magnesium, Titanium alloys. Phase diagrams, properties and typical alloys with reference to their applications.	8

3.	Mechanical properties of metals- Elastic deformation and plastic deformation, Interpretation of tensile stress-strain curves, Diffusion mechanisms and steady state and non-steady state diffusion, Dislocations and strengthening mechanisms, Nucleation of metals, Recrystallization and growth.	10
	Unit 2	
4.	Composite materials-Fiber reinforced, laminated and dispersed materials with metallic matrix of aluminium, copper and Titanium alloys and with non-metallic matrix of unsaturated polyesters and epoxy resins. Development, Important properties and applications of these materials.	7
5.	Smart materials-Shape Memory Alloys, Intelligent materials for bio-medical applications, Polymers and Plastics from industry. Development, important properties and applications of these materials. Construction material:concrete materials, properties of concrete, reinforced and prestressedconcrete,asphalt, the structure of wood, moisture content and density of wood, mechanical properties of wood.	8
6.	Case study of the failure of components due to wrong selection of materials-Study and analysis of appropriate material for some specific application like aerospace, boiler tubes, turbine blades, automobiles and infrastructures (building and bridges). Economic environmental and social issues of material usage- environmental and societal considerations, recycling issues and life cycle analysis.	9

Recommended Books:

1. Materials and metallurgy by OP Khanna, Published by DhanpatRai.
2. Heat treatment principles and techniques by Rajan and Sharma, Published by PHI.
3. Introduction to physical metallurgy by Sidney H Avner, Published by TMH.
4. Materials Science & Engineering by William D. Callister, , Wiley India

The science and engineering of materials by Donald R. Askeland and pradeepP.Phule

Subject Code : MEO-712

Title of the course : Robotics

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Develop the ability to analyze and design the motion for articulated systems.

CO2: Acquire the knowledge on advanced algebraic tools for the description of motion.

CO3: Understand the basic concepts of industrial robotics, namely in terms of classification, kinematics, sensors, and typical applications

CO4: Describe current status of robotics technology and new development

CO5: Understand the context and importance of robotics in the different society sectors.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	1	1	2	2	3	1	2	1	1	2
CO2	3	2	2	1	1	1	2	3	2	3	1	1	1	2	3
CO3	3	3	2	1	1	1	1	3	3	3	2	2	1	1	3
CO4	3	2	2	1	1	1	2	2	2	3	2	1	1	2	2
CO5	3	1	2	1	1	1	2	3	2	3	1	1	1	2	3
Average	3	2	2	1	1.2	1	1.6	2.6	2.2	3	1.4	1.4	1	1.6	2.6

Course Description	Lecture(s)
Unit-I	
Introduction Evolution of robot and robotics, laws of robotics, robot anatomy: Links, joints, Degrees of freedom (DOF), Precision movement, robot specifications and work volume, Types of Robot drives-Basic robot motions, Arm configuration, wrist configuration.	**05**
End Effectors End effectors classification-Mechanical, magnetic, vacuum and adhesive gripper, Robot control-unit control system concept-servo and non servo control of robot joints, adaptive and optimal control.	**07**

Sensors Sensor devices Types of sensors- contact, position and displacement sensors, Force and torque sensors-proximity and range sensors-acoustic sensors- Robot vision systems, sensing and digitizing- Image processing and analysis.	**08**
Unit-II	
Coordinate Frame, Mapping and Transforms Coordinate frames, description of objects in space, transformation of vectors, fundamental rotation matrices**.**	**05**
Kinematics Denavit- Hartenberg Notation, kinematic relationship between adjacent links, Manipulator transformation matrix, Inverse kinematics, Concept of manipulator jacobian.	**09**
Robot Programming Robot language classification-programing methods off and on line programming, Lead through method, Teach pendent method, Language, simple program.	**08**
Industrial Applications Application of robots- Material handling- machine loading and unloading, Assembly, Inspection, Welding, spray painting, Recent developments ion robots-safety considerations.	**06**

Subject Code : MEO-713
Title of the course : Non conventional energy resources

L	T	P	Credits	Weekly Load
3	0	0	3	3

COURSE OUTCOMES:
After successful completion of course, the students should be able to

CO1: Understand the operation of various non conventional energy resources.
CO2: Analyze the various non conventional energy resources.
CO3: Familiarize the components of non conventional energy resources.
CO4: Design of solar energy system and wind energy system.
CO5: Identify the application of various non conventional energy resources.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	2	1	1	1	2	1	2	1	1	2
CO2	3	3	1	2	3	2	2	1	2	1	2	2	1	1	2
CO3	3	3	3	3	3	3	2	3	3	3	1	2	1	1	1
CO4	3	3	2	3	3	2	3	2	3	1	2	1	2	2	1
CO5	3	3	3	3	3	3	3	3	3	1	3	3	1	2	1
Average	3	2.8	2	2.4	2.8	2.4	2.2	2	2.4	1.6	1.8	2	1.2	1.4	1.4

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	
Renewable and non-renewable energy sources, their availability and growth in India: energy consumption as a measure of Nations Development: strategy for meeting the future energy requirements.	(12 Hrs)
Solar Energy	
Solar radiations-beam and diffusion radiations; earth sun angles, attenuation and measurement of solar radiation; Optical properties of materials and selective surfaces.	
Solar Energy Equipments	
Principles, introduction of different types of collectors, flat plate, cylindrical, and parabolic collectors; Solar energy storage system-their types, characteristics and capacity; solar ponds. Application of solar energy in water, space and process	(12 Hrs)

heating, solar refrigerant and air conditioning; water desalination and water pumping; Solar thermal power generation; solar cells and batteries.	
Wind Energy	
Principle of wind energy conservation; basic components of wind energy conversion systems; wind mill components, various types and their construction features; wind data and site selection considerations.	
Unit-II	
Direct Energy Conversion Systems	
i)Magnetic Thermodynamic(MHD) Generators; Operating principle, types and working of different MHD system-their relative merits; MHD materials and production of magnetic fields. ii) Thermo-Electric Generators; Thermo-electric effects and materials; thermoelectric devices and types of thermo-electric generators; thermo-electric refrigeration. iii) Thermionic Generators; Thermionic emission and materials; working principle of thermionic convertors. iv) Fuel Cell; Thermodynamic aspect; types, components and working of fuel cell. Performance, applications and economic aspects of above mentioned direct energy conversion systems.	(12Hrs)
Miscellaneous Non-Conventional Energy System	
i)Bio-Mass; Concept of bio-mass conversion, photo-synthesis and bio-gasification; bio gas generators and plants, their types constructional features and functioning; fuel properties of bio gas and community bio gas plants ii) Geothermal; Sources of geothermal energy types, constructional features and associated prime movers iii) Tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices, Advantages/disadvantages and applications of above mentioned energy system.	(12 Hrs)

Recommended Books;

Title	Author(s)	Publisher
Solar Energy: Fundamental And Application.	Jai Prakash, H.P. Garg	Tata McGraw-Hill.
Solar energy: Principles of Thermal collection & storage.	S.P. Sukhatme	Tata McGraw-Hill
Solar Engineering of Thermal Process.	Duffie Beckman	John WilleyDuffie
Energy conversion.Chang		Publishers prentice Hall.

Title of the course : **Environmental Studies**

Subject Code : **CHM-711**

L	T	P	Credits	Weekly Load
3	0	0	3	3

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

CO1	Creat an awareness about environmental problems among students
CO2	Impart basic knowledge about the environment and its allied problems.
CO3	Develop an attitude of concern for the environment.
CO4	Motivate public through students to participate in environment protection and environment improvement.
CO5	Acquiring skills to help the concerned individuals in identifying and solving environmental problems.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	2	1	1	1	1	1	2	3	3	2	2	1	2	2
CO2	1	1	1	2	2	1	2	1	1	2	2	2	1	2	2
CO3	1	2	2	1	2	2	2	1	2	3	3	3	2	1	1
CO4	2	1	2	1	2	1	1	1	2	2	3	3	1	2	2
CO5	1	1	2	1	2	1	2	1	3	3	3	2	2	3	1
Average	1.2	1.4	1.6	1.2	1.8	1.2	1.6	1.2	2.2	2.6	2.6	2.4	1.4	2	1.6

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	Ecology and environment	Ecosystem; components, functioning, food chain and web, ecological pyramids. Biogeochemical cycles; water cycle, carbon cycle, nitrogen cycle. Biodiversity and its conservation.	08
	Sustainable development	Sustainable development; conflict between development and environmental conservation, international endeavors. Sustainable utilization of resources; energy resources, water resources, forest resources.	08
Unit-2	Environmental pollution	Water pollution; wastewater characterization, primary treatment, secondary biological treatment, general discharge standards. Air pollution; major pollutants, treatment devices, ambient standards. Solid waste management.	10
	Environmental Regulations	Green House Effect and Kyoto Protocol. Ozone layer depletion and Montreal Protocol. Environment Protection Act. Hazardous waste management.	06
			Total=32

Recommended Books:

1. E. Bharucha, Textbook for Environmental Studies; UGC Publication.
2. K.D. Wanger, Environmental Management; W.B. Saunders Publication.
3. E.P. Odum, Fundamentals of Ecology; W.B. Saunders Publication..
4. Pollution Control Acts, Rules and Notifications; CPCB Publication.

27

HUT 711/722 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	1	0	3.5

Course outcomes

After successful completion of the course, the students should be able to

CO 1: Understand the concepts of management, administration and the evolution of management thoughts.

CO 2: Understand and apply the planning concepts.

CO 3: Analyze the different organizational structures and understand the staffing process.

CO 4: Analyze the various motivational and leadership theories and understand the communication and controlling processes.

CO 5: Understand the various international approaches to management

Pre-requisite:

1. Nil

CO/PO Mapping

(S/M/W indicates strength of corerelation) S-Strong,M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO :1											M	
CO :2											S	
CO :3											S	
CO :4									S	S		
CO :5											S	

Course Assessment methods:

Direct	Indirect
1. Minor –I 2. Minor – II 3. Quiz-1.Quiz-11 4.Assignment 5 End semester exam	**Course and Survey**

UNIT- I

MANAGEMENT CONCEPTS **9 Hrs**

Management – Definition – Importance – Functions – Skills required for managers - Roles andfunctions of managers – Science and Art of Management –Management and Administration.Evolution of Classical, Behavioral and Contemporary management thoughts.

PLANNING **9 Hrs**

Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives. Forecasting – Purpose
– Steps and techniques. Decision-making – Steps in decision making.

UNIT- II

ORGANISING **12 Hrs**

Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority –Benefits and Limitations. Centralization Vs De-Centralization and Delegation of Authority. Staffing – Manpower Planning – Recruitment – Selection – Placement
– Induction.

UNIT- III

DIRECTING & CONTROLLING **10 Hrs**

Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation.Leadership – Styles and theories of Leadership.Communication – Process – Types – Barriers – Improving effectiveness in Communication.
Controlling – Nature – Significance – Tools and Techniques.

UNIT- IV

CONTEMPORARY ISSUES IN MANAGEMENT **10 Hrs**

Corporate Governance Social responsibilities – Ethics in business – Recent issues.
American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management.

REFERENCES:

1. Tripathy PC And Reddy PN, "Principles of Management", Tata McGraw-Hill, 4th Edition, 2008.
2. Dinkar Pagare, "Principles of Management", Sultan Chand & Sons, 2000.
3. Kanagasapapathi. P "Indian Models of Economy, Business and Management", Prentice Hall of India, New Delhi, ISBN: 978-81-203-3423-6, 2008.
4. Vijayaraghavan, G.K.and Sivakumar, M. "Principles of Management", Lakshmi Publications, 5th Edition, 2009.
5. Harold Koontz & Heinz Weihrich, "Essentials of Management – An International perspective", 8th edition. Tata McGraw-Hill, 2009.
6. Charles W.L. Hill and Steven L McShane – Principles of Management, Tata Mc Graw-Hill, 2009.

Subject Code : MET-711
Title of the course : Metrology & Mechanical Measurements

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Know Importance of use of standard measurement practices in system analysis and quality control in a legal and ethical way.

CO2: Understanding of basic principle of sensing in measurement of physical quantities and automation of instruments.

CO3: Understanding of basics of micron and submicron level measurements by mechanical and optical methods and latest development in such measurements.

CO4: **U**se and develop sustainable measurement systems for shop floor.

CO5: Handle various measuring instruments

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	1	1	2	1	1	1	2	2	1
CO2	3	3	3	3	3	1	1	1	2	2	1	1	1	2	1
CO3	3	3	3	3	3	1	2	1	2	1	1	1	1	2	2
CO4	3	3	3	3	3	1	1	1	2	1	2	1	2	1	2
Average	3	3	3	3	3	1	1.25	1	2	1.25	1.25	1	1.5	1.75	1.5

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	
Measurement, definition, aim, method of measurement, measurements in design, factor in selection of measuring instruments, measurements systems, time element in measurement, error in measuring instruments, temperature problem, static & dynamic characteristics of measuring instruments, calibration, error, classification, system error analysis, theoretical relationships.	07
Standard of Measurements	
Introduction, legal status, present measurement system & its advantage over previous system, standard of length, mass, time, temp. etc.	05
Displacement & Dimensional Measurement	
Problems of dimensional measurement, gage block, surface plate, temp problem etc., use of	07

different type of comparators, optical method, optical flats, application of monochromatic light & optical flats, use of optical flats & monochromatic light for dimensional comparison, interferometer.	
Surface Testing & Measurement	
Surface roughness, definition, various methods to measure surface roughness, different instruments for measuring surface roughness, roughness standard.	05
Unit-II	
Speed Measurement	
Introduction, use of counters, stroboscope, direct application of frequency standard by comparative methods, calibration of frequency sources, tachometers, different types- mechanical, electrical, frequency tachometer.	06
Stress Strain Measurements & Strain Graphs	
Introduction, mechanical strain gauges, optical strain gauges, electrical strain gauges, stress measurement by variable resistance strain gauge, sensing element materials, forms of strain gauge sensing elements, strain gauge adhesive, protective coating, strain gauge mounting techniques.	06
Measurement of Force & Torque	
Introduction, measuring methods, elastic transducers, strain gauge, load cell, piezo type load cell, hydraulic & pneumatic system, torque measurement, dynamometer, classification, type & characteristics.	06
Screw Thread Measurements	
Errors in threads, screw thread gauges, measurement of elements of the external & internal threads using caliper gauges, various other methods to measure screw thread parameters	03
Spur Gear Measurement	
Geometry of spur gear, measurement of spur gear parameters, run out, pitch, profile, lead, backlash, tooth thickness, composite elements, various other methods to measure spur gear parameters.	03

Total=48

Recommended Books:

1. Nakra&Chaudhary, Instrumentation, Measurement & Analysis; Tata McGraw Hill
2. E. O. Doebelin, Measurement Systems, Application & Design; Tata McGraw Hill
3. J.W. Dally, R.F. William and Mc Connell, Instrumentation for Engg. Measurement; John Wiley and Sons
4. K.J. Aume, Metrology &Interchangeability; McDonald and Company Ltd.
5. T. G. Beckwith, L.N. Buck and R. D. Marangoi, Mechanical Measurements; Addison Wesley Reading

Subject Code : MEP-711
Title of the course : Metrology & Mechanical Measurements Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Know Importance of use of standard measurement practices in system analysis and quality control in a legal and ethical way.

CO2: Understanding of basic principle of sensing in measurement of physical quantities and automation of instruments.

CO3: Understanding of basics of micron and submicron level measurements by mechanical and optical methods and latest development in such measurements.

CO4: Use and develop sustainable measurement systems for shop floor.

CO5: Handle various measuring instruments

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	1	1	1	2	1	1	1	2	2	1
CO2	3	3	3	3	3	1	1	1	2	2	1	1	1	2	1
CO3	3	3	3	3	3	1	2	1	2	1	1	1	1	2	2
CO4	3	3	3	3	3	1	1	1	2	1	2	1	2	1	2
Average	3	3	3	3	3	1	1.25	1	2	1.25	1.25	1	1.5	1.75	1.5

List of Experiments

1. Linear measurement of the test samples by
   a) Vernier caliper, b) Micrometer, c) Vernier depth gauge and d) height gauge
2. Study and measurements using telescopic gauge and bore gauge
3. Study and measurement using dial test indicator
4. Study and measurements using profile projector
5. Study and measurements using tool room microscope
6. Angle measurement of test sample using sine bar
7. Study and measurement using electronic comparator
8. Speed measurement of shaft by stroboscope and tachometer
9. Measurement of surface roughness by SURFCODER

10. Calibration of dial gauge by dial calibration tester
11. Calibrate of pressure gauges with dead weight calibrator
12. Calibration of verniercaliper and micrometer

Subject Code : MET-712
Title of the course : Industrial Automation and Mechatronics

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Associate the interface of computers with the outside world
CO2: Construct the model of physical system dynamics
CO3: Demonstrate the simulation and analysis of complex physical systems
CO4: Identify the automation of Manufacturing processes

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	1	2	2	1	1	1	2	1	2	1	1	2
CO2	2	3	1	2	3	2	2	1	2	1	2	2	1	1	2
CO3	2	3	3	3	3	3	2	3	3	3	1	2	1	1	1
CO4	3	3	2	3	3	2	3	2	3	1	2	1	2	2	1
Average	2	2.75	1.75	2.25	2.75	2.25	2	1.75	2.25	1.75	1.5	1.75	1.25	1.25	1.5

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	
The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics, Electrical, Control, computer and Instrumentation	**01**
Fundamentals of Electronics and digital circuits	
Number systems: Binary, Octal, Hexadecimal, Boolean Algebra, Logic Gates, Karnaugh maps and simplification of logic circuits, Operational Amplifiers, Types of Operational Amplifiers	**08**
Application of Personal Computer in Control and Automation	
Analog and Digital signal, Analog to Digital Conversion, Digital to Analog Conversion: Weighted resistor method and R-2R method, C programming for Digital Input and output, ADC and DAC, Control of DC motor and Stepper motor.	**08**
Sensors and Actuators	
Strain Gauge, Potentiometer, Optical encoders: incremental and absolute encoders, Linear variable differential transformer(LVDT), Piezoelectric, Proximity sensor, Resistance Temperature Detector(	**07**

RTD), Thermistors, Thermocouple, Hall effect sensor Permanent Magnet DC Motor, Stepper Motor	
Unit-II	
Pneumatics and Hydraulics	
Hydraulics and Pneumatic power supplies, Selection of Pnuematic Pipeline Materials, Pressure drop in pipeline, FRL unit, Direction control valves: Types, Nomenclature, actuation systems, Pressure control valves: Pressure limiting, pressure relief and pressure sequence valves, Check valves: Non return valve, Shuttle valve, Non-return flow control valve, twin pressure sequence valve, Time delay valve, Basic Pneumatic Circuits, Pilot operation, Cylinder sequencing and process control, Movement Diagram Actuators: Single acting and double acting cylinders, Cushion assembly, Rotary actuators, vane motors, Jeroter.	**09**
Programmable Logic Controller (PLC)	
Function of PLC, Architecture, Components of PLC, selection of PLC, Ladder Logic diagram, Logic functions: latching, sequencing, counters, shift registers, jumpers, manipulation of data, arithmetic operations	**07**
Fundamentals of Linear Control	
Laplace Transform, Transfer Functions, Block Diagrams, Response Analysis and Simulation: First order and second order systems	**08**

Total=48

Recommended Books:

1. W. Bolten, Mechatronics, Pearson Education
2. Andrew Parr, Pneumatic Systems, TMH
3. A.P. Malvino, Digital Principles and Applications, McGraw Hill
4. Norman S. Nise, Control Systems Engineering, Wiley

Subject Code : MEP-712
Title of the course : Industrial Automation and Mechatronics Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Associate the interface of computers with the outside world
CO2: Construct the model of physical system dynamics
CO3: Demonstrate the simulation and analysis of complex physical systems
CO4: Identify the automation of Manufacturing processes

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	1	2	2	1	1	1	2	1	2	1	1	2
CO2	2	3	1	2	3	2	2	1	2	1	2	2	1	1	2
CO3	2	3	3	3	3	3	2	3	3	3	1	2	1	1	1
CO4	3	3	2	3	3	2	3	2	3	1	2	1	2	2	1
Average	2	2.75	1.75	2.25	2.75	2.25	2	1.75	2.25	1.75	1.5	1.75	1.25	1.25	1.5

LIST OF EXPERIMENTS :

S.NO.	DESCRIPTION OF EXPERIMENT
1.	To study system introduction: computer-machine interface.
2.	Familiarization with Automation Studio 5.7
3.	Simulation of working of single acting cylinder with 3/2 DC valve.
	Simulation of working of double acting cylinder with 3/2 DC valve.
	Simulation of working of double acting cylinder with 5/2 DC valve.
	Simulation of Pilot operation
	Simulation of throttle-in and throttle-out process
4.	Simulation of semi-automatic pneumatic ckt.
5.	Simulation of fully -automatic pneumatic ckt.
6.	Study and installation of DAQ board PCL- 208
7.	To study digital input (DI) and digital output (DO)
8.	To study analog to digital (A/D) conversion

9.	To study digital to analog (D/A) conversion.
10.	To study the pneumatic trainer
11.	To study the op-amp and logic gate kit

Subject Code : MET-713
Title of the course : Mechanical Design - II

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Develop mathematical model, conceptual understanding science, physical and natural science disciplines of Mechanical engineering.

CO2: Analyze complex Mechanical Engineering problems and apply appropriate engineering techniques and design processes.

CO3: Develop creative solutions to problems and conceive innovative approaches of design Mechanical systems.

CO4: Exercise initiative, judgment, and autonomy in contributing as a member of an engineering team

CO5:Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Mechanical Engineering discipline.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	2	2	2	1	1	2	3	2	2	3
CO2	2	2	3	3	3	2	2	2	1	1	2	3	2	1	2
CO3	2	2	3	3	3	2	2	2	1	1	2	3	2	1	2
CO4	2	2	3	3	3	2	2	2	1	1	2	3	2	1	2
CO5	2	2	3	3	3	2	2	2	1	1	2	3	2	2	2
Average	2	2	3	3	3	2	2	2	1	1	2	3	2	1.4	2.2

Theory

Course Description	**Lecture(s)**
Unit-I	
Keys and Couplings	
Definition of term “key” & its various types. Splines. Deign of keys for various load cases. Shaft couplings and its various types Design of various shaft couplings; sleeve or muff, clamp or compression, flange; protected and unprotected, flexible and universal couplings,	**09**
Clutches	
Design procedure for positive, friction and centrifugal clutch.	**07**
Brakes	

Introduction, heat generation equation, design of shoe, band-brake and combination of shoe and band brake, design of calliper type and disc brake.	**08**
Unit-II	
Springs	
Design of Helical Springs, Buckling, Surge, Stress and Deflection in non-circular springs, Helical Torsion Springs, Spiral Springs, Design of leaf spring; Material and Construction, equalized stresses length of leaves, standard sizes of Automobile suspension springs.	**09**
Gears	
Design of spur gear, helical gear, bevel gear and worm gear.	**07**
I.C. Engine parts	
Principal parts of an I.C. engine, Design of a Cylinder, Design considerations for piston, piston rings, piston barrel, piston skirt, Design procedure for connecting rods and crankshafts.	**08**

Total=48

Recommended Books:

1. Shigley, J.E., and Mischke, C.R., "Mechanical Engineering Design (in S.I. Units)", 6th Ed., Tata McGraw-Hill, 2006.
2. Juvinall, R.C., and Marshek, K.M., "Fundamentals of Machine Component Design", 4th Ed., John Wiley & Sons, 2006.
3. Sharma & Aggarwal, "A Text book of Machine Design" , Katson.
4. Machine Design-An Integrated Approach, Norton, Pearson Education.
5. Mahadevan, K., and B., Reddy, "Design Data Hand Book", CBS Publishers, 2003.
6. P. S. G, "Design data handbook", P. S. G., Coimbatore.

Subject Code : MEO-721
Title of the course : Finite Element Methods

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Explain strain-displacement and stress-strain relations with and without the temperature effect.

CO2: Explain various numerical methods which can be applied to mechanical problems.

CO3: Discretize the continuum domain into finite element mesh using various types of elements.

CO4: Apply the finite element methods and analyze the implementation to solve static, scalar field and dynamic problems.

CO5: Formulate the computer implementation of the finite element methods.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	1	1	2	1	1	1	2	2	1	3	2
CO2	3	1	2	1	1	1	2	2	1	1	1	2	1	3	1
CO3	3	1	2	1	2	1	2	1	1	1	1	2	2	2	1
CO4	3	1	2	1	1	1	2	1	2	1	2	1	2	2	2
CO5	2	1	2	1	1	1	2	1	1	2	1	2	3	2	1
Average	2.8	1	2	1	1.2	1	2	1.2	1.2	1.2	1.4	1.8	1.8	2.4	1.4

Course Description	**Lectures**
Unit-I	
Introduction	
Historical Background, Stresses and equilibrium, Boundary Conditions, Strain-Displacement Relations, Stress-Strain Relations, Temperature Effects, Vectors and Matrices.	**06**
Introduction & Fundamental Concepts	
Rayleigh-Ritz Method, Galerkin's Method, Point Collocation Method, Least Square Method, Weighted Residual Method.	**06**
1-D FE Modeling	
Finite Element Modeling, Coordinates and Shape Functions, The Potential Energy Approach, The Galerkin's Approach, Assembly of Global Stiffness matrix and Load vector, Properties of Stiffness Matrix, Treatment of Boundary Conditions and Temperature Effects.	**08**

2-D FE Modeling	
Finite Element Modeling, Constant Strain Triangle (CST).	**04**
Unit-II	
2-D FE Modeling	
The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle.	**05**
Truss	
Introduction, Plane Trusses, Assembly of Global Stiffness Matrix and Load Vector. (For 1D and 2D problems only)	**08**
Scalar Field Problems	
Introduction, Steady-state heat transfer, Potential Flow, Fluid Flow in ducts.	**04**
Dynamic Considerations	
Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors. (Introduction only)	**04**
Computer Implementation	
Introduction; Computer Program Organization for Calculation of System Matrices.	**03**

Subject Code : MEO-722
Title of the course : Design of Experiments

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Understand the basic concepts of optimization.
CO2: Understand the basic concepts of experimentation analysis
CO3: Develop mathematical model for random phenomena.
CO4: Develop engineering solutions based on statistical analysis.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	1	1	1	2	1	1	1	2	2	1
CO2	3	3	3	3	3	1	1	1	2	2	1	1	1	2	1
CO3	3	3	3	3	3	1	2	1	2	1	1	1	1	2	2
CO4	3	3	3	3	3	1	1	1	2	1	2	1	2	1	2
Average	3	3	3	3	3	1	1.25	1	2	1.25	1.25	1	1.5	1.75	1.5

Theory

Course Description	Lecture(s)
Unit-I	
Introduction Introduction to optimization techniques & types, strategy of experimentation, procedure to design the experimentation.	**04**
Collection of data Introduction, primary & secondary data, graphical representation of data, bar chart, histograms, dot plot, scatter plot & box-whiskor plot, sampling & sampling distribution, acceptance sampling; single, double & multiple sampling plan,	**08**
Data analysis Measures of central tendency; arithmetic mean, median, mode, measures of dispersion, range, deviation, variance, correlation, types of correlation, normal distribution.	**10**
Unit-II	

Regression analysis Introduction, uses of regression analysis, difference between correlation and regression analysis, regression line and equations; regression equation of Y on X & regression equation of X on Y, standard error of estimate.	**08**
Analysis of variance Introduction, assumption, techniques of analysis of variance; one way ANOVA, two ways ANOVA, numerical on ANOVA.	**08**
Hypo thesis testing Definition, degree of freedom, hypotheses testing, critical region, level of significance, errors in sampling, test of significance for small samples & large samples, T - test, Z – test	**10**

Recommended Books:

Title	***Author(s***	***Publisher***
Design & analysis of experiments,	Douglas C Montgomery	John Wiley
Statistical design and analysis of experiment	John. P. W. M.	John Wiley
Statistical methods for engineering & science	HC Taneja,	I.K. international pub. House
Statistical methods	SP Gupta	Sultan Chand & son’s

Subject Code : MET-721
Title of the course : AUTOMOBILE ENGINEERING

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the basic knowledge of automobile component, different systems and its performance.

CO2: Assess the basics about Automotive Engine System and fuel supply System and apply to different type of vehicles.

CO3: Understand the concept of Automobile Chassis, hydraulically operated clutch, fly wheel, and automotive brake system.

CO4: Understand about Automotive Transmission, types of gear, working of gear boxand apply the knowledge to Gear selector mechanism, differentials and drive axles.

CO5: Learn the basic concepts of Automotive Electronic and Electrical Equipment and application to various parts of automobile

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	1	1	2	2	3	3	3	1	1
CO2	3	3	3	3	3	1	2	1	2	2	2	3	1	3	1
CO3	3	3	3	3	3	1	1	2	2	2	2	3	2	2	2
CO4	3	3	3	3	3	1	1	1	2	2	2	3	2	2	2
CO5	3	3	3	3	3	1	1	3	2	2	2	3	2	2	3
Average	3	3	3	3	3	1	1.2	1.6	2	2	2.2	3	2	2	1.8

Theory

Unit	Main Topic	Course out line	Lectures
Unit-I			
	1. Engine fundamentals and performance.	Introduction-Engine fundamentals, engine operations, engine type and construction. Engine measurement and performance.	**6**
	2.Automobile Engine Components:	Automobile Engine Components: connecting rods, rod bearings, piston rings, crank shaft, cylinder	**6**

		blocks, valves & valves train,	
	3.Engine fuel supply System	Automotive engine fuels, fuel and exhaust system, carburetors, carburetor fuel system service, diesel fuel engines injection system, gasoline fuel injection system.	**6**
	4. Automotive Engine System	Engine lubricating system, engine cooling systems, emission control & tune up. .	**6**
Units-II	**5.Automotive Chassis**	Automotive Chassis:Spring and suspension system, steering systems, automobile clutches, hydraulically operated clutch, pressure plate, fly wheel, adjusting wheel, spacing, and automotive brake system.	**8**
	6.Automotive Transmission:	Automotive Transmission:Gear ratio, types of gear, types of gear box, working of gear box, Gear selector mechanism, planetary type gear box, universal joints, and differentials and drive axles.	**8**
	7.Automotive Electronic and Electrical Equipment:	Automotive Electronic and Electrical Equipment:The automotive electrical system, starting system, central point ignition, electronic ignition system, automotive battery.	**8**

Total-48

Recommended Books:

Title	**Authors**	**Publishers**
1.Automobile Engineering	Nakre	Standard
2. Automobile Mechanics	Crouse	Tata McGraw Hill
3. Automobile Engineering	Kirpal Singh	Standard
4. A Tex Book of IC Engine	Mathur& Sharma	DhanpatRai

Subject Code : MEP-721
Title of the course : AUTOMOBILE ENGINEERING

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the basic knowledge of automobile component, different systems and its performance.

CO2: Assess the basics about Automotive Engine System and fuel supply System and apply to different type of vehicles.

CO3: Understand the concept of Automobile Chassis, hydraulically operated clutch, fly wheel, and automotive brake system.

CO4: Understand about Automotive Transmission, types of gear, working of gear boxand apply the knowledge to Gear selector mechanism, differentials and drive axles.

CO5: Learn the basic concepts of Automotive Electronic and Electrical Equipment and application to various parts of automobile

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	1	1	2	2	3	3	3	1	1
CO2	3	3	3	3	3	1	2	1	2	2	2	3	1	3	1
CO3	3	3	3	3	3	1	1	2	2	2	2	3	2	2	2
CO4	3	3	3	3	3	1	1	1	2	2	2	3	2	2	2
CO5	3	3	3	3	3	1	1	3	2	2	2	3	2	2	3
Average	3	3	3	3	3	1	1.2	1.6	2	2	2.2	3	2	2	1.8

List of Experiments

1. Construction Details and working of 4-stroke and 2-stroke petrol engine.
2. Construction Details and working of engine components in 4-stroke Diesel engine.
3. Construction Details and working of fuel supply system in petrol engine.
4. Construction Details and working of ignition system in petrol engine.
5. Construction Details and working of fuel supply system in diesel engine.
6. Construction Details and working of clutch and its various components.
7. Construction Details and working of gear box and its components.
8. Construction Details and working of differential.

9. Construction Details and working of brakes in automobile.
10. Construction Details and working of steering system of a car.
11. Construction Details and working of suspension system of an automobile.

Title of the course : **Human values and professional ethics**

Subject Code : **HUM-721**

L	T	P	Credits	Weekly Load
2	0	0	2	2

CO1: Students will understand the importance of Values and Ethics in their Personal lives and professional careers

CO2: The students will learn the rights and responsibilities

CO3: Responsibilities of employee, team member and a global citizen.

CO4: Apply practical strategies for handling ethical dilemmas.

CO5: Understand the importance of communication and ethics with all stakeholders.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	3	2	3	3	1	2	2	1	2	1
CO2	1	1	1	1	2	3	2	2	2	1	2	1	1	1	1
CO3	2	1	1	1	2	1	2	1	2	1	2	1	1	2	1
CO4	2	1	1	2	1	2	3	2	1	2	1	1	2	1	1
CO5	1	1	1	1	2	3	2	2	2	1	2	1	1	1	1
Average	1.4	1	1	1.2	1.8	2.4	2.2	2	2	1.2	1.8	1.2	1.2	1.4	1

Course Description	**Lecture(s)**
Unit-I	
Values and Self Development	

Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.	04
Personality and Behavior Development	
Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature.	04
Unit-II	
Character and Competence	
Science vs. God, Holy books vs. blind faith, Self management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self control, Honesty, Studying effectively.	03
Human Rights	
Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.	02
Competence in professional ethics	
Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems	03

Total=16

Recommended Books:

1) S.K.Chakraborty, Values and Ethics for Organizations Theory and Practice; Oxford University Press, New Delhi,2001.

2) S.K. Kapoor, Human rights under International Law and Indian Law; Prentice Hall of India, New Delhi, 2002.

3) D.D. Basu, Indian Constitution; Oxford University Press, New Delhi, 2002.

4) W.K. Frankena, Ethics; Prentice Hall of India, New Delhi, 1990.

5) R. R. Gaur, R. Sangal, G. P. Bagaria, A Foundation Course in Value Education. 2009,

6) M Govindrajran, S Natrajan, V.S. Senthil Kumar, Engineering Ethics(including Human Values); Eastern Economy Edition, Prentice Hall of India Ltd.

Subject Code : MET-722
Title of the course : Operations Research

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Understand the basic concepts & issues of engineering optimization and application of optimization techniques.

CO2: Formulate the linear programming problem using different approaches and attempt the variations of the class of problems.

CO3: Device assignment model, and attempt the variations of the class of problems.

CO4: Draw the network diagrams for project management.

CO5: Understand the basic concepts of queuing theory and analyze the case studies based on (M/M/1) model.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	1	1	1	2	2
CO2	3	3	2	3	2	1	3	2	2	1	3	1	1	1	1
CO3	2	2	2	2	3	1	3	2	2	2	2	2	1	1	2
CO4	2	2	2	3	3	1	3	2	2	2	2	2	1	2	1
CO5	2	2	2	2	3	1	3	2	2	2	2	3	1	1	1
Average	2.4	2.4	2.2	2.6	2.8	1.4	3	2.2	2.2	2	2	1.8	1	1.4	1.4

Theory

Course Description	Lecture(s)
Unit-I	
Introduction	**04**
Meaning of OR, historical development, characteristics of OR, application of OR, main feature of	

OR, scope of OR, Classification of optimization techniques in brief.	
Linear Programming	**10**
Introduction, formulation of LP problem, graphical representation and solution to LP problems, simplex method, two phase method, degeneracy problem, Big-M method, duality in linear programming.	
Transportation Model	**10**
Definition, mathematical formulation, optimal solution of transportation problem, optimality test, balanced and unbalanced problem, minimization and maximization problem, different methods of finding solution.	
Unit-II	
Assignment Model	**08**
Introduction, mathematical formulation, Hungarian method for assignment problem, minimization and maximization problem, unbalanced, sequencing and traveling salesman problems.	
NETWORK ANALYSIS IN PROJECT PLANNING (PERT & CPM)	**10**
Introduction, evolution and application of PERT & CPM technique, Drawing of network diagram, float and slack times, time estimates, critical path, crashing and updating problem.	
Queuing Model	**06**
Introduction, elements/structure, operating characteristics, classification of Queuing model, Kendall's Notation for representing Queuing Model, Case studies on (M/M/I) Model.	

Total=48

Recommended Books:

	Title	*Author(s)*	*Publisher*
1.	Engineering Optimization	S. S. Rao	New Age International
2.	Operations Research	A. H. Taha	Prentice Hall of India
3.	Operations Research	P. K. Gupta & D. S. Hira	S. Chand & Co.
4.	Operations Research	A. D. Belegundu	Prentice Hall of India
5.	Operations Research	C. K. Mustafi	New Age International

Subject Code : MET-723A
Title of the course : Sustainable Design and Manufacturing

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Compare and evaluate alternative manufacturing processes in terms of energy and materials consumption;

CO2: Develop a new product addressing sustainability issues;

CO3: Describe pros and cons of alternative manufacturing systems and supply chains on sustainability;

CO4: Compare and evaluate alternative energy sources to manufacture a product, Conduct a life cycle assessment (LCA) on a product

CO5: Function better in a multi-disciplinary team, Adopt a new behaviour to address sustainability issues

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	3	1	1	1	3	3	3	2	1	1	1
CO2	2	3	2	1	2	1	1	2	2	2	3	2	1	1	2
CO3	2	3	3	1	3	1	2	1	2	2	3	2	1	2	1
CO4	2	3	3	3	3	1	1	1	2	2	3	2	1	1	1
CO5	2	3	3	1	3	1	2	1	2	2	3	3	1	2	1
Average	2	3	2.8	1.4	2.8	1	1.4	1.2	2.2	2.2	3	2.2	1	1.4	1.2

Main Topics & Course Outline	*Lectures*
UNIT-I	
Life cycle inventory Introduction to life cycle inventory (lci) databases; Factors affecting life cycle inventory (such as electricity consumption); Elements that contribute to life cycle inventory, such as CO2 emissions; Procedure for generating LCI databases; Organizations involved in	**6**

publishing LCI (such as Econinvent)	
Life cycle assessment Introduction to product life cycle; Different phases of a product life cycle; Product life cycle assessment: techniques and tools; impact assessment methods: TRACI, RECIPE, etc; Comparing life cycle assessment of products.	**6**
Sustainable Manufacturing Introduction to sustainable manufacturing; Concepts of important pillars of sustainable manufacturing; Tools for assessing sustainable manufacturing; Benefits to environment, economy and society.	6
UNIT-II	
Material, energy and waste analysis Introduction to material, energy and waste (MEW) flow analysis; methods for tracking MEW flow information; Tools available for MEW analysis.	6
Sustainability of processes Manufacturing processes taxonomy; evaluating sustainability of manufacturing processes; effect of process sustainability on design and supply chain	6
Recent issues in sustainable design and manufacturing Techniques and tools for integrating sustainability into the early design phases; Design for Environment.	6
Case studies Integrating factories and enterprise with smart grid; Strategic decision making; Contribution of sustainable products and processes to competitive advantage, operational efficiency, and entrepreneurial opportunities; Sustainable materials, processes and production.	12
Total lectures	48

Recommended Books		
Title	***Author(s)***	***Publisher***
Design and Manufacture for Sustainable Development	Bernard Hon	Professional Engineering Publishing
Sustainable Materials, Processes and Production	1. Rob Thompson	----------
Environemntal Life Cycle Analysis	David F. Ciambrone	CRC Press

Subject Code : MET-723B
Title of the course : Smart Manufacturing

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: understand the concept of smart manufacturing
CO2: identify the intricacy of data management system
CO3: apply various tools for smart manufacturing
CO4: understand the concept of KPIs and Manufacturing execution systems
CO5: identify the cases studies using modern manufacturing operations management.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	2	2	2	1	1	2	3	1	2	1
CO2	2	2	3	3	3	2	2	2	1	1	2	3	1	1	1
CO3	2	2	3	3	3	2	2	2	1	1	2	3	1	2	1
CO4	2	2	3	3	3	2	2	2	1	1	2	3	1	2	1
CO5	2	2	3	3	3	2	2	2	1	1	2	3	2	1	1
Average	2	2	3	3	3	2	2	2	1	1	2	3	1.2	1.6	1

Main Topics & Course Outline	*Lectures*
UNIT-I	
Introduction Introduction to the concept of smart manufacturing (SM): plant-wide optimization; agile supply chain, sustainable production; Important constituents of smart manufacturing; Application and benefits of smart manufacturing	**5**
Layers in smart manufacturing Manufacturing ecosystem; Multiple layers of data management: macro, meso, micro	**3**
SM platforms Architecture of SM platforms; flexibility; interpretability; scalability; optimization of manufacturing operations.	3
Tools and equipment Tools and equipment required for SM; SM App store.	3
UNIT-II	
Manufacturing execution systems Introduction to the manufacturing execution systems (MES), tools and techniques; MES key performance indicators (KPIs); Applications and advantages of MES.	5
Manufacturing operations management Introduction to manufacturing operations management (MOM), tools and techniques; MOM key performance indicators; Applications and advantages of MOM.	5
Recent issues in smart manufacturing Integrating factory and enterprise information with supply chain; integrating factory with smart grid; phases of smart manufacturing; smart manufacturing test-bed.	4
Case studies Industry case studies on: smart factories, integrating factories and enterprise with smart grid, strategic decision making, etc.	12
Recommended Books	

Title	*Author(s)*	*Publisher*
Smart Manufacturing with Artificial Intelligence	Jake Krakauer	
Robotics in Smart Manufacturing	Pedro Neto, António Paulo Moreira.	Springer

Subject Code : MET-723C
Title of the course : Industrial Maintenance

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO1: Diagnose few/ specific problems in Mechanical System.
CO2: Operate tools/ instrument used in health monitoring of mechanical component.
CO3: Understand and Implement maintenance strategies in the plant
CO4: Make decision on repair and replacements.
CO5: Calculate losses in TPM and OEE , Implement lean manufacturing paradigm in TPM.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	2	3	3	3	2	2	2	1	1	2	3	2	2	3
CO2	2	2	3	3	3	2	2	2	1	1	2	3	2	1	2
CO3	2	2	3	3	3	2	2	2	1	1	2	3	2	1	2
CO4	2	2	3	3	3	2	2	2	1	1	2	3	2	1	2
CO5	2	2	3	3	3	2	2	2	1	1	2	3	2	2	2
Avera ge	2	2	3	3	3	2	2	2	1	1	2	3	2	1.4	2.2

Theory

Course Description	Lecture(s)
Unit-I	
Maintenance Types Introduction, maintenance objectives, maintenance costs, types of maintenance techniques: breakdown maintenance, shut down maintenance, corrective maintenance, preventive maintenance, predictive maintenance, productive maintenance, total productive maintenance. Advantages and limitations of different types of maintenance techniques.	**12**
Condition Base Maintenance Condition monitoring, condition base maintenance, different condition base maintenance monitoring methods: leakage analysis, vibration analysis, noise analysis, thermography and ferrography.	**12**
Unit-II	

Maintenance Management Maintenance planning and control, maintenance organization, maintenance performance measurement, replacement decisions, availability of spares, computer based maintenance.	**12**
Total Productive Maintenance Introduction to TPM, Pillars of TPM, six major losses in TPM, calculation of OEE, leanness through TPM, procedure for implementing TPM in lean manufacturing paradigm.	**12**

Total = 48

Recommended Books

Title	***Author(s)***	***Publisher***
Industrial Maintenance Management	Sushil Kumar Srivastava	S Chand & Co.
Maintenance Engineering	Mishra	PHI
Reliability, Maintenance and Safety	A.K.Gupta	University ScienceEngineering Press
Reliability Engineering	L.S. Srinath	East-West Press

Subject Code : MEO-723
Title of the course : Cryogenics Engineering

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Comprehend the cryogenic systems.
CO2: Able to conduct experiments for different materials at cryogenic temperature.
CO3: To analyze properties of materials subjected to cryogenic temperature.

Pre-requisite knowledge:

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	1	1	1	2	3	3	2	2	1
CO2	3	3	3	2	2	2	2	1	2	3	3	3	1	1	2
CO3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	1
Average	3	3	3	2.2	2.2	2.4	2.5	2	2.4	2.8	3	3	1.6	1.8	1.4

Course Description	**Lecture(s)**
Unit-I	
Basics	**04**
Definition of cryogenics, Physical properties of various cryogenic fluids, industrial applications of cryogenic fluids.	
Low temperature measurement	**10**
Measurement systems for low temperature:-temperature measurements, pressure measurements, flow measurements, liquid level measurements, fluid quality measurements.	
Cryogenic insulations	**10**
Types of insulations, vacuum insulation, gas filled powders & fibrous insulation, evacuated powder & fibrous insulation multi layer insulation, comparison of performance of various insulation.	
Unit-II	
Properties of materials at low temperature:	**10**

Mechanical properties, specific heat, thermal expansion, electrical resistance, thermal conductivity, emissivity, reflectivity and absorptivity. Properties of cryogenic fluids.	
Hazards	**08**
Physical hazards, chemical hazards, physiological hazards, combustion hazards, oxygen hazards, accidents in cryogenic plants & prevention.	
Safety	**06**
Safety in handing of cryogens, care of storage of gaseous cylinders, familiarization with regulations of department of explosives.	