Diploma Engineering

Curriculum Structure

&

Detailed Syllabus

(III to VI Semester)

Mechanical Engineering

(ME)

(III to VI Semester)

Semester III

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-1	MEPC301	Basic Mechanical Engineering	2	1	0	3	3
2	Programme core course-2	MEPC302	Thermal Engineering - I	2	1	0	3	3
3	Programme core course-3	MEPC303	Fluid Mechanics & Hydraulic Machinery	2	1	0	3	3
4	Programme core course-4	MEPC304	Manufacturing Engineering	2	0	0	2	2
5	Programme core course-5	MEPC305	Material Science & Engineering	2	0	0	2	2
6	Programme core course-6	MEPC306	Computer Aided Machine Drawing Practice	0	0	4	4	2
7	Programme core course-7	MEPC307	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	2	1
8	Programme core course-8	MEPC308	Thermal Engineering Lab-I	0	0	2	2	1
9	Programme core course-9	MEPC309	Manufacturing Engineering Lab-I	0	0	2	2	1
10	Summer Internship-I (3 to 4 weeks) after IInd Semester	MESI310	Internship	0	0	0	0	2
			Total	**10**	**3**	**10**	**23**	**20**

Semester IV

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-10	MEPC401	Measurements & Metrology	2	1	0	3	3
2	Programme core course-11	MEPC402	Thermal Engineering - II	2	1	0	3	3
3	Programme core course-12	MEPC403	Strength of Materials	2	1	0	3	3
4	Programme core course-13	MEPC404	Material Testing Lab	0	0	2	2	1
5	Programme core course-14	MEPC405	Thermal Engineering Lab-II	0	0	2	2	1
6	Programme core course-15	MEPC406	Measurements & Metrology Lab	0	0	2	2	1
7	Programme elective course-1 (Any One to be selected)	MEPE407/A	Tool Engineering	3	0	0	3	3
		MEPE407/B	Heat Transfer					
8	Humanities & Social Science- 4	HS 408	Professional Skill Development	2	1	0	3	3
9	Minor Project	MEPR409	Minor Project	0	0	4	4	2
10	Mandatory Course-1	AU410	Essence of Indian Knowledge and Tradition	2	0	0	2	0
			Total	**14**	**3**	**10**	**27**	**20**

Semester V

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-16	MEPC501	Advanced Manufacturing Processes	3	0	0	3	3
2	Programme core course-17	MEPC502	Theory of Machines & Mechanisms	2	0	0	2	2
3	Programme core course-18	MEPC503	Industrial Engineering & Management	2	0	0	2	2
4	Programme core course-19	MEPC504	CAD/CAM Lab	0	0	2	2	1
5	Programme core course-20	MEPC505	Manufacturing Engineering Lab-II	0	0	2	2	1
6	Programme elective course-2 (Any One to be selected)	MEPE506/A	Computer Aided Design and Manufacturing	3	0	0	3	3
		MEPE506/B	Refrigeration & Air-conditioning					
7	Programme elective course-3 (Any One to be selected)	MEPE507/A	Mechatronics	3	0	0	3	3
		MEPE507/B	Industrial Robotics & Automation					
8	Open elective course-1	(Any one to be selected from Annexure-I)		3	0	0	3	3
9	Summer Internship-II (6 weeks) after IV Semester	MESI509	Summer Internship-II	0	0	0	0	3
10	Major Project	MEPR510	Major Project- I	0	0	2	2	1
			Total	**16**	**0**	**6**	**22**	**22**

Semester VI

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-21	MEPC601	Design of Machine Elements	2	1	0	3	3
2	Programme core course-22	MEPC602	Production & Operations Management	2	0	0	2	2
3	Programme elective course-4 (Any One to be selected)	MEPE603/A	Elective Material Handling Systems	3	0	0	3	3
		MEPE603/B	Power Plant Engineering					
4	Humanities and Social Science course- 5	HS604	Entrepreneurship and Start-up's	3	1	0	4	4
5	Open elective-2	(Any one to be selected from Annexure-II)		3	1	0	4	4
6	Mandatory Course-2	AU606	Indian Constitution	2	0	0	2	0
7	Major Project	MEPR607	Major Project- II	0	0	6	6	3
8	Seminar	MESE608	Seminar	2	0	0	2	1
			Total	**17**	**3**	**6**	**26**	**20**

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DETAILED SYLLABUS

Semester III

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-1	MEPC301	Basic Mechanical Engineering	2	1	0	3	3
2	Programme core course-2	MEPC302	Thermal Engineering - I	2	1	0	3	3
3	Programme core course-3	MEPC303	Fluid Mechanics & Hydraulic Machinery	2	1	0	3	3
4	Programme core course-4	MEPC304	Manufacturing Engineering	2	0	0	2	2
5	Programme core course-5	MEPC305	Material Science & Engineering	2	0	0	2	2
6	Programme core course-6	MEPC306	Computer Aided Machine Drawing Practice	0	0	4	4	2
7	Programme core course-7	MEPC307	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	2	1
8	Programme core course-8	MEPC308	Thermal Engineering Lab-I	0	0	2	2	1
9	Programme core course-9	MEPC309	Manufacturing Engineering Lab-I	0	0	2	2	1
10	Summer Internship-I (3 to 4 weeks) after IInd Semester	MESI310	Internship	0	0	0	0	2
			Total	10	3	10	23	20

BASIC MECHANICAL ENGINEERING

Course Code	MEPC301
Course Title	Basic Mechanical Engineering
Number of Credits	3(L: 2, T: 1, P: 0)
Prerequisites	NIL
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Understand laws of thermodynamics, thermal and thermodynamic Processes and cycles and refrigeration. (K2)
CO2: Explain basics of heat transfer and components of a thermal power plant and boiler operation. (K2)
CO3:Summarize theSteam Turbines and internal combustion engines (K2)
CO4: Identify engineering materials, their properties, manufacturing methods encountered in engineering practice (k2)
CO5: Understand functions and operations of machine tools including milling, shaping, grinding And lathe machines. (k2)

Course Content:-

Module- 1: Introduction to Thermodynamics
Number of class hours:6 hrs.

Suggestive Learning Outcomes:
1) Describe basic concepts of Thermodynamics.
2) State different laws of Thermodynamics
3) Explain different types of Thermodynamics processes and cycles.
4) Distinguish between Heat Pump & Refrigerator.

Detailed content of the unit: -

Introduction to Thermodynamics - Role of Thermodynamics in Engineering and Science,Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementaryintroduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions forvarious non-flow and flow processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/ COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams,Concept of Entropy (Definition only).

Module- 2: Heat transfer & Thermal Power Plant:
Number of class hours:6 hrs

Suggestive Learning Outcomes:
1) Identify various modes of heat transfer.
2) Estimate Overall Heat Transfer Co-efficient.
3) Compare different types of boilers.

Detailed content of the unit: - 6 hrs
Modes of Heat Transfer; Conduction: CompositeWalls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems:
Thermal Power Plant Layout; Rankine Cycle; Fire Tube and Water Tubeboilers, Babcock & Wilcox, Cochran Boilers;

Module-3:Steam Turbines and Internal Combustion Engines
Number of class hours:6 hrs

Suggestive Learning Outcomes:
1) Distinguish between Impulse and Reaction Turbines.
2) Compare Otto, Diesel and Dual cycles.
3) Classify Internal Combustion Engine.

Steam Turbines: Impulse and Reaction Turbines; Condensers: Jet & Surface Condensers,Cooling Towers;

Internal Combustion Engines: Otto, Diesel and Dual cycles; P-V and T-S Diagrams; IC Engines: 2 - Stroke and 4 - Stroke I.C. Engines, S.I. and C.I. Engines.

Module-4: Materials and Manufacturing Processes
Number of class hours:6 hrs

Suggestive Learning Outcomes:
1)Illustrate Engineering Materials, Classification and theirProperties.
2) Describe metal working processes.
3) Discuss joining processes.

Materials and Manufacturing Processes: Engineering Materials, Classification and theirProperties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Module- 5 Machine Tools and Machining Processes:
Number of class hours:6 hrs

Suggestive Learning Outcomes:
1) Demonstrate Different types of Machine Tools and operations.
2) Differentiate Shaper and Planer Machines.

Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, LatheOperations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

References: -
1. Basic Mechanical Engineering – M.P. Poonia & S.C. Sharma, Khanna Publishing House, Delhi
2. Elements of Mechanical Engineering – M. L. Mathur, F. S. Mehta and R. P. Tiwari, Jain Brothers,
New Delhi
3. Engineering Heat Transfer – Gupta & Prakash, Nem Chand & Brothers, New Delhi
4. Workshop Technology (Vol. 1 and 2) – B. S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi.
5. Basic Mechanical Engineering – J Benjamin
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6. Elements of Mechanical Engineering – Roy and Choudhary
7. Engineering Thermodynamics – Spalding and Cole ...
8. Online Swayam Moocs Courses

THERMAL ENGINEERING - I

Course Code	MEPC302
Course Title	Thermal Engineering – I
Number of Credits	3(L: 2, T: 1, P: 0)
Prerequisites	NIL
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Explain various sources of Energy and their applications. (K2)
CO2: Classify I.C. engines and understand their working and constructional features. (K2)
CO3: Sketch the energy flow diagram of an I.C. engine and evaluate its performance. (K3)
CO4: Evaluatethe performance f an I.C. engine (K4)
CO5: Describe different types of air compressors and demonstrate the applications of refrigeration and air-conditioning systems. (K2)

Course Content:-

Module- 1: Sources of Energy

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:
1) Classify different types of energy.
2) Describe Solar Energy,WindEnergy andGeothermal Energy
3) Explain Bio-diesel; HydraulicEnergy, Nuclear Energy; Fuel cell.

Detailed content of the unit: -
Brief description of energy Sources: Classification of energy sources- Renewable, Non-Renewable; Fossil fuels, including CNG, LPG; Solar Energy: Flat plate and concentratingcollectors & its applications (Solar Water Heater, Photovoltaic Cell, Solar Distillation); WindEnergy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; HydraulicEnergy, Nuclear Energy; Fuel cell.

Module- 2: Internal Combustion Engines:

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:
1) Discuss various air standard cycle used in I. C. Engine.
2) Express the working and constructional features of I. C. Engine.
3) Compare Working of four-stroke andtwo-stroke petrol and diesel engines.

Detailed content of the unit: -
Assumptions made in air standard cycle analysis; Brief descriptionof Carnot, Otto and Diesel cycles with P-V and T-S diagrams; Internal and external combustionengines; advantages of I.C. engines over external combustion engines; classification of I.C.engines; neat sketch of I.C. engine indicating component parts; Function of each part and materialsused for the component parts - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod,wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve; Working of four-stroke andtwo-stroke petrol and diesel engines; Comparison of two stroke and four stroke engines; Comparisonof C.I. and S.I. engines; Valve timing and port timing diagrams for four stroke and two strokeengines.

Module- 3: I.C. Engine Systems:

Number of class hours:6 Hrs.

Suggestive Learning Outcomes:
1) Illustrate the construction and working of Fuel system and Cooling system.
2) Describe Ignition systems and lubricating systems.
3) List various types of governing of I.C. engines.

Detailed content of the unit: -

Fuel system of Petrol engines; Principle of operation of simple and Zenithcarburettors; Fuel system of Diesel engines; Types of injectors and fuel pumps; Cooling system- air cooling, water cooling system with thermo siphon method of circulation and water cooling systemwith radiator and forced circulation (description with line diagram). Comparison of air coolingand water cooling system; Ignition systems – Battery coil ignition and magneto ignition (description and working) Comparison of two systems; Types of lubricating systems used in I.C. engines withline diagram; Types of governing of I.C. engines – hit and miss method, quantitative method, qualitativemethod and combination methods of governing; their applications; Objective of super charging.

Module- 4: Performance of I.C. Engines:
Number of class hours:6 Hrs.

Suggestive Learning Outcomes:
1) Evaluate Brake power; Indicated power; Frictional power.
2) Calculate different types of efficiency.
3) Demonstrate Performance test and Morse test.
Detailed content of the unit: -
Brake power; Indicated power; Frictional power; Brake andIndicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency;Relative efficiency; Performance test; Morse test; Heat balance sheet; Methods of determination ofB,P., I.P. and F.P.; Simple numerical problems on performance of I.C. engines.

Module- 5: Air Compressors and Refrigeration & Air-conditioning:

Number of class hours:6 Hrs.

Suggestive Learning Outcomes:
1) Classify various types of air compressor.
2) Estimate COP of Refrigeration system.
3) Distinguish various types of Air-Conditioning system.

Detailed content of the unit: -
Functions of air compressor; Uses of compressed air; Types of air compressors;Single stage reciprocating air compressor - its construction and working (with line diagram) using P-V diagram; Multi stage compressors – Advantages over single stage compressors; Rotarycompressors: Centrifugal compressor, axial flow type compressor and vane type compressors.
Refrigeration; Refrigerant; COP; Air Refrigeration system: components, working & applications; Vapour Compression system: components, working & applications; Air conditioning; Classification of Air-conditioning systems; Comfort and Industrial Air-Conditioning; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system,Year-round Air-Conditioning system.

Reference Books:
1. Introduction to Renewable Energy – Vaughn Nelson, CRC Press
2. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
3. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai.
4. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.
5. Thermal Engineering – R. K. Rajput,8th Edition, Laxmi publications Pvt Ltd, New Delhi.

FLUID MECHANICS & HYDRAULIC MACHINERY

Course Code	MEPC303
Course Title	Fluid Mechanics & Hydraulic Machinery
Number of Credits	3(L: 2, T: 1, P: 0)
Prerequisites	NIL
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Analyse various properties such as pressure, velocity, flow rate using various instruments. (K4)
CO2: Calculate different parameters such as co-efficient of friction, power, efficiency etc of various systems. (K4)
CO3:Explain the working principle of Impact of Jet. (K3).
CO4: Test the performance of turbines. (K4)
CO5: Sketch the characteristics curves of turbines and pumps. (K3)

Course Content:-

Module- 1: Properties of fluid, Fluid Pressure & Pressure Measurement
Number of class hours: 5 hrs.

Suggestive Learning Outcomes:
1) Analyze various properties of fluid.
2) CalculateFluid pressure, Pressure head, Pressure intensity.

Detailed content of the unit: -
Properties of fluid: Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity,Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.**Fluid Pressure & Pressure Measurement:** Fluid pressure, Pressure head, Pressure intensity, Conceptof vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differentialmanometers, Bourdon pressure gauge, Concept of Total pressure on immersed bodies, centre pressure, Simple problems on Manometers.

Module-2: Fluid Flow, Flow through Pipes:
Number of class hours: 6 hrs.

Suggestive Learning Outcomes:
1) Discuss various types of fluid flows.
2) State and apply Bernoulli'stheorem.
3) State and analyze Darcy's equation and Chezy's equation for frictionallosses
Detailed content of the unit: -
Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli'stheorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge,coefficient of discharge and numerical problems.

Flow Through Pipes: Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictionallosses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problemsto estimate major and minor losses

Module-3: Impact of jets:
Number of class hours: 5 hrs

Suggestive Learning Outcomes:
1) Explain the working principle of Impact of Jet.
2) Calculate on work done and efficiency.

Detailed content of the unit: -
Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet oncurved vanes with special reference to turbines & pumps, Simple Numerical on work done and efficiency.

Module-4: Hydraulic Turbines:
Number of class hours: 7hrs

Suggestive Learning Outcomes:
1) Distinguish different types of hydraulic turbines.
2) Calculate Work done, Power,efficiency of turbines.

Detailed content of the unit: -
Layout of hydroelectric power plant, Features of Hydroelectric powerplant, Classification of hydraulic turbines, Selection of turbine on the basis of head and dischargeavailable, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Drafttubes – types and construction, Concept of Cavitation in turbines, Calculation of Work done, Power,efficiency of turbines, Unit quantities and simple numerical.

Module-5: Centrifugal Pumps:,Reciprocating Pumps:
Number of class hours:**7hrs**

Suggestive Learning Outcomes:
1) Explain working and applications of Centrifugal Pumps and Reciprocating Pumps.
2) Compute Manometric efficiency and Overall efficiency.
3) Differentiate between Centrifugal Pumps and Reciprocating Pumps.

Detailed content of the unit: -
Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometricefficiency, Overall efficiency. Numerical on calculations of overall efficiency and power required to drive pumps.
Reciprocating Pumps: Construction and working principle and applications of single and double acting reciprocating pumps
Concept of Slip, negative slip, Cavitationand separation

Reference Books:
1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi

2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New
Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., StandardBook House. New Delhi
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

MANUFACTURING ENGINEERING

Course Code	MEPC304
Course Title	Manufacturing Engineering
Number of Credits	2(L: 2, T: 0 P: 0)
Prerequisites	NIL
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Know and identify basic manufacturing processes for manufacturing different components.[K2]
CO2: Operate& control different machines and equipment.[K3]
CO3: Produce jobs as per specified dimensions and inspect the job for specified dimensions.[K3]
CO4: Select the specific manufacturing process for getting the desired type of output.[K1]
CO5: Employ safety practices while working on various machines.[K3]

Course Content:-

Module- 1: Cutting Fluids & Lubricants, Lathe Operations:

Number of class hours: 5hrs.

Suggestive Learning Outcomes:
1) Identify basic manufacturing processes.
2) Indicate Properties and applicationsof lubricants.
3) Demonstrate various operations of Lathe.

Detailed content of the unit: -
Introduction; Types of cutting fluids, Fluids and coolants requiredin turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of applicationof cutting fluid; Classification of lubricants (solid, liquid, gaseous), Properties and applicationsof lubricants.

Lathe Operations: Types of lathes – light duty, Medium duty and heavy duty geared lathe, CNC lathe;Specifications; Basic parts and their functions; Operations and tools – Turning, parting off, Knurling , facing, Boring, drilling, threading, step turning, taper turning.

Module- 2: Broaching Machines:
Number of class hours:5hrs.

Suggestive Learning Outcomes:
1) Operate different types of broaching machines.
2)Operate and Control of drilling machine

Detailed content of the unit: -
Introduction to broaching; Types of broaching machines – Horizontaltype (Single ram & duplex ram), Vertical type, Pull up, pull down, and push down; Elements of broachtool; broach teeth details; Nomenclature; Tool materials.
Drilling: Classification, Basic parts and their functions, Radial drilling machine, types of operations;Specifications of drilling machine, Types of drills and reamers

Module- 3: Welding&Milling
Number of class hours:5hrs.

Suggestive Learning Outcomes:
1) Explain different types of welding techniques.
2) Describe different types ofmilling operations

Detailed content of the unit: -
Classification; Gas welding techniques; Types of welding flames; Arc Welding –Principle, Equipment, Applications; Shielded metal arc welding; Submerged arc welding; TIG / MIGwelding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects;Brazing and soldering: Types, Principles, Applications.
Milling: Introduction; Types of milling machines: plain, Universal, vertical; constructional details– specifications; Milling operations: simple, compound and differential indexing; Milling cutters –types; Nomenclature of teeth; Teeth materials; Tool signature of milling cutter; Tool & work holdingdevices.

Module- 4: Gear Making and Press working
Number of class hours:5hrs.

Suggestive Learning Outcomes:
1) Describe different types of gear manufacturing processes.
2) Define various Press working operations.

Detailed content of the unit: -
Manufacture of gears – by Casting, Moulding, Stamping, Coining Extruding,Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter;Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes;

Gear materials and specification; Heat treatment processes applied to gears.
Press working: Types of presses and Specifications, Press working operations - Cutting, bending,drawing, punching, blanking, notching, lancing; Die set components- punch and die shoe, guide pin,bolster plate, stripper, stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing,effect of clearance.

Module- 5: Grinding and finishing processes:
Number of class hours:5hrs.

Suggestive Learning Outcomes:
1) Select suitable grinding wheels for different operations.
2) Describe different finishing operations.

Detailed content of the unit: -
Principles of metal removal by Grinding; Abrasives –Natural & Artificial; Bonds and binding processes: Vitrified, silicate, shellac, rubber, Bakelite; Factorsaffecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, gradeand strength of bond, structure of grain, spacing, kinds of bind material; Standard marking systems:Meaning of letters & numbers sequence of marking, Grades of letters; Grinding machines classification:Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centre-lessgrinding; Advantages & limitations of centre less grinding; Finishing by grinding: Honing,Lapping, Super finishing; Electroplating: Basic principles, Plating metals, applications; Hot dipping:Galvanizing, Tin coating, Parkerising, Anodizing; Metal spraying: wire process, powder process and applications; Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubberbased coating; Finishing specifications.

Reference Books:
1. Manufacturing technology – P N Rao, Tata McGraw-Hill Publications
2. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, MediaPromoters and Publishers Limited.
3. Production Technology (Volume I & II) – O. P. Khanna & Lal, Dhanpat Rai Publications.
4. Fundamental of metal cutting and machine tools– B. L. Juneja, New age international limited.
5. Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications
6. Production Technology – R.B. Gupta, Satya Prakashan, New Delhi

MATERIAL SCIENCE & ENGINEERING

Course Code	MEPC305
Course Title	Material Science & Engineering
Number of Credits	2(L: 2, T: 0, P: 0)
Prerequisites	NIL
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1 Explain about crystal structures and atomic bonds. (K2)
CO2 Describe about classification of ferrous metals and their properties.(K2)
CO3 Explain about non-ferrous metals, cutting tool materials and composites alongwith their properties.(K2)
CO4 Describe about the various metallic failures and knowledge in testing ofmaterials. (K2)
CO5 Explain the principle of corrosion, their types and its prevention methods alongwith the various surface engineering processes.(K2)

Course Content:-

Module- 1: Crystal structures and Bonds:
Number of class hours: 5 Hrs.

Suggestive Learning Outcomes:
1) Explain basic crystal systems.
2) Describe different types of bonding.

Detailed content of the unit: -
Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for metallic elements: BCC, FCC and HCP; Coordination number for Simple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC;Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP; Simple problems on finding number ofatoms for a unit cell.
Bonds in solids: Classification - primary or chemical bond, secondary or molecular bond; Types of primary bonds: Ionic, Covalent and Metallic Bonds; Types of secondary bonds: Dispersion bond,Dipole bond and Hydrogen bond.

Module- 2: Phase diagrams, ferrous metals and its Alloys:
Number of class hours:5 Hrs.

Suggestive Learning Outcomes:
1) Interpret Iron-Carbon binary diagram.
2) Classify different type ferrous metals and its alloys.
3) Understand standard commercial grades of steel as per BIS and AISI.

Detailed content of the unit: -
Isomorphs, eutectic and eutectoid systems;
Iron-Carbon binary diagram; Iron and Carbon Steels; flow sheet for production of iron and steel; Iron ores – Pig iron: classification, composition and effects of impurities on iron; Cast Iron: classification,composition, properties and uses; Wrought Iron: properties, uses/applications of wroughtIron; comparison of cast iron, wrought iron and mild steel and high carbon steel; standard commercialgrades of steel as per BIS and AISI; Alloy Steels – purpose of alloying; effects of alloying elements– Important alloy steels: Silicon steel, High Speed Steel (HSS), heat resisting steel, spring steel,Stainless Steel (SS): types of SS, applications of SS – magnet steel – composition, properties and uses

Module-3: Non-ferrous metals and its Alloys:
Number of class hours:5 Hrs.

Suggestive Learning Outcomes:
1) Summarised properties and uses ofNon-ferrous metals and its Alloys.
2) Discuss various types of bearingalloys

Detailed content of the unit: -

Properties and uses of aluminium, copper, tin, lead,zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses;Aluminium alloys: Duralumin, hindalium, magnelium – composition, properties and uses; Nickel alloys:Inconel, Monel metal, nichcrome – composition, properties and uses. Anti-friction/Bearing alloys:Various types of bearing bronzes - Standard commercial grades as per BIS/ASME.

Module-4: Failure analysis & Testing of Materials:
Number of class hours:5 Hrs.

Suggestive Learning Outcomes:
1) Describe about the various metallic failures in metals.
2) Demonstrate different types Destructive testing andNon-destructive testing.
3) Compute the Brinell and Rockwell hardness number.

Detailed content of the unit: -
Introduction to failure analysis; Fracture: ductilefracture, brittle fracture; cleavage; notch sensitivity; fatigue; endurance limit; characteristics of fatiguefracture; variables affecting fatigue life; creep; creep curve; creep fracture; Destructive testing:Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatiguetest; creep test. Non-destructive testing: Visual Inspection; magnetic particle inspection; liquidpenetrate test; ultrasonic inspection; radiography.

Module-5: Corrosion & Surface Engineering:
Number of class hours:5 Hrs.

Suggestive Learning Outcomes:
1) Explain the principle of corrosion.
2) Describe various surface engineering processes
3) UnderstandPollution norms for treating effluents as per standards.

Detailed content of the unit: -

Nature of corrosion and its causes; Electrochemical reactions;Electrolytes; Factors affecting corrosion: Environment, Material properties and physical conditions;Types of corrosion; Corrosion control: Material selection, environment control and design;
Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishingof surfaces; Organic coatings; Electroplating and Special metallic plating; Electro polishing and photo-etching; – Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVDand CVD; Surface analysis; Hard-facing, thermal spraying and high-energy processes; Process/materials election. Pollution norms for treating effluents as per standards

Reference Books:
1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi.
2003.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria & Sons, New Delhi, 2004.
3. Material Science – R.S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005.

COMPUTER AIDED MACHINE DRAWING PRACTICE

Course Code	MEPC306
Course Title	Computer Aided Machine Drawing Practice
Number of Credits	2 (L: 0, T: 0, P: 4)
Prerequisites	Engineering Graphics
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to
CO1: Understand the representation of materials used in machine drawing. (K2)
CO2: Draw the development of surfaces for sheet metal working applications. (K3)
CO3: Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded Joints. (K3)

CO4: Construct an assembly drawing using part drawings of machine components. (K5)
CO5: Able to create 3-D modelling of an article and show the intricate parts of the components. (K3)

Course Content:-

List of Practical's/Activities (To perform minimum 6 practical)

Introduction to CAD software
Drawing aids and editing commands
Basic dimensioning, hatching, blocks and views
Isometric drawing, printing and plotting
Machine drawing practice using Auto CAD: (Detailed drawings of following machine partsare to be given to the students to assemble and draw the sectional or plain elevations, plansand side views with dimensioning and bill of materials using cad software.)

1. Sleeve & Cotter Joint
2. Spigot & Cotter Joint
3. Knuckle Joint
4. Stuffing Box
5. ScrewJack
6. Foot Step Bearing
7. Universal Coupling
8. Plummer Block
9. Machine Vice
10. Connecting Rod
11. Protected Type Flanged Coupling.

Reference Books:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company,New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International, 2009

FLUID MECHANICS & HYDRAULIC MACHINERY LAB

Course Code	MEPC307
Course Title	Fluid Mechanics & Hydraulic Machinery Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Fluid Mechanics & Hydraulic Machinery
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1:Measure various properties such as pressure, velocity, flow rate using various instruments. (K5)
CO2: Calculate different parameters such as co-efficient of friction, power, efficiency etc. of varioussystems. (K4)
CO3: Understand the need and importance of calibration of pressure gauges. (K2)
CO4: Describe the construction and working of turbines and pumps.(K2)
CO5: Test the performance of turbines and pumps and Plot characteristics curves. (K5)

List of Practical /Activities (To perform minimum 6 practical)

1. Verification of Bernoulli's theorem.
2. Determination of Coefficient of Discharge of Venturimeter.
3. Determination of Coefficient of Discharge, coefficient of contraction and coefficient of Velocity of Orifice meter
1. Determination of coefficient of friction of flow through pipes.
2. Determination of force exerted by the jet of water on the given vane.
3. Determination of minor losses of flow through pipes.
4. Calibration of pressure gauge using dead weight pressure gauge tester.
5. Trial on centrifugal pump to determine overall efficiency.
6. Trial on reciprocating pump to determine overall efficiency.
7. Trial on Pelton wheel to determine overall efficiency.
8. Trial on Francis turbine to determine overall efficiency.
9. Trial on Kaplan turbine to determine overall efficiency.

THERMAL ENGINEERING LAB-I

Course Code	MEPC308
Course Title	Thermal Engineering Lab-I
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Thermal Engineering – I
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Understand the determination of flash and fire point of a given sample of fuel using given Apparatus(Abels, Cleveland &Penesky martin) (K2)

CO2: Understand the determination of Viscosity of a given sample of oil using given apparatus. (K2)

CO3: Understand the determination of Calorific value of a given sample of fuel using given apparatus. (K2)

CO4:Understand the determination of amount of carbon residue of a given sample of petroleum product.(K2)

CO5: Understand the functions of various parts of IC engines and the working of IC engines.(K2)

List of Practical/Activities (To perform minimum 6 practical)

1. Flash & Fire point tests using Able's/Cleveland/Pensky Martin Apparatus
2. Viscosity measurement, Saybolt viscometer
3. Calorific value tests using Bomb Calorimeter (Solid and Liquid fuels) and Junkers Gas Calorimeter (Gaseous fuels)
4. Carbon residue test using Conradson's apparatus.
5. Assembling and disassembling of I.C. Engines
6. Port timing diagram of Petrol engine
7. Port timing diagram of Diesel engine
8. Valve timing diagram of Petrol engine
9. Valve timing diagram of Diesel engine
10. Study of petrol and diesel engine components and Models

Reference Books:

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, New Delhi

MANUFACTURING ENGINEERING LAB-I

Course Code	MEPC309
Course Title	Manufacturing Engineering Lab-I
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Manufacturing Engineering
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Prepare a mould sand mix and molten metal and calculate the amount of metal to bepoured in the mould. (K3)
CO2: Centre the job and select the proper tool to perform the job on lathe machine. (K5)
CO3: Calculate the taper angle and practice different taper turning methods on lathe. (K4)
CO4: Prepare the edges for welding and select the suitable electrode, voltage and current. (K3)
CO5: Operate the welding transformer and generator to perform various weld joint operations. (K3)

List of Practical's/Activities(To perform minimum 6 practical)

1. Moulding & casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley
2. Arc welding (i) Lap Joint (ii) Butt Joint (iii) T- Joint
3. Gas welding (i) Lap Joint (ii) Butt Joint
4. Spot welding (i) Lap Joint
5. Turning Exercise (i) Facing, Step Turning & Chamfering (ii) Step Turning & Taper Turning
6. (i) Step Turning & Groove Cutting (ii) Step Turning && Knurling (iii) Step Turning &
7. (i) Thread Cutting (ii) Turning and Drilling
8. Grinding the Lathe Cutting tools to the required angles
9. Study of Lathe, Drilling machine, shaping machine and slotting machine
10. The dismantling some of the components of lathe and then assemble the same
11. List the faults associated with lathe and its remedies
12. The routine and preventive maintenance procedure for lathe

Reference Books:

1. Elements of Workshop Technology (Volume I & II) – Hajra Choudhary& Bhattacharaya, Media
Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajender Singh, New age International (P) Ltd. NewDelhi, 2006
3. Workshop Technology – Raghuwanshi, Khanna Publishers. Jain &Gupta, New Delhi, 2002
4. Production Technology – Jain & Gupta, Khanna Publishers, New Delhi, 2006.
5. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi
6. Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi -

Summer Internship-I

Course Code	MESI-310
Course Title	Summer Internship-I
Number of Credits	2 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Internship

Internships may be full-time or part-time; they are full-time in the summer vacation and part-time during the academic session.

Sl. no.	Schedule	Duration	Activities	Credits	Hours of Work
1	Summer Vacation after 2nd Semester	3-4 Weeks	Inter/ Intra Institutional Activities **	2	80 Hours

(** Students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective Institutions; contribution at incubation/ innovation /entrepreneurship cell of the Institute; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the Institutes and Participation in all the activities of Institute's Innovation Council for e.g.: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.)

Benefits to Students:

1. An opportunity to get hired by the Industry/ organization.
2. Practical experience in an organizational setting.
3. Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
4. Helps them decide if the industry and the profession is the best career option to pursue.
5. Opportunity to learn new skills and supplement knowledge.
6. Opportunity to practice communication and teamwork skills.
7. Opportunity to learn strategies like time management, multi-tasking etc. in an industrial setup.
8. Opportunity to meet new people and learn networking skills.
9. Makes a valuable addition to their resume.
10. Enhances their candidacy for higher education.

11. Creating network and social circle and developing relationships with industry people.
12. Provides opportunity to evaluate the organization before committing to a full-time position.

Course Outcome:-

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

C.O.1: Explain the real life organizational and industrial environment situations (K2).

C.O.2: Develop organizational dynamics in terms of organizational behaviour, culture and professional ethics (K1).

C.O.3: Understand the importance of Team work (K2).

C.O.4: Explain invaluable knowledge and networking experience (K2).

C.O.5: Develop skill to build a relationship with a prospective employer (K3).

Course Content:-

Internships are educational and career development opportunities, providing practical experience in a field or discipline. The Summer Internship-I is a student centric activity that would expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

1. Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job.
6. Learn to apply the Technical knowledge in real industrial situations.
7. Gain experience in writing Technical reports/projects.
8. Expose students to the engineer's responsibilities and ethics.
9. Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.

10. Promote academic, professional and/or personal development.
11. Expose the students to future employers.
12. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
13. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Overall compilation of Internship Activities / Credit Framework:

Major Head of Activity	Credit	Schedule	Total Duration	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Performance appraisal/ Maximum points/ activity
Inter/ Intra Institutional Activities	2	Summer Vacation after 2nd Semester	3-4 Weeks	Inter/ Intra Institutional Workshop/ Training	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Working for consultancy/ research project	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Festival (Technical / Business / Others) Events	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council	Certificate	Cell In-charge	Satisfactory/ Good/ Excellent
				Learning at Departmental Lab/Tinkering Lab/ Institutional workshop	Certificate	Cell In-charge	Satisfactory/ Good/ Excellent

STUDENT'S DIARY/ DAILY LOG

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students.

The daily training diary should be signed at the end of each day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and get ratified on the day of his visit.

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

a) Regularity in maintenance of the diary.
b) Adequacy & quality of information recorded.
c) Drawings, sketches and data recorded.
d) Thought process and recording techniques used.
e) Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria:

a) Originality.
b) Adequacy and purposeful write-up.
c) Organization, format, drawings, sketches, style, language etc.
d) Variety and relevance of learning experience.
e) Practical applications, relationships with basic theory and concepts taught in the course.

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Semester IV

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-10	MEPC401	Measurements & Metrology	2	1	0	3	3
2	Programme core course-11	MEPC402	Thermal Engineering - II	2	1	0	3	3
3	Programme core course-12	MEPC403	Strength of Materials	2	1	0	3	3
4	Programme core course-13	MEPC404	Material Testing Lab	0	0	2	2	1
5	Programme core course-14	MEPC405	Thermal Engineering Lab-II	0	0	2	2	1
6	Programme core course-15	MEPC406	Measurements & Metrology Lab	0	0	2	2	1
7	Programme elective course-1 (Any One to be selected)	MEPE407/A	Tool Engineering	3	0	0	3	3
		MEPE407/B	Heat Transfer					
8	Humanities & Social Science- 4	HS 408	Professional Skill Development	2	1	0	3	3
9	Minor Project	MEPR409	Minor Project	0	0	4	4	2
10	Mandatory Course-1	AU410	Essence of Indian Knowledge and Tradition	2	0	0	2	0
			Total	14	3	10	27	20

MEASUREMENTS & METROLOGY

Course Code	MEPC401
Course Title	MEASUREMENTS & METROLOGY
Number of Credits	3(L: 2, T: 1 P: 0)
Prerequisites	NIL
Course Category	Programme core course

Course Outcomes: -By the end of the course, the students are expected to

CO1: Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology. [K1]
CO2: Distinguish between various types of errors. [K2]
CO3: Understand the principle of operation of an instrument and select suitable measuring device for a particular application. [K2]
CO4: Appreciate the concept of calibration of an instrument. [K2]
CO5: Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form. [K3]

Course Content:-

Module- 1:Introduction to measurements andMeasuring instruments
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Explain the basics of measurements.
2) Describe different types of measuring instruments.

Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error.
Measuring instruments: Introduction; Thread measurements: Thread gauge micrometer; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Coordinating measuring machine.

Module-2: Transducers and Strain gauges and Measurement of force, torque, and pressure
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Explain the principal of Transducers and Strain gauges.
2) Describe the measurement of force, torque, and pressure.

Transducers and Strain gauges: Introduction; Transducers: Characteristics, classification of transducers, two coil self-inductance transducers, Piezoelectric transducer; Strain Measurements: Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements.

Measurement of force, torque, and pressure: Introduction; Force measurement: Spring Balance, Proving ring, load cell; Torque measurement: Prony brake dynamometer, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

Module-3:Applied mechanical measurements

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Classify different types of speed and displacement measuring instruments.

2) Describe the principal of hair hygrometer, hydrometer, sight glass, Float gauge and Sphygmomanometer

Applied mechanical measurements:

Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers;

Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotameters, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer.

Miscellaneous measurements: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmomanometer.

Module- 4:Limits, Fits & Tolerances,Angular Measurement andScrew thread Measurements

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Explain the basics of Limits, Fits & Tolerances.

2) Describe the working principal of Angular measuring instrument and Screw thread measuring instruments.

Limits, Fits & Tolerances: Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor's Principle; Design of Plug; Ring Gauges; IS 919-1993 (Limits, Fits & Tolerances, Gauges} IS 3477-1973; concept of multi gauging and inspection. **Angular Measurement:** Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges).

Screw thread Measurements: ISO grade and fits of thread; Errors in threads; Pitch errors; Mea-Mechanical Engineering Curriculum Structure 236 measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

Module- 5:Gear Measurement and Testing andMachine tool testing
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Demonstrate the principal of different types of Gear tooth measuring instruments.
2) Explain the different types of machine tool testing instruments.

Gear Measurement and Testing: Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, run out, composite.
Machine tool testing: Parallelism; Straightness; Squareness; Co-axiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.

Reference Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor,Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering Metrology – Rega Rajendra, Jaico publishers, 2008
5. Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata cgraw Hill, 2005.
7. Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
9. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS
10. Engineering Metrology – K. J. Hume, Kalyani publishers

THERMAL ENGINEERING - II

Course Code	MEPC402
Course Title	Thermal Engineering – II
Number of Credits	3(L: 2, T: 1, P: 0)
Prerequisites	Thermal Engineering – I (MEPC302)
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines. (K2)
CO2: Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart. (K3)

CO3: Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories. (K2)
CO4: Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and byusing Mollier chart. (K3)
CO5: Compare various types of steam turbines with respect to their velocity diagram, work done and diagram efficiency. (K4)

Course Content:-

Module- 1: Gas Turbines and Jet Propulsion

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Classify different types of gas turbines.
2) Compare with I.C. engines and steam turbines.
3) Describe the working of turbojet, ramjet and rocket engine.

Detailed content of the unit: -

Gas Turbines: Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbinewith reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General lay-out of Open cycle constant pressure gas turbine; P-V and T-S diagrams and working; General lay-out of Closed cycle gas turbine; P-V and T-S diagrams and working.
Jet Propulsion: Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.

Module- 1I: Properties of Steam

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Describe the formation of steam and also know the industrial use of steam..
2) Determine internal energy, enthalpy and entropy of wet, dry and superheated steam using steam table.
3) Explain the working of various types of calorimeters.

Detailed content of the unit: -

Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region,

critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat; Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the followingprocesses: Isochoric process, Isobaric process, Hyperbolic process, Isothermal process, Isentropicprocess, Throttling process, Polytropic process; Simple direct problems on the above using tablesand charts; Steam calorimeters: Separating, throttling, Combined Separating and throttling calorimeters – problems.

Module- III: Steam Generators

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Classify steam boiler with example.
2) Describe various types of mountings and accessories.
3) Explain the term actual evaporation, factor of evaporation, boiler efficiency and draught.

Detailed content of the unit: -

Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers; Boiler mountings: Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type, high pressure and low water safety alarm); Boiler accessories: feed pump, economiser, super heater and air pre-heater; Study of steam traps & separators; Explanation of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above; Draught systems (Natural, forced & induced).

Module- IV: Steam Nozzles

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Describe the flow of steam through nozzle.
2) Calculate the velocity of steam at the exit of nozzle.
3) Discuss the effect of friction in nozzle and the working of steam jet injector

Detailed content of the unit: -

Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method and Mollier chart; Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maximum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems

Module- V: Steam Turbines

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Classify steam turbine with example.
2) Explain the working principle of De-Laval and Parson's reaction turbine.
3) Describe various methods of governing of steam turbine.

Detailed content of the unit: -

Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple De-Laval turbine with line diagrams- Velocity diagrams; Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency; Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity; Working principle with line diagram of a Parson's Reaction turbine–velocity diagrams; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re-heating and re-heating factors (Problems omitted); Governing of steam turbines: Throttle, By-pass & Nozzle control governing.

Reference Books:

A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication, New Delhi
2. Thermal Engineering – R.K. Rajput, Laxmi Publication New Delhi
3. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
4. Treatise on Heat Engineering in MKS and SI Units – V.P. Vasandani& D.S. Kumar, Metropolitan
Book Co. Pvt. Ltd, New Delhi.

STRENGTH OF MATERIALS

Course Code	MEPC403
Course Title	Strength of Materials
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	Engineering Mechanics
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces. (K3)
CO2: Compute shear force and bending moment at any section of beam and draw the S.F. & B.M
diagrams of for UDL and Point loads. (K3)
CO3: Apply the Theory of Simple Bending and Deflection of Beams. (K3)
CO4: Calculate the Torsion in Shafts and the stress and deflection of the spring. (K4)
CO5: Analyze the longitudinal and hoop stresses in the Thin Cylindrical Shells**.** (K4)

Course Content:-

Module- 1:Simple Stresses and Strains and Strain Energy

Number of class hours: 6 hrs.

Suggestive Learning Outcomes:

1) Describe Types of forces; Stress, Strain and their nature.
2) Establish the relation between elastic constants
3) Explain Significance of factor of safety.
4) Understand Strain energyor resilience.

Detailed content of the unit: -

Simple Stresses and Strains: Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics.
Strain Energy: Strain energy or resilience, proof resilience and modulus of resilience; Derivation ofstrain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load; related numerical problems.

Module- 2:Shear Force & Bending Moment Diagrams

Number of class hours: 6 hrs.

Suggestive Learning Outcomes:

1) Identify different types of beams.
2) Differentiate different types of loads.
2) Calculate the shear force and bending moment.
3) Draw the S.F and B.M. diagrams.

Detailed content of the unit: -

Shear Force & Bending Moment Diagrams: Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam; Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

Module-3:Theory of Simple Bending and Deflection of Beams

Number of class hours: 6 hrs

Suggestive Learning Outcomes:

1) Derive the Bending Equation.
2) Explain deflection of cantilever and simply supported beams with point load and UDL.

Detailed content of the unit: -

Theory of Simple Bending and Deflection of Beams: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions
in theory of simple bending; Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross- section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

Module-4:Torsion in Shafts and Springs

Number of class hours: 6 hrs

Suggestive Learning Outcomes:

1) Calculate the polar M.I. for solid and hollow shafts.
2) Derive the torsional equation.
3) Classify different types of springs.
4) Explain the deflection formula for closed coil helical spring.

Detailed content of the unit: -

Torsion in Shafts and Springs: Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation $T/J=fs/R=G\theta/L$;
Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclatureof closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size
of coil and number of coils.

Module-5: Thin Cylindrical Shells

Number of class hours: 6 hrs

Suggestive Learning Outcomes:

1) Explain the longitudinal and hoop stresses.
2) Derive the expressions for the longitudinal and hoop stress for seamless and seam shells.

Detailed content of the unit: -

Thin Cylindrical Shells: Explanation of longitudinal and hoop stresses in the light of circumferentialand longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.

References:

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017
2. Strength of Materials – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications,
New Delhi, 2013

3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

6. NPTEL Online Courses.

MATERIAL TESTING LAB

Course Code	MEPC404
Course Title	Material Testing Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Material Science & Engineering, Strength of Materials
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Identify the given specimen by viewing the micro structure using metallurgical microscope. (K3)

CO2: Identify the cracks in the specimen using different techniques. (K3)

CO3: Determine the various types of stress and plot the stress strain diagram for mild steel. (K5)

CO4: Determine the torsion, bending, impact and shear values of given materials. (K5)

CO5: Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring. (K5)

Course Content:-

List of Practical / Activities (To perform minimum 6 practical)

1. Prepare a specimen and examine the microstructure of the Ferrous and Non- ferrous metals using the Metallurgical Microscope.
2. Detect the cracks in the specimen using Magnetic particle test.
3. Detect the cracks in the specimen using Visual inspection and ring test.
4. Detect the cracks in the specimen using Die penetration test.
5. Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum.
6. Finding the resistance of materials to impact loads by Izod test and Charpy test.
7. Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
8. Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
9. Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
10. Single or double Shear test on M.S. bar to finding the resistance of material to shear load.

Reference Books:

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

THERMAL ENGINEERING LAB-II

Course Code	MEPC405
Course Title	Thermal Engineering Lab-II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Thermal Engineering – I, Thermal Engineering – II
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Evaluate the performance characteristics of single cylinder diesel/petrol engine at differentloads and draw the heat balance sheet. (K5)
CO2:Calculate the indicated power of individual cylinders of an engine by using morse test.(K3)
CO3: Evaluate the performance characteristics Multi stage air compressor (K5)
CO4: Evaluate the co efficient of performance of refrigerator(K5)
CO5: Calculate the thermal conductivity of material(K3)

List of Practical/Activities (To perform minimum 6 practical)

11. Conduct Performance test on 2-S CI/SI engine.
12. Conduct Performance test on 4-S CI/SI engine.
13. Conduct Heat balance test on CI/SI engine.
14. Conduct Morse test to determine the indicated power of individual cylinders.
15. Conduct performance test on multi stage reciprocating compressor
16. Conduct performance test on VCR test rig to determine COP of the refrigerator
17. Conduct performance test on A/C test rig to determine COP of the refrigerator
18. Leak detection of refrigeration equipment
19. Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick cylinder
20. Study of high pressure boiler, boiler mountings and accessories with model

Reference Books:

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi

MEASUREMENTS & METROLOGY LAB

MEPC406	MEPC406
Course Title	Measurements & Metrology Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Measurements & Metrology
Course Category	Programme core course

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

CO1: Measure various component of linear measurement using Vernier calipers and Micrometer.[K3]
CO2: Measure various component of angle measurement using sine bar and bevel Protractor. [K4]
CO3: Measure the geometrical dimensions of V-thread and spur gear. [K4]
CO4: Measure the geometrical dimensions of V-Thread using thread Vernier gauge. [K3]
CO5: Measure the thickness of ground MS plates using slip gauges. [K4]

List of Practical/ Activities (To perform minimum 6 practical)

1. Measure the diameter of a wire using micrometer and compare the result with digital micrometer
2. Measure the angle of the machined surface using sine bar with slip gauges.
3. Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
4. Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.
5. Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
6. Measure the thickness of ground MS plates using slip gauges.

Reference Books:

1. Engineering Metrology – R. K. Jain
2. Engineering precision metrology – R. C. Gupta
3. A Hand book of Industrial Metrology – ASME

TOOL ENGINEERING

Course Code	MEPE407/A
Course Title	Tool Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Understand concepts, principles and procedures of tool engineering. **(K1)**
CO2: Classify and explain various tools and tool operations. **(K2)**
CO3: Select proper tool and a die for a given manufacturing operation to achieve highest productivity. **(K2)**
CO4: Estimate tool wear and tool life. **(K3)**
CO5: Understand the types of press, forming dies and their constructions. **(K1)**

Course Content:-

Module- 1: Metal Cutting

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Describe Mechanics of Metal cutting.
2) Describe characteristics and applications of cutting fluids.
3) Explain the tool wear and tool life equations.

Detailed content of the unit: -

Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle ; simple numerical only; types of metal cutting process; orthogonal; oblique and form cutting;
Cutting fluids: types; characteristics and applications
Tool wear: Types of wear; Tool life; Tool life equations.

Module- 2: Machinability

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Describe Machinability and its factor.
2) Describe different cutting tool materials and their heat treatment processes.
3) Explain the cutting tool geometry.

Detailed content of the unit: -

Definition; factors affecting Machinability; Machinability index
Tool materials: Types; characteristics; applications; Heat treatment of tool steels; Specification of carbide tips; Types of ceramic coatings.
Cutting Tool Geometry: Single point cutting tool; drills; reamers; milling; cutters

Module- 3: Types of Dies and Construction

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:
1) Understand the applications of different types of die.
2) Describe compound and combination dies.
3) Explain the punch and die mountings.

Detailed content of the unit: -

Simple Die; Compound Die; Progressive Die; Combination Die
Punch & Die mountings: pilots; strippers; mis-feed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.

Module- 4: Die Design Fundamentals

Number of class hours: 6 Hrs

Detailed content of the unit: -
Suggestive Learning Outcomes:

4) Describe the die operations such as blanking, coining etc.
5) Describe compound Die set; Die shoe; Die area
3) Calculate material utilization factor.

Detailed content of the unit: -

Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.

Module- 5: Forming Dies

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Understand Bending Dies; bend allowance; spring back etc.
2) Describe Drawing operations and able to calculate drawing blank size.
3) Explain the Constructional features of - Pressure Die casting dies.

Detailed content of the unit: -

Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length

Drawing: operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies.

Fundamentals of other Tools: Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.

Reference Books:

1. Tool Design - Donaldson Anglin, Tata McGraw Hill.
2. Production Technology- H.M.T.Jain, Tata McGraw Hill.
3. A Text Book of Production engineering – P.C. Sharma, S.Chand & Co.
4. Production Technology, R.K.Jain, Khanna Publishers.

HEAT TRANSFER

Course Code	MEPE407/B
Course Title	Heat Transfer
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Mechanical Engineering (MEPC301)
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Know the basics of heat transfer (K1).
CO2: Explain the concepts of conduction and convection (K2).
CO3: Solve the effectiveness of fins (K3).
CO4: Identify concepts of radiation (K2).
CO5: Understand the basics and functions of heat exchangers (K2).

Course Content:-

Module- 1: Conduction
Number of class hours: 6 hrs.

Suggestive Learning Outcomes:
1) Describe Fourier law.
2) Correlate conductivity and heat transfer rate.
3) Distinguish between the heat transfers inplane wall, tube and sphere.
4) Identify various boundary conditions.

Detailed content of the unit: -

Conduction - Fourier law of heat conduction for isotropic material; Thermal conductivity; Derivation of the energy equation in three dimensions including transient effect; Non-dimensional - thermal diffusivity and Fourier number; Types of boundary conditions (Dirichlet, Neumann, mixed type); One dimensional solution with and without heat generation; Analogy with electrical circuits.

Module- 2: Fins:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Identify the methods to evaluate fins.
2) Estimate effectiveness and efficiency of fins.
3) Calculate the dimensions of fins.

Detailed content of the unit: - 6 hrs

Fins: Rectangular and pin fins. Fin effectiveness and efficiency;Critical thickness of insulation, Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heisler Chart

Module-3: Convection:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Recognize free convection.
2) Compare significances of non-dimensional numbers.
3) Interpret the boundary layer.

Convection: Introduction, Newton's law of cooling; Momentum and energy equations in two dimensions; non-dimensionalisation, importance of non-dimensional quantities and their physical significance. Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat and mass transfer, Natural convection, effect of coupling on the conservation equations.

Module-4: Radiation:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Illustrate emissivity, reflectivity, and transmissivity.
2) Describe radiation exchange phenomena for different surfaces.
3) Demonstrate irradiation, radiosity.

Radiation : Physical mechanism of thermal radiation, laws of radiation, definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmissivity, irradiation, radiosity, radiation exchange between black bodies, concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method, radiation shielding.

Module- 5Heat exchangers:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Understand the basics and functions of heat exchangers.
2) Calculate different parameters of heat exchangers.

Heat exchangers: Types of heat exchangers, parallel and counter flow types, Introduction to LMTD, correction factors,fouling factor. Concepts of NTU method for heat exchangers

References:

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 7th ed., 2011.
2. Ozisik, M.N., Heat Transfer - A Basic Approach, Mc-Grawhill, 1985.
3. Holman, J.P., Heat Transfer, Mc-Grawhill, 8th Ed., 1997.
4. Gupta, V., Elements of Heat & Mass Transfer, New Age International, 2nd Ed., 1994.
5. Cengel, Y.A., "Heat Tran5fer - A Practical Approach", McGraw-Hill, 1998.
6. Rajput, R.K., "Heat & Mass Transfer" Khanna Publishers.

PROFESSIONAL SKILL DEVELOPMENT

Course Code	HS 408
Course Title	Professional Skill Development
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	NIL
Course Category	Humanities & Social Science

Course Outcomes:

After successful completion of this course, students would be able to:

CO1: Understand the importance of soft skills and personality in a person's career growth. K2

CO2: Communicate uprightly while looking for a job. K3

CO3: Learn and utilize the key skills while facing job interview. K2 & K3

CO4: Demonstrate effective writing skills for professional excellence. K2

CO5: Explore ways to make oral communications interesting and captivating. K3

Unit – 1Soft Skills & Personality Development

Number of Class Hours: 06 **Marks: 08**

Learning Outcomes:

1) Get acquainted with the details of soft skills and the importance of personality K1
2) Understand the importance of communication skills in developing one's personality. K2
3) Understand the importance of soft skills and personality in a person's career growth K2

Detailed Content:

1. **Soft skills - Demand of Every Employer:** How soft skills complement hard skills, Soft skills as competitive weapon, Classification of soft skills into personal and interpersonal traits, Soft skills needed for career growth- Time management, Leadership traits, Communication and networking skills, Teamwork and Interpersonal skills, Empathy and Listening skills, Responsibility, Attitude, Ethics, Integrity, Values and Trust.

2. **Personality Development – A must for career Growth:** Grooming one's personality as a signal that others read, mapping different personality types – Perfectionists, Helpers, Achievers, Romantics, Observers, Questioners, Enthusiasts or adventurers, Bosses or asserters, Mediators or peacemakers.

Unit – 2 Looking for a Job

Number of Class Hours: 05 **Marks: 08**

Learning Outcomes:

1) Learn to write Job Applications, Cover Letter, Resume, Curriculum Vitae, bio data K2
2) Develop interpersonal skills/ soft skills through Group Discussion. K3

Detailed Content

1. Job Application : Job Application Letters in response to advertisements,Self-application letters for Jobs
2. Curriculum Vitae/Resume: Formats of Resume and CV for a fresher and for someone with experience, Differences between Resume, CV, Bio-data, and choice of referees.
3. Group Discussion : A test of soft skills

Unit – 3 Job Interviews

Number of Class Hours: 05 **Marks: 08**

Learning Outcomes:

1) Understand the importance of Job interviews in the selection procedure K2
2) Comprehend and Adapt to various types, stages and processes of job interviews K1&K3
3) Demonstrate appropriate body language in interviews K3

Detailed Content

1. Job Interviews: Definition, processes of Interviews, Types of Interviews
2. Stages in Job interviews: Before interview stage, On D' Day, after interview stage.

3. Importance of Body language in Interviews: : Facing an interview, Using proper verbal and non- verbal cues, the perfect handshake ,Exhibiting confidence, the business etiquettes to maintain, body language ,and dress code - what to speak, how to speak in an interview and answer interview questions, negative body language, handling an awkward situation in an interview.
4. Probable interview questions and answers.
5. Mock interviews to be conducted by mock interview boards.

Unit – 4 Enhancing Writing skills

Number of Class Hours: 12 **Marks: 08**

Learning Outcomes:

1) Write dialogues on given topics / situations K3
2) Express facts & ideas effectively in written form K3
3) Learn to write formal and informal letters & emails. K2

Detailed Content

1) **Art of Condensation**: Principles to increase clarity of written communication.
2) **Dialogue Writing:** Meeting and Parting, Introducing and Influencing, Requests, Agreeing and Disagreeing, Inquiries and Information.
3) **Letter Writing:** Placing an order, Letter to Inquiry, Letter of Complaint, Letter seeking permission.
4) **E-mail writing**: writing the perfect e-mail, steps to the perfect e-mail, formal and informal greetings, requests through an e-mail, writing an apology, complaint and seeking help and information in an e-mail, informing about a file attached in an email, writing the formal ending of an e-mail.

Unit – 5 Conversations, Panel Discussion and Public Speaking

Number of Class Hours: 12 **Marks: 08**

Learning Outcomes:

1. Speak persuasively on a given topic fluently and clearly. K3
2. Participate in formal and informal conversations. K3
3. Express ideas and views on given topics. K3

Detailed Content

1) **Conversation & Dialogue Practice:**

a) Introducing oneself
b) Introduction about family
c) Discussion about the weather
d) Seeking Permission to do something
e) Seeking Information at Railway Station/ Airport
f) Taking Appointments from superiors and industry personnel
g) Conversation with the Cashier- College/ bank
h) Discussing holiday plans
i) Asking about products in a shopping mall
j) Talking over the Telephone

2) **Panel Discussion:** Act of a moderator - ways to respond to audience questions.
Suggested topics: Current Affairs

3) **Public Speaking:** Art of Persuasion, Making speeches interesting, delivering different types of speeches: Ceremonial, Demonstrative, Informative, and Persuasive.

List of Software/Learning Websites

1. http://www.free-english-study.com/
2. http://www.english-online.org.uk/course.htm
3. http://www.english-online.org.uk/
4. http://www.talkenglish.com/
5. http://www.learnenglish.de/

Reference Books:
(Name of Authors/ Title of the Book /Edition /Name of the Publisher)

1) Sanjay Kumar &PushpLata Communications Skills , 2nd Edition,Oxford University Press
2) Meenakshi Raman & Sangeeta Sharma Technical Communication: Principles & Practice Oxford University Press
3) M. Raman & S. Sharma Technical Communication Oxford University Press
4) Barun Kumar Mitra, Personality Development and Soft Skills Oxford University Press

MINOR PROJECT

Course Code	MEPR409
Course Title	Minor Project
Number of Credits	2 (L: 0, T: 0, P: 4)
Prerequisites	Nil
Course Category	Minor Project

Course Outcome:-

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

C.O.1: Demonstrate a through and systematic understanding of project contents (K2).

C.O. 2: Identify the methodologies and professional way of documentation and communication (K3).

C.O. 3: Illustrate the key stages in development of the project (K2).

C.O. 4: Develop the skill of working in a Team (K3).

C.O. 5: Apply the idea of mini project for developing systematic work plan in major project (K3).

Course Content:-

The minor project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Perform detailed study about various components of a project.
2) Study about methodologies and professional way of documentation and communication related to project work.
3) Develop idea about problem formulation.
4) Knowledge of how to organize, scope, plan, do and act within a project thesis.
5) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
6) Demonstrate the implementation of a minor project work.

ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	AU410
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Mandatory Course

Course Outcomes: -

After completion of the course the students will be able to-

CO 1: Understand the essence of Indian tradition and the importance of carrying them forward. (**K_2**)
CO 2: Understand the Vedic literature and important ideas discussed in the Vedas. (**K_2**)
CO 3: Describe scientific heritage of ancient India along with comprehending its relevance and application in various modern scientific disciplines. (**K_1**)
CO 4: Relate the theoretical and practical sides of the science of Yoga and Ayurveda with modern knowledge systems. (**K_1**)
CO 5: Explain the worth of Indian intellectual heritage, traditional practices and Indian lifestyle from scientific lenses. (**K_4**)

Module- 1

Name of the Module: Introduction to Vedic Literature

Number of class hours:**05**

Content:

- General structure of Vedic Literature,
- Different theories on the age of the Vedas,
- Educational system in the Vedic times
- subject-matter of Ṛigveda-samhitā, Sāmaveda-Saṁhitā, Yajurveda-Saṁhitā, Atharvaveda-Saṁhitā, Brāhmaṇa and Āraṇyaka literature, Upaveda

Learning outcomes of the Module

1	Describe the Vedic literature (K1)
2	Outline the heritage of ancient India specially the scientific knowledge that is embedded in the Vedas will be shown through this module (K2)

Module- 2

Name of the Unit: Fundamental doctrines of the Upaniṣhads

Number of class hours:**05**

Content:

- General introduction of Upaniṣhadic literature
- Philosophical ideas and ethics in Upaniṣhads

Learning outcomes of the Module

1.	Understand Upaniṣhads and its significance as the perennial source Indian philosophy (K2)
2.	Explain the scientific temperament, knowledge and methods of scientific enquiry that is embedded in the Upaniṣhads (K2)

Module- 3

Name of the Unit: Vedāṅgas, Purāṇas and Dharmaśāstra Literature

Number of class hours:**05**

Content:

- Introduction to Vedāṅga Literature
- History of Sanskrit Grammar
- An Overview of Purāṇic literature
- History of Dharmaśāstra

Learning outcomes of the Module

1.	Describe various scientific and academic disciplines of ancient India along with scientific knowledge that is rooted in the Puranic literature (K1)
2.	Remember ancient system of Law and Governance in a nutshell especially the principles and philosophy behind the ancient constitutions (K1)

Module- 4

Name of the Module: Introduction to Indian Philosophical Systems, Scientific aspects of Indian knowledge systems

Number of class hours:**05**

Content:

- General introduction to Indian Philosophical systems, i.e. Orthodox and Heterodox
- Glimpse of ancient Indian Science and technology.

Learning outcomes of the Module

1.	Describe the Indian Philosophical systems and their relevance and application in modern scientific enquiry (K1)
2.	Remember the various scientific methods, means and validity of knowledge as discussed in these systems, methods of discussion, debate and systemic learning as structured in ancient Indian knowledge literature (K1)

Module- 5

Name of the Unit: Introduction to Yoga &Ayurveda

Number of class hours:**05**

Content:

- General ideas about Yoga,
- Origin and Development of Pātañjali Yoga,
- Origin and Development of Ayurveda and its relevance

Learning outcomes of the Module

1.	Understand about principles and philosophy of Yogic sciences and Ayurveda. (K2)
2.	Identify various ancient texts, practices of Yoga and Ayurveda along with gaining basic practical and theoretical knowledge which they will be able to relate with modern healthcare systems (K4)

References: -

1) Capra, Fritjof. The Tao of Phisics. New York: Harpercollins, 2007.
2) Capra, Fritjof. The Web of Life. London: Harpar Collins Publishers, 1996.
3) Dasgupta, Surendranath & De, Sushil Kumar. A History of Sanskrit Literature.Delhi: Motilal Banarsidass, 2017.
4) Dasgupta, Surendranath. A History of Indian Philosophy. Delhi: Motilal Banarsidass, 1991.
5) Gonda, Jan. A History of Vedic Literature. Delhi: Monohar Publishers and Distributors, 2020.
6) Jha, R.N. Science and Consciousness Psychotherapy and Yoga Practices. Delhi: VidyanidhiPrakashan, 2016.

7) Kane. P.V. History of Dharmasastra, Poona: Bhandarkar Oriental Research Institute, 1930.
8) Max Muller. Ancient Sanskrit Literature, London: Spottiswoode and Co., 1859.
9) Pride of India,New Delhi: Samskrita Bharati, 2006.
10) Shastri, Gourinath. A History of Vedic Literature, Kolkata: Sanskrit Pustak Bhandar, 2006.
11) Sinha, Jadunath. Indian Philosophy. Delhi: Motilal Banarsidass,1938.
12) Wujastiyk, Dominik. The Roots of Ayurveda. India: Penguin India, 2000.

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Semester V

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-16	MEPC501	Advanced Manufacturing Processes	3	0	0	3	3
2	Programme core course-17	MEPC502	Theory of Machines & Mechanisms	2	0	0	2	2
3	Programme core course-18	MEPC503	Industrial Engineering & Management	2	0	0	2	2
4	Programme core course-19	MEPC504	CAD/CAM Lab	0	0	2	2	1
5	Programme core course-20	MEPC505	Manufacturing Engineering Lab-II	0	0	2	2	1
6	Programme elective course-2 (Any One to be selected)	MEPE506/A	Computer Aided Design and Manufacturing	3	0	0	3	3
		MEPE506/B	Refrigeration & Air-conditioning					
7	Programme elective course-3 (Any One to be selected)	MEPE507/A	Mechatronics	3	0	0	3	3
		MEPE507/B	Industrial Robotics & Automation					
8	Open elective course-1	(Any one to be selected from Annexure-I)		3	0	0	3	3
9	Summer Internship-II (6 weeks) after IV Semester	MESI509	Summer Internship-II	0	0	0	0	3
10	Major Project	MEPR510	Major Project- I	0	0	2	2	1
			Total	16	0	6	22	22

ADVANCED MANUFACTURING PROCESSES

Course Code	MEPC501
Course Title	Advanced Manufacturing Processes
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Mechanical Engineering Manufacturing
Course Category	Programme core course-16

Course Outcomes: - By the end of the course, the students are expected to

CO1: Know the Operation and control of different advanced machine tools and equipment. **(K1)**
CO2: Produce jobs as per specified requirements by selecting the specific machining process. **(K2)**
CO3: Develop the mind set for modern trends in manufacturing and automation. **(K1)**
CO4: Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing of plastics. **(K2)**

Course Content:-

Module- 1: Jigs & Fixtures

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

6) Know the functions of Jigs and Fixtures.
7) Know the design of drill jigs.
3) Basic principles of the clamping.

Detailed content of the unit: -

Definition of jig; Types of jigs: Leaf jig, Box and Handle jig, Template jig, Plate jig, Indexing jig, Universal jig, Vice jigs - constructional details of the above jigs; General consideration in the design of drill jigs; Drill bush; Types of fixtures: Vice fixtures, Milling fixtures, Boring fixtures, Grinding fixtures - constructional details of the above fixtures; Basic principles of location; Locating methods and devices; Basic principles of the clamping; Types of clamps: Strap clamps, Cam clamps, Screw clamps, Toggle clamps, Hydraulic and Pneumatic clamps.

Module- 2: Jig Boring

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Application of Jig boring on vertical milling machine.
2) Know the applications of jig-boring machines.
3) Identify different fabrication methods of plastic processing

Detailed content of the unit: -

Introduction; Jig boring on vertical milling machine; Types jig boring machines: Open front machine, Cross rail type machine - constructional details & their working; System of location of holes.

Plastic Processing: Processing of plastics; Moulding processes: Injection moulding, Compression moulding, Transfer moulding; Extruding; Casting; Calendaring; Fabrication methods-Sheet forming, Blow moulding, Laminating plastics (sheets, rods & tubes), Reinforcing; Applications of Plastics.

Module- 3: Modern Machining Processes

Number of class hours: 8 Hrs.

Suggestive Learning Outcomes:

Detailed content of the unit: -

1) Able to distinguish between non-conventional machining and traditional machining processes.
2) Application of different non-traditional machining (NTM).
3) Influence of the process parameter in NTM.

Detailed content of the unit: -

Introduction – comparison with traditional machining; Ultrasonic Machining: principle, Description of equipment, applications; Electric Discharge Machining: Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications; Wire cut EDM: Principle, Description of equipment, Controlling parameters; applications; Abrasive Jet Machining: principle, description of equipment, application; Laser Beam Machining: principle, description of equipment, application; Electro Chemical Machining: description of equipment, application.

Module- 4: CNC Milling Machines

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Know about the advancements in the area of manufacturing and production processes.
2) Acquire the knowledge & skills necessary for working in modern manufacturing environment.
3) Know the working of machine tool automation.

Detailed content of the unit: -

Vertical and horizontal machining center: Constructional features, Axis identification, Electronic control system. Automatic tool changer and tool magazine; CNC programming: Preparatory functions (G code), miscellaneous functions (M code), Part programming including subroutines and canned cycles. Principles of computer aided part programming.
Machine Tool Automation: Introduction and Need; (A) Single spindle automates, transfer lines. (B) Elements of control system, Limit switches, Proximity switches, Block diagram for feedback and servo control system, Introduction to PLC, Block diagram of PLC.

Module- 5: Special Purpose Machines (SPM)

Number of class hours: 4 Hrs.

Suggestive Learning Outcomes:

1) Get familiarized with, Special Purpose Machine (SPM) and its design
2) Understand different types of maintenance
3) Concept of Total Productive Maintenance (TPM).

Detailed content of the unit: -
Concept, General elements of Special Purpose Machine (SPM), Productivity improvement by SPM, Principles of SPM design
Maintenance of Machine Tools: Types of maintenance, Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records, Housekeeping. Introduction to Total Productive Maintenance
(TPM).

Reference Books:

1. Production Technology – HMT, Banglore, Tata Mc-Graw Hill
2. CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
3. Non conventional Machining – P. K. Mistra, NarvasaPublishining House
4. Manufacturing Processes – Begman& Amsted, John Willey and Sons.
5. Advanced manufacturing technology – David L. Goetsch
6. Exploring Advanced Manufacturing Technologies – Stephen F. Krar& Arthur Gil, Industrial Press.

THEORY OF MACHINES & MECHANISMS

Course Code	MEPC502
Course Title	Theory of Machines & Mechanisms
Number of Credits	2(L: 2, T: 0 P: 0)
Prerequisites	NIL
Course Category	Programme core course

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

CO1: Understand Kinematics and Dynamics of different machines and mechanisms [K1]
CO2: Select Suitable Drives and Mechanisms for a particular application [K2]
CO3: Appreciate concept of balancing and Vibration. [K3]
CO4: Develop ability to come up with innovative ideas. [K4]
CO5: Understand different types of cams and their motions and also draw cam profiles for various motion. [K1]

Course Content:-

Module- 1: Cams and Followers
Number of class hours: 5 Hrs.
Suggestive Learning Outcomes:
1) Explain the concept of Cams and Followers.
2) Draw the profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion.

Cams and Followers: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method).

Module-2: Power Transmission
Number of class hours: 5 Hrs.
Suggestive Learning Outcomes:
1) Calculate the Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension of different types of belt drive.
2) Describe the principal of different types of gears and gear trains.

Power Transmission: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission

(Simple numerical); Chain Drives – Advantages & Disadvantages; Selection of Chain & Sprocket wheels; Methods of lubrication; Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for compound, reverted and simple epicyclic gear train; Methods of lubrication; Law of gearing; Rope Drives – Types, applications, advantages & limitations of Steel ropes.

Module-3: Flywheel and Governors
Number of class hours: 5 Hrs.
Suggestive Learning Outcomes:
1) Understand the concept, function, application and significance of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine.
2) Describe the principal of different types of Governors.

Flywheel and Governors: Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no Numerical); Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Governors - Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications & Terminology of Governors; Comparison between Flywheel and Governor.

Module- 4: Brakes, Dynamometers, Clutches & Bearings
Number of class hours: 5 Hrs.
Suggestive Learning Outcomes:
1) Explain the basics of different types of Brakes, Dynamometers.
2) Describe the Construction and working of different types of Clutches & Bearings.

Brakes, Dynamometers, Clutches & Bearings: Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers; Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; Construction and working of i) Rope Brake Dynamometer, ii) Hydraulic Dynamometer, iii) Eddy current Dynamometers; Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multi plate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numerical on single and Multi plate clutch); Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot Torque & power lost in friction (no derivation) Simple numerical.

Module- 5: Balancing & Vibrations
Number of class hours: 5 Hrs.
Suggestive Learning Outcomes:
1) Demonstrate the Concept of balancing for single rotating mass and for several masses revolving in same plane.
2) Explain the Concept and terminology used in vibrations and their effects.

Balancing & Vibrations: Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; Concept and terminology used in vibrations, Causes of vibrations in machines; their harmful effects and remedies.

Reference Books:
1. Theory of machines – S.S, Rattan, Tata McGraw-Hill publications.
2. Theory of machines – R.K. Bansal, Laxmi publications
3. Theory of machines – R.S. Khurmi & J. K. Gupta, S. Chand publications.
4. Dynamics of Machines – J B K Das, Sapna Publications.
5. Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd

INDUSTRIAL ENGINEERING & MANAGEMENT

Course Code	MEPC503
Course Title	Industrial Engineering& Management
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Programmecorecourse

Course Outcomes: - By the end of the course, the students are expected to
CO1: Explain the different types of layout and plant maintenance with safety. (K2)
CO2: List and explain the need of method study and work measurements. (K2)
CO3: Explain the production planning and quality control, and its functions. (K2)
CO4: Understand the basic principles, approaches and functions of management and identifyconcepts to specific situations. (K2)
CO5: List and explain the different financial sources and methods of inventory management. (K2)

Course Content:-

Module- 1: Plant Engineering and Plant Safety

Number of class hours: 5 Hrs.

Suggestive Learning Outcomes:
1) Understand Plant layout.
2) Explain Materialhandling equipment.
3) Describe Plant maintenance
4) Illustrate Importance of Plant Safety.

Detailed content of the unit: -

Plant Engineering: Plant; Selection of site of industry; Plant layout; Principles of a goodlayout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Materialhandling equipment; Plant maintenance; Importance; Break down maintenance; Preventivemaintenance and Scheduled maintenance.
Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Preventionof Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation;Mediation.

Module- 2: Work Study, Method Study and Work Measurement

Number of class hours: 5 Hrs.

Suggestive Learning Outcomes:

4) Describe Work Study techniques.
5) Explain Method Study procedure**.**
6) Define and explain Work Measurement.

Detailed content of the unit: -

Work Study: Productivity; Standard of living; Method of improving Productivity; Objectives;Importance of good working conditions
Method Study: Definition; Objectives; Selection of a job for method study; Basic procedure for conductof Method study; Tools used; Operation process chart; Flow process chart; Two handed processchart; Man Machine chart; String diagram and flow diagram.
Work Measurement: Definition; Basic procedure in making a time study; Employees rating factor;Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculationof standard time; Numerical Problems; Basic concept of production study; Techniques of WorkMeasurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determinedMotion Time System (PMTS).

Module- 3: Production Planning and Control, Quality Control

Number of class hours: 5 Hrs.

Suggestive Learning Outcomes:

1) Demonstrate the methods of Production Planning and Control.
2) Explain different types of Quality Control techniques.

Detailed content of the unit: -

Production Planning and Control: Introduction; Major functions of Production Planningand Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling;Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles ofProduct and Process Planning; Make or Buy decision; Numerical problems.
Quality Control: Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection;Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Methodof Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve(O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 QualityManagement System Registration/Certification procedure; Benefits of ISO to the organization.

Module- 4: Principles of Management and Personnel Management

Number of class hours: 5 Hrs.

Suggestive Learning Outcomes:

1) Describe different Principles of Management.
2) Explain the scope of Human Resource Management.
3) Define Job Evaluation, Merit Rating and Wages and Salary Administration.

Detailed content of the unit: -

Principles of Management: Definition of Management; Administration; Organization; F.W.Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization:Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership;Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; ModernManagement Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zerodefect concept; 5S Concept; Management Information Systems. **Personnel Management:** Responsibilityof Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training;On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectivesand Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type ofWage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan; Numerical Problems.

Module- 5: Financial Management and Material Management

Number of class hours: 5 Hrs.

Suggestive Learning Outcomes:

1) Describe the basics Financial Management.
2) Explain the methods of Material Management.

Detailed content of the unit: -

Financial Management: Fixed and Working Capital; Resources of Capital; Shares Preferenceand Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: DirectCost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation;Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method;Numerical Problems.
Material Management: Objectives of good stock control system; ABC analysis of Inventory; Procurementand Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantityproblems; Supply Chain.

Reference Books:
1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications(P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill InternationalEdition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

CAD/CAM LAB

Course Code	MEPC504
Course Title	CAD/CAM LAB
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Engineering graphics, Computer Aided Machine Drawing
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Understand the fundamentals and use CAD (K2).
CO2: Conceptualize drafting and modelling in CAD (K2).
CO3: Interpret the various features in the menu of solid modelling package (K2).
CO4: Synthesize various parts or components in an assembly (K5).
CO5: Prepare CNC programmes for various jobs (K3).
Course Content:-

S.No.	Topics for practice
PART-A	**Introduction:** Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.
	Exercises: 3D Drawings of 1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing: 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing.
PART-B	**CNC Programming and Machining:** Introduction; 1). Study of CNC lathe, milling; 2). Study of international standard codes: G-Codes and M-Codes; 3). Format – Dimensioning methods; 4). Program writing – Turning simulator – Milling simulator, IS practice – commands menus; 5). Editing the program in the CNC machines; 6). Execute the program in the CNC machines; Exercises: Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.
	CNC Turning Machine: (Material: Aluminium/Acrylic/Plastic rod) 1. Using Linear and Circular interpolation - Create a part program and produce component in the Machine. 2. Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine. 3. Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.
	CNC Milling Machine (Material: Aluminium/ Acrylic/ Plastic) 1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine. 2. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine. 3. Using subprogram - Create a part program for mirroring and produce component in the

	Machine.

Reference Books:

1. Machine Drawing – P.S. Gill S. K. Kataria& Sons, Delhi, 17th revised edition, 2001
2. Mechanical Draughtsmanship - G.L. TamtaDhanpat Rai & Sons, Delhi, 1992
3. Inside AutoCAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985
4. CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan & V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition,
5. Engineering AutoCAD, A.P. Gautam & Pradeep Jain, Khanna Book Publishing Co., Delhi

MANUFACTURING ENGINEERING LAB-II

MEPC406	MEPC505
Course Title	Manufacturing Engineering Lab-II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Manufacturing Engineering
Course Category	Programme core course

Course outcomes:

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

CO1: Dismantle and assemble the components on drilling, shaping, milling and grinding machines. [K3]
CO2: Perform operations on drilling, shaping, milling and grinding machines. [K4]
CO3: Produce articles of industrial application such as Spur gear, square headed bolt, V- block. [K4]
CO4: Make use of various measuring instruments for taking dimensions. [K2]
CO5: Servicing of drilling, shaping, milling and grinding machines. [K3]

List of Practical / Activities (To perform minimum 6 practical)

1. Drilling Exercise (Three different sized holes for different materials maintaining uniform distance between them)

2. Milling-square-hexagon from round bars with indexing and without indexing

3. Generation of spur gear teeth on a round bar

4. Simple planning exercise cutting 'T' slots (one model)

5. Shaping a Hexagon on a round bar, key ways, grooves splines

6. Shaping step block cut dovetail to angles 60, 90, 120 degrees

7. Cylindrical grinding of external surface and internal surface using universal grinding machines

8. Grinding Cutting tools to the required angles

9. Grinding of milling cutters etc, on a tool and cutter grinder Mechanical Engineering Curriculum Structure 250

10. Grinding flat surface on a surface grinder using magnetic chuck and clamping devices

11. Dismantling some of the components of drilling machine and service, assemble the same

12. Dismantling some of the components of shaper head and then assemble the same

13. Dismantling some of the components of Milling machines and service, assemble the same

14. Servicing of universal grinding machine

Reference Books:

1. Elements of Workshop Technology (Volume I & II) – HajraChowdry&Bhattacharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajender Singh, New age International (P) Ltd. NewDelhi, 2006
3. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi
4. Manufacturing process – Myro N Begman, 5th edition, Tata McGraw Hill, New Delhi

COMPUTER AIDED DESIGN AND MANUFACTURING

Course Code	MEPE506/A
Course Title	COMPUTER AIDED DESIGN AND MANUFACTURING
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Computer Aided Machine Drawing Practice
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Clarify the concepts of drafting and modelling using CAD (K2).
CO2: Articulate the need for integration of CAD and CAM (K2).
CO3: Interpret the concepts of flexible manufacturing system (K2).
CO4: Employ NC part programming and manual part programming (K3).
CO5: Illustrate Group Technology (K2).

Course Content:-

Module- 1: Fundamentals of CAD/CAM:
Number of class hours: 6 hrs.

Suggestive Learning Outcomes:
1) Know automation.
2) Correlate design workstation and graphic terminal.
3) Distinguish system software and application software.
4) Prepare CAD database.
5) Apply 3D-Wire frame modelling.

Detailed content of the unit: -

Fundamentals of CAD/CAM: Automation; Design process; Application of computers for design;
Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphicterminal; CAD Software: Definition of system software and application software; CAD database andstructure.
Geometric Modelling: 3D-Wire frame modelling; Wire frame entities and their definitions; Interpolationand Approximation of curves; Concept of Parametric and Non-parametric representation ofcurves; Curve fitting techniques.

Module- 2: Surface Modelling:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Recognize parametric space of surface.
2) Comprehend sweep representation.
3) Use solid Modelling.

Surface Modelling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parameterization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.

Module-3: NC Control Production Systems:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Recognize Numerical control.
2) Compare NC part programming and manual part programming.
3) Prepare computerized part program.

NC Control Production Systems: Numerical control; Elements of NC system; NC part programming;
Methods of NC part programming; Manual part programming, Computer assisted partprogramming; Post processor; Computerized part program.

Module-4: Group Technology:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Illustrate Group Technology.
2) Classify parts.
3) Demonstrate MRP.

Group Technology: Part families; Parts classification and coding; Production analysis; Machine cell design; Computer aided process planning: Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.

Module- 5: Flexible manufacturing system:
Number of class hours: 6 hrs

Suggestive Learning Outcomes:
1) Understand the F.M.S equipment.
2) Summarize CIM system and its benefits.

Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits;Computer aided quality control; automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; Machine vision; CIM system and Benefits.

Reference Books:

1. CAD/CAM Principles and Applications, P.N.Rao, Tata McGraw-Hill
2. Computer Aided Design and Manufacturing, Groover M.P. &Zimmers Jr, Prentice hall of India
3. CAD/CAM/CIM, RadhaKrishna P. & Subramanyam, Wiley Eastern Ltd

REFRIGERATION & AIR-CONDITIONING

Course Code	MEPE506/B
Course Title	Refrigeration & Air-conditioning
Number of Credits	3(L: 3, T: 0, P: 0)
Prerequisites	Thermal Engineering – I (MEPC302)
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Define refrigeration and types of Refrigeration cycles. (K1)
CO2: Explain Vapour Compression and Vapour Absorption System working principles. (K2)
CO3: Classify the components required for refrigeration system and identify the refrigerants. (K2)
CO4: Describe the controlling components for a refrigeration system and summarize the application of refrigeration. (K2)
CO5: Explain the working principles of Air-conditioning systems and predict faults in refrigeration & air-conditioning system. (K2)

Course Content:-

Module- I: Introduction to Refrigeration

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

4) Classify different types of refrigeration.
5) Explain the working principles of refrigeration cycles.
6) Describe the merits and demerits of air refrigeration.

Detailed content of the unit: -

Definition of Refrigeration; Refrigerating effect-unit of refrigeration-Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle; Air refrigeration- Bell - Coleman cycle, PV& TS diagram; Advantage and disadvantages in air refrigeration; Simple problems

Module- II: Refrigeration systems

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

3) Describe the vapour compression refrigeration cycle with flow diagram.
4) Explain the vapour absorption refrigeration cycle with flow diagram.
5) Compare vapour compression refrigeration cycle with vapour absorption refrigeration cycle.

Detailed content of the unit: -

Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required; Types of Vapour Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages; Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.

Module- III: Refrigeration equipments, refrigerants and lubricants

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

4) Classify compressor with example.
5) Describe various types of condensers and evaporators required for refrigeration system
6) Tabulate the refrigerants by group number.

Detailed content of the unit: -

Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor; Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water-cooled condensers; Evaporators -natural, convection, forced convection types.Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties.

Module- 1V: Refrigerant flow controls and application of refrigeration

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

4) Describe the flow of refrigerant through controlling components.
5) Explain the evaporator pressure regulator.
6) Identify the application of refrigeration.

Detailed content of the unit: -

Capillary tube; Automatic Expansion valve; Thermo static expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator.Slow and quick freezing; Cold storage and Frozen storage; dairy refrigeration; Ice making industry; Water coolers

Module- V: Air conditioning, refrigeration and air-conditioning tools

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

4) Identify the factors affecting air-conditioning.
5) Define psychrometric process.
6) Describe various types of faults in refrigeration and air-conditioning system.

Detailed content of the unit: -

Introduction to Air conditioning; Factors affecting Air conditioning; Psychrometric chart and its use; Psychrometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipments used in air conditioning cycle; Air conditioning units and plants. Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; servicing procedure.

Reference Books:

1.Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, Dhanpat Rai publications.
3. Refrigeration and Air Conditioning – A.S.Sarao& G.S. Gabi, 6th edition, Satya Prakashanpublications,New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – M.ZakriaBaig, Premier/ Radiant Publishing House.
6. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

MECHATRONICS

Course Code	MEPE507/A
Course Title	Mechatronics
Number of Credits	3(L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Describe about various types of controllers and sensors. (K2)
CO2: Explain the various mechanical, electrical and pneumatic actuation systems. (K2)
CO3: Discuss the mathematical model, system model and input/output systems. (K2)
CO4: Explain the basic PLC architecture and PLC programming concepts. (K2)
CO5: Describe the design examples of Mechatronics system and the condition monitoring ofproduction systems using sensors. (K2)

Course Content:-

Module- 1: Introduction to Mechatronics and Measurement System terminology

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

7) Recognize the importance of Mechatronics.
8) Classify different types of control systems.
9) Describe different types of sensors.

Detailed content of the unit: -

Mechatronics; Importance of Mechatronics; Systems: Measurement systems; Control systems and their types; Closed-loop control System; Automatic water level controller; Sequential controllers-washing machine; Displacement, Position & Proximity Sensors; Velocity and Motion Sensors; Force Sensors; Fluid Pressure Sensors; Flow Sensors; Liquid Level Sensors; Temperature Sensors; Light Sensors; Selection of Sensors

Module- 2: Mechanical Actuation Systems; Electrical Actuation Systems and Pneumatic & Hydraulic Systems

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

6) Describe the gear trains, belt & chain drives and bearings.

7) Explain the switches & relays, motors and servomotors.
8) Define DCV, PCV and rotary actuators.

Detailed content of the unit: -

Types of motion; Freedom and constraints; Loading; Gear Trains; Pawl & Ratchet; Belt & Chain drives; Bearings: Selection, Ball & Roller bearings; Mechanical aspects of motor selection. Switches & Relays; Solenoids; D.C Motors; A.C.Motors; Stepper Motors: Specifications and Control of stepper motors; Servomotors: D.C Servomotor and A.C Servomotor, Power supplies; DCV; PCV; Cylinders; Rotary actuators.

Module- 3: Mathematical Model, System Model and Input/Output Systems

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

7) Classify different system building blocks.
8) Describe various types of engineering systems.
9) Explain interfacing and interface requirements.

Detailed content of the unit: -

Introduction to Mathematical model; Mechanical System building blocks; Electrical System building blocks; Fluid System building blocks; Thermal System building blocks. Engineering Systems: Rotational, Translational Systems; Electro-Mechanical System; Hydro-Mechanical System.Interfacing; Input/output ports; Interface requirements: Buffers, Handshaking, Polling and interrupts, Serial interfacing; Introduction to PIA; Serial communications interface; Example of interfacing of a seven-segment display with a decoder.

Module- 4: Programmable Logic Controller (PLC)

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

7) Define basic block diagram and structure of PLC.
8) Explain the Ladder diagram and its logic functions.
9) Describe data handling and analog input/output.

Detailed content of the unit: -

Definition; Basic block diagram and structure of PLC; Input/Output processing; PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing; PLC mnemonics;

Timers; Internal relays and Counters; Shift registers; Master and Jump Controls; Data handling; Analog input/output; Selection of PLC.

Module- 5: Design Examples, Advanced Applications in Mechatronics and Sensors for Condition Monitoring Systems of Production Systems

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

7) Identify the design process stages and possible design solutions.
8) Explain the case studies of Mechatronics systems.
9) Describe various types of monitoring method.

Detailed content of the unit: -

Design process stages; Traditional Vs Mechatronics designs; possible design solutions: Timed switch, Wind-screen wiper motion, Bath room scale; Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine only. Examples of Monitoring methods: Vibration monitoring, Temperature monitoring, Wear behavior monitoring; Mechatronics control in automated manufacturing: Monitoring of Manufacturing processes, On-line quality monitoring, Model based systems, Hardware in-the-loop simulation, Supervisory control in manufacturing inspection, Integration of heterogeneous systems.

Reference Books:

1. Mechatronics – W. Bolton, Pearson Education India.
2. A Text Book on Mechatronics – R.K.Rajput, S.Chand& Co, New Delhi.
3. Mechatronics – M.D.Singh& Joshi, Prentice Hall of India.
4. Mechatronics – HMT, Tata McGraw Hill, New Delhi.
5. Mechatronics System – Devadas Shetty, PWS Publishing
6. Exploring Programmable Logic Controllers with applications – Pradeep Kumar Srivatsava, BPBPublications.

INDUSTRIAL ROBOTICS & AUTOMATION

Course Code	ME/PE -507/B
Course Title	Industrial Robotics & Automation
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Explain robot anatomy, classification, characteristics of robot**.(K1)**

CO2: Explain the various robotic actuators on hydraulic, pneumatic and electrical drives. **(K2)**
CO3: Describe various types of sensors and concepts on robot vision system. **(K2)**
CO4: Explain the concepts of robot programming languages **(K3)**

Course Content:-

Module- 1: Fundamentals of Robotics

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Familiar with the various drive systems for robot
2) Understand the Robot controller
3) Sensors and their applications in robots and programming of robots.

Detailed content of the unit: -

Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classificationof robots; Cartesian, Cylindrical, Spherical, Vertical articulated; Structural Characteristicsof robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robotwork Volumes, comparison; Advantages and disadvantages of robots.

Module- 2: Robotic Drive System and Controller

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:
1) Familiar with the various drive systems for robot
2) Understand the Robot controller
3) Sensors and their applications in robots and programming of robots..

Detailed content of the unit: -

Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.

Module- 3: Sensors
Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Classify compressor with example.
2) Describe various types of condensers and evaporators required for refrigeration system
3) Tabulate the refrigerants by group number.

Detailed content of the unit: -

Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo-Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing.
Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Imageprocessing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle &construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving

Module-4: Robot kinematics and Robot Programming

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Forward Kinematics and Reverse Kinematics of Manipulators.
2) Solving Deviations and Problems.
3) Basic of Robot programming Languages.

Detailed content of the unit: -

Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands; and Simple programs

Module- 5: Automation

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) To conceptualize automation and understand applications of robots in various industries.

2) Basic elements of automated system, advanced automation functions, levels of automation.
3) Application of robots in machining; welding; assembly and material handling.

Detailed content of the unit: -
Basic elements of automated system, advanced automation functions, levels of automation

Industrial Applications: Application of robots in machining; welding; assembly and material handling.

Reference Books:

1. Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson EducationInc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGrawHill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, Mc- Graw Hill Book Co, 1987
4. Robotics for Engineers – Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi,2008.
6. Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

Summer Internship-II

Course Code	SI-509
Course Title	Summer Internship-II
Number of Credits	3 (L: 0, T: 0, P: 0)
Prerequisites	Fundamental and basic practical skills of relevant discipline/programme
Course Category	Internship

Internships may be full-time or part-time; they are full-time in the summer vacation and part-time during the academic session.

Sl. no.	Schedule	Duration	Activities	Credits	Hours of Work
1	Summer Vacation after 4th Semester	6 Weeks	Industrial/Govt./NGO/MSME/ Rural Internship/Innovation / Entrepreneurship ##	3	120 Hours

(##During the summer vacation after 4th Semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship /Innovation /Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. In case a student want to pursue his/her family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the TPO.)

Course Outcome: -

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

C.O.1: Describe a better understanding of the engineering / technological workplace(K2).

C.O.2: Develop and demonstrate workplace competencies necessary for professional and academic success (K2).

C.O.3: Classify career preferences and professional goals (K3).

C.O.4: Develop preliminary portfolio including work samples from the internship (K2).

C.O.5: Increase competitiveness for full-time engineering employment / start-up (K3).

Course Content:-

Internships are educational and career development opportunities, providing practical experience in a field or discipline. The Summer Internship-II is a student centric activity that would expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

1. Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job.
6. Learn to apply the Technical knowledge in real industrial situations.
7. Gain experience in writing Technical reports/projects.
8. Expose students to the engineer's responsibilities and ethics.
9. Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
10. Promote academic, professional and/or personal development.
11. Expose the students to future employers.
12. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
13. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Overall compilation of Internship Activities / Credit Framework:

Major Head of Activity	Credit	Schedule	Total Duration	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Performance appraisal/ Maximum points/ activity
Innovation / IPR / Entrepreneurship	3	Summer Vacation after 4th Semester	6 Weeks	Participation in innovation related completions for eg. Hackathons etc.	Certificate	Faculty Mentor	Satisfactory/ Good/ Excellent
				Development of new product/ Business Plan/ registration of start-up	Certificate	Programme Head	Satisfactory/ Good/ Excellent
				Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.	Certificate	President/ Convener of ICC	Satisfactory/ Good/ Excellent
				Work experience at family business	Declaration by Parent	TPO	Satisfactory/ Good/ Excellent
Internship	3	Summer Vacation after 4th Semester	6 Weeks	(Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ Online Internship	Evaluating Report	Faculty Mentor/ TPO/ Industry supervisor	Satisfactory/ Good/ Excellent
Rural Internship	3	Summer Vacation after 4th Semester	6 Weeks	Long Term goals under rural Internship	Evaluating Report	Faculty Mentor/ TPO/ NSS/ NCC head	Satisfactory/ Good/ Excellent

STUDENT'S DIARY/ DAILY LOG

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students.

The daily training diary should be signed at the end of each day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and get ratified on the day of his visit.

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

a) Regularity in maintenance of the diary.
b) Adequacy & quality of information recorded.
c) Drawings, sketches and data recorded.
d) Thought process and recording techniques used.
e) Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria:

a) Originality.
b) Adequacy and purposeful write-up.
c) Organization, format, drawings, sketches, style, language etc.
d) Variety and relevance of learning experience.
e) Practical applications, relationships with basic theory and concepts taught in the course.

Major Project - I

Course Code	CEPR-510
Course Title	Minor Project
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Project Work (PR)

Course Outcome:-

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

C.O. 1: Demonstrate a sound technical knowledge of their selected project topic and the knowledge, skills and attitudes of a professional engineer (K2).

C.O. 2: Develop the skill of working in a Team (K3).

C.O. 3: Design engineering solutions to complex problems utilising a systems approach (K6).

C.O. 4: Design the solution of an engineering project involving latest tools and techniques (K6).

C.O. 5: Develop the skill of effective communication with engineers and the community at large in written an oral forms. (K3)

Course Content:-

The major project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.

7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a major project work.

Semester VI

Sl. No.	Category	Code No.	Course Title	Hours per week			Total Contact Hrs/Week	Credit
				L	T	P		
1	Programme core course-21	MEPC601	Design of Machine Elements	2	1	0	3	3
2	Programme core course-22	MEPC602	Production & Operations Management	2	0	0	2	2
3	Programme elective course-4 (Any One to be selected)	MEPE603/A	Elective Material Handling Systems	3	0	0	3	3
		MEPE603/B	Power Plant Engineering					
4	Humanities and Social Science course- 5	HS604	Entrepreneurship and Start-up's	3	1	0	4	4
5	Open elective-2	(Anyone to be selected from Annexure-II)		3	1	0	4	4
6	Mandatory Course-2	AU606	Indian Constitution	2	0	0	2	0
7	Major Project	MEPR607	Major Project- II	0	0	6	6	3
8	Seminar	MESE608	Seminar	2	0	0	2	1
			Total	**17**	**3**	**6**	**26**	**20**

DESIGN OF MACHINE ELEMENTS

Course Code	MEPC601
Course Title	Design of MachineElements
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	Engineering Mechanics, Strength of Materials and Theory of Machines & Mechanisms
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Analyze the various modes of failure of machine components under different load patterns.(K4)
CO2: Design and prepare part and assembly drawings.(K5)
CO3: Apply design data books and different codes of design.(K3)
CO4: Design and prepare drawings of Shafts and Spur Gears.(K5)
CO5: Design and prepare drawings of Fasteners and Ergonomics. (K5)

Course Content: -

Module- 1: Introduction to Design

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Calculate factor of safety.
2) Explain standardization.
3) Apply design data book.
4) Illustrate Theories of Elastic Failures.

Detailed content of the unit: -

Introduction to Design: Machine Design philosophy and Procedures; General Considerationsin Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress – StrainDiagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing;Bending and Torsion; Principal Stresses; Simple Numerical; Creep strain and Creep Curve; Fatigue;S-N curve; Endurance Limit; Factor of Safety and Factors governing selection of factor of Safety;StressConcentration: Causes & Remedies; Converting actual load or torque into design load or torque usingdesign factors like velocity factor, factor of safety & service factor; Properties of Engineering materials;Designation of materials as per IS and introduction to International standards & advantages ofstandardization; Use of design data book; Use of standards in design and preferred numbers series;Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximumdistortion energy theory.

Module- 2: Design of simple machine parts and Antifriction Bearings

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Design and draw Cotter Joint; Knuckle Joint.
2) Design Simple machine parts**.**
3) Classify different types of bearing.

Detailed content of the unit: -

Design of simple machine parts: Cotter Joint; Knuckle Joint; Turnbuckle; Design of Levers:Hand/Foot Lever & Bell Crank Lever; Design of C–Clamp; Off-set links; Overhang Crank; Arm of Pulley.
Antifriction Bearings: Classification of Bearings; Sliding contact & Rolling contact; Terminology ofBall bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limitingspeed; Selection of ball bearings using manufacturer's catalogue.

Module- 3: Design of Shafts, Keys, Couplings and Spur Gears

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Design and draw Shafts, Keys, Couplings
2) Design spur gears.

Detailed content of the unit: -

Design of Shafts, Keys, Couplings and Spur Gears: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria; ASME code ofdesign for line shafts supported between bearings with one or two pulleys in between or one overhungpulley; Design of Sunk Keys; Effect of Keyways on strength of shaft; Design of Couplings – MuffCoupling, Protected type Flange Coupling, Bush-pin type flexible coupling; Spur gear design considerations;Lewis equation for static beam strength of spur gear teeth; Power transmission capacity ofspur gears in bending. 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization

Module- 4: Design of Power Screws and Design of springs

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Design the Screw Jack; Toggle Jack.

2) Classify different types of springs.
3) Design the Helical springs.

Detailed content of the unit: -

Design of Power Screws: Thread Profiles used for power Screws - Relative merits and demeritsof each; Torque required to overcome thread friction; Self-locking and overhauling property; Efficiency of power screws; Types of stresses induced; Design of Screw Jack; Toggle Jack.
Design of springs: Classification and Applications of Springs; Spring terminology; Materials andSpecifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored insprings; Design of Helical, Tension and Compression springs subjected to uniform applied loads likeI.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Constructionand Application.

Module- 5: Design of Fasteners and Ergonomics & Aesthetic consideration in design

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Describe Stresses in Screwed fasteners
2) Design the bolted joints.
3) Analyse the Ergonomics of Design.

Detailed content of the unit: -

Design of Fasteners: Stresses in Screwed fasteners; Bolts of Uniform Strength; Design ofBolted Joints subjected to eccentric loading; Design of Parallel and Transverse fillet welds; axiallyloaded symmetrical section; Merits and demerits of screwed and welded joints.
Ergonomics & Aesthetic consideration in design: Ergonomics of Design: Man–Machine relationship;Design of Equipment for control, environment & safety; Aesthetic considerations regardingshape, size, color & surface finish.

Reference Books:
1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co, Delhi(ISBN: 978-9382609-513)
3. Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
4. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
5. Machine design – Pandya & Shah, Dhanpat Rai & Son,New Delhi.
6. Machine design – R.K.Jain, Khanna Publication, New Delhi.
7. Design Data Book – PSG Coimbtore, PSG Coimbtore.

8. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – AbdullaShariff, Dhanpat Rai & Sons, New Delhi.

PRODUCTION & OPERATIONS MANAGEMENT

Course Code	MEPC602
Course Title	Production & Operations Management
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Programme core course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Define operations management and explain its relationship to productivity and also understand tools and techniques (K1).
CO2: Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods (K2).
CO3: Explain layout strategy and how operations managers determine facility arrangements and size (K3).
CO4: Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity (K3).
CO5: Understand make-or-buy decisions and the selection and integration of suppliers. And calculate how much to order and when to order (K2).

Course Content: -

Module- 1: Process Planning and Process Engineering:
Number of class hours: 5 hrs.

Suggestive Learning Outcomes:
1) Describe Process Planning.
2) Determine the Principal Process.
3) Distinguish Dimensional Analysis from Tolerance Analysis.

Detailed content of the unit: -

Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed,

Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation, Terms used in work piece dimensions, Tolerance stacks. Work piece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control.

Module- 2: Production Forecasting and Scheduling:

Number of class hours: 5 hrs

Suggestive Learning Outcomes:
1) Describe various Forecasting methods.
2) Evaluate the importance of scheduling. Compare scheduling and sequencing

Detailed content of the unit: - 4 hrs
Production Forecasting: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behaviour, Forecasting methods- Qualitative and Quantitative, Forecast accuracy.
Scheduling:
Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling

Module-3: Break-Even Analysis and Aggregate Operations Planning:
Number of class hours: 5 hrs

Suggestive Learning Outcomes:
1) Understand Break-even analysis.
2) Apply Break-even analysis charts.
3) Compare different Aggregate production planning.

Break-Even Analysis: Introduction, Break-even analysis charts, Break even analysis for process, plant and equipment selection.
Aggregate Operations Planning: Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, aggregate planning for services.

Module-4: Assembly Line Balancing
Number of class hours: 5 hrs

Suggestive Learning Outcomes:
1) Illustrate Assembly lines, Assembly line balancing.
2) Describe different line layouts.

Assembly Line Balancing: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, mixed model line balancing, current thoughts on assembly lines, computerized assembly line balancing.

Module- 5: Material Management:
Number of class hours: 5 hrs

Suggestive Learning Outcomes:
1) Understand Purchasing and Stores.
2) Explain policies and procedures of material management.

Material Management: Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating.

References:

1. Production and Operations Management – K. Aswathappa, K.Shridhara Bhat, Himalaya Publishing House, 2014.
2. Production and Operations Management – Shailendra Kale, McGraw Hill Educations (India) Private Limited, 2013.
3. Production and Operations Management – R. Paneerselvam, PHI Learning Private Limited, 2013.
4. Operations Management – Joseph Monk, TMH Publishers, New Delhi, 2004.
5. Modern Production /Operations Management – Buffa Elwood S, John Wiley Publishers, Singapore, 2002.

MATERIAL HANDLING SYSTEMS

Course Code	MEPE603/A
Course Title	Material Handling Systems
Number of Credits	3(L: 3, T: 0 P: 0)
Prerequisites	NIL
Course Category	Programme elective course

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

CO1: Understand constructional & operational features of various materials handling systems. [K1]

CO2: Identify, compare & select proper material handling equipment for specified applications. [K3]

CO3: Know the controls & safety measures incorporated on material handling equipment. [K2]

CO4: Appreciate the role of material handling devices in mechanization & automation of industrial process. [K3]

CO5: Understand & appreciate safety instrumentation for equipment. [K2]

Course Content: -

Module- 1:Introduction to Material Handling System
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Describe the concept of material handling.
2) Explain modern trends in Materials handling.

Introduction to Material Handling System: Main types of Material handling equipments& their applications; Types of load to be handled; Types of Movements; Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

Module-2:Hoisting Machinery &Equipments
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Describe the construction, working & maintenance of different types of hoists.
2) Explain the construction, working & maintenance of different types of cranes.
3) Describe the construction, working & maintenance of different types of elevating equipments.

Hoisting Machinery &Equipments: Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists, Worm geared and Spur geared hoists, Electric & Pneumatic hoists, Jumper; Construction, Working & Maintenance of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Cable cranes, Floating cranes & Cranes travelling on guide rails; Construction, Working & Maintenance of Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts, and Mast type's elevators, Vertical skip hoist elevators.

Module-3:Conveying Machinery and Surface Transportation Equipment
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Explain the construction, working & maintenance of various traction type conveyors and traction less type conveyors.
2) Explain the construction, function& workingof different types of traction less equipment and cross handling equipment.

Conveying Machinery: Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators; Construction, Working & Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.267 Mechanical Engineering Curriculum Structure

Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers; Construction, Function, Working of Cross handling equipment such as Winches, Capstans, Turntables, Transfer tables, Monorail conveyors.

Module- 4:Components of Material Handling Systems and Load handling attachments
Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Explain the different components of material handling systems.
2) Describe the construction and working of different types of Load handling attachments.

Components of Material Handling Systems: Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices;

Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals; Construction & Working of Arresting gear & Brakes; Construction & use of electromagnetic shoe brakes, Thrusters operated shoe brakes, Control brakes.

Module- 5:Mechanism used in Material Handling Equipment and Selection of Material Handling Equipment

Number of class hours: 6 Hrs.
Suggestive Learning Outcomes:
1) Demonstrate the basics of Mechanism used in Material Handling Equipment
2) Explain the concept of selection of material handling equipment.

Mechanism used in Material Handling Equipment: Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Travelling Mechanism, Slewing Mechanism, Rope & chain operated Cross- Traverse Mechanism.

Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Methods of stocking at initial, final & intermediate points, Nature of production process involved, Specific load conditions & Economics of material handling system.

Reference Books:
1. Material handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
2. Plant Layout & Materials Handling – Apple J. M., JohnWiley Publishers.
3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.

4. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
5. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

POWER PLANT ENGINEERING

Course Code	MEPE603/B
Course Title	Power Plant Engineering
Number of Credits	3(L: 3, T: 0, P: 0)
Prerequisites	Thermal Engineering – I (MEPC302)
Course Category	Programme elective course

Course Outcomes: - By the end of the course, the students are expected to

CO1: Describe the location of power plant and classify the power plants. (K2)
CO2: Enlist various load terminologies in power plants. (K1)
CO3: Explain the working of hydroelectric power plant. (K2)
CO4: Summarize the working principles of diesel, gas and nuclear power plants. (K2)
CO5: Recognize the issues and necessity of safety concepts of power plants. (K1)

Course Content: -

Module- I: Introduction to Power plant

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Familiarized with the present and future power scenario of India.
2) Describe the location of power plant.
3) Classify the power plants.

Detailed content of the unit: -

Introduction to power plant; Indian Energy scenario in India; Location of power plant; Choice of Power plant; Classification of power plants.

Module- II: Economics of power plant

Number of class hours: 6 Hrs.

Suggestive Learning Outcomes:

1) Describe various factor affecting the operation of power plant
2) Explain the methods of meeting the fluctuating load in power plant.
3) Discuss the performance and operatingcharacteristics of power plant.

Detailed content of the unit: -

Terminology used in power plant: Peak load, Base load, Load factor, Load curve; Various factor affecting the operation of power plant; Methods of meeting the fluctuating load in power plant; Load sharing- cost of power-tariff methods; Performance and operating characteristics of power plant.

Module- III: Hydro power plant
Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Understand hydrograph and flow duration curve.
2) Classify the hydroelectric power plant.
3) Describe the advantage and disadvantage of hydroelectric power plant.

Detailed content of the unit: -

Introduction to Hydroelectric power plant; Rainfall, Runoff and its measurement, Hydrograph, flow duration curve; Selection of sites for hydroelectric power plant; General layout of Hydroelectric power plant and its working; Classification of the Plant-Run off river plant, storage river plant, pumped storage plant; Advantages and disadvantages of hydroelectric power plant.

Module- IV: Diesel, gas turbine and nuclear power plant

Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Describe the components of diesel power plant.
2) Explain the working of gas turbine power plant.
3) Understand the working of a nuclear power plant.

Detailed content of the unit: -

The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; Gas turbine power Plant-Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram). Introduction; Nuclear Power-Radio Activity-Radioactive charge-types of reactions; Working of a nuclear power plant; Thermal fission Reactors- PWR, BWR and gas cooled reactors; Advantages and Disadvantages of Nuclear power plant.

Module- V: Environmental impact of power plant and power plant safety
Number of class hours: 6 Hrs

Suggestive Learning Outcomes:

1) Discuss the social and economical issues of power plant.
2) Describe the safety policy to be observed in power plants.
3) Identify the statutory provision related to boiler operation.

Detailed content of the unit: -

Social and Economical issues of power plant; Greenhouse effect; Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Air, water, Thermal pollution from power plants; Radiations from nuclear power plant effluents. Plant safety concept; Safety policy to be observed in power plants; Safety practices to be observed in boiler operation; Safety in oil handling system; Safety in Chemical handling system; Statutory provision related to boiler operation.

Reference Books:
1. Power plant Engineering-P.K. Nag 4th edition, Tata McGraw Hill Education, 2014.
2. Power plant Engineering – Frederick T. Morse, Litton Educational Publishing Inc. 1953.
3. A Course in Power Plant Engineering – Subhash C. Arora, S. Domakundwar, Dhanpat Rai, 1984.
4. Power Plant Engineering – P.C. Sharma, S.K.Kataria& sons, 2009.
5. Power System Engineering – R.K. Rajput, Firewell Media,2006.

ENTREPRENEURSHIP AND START-UP'S

Course Code	:	HS 604
Course Title	:	Entrepreneurship and Start-ups
Number of Credits	:	4
Prerequisites (Course code)	:	None
Course Category	:	HS

CO1 Understand the basic concepts of Entrepreneurship and Startups.

CO2 Illustrate skills of discovering business ideas, visualizing and planning a business.

CO3 Analyze market and business risk for strategy development.

CO4 Demonstrate skills of organizational management.

CO5 Exhibit knowledge of financing methods, institutions and skills for communication of ideas.

Course Content:

Unit1-Introduction and Basics of Entrepreneurship and Start–Ups

Suggestive Learning Outcomes:

(1) Describe the Basic Elements of Entrepreneur and Entrepreneurship

(2) Distinguish between Entrepreneur, Manager and Intrapreneur

Content:

- Definitions, Traits of an entrepreneur, Factors influencing entrepreneurship, Types and Functions of Entrepreneurs, Need for promotion of entrepreneurship, Intrapreneur, Motivation
- Role of Entrepreneurs in Economic Development
- Similarities/differences between - Entrepreneur and Manager, Entrepreneur and Intrapreneur.

Unit2–Business Ideas and their implementation

Suggestive Learning Outcomes:

(1) Illustrate different Types of Business Planning and Business Structure

(2) Select specific Institutions Assisting Entrepreneur

Content:

- Discovering ideas
- Visualizing the business
- Business Plan, - Types of planning, Importance of planning, Steps in planning

- Types of Business Structures
- Institutions assisting entrepreneur

Unit3–**Idea to Start-up**

<u>Suggestive Learning Outcomes</u>:

(1) Identify Steps for Starting a SSI

(2) Predict the Target Market and Associated Risk

Content:

- Market analysis – Identifying the target market
- Competition evaluation and Strategy Development
- Steps for starting a small enterprise
- Risk analysis

Unit4–Management of Enterprise

<u>Suggestive Learning Outcomes</u>:

(1) Apply the Basic Accounting Concepts in Business

(2) Demonstrate Knowledge of Pricing, Positioning and Advertising of Products

Content:

- Recruitment and management of talent.
- Determinants of Price, Pricing methods in practice.
- Market Positioning, Advertising and Sales Promotion
- Accounting - Understanding basics of Transaction, Journal, Ledger, Cashbook, Trial Balance, Cost Sheet and Final Accounts through simple problems

Unit5-Financing and Communication of Ideas

Suggestive Learning Outcomes:

(1) Exhibit Knowledge of various Financial Institutions and Financing Methods

(2) Illustrate Business Ideas through Communication Skills

Content:

- Financial Institutions
- Financing methods available for start-ups in India
- Communication of Ideas to potential investors–Investor Pitch

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN–978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN–978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN–978-0755388974
4.	Entrepreneurship	Alpana Trehan	Dreamtech PressISBN: 978-93-5004-026-3
5	Marketing and Sales Management	D C Kapoor	S Chand and Company Ltd. ISBN: 81-219-2430-8
S.No.	**Title of Book**	**Author**	**Publication**

6	Business Economics	H L Ahuja	S Chand and Company Ltd. ISBN: 81-219-1791-3
7	Financial Accounting (Principles and Practice)	Jawahar Lal & Seema Srivastava	S Chand Publishing
8	Accounting for Management	N.P. Srinivasan & Sakthivel Murugan	S Chand Publishing
9	Marketing	Harsh V Verma and Ekta Duggal	Oxford University Press ISBN: 0-19-945910-X
10	Marketing (Asian Edition)	Paul Baines, Chris Fill, Kelly Page and Piyush K. Sinha	Oxford University Press
11	Entrepreneurship	Rajeev Roy	Oxford University Press ISBN: 0-19-807263-5
12	Entrepreneurship Development	Kumar S Anil	New Age Publishers
13	Human Resource Management	Uday Kumar Haldar and Juthika Sarkar	Oxford University Press
14	Fundamentals of Entrepreneurship	S K Mohanty	Prentice Hall of India Private Limited ISBN: 81-203-2867-1
15	Entrepreneurship Development	S Skhanka	S Chand and Company Ltd. ISBN: 81-219-1801-4

SUGGESTED SOFTWARE/LEARNINGWEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup
b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
c. https://www.finder.com/small-business-finance-tips
d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

INDIAN CONSTITUTION

Course Code	:	AU- 606
Course Title	:	Indian Constitution
Number of Credits	:	0 (L: 2, T:0; P:0)
Prerequisites (Course code)	:	None
Course Category	:	AU

Course Outcomes:

CO1. Illustrate Preamble, Basic Structure, Fundamental Rights and Duties of Indian Constitution(K3).

CO2. Discuss the Structure of The Indian Union Government (K2).

CO3. Memorize the Role andPower of Governor, Chief Minister and Council ofMinisters and explain the role of State Secretariat (K2).

CO4. Describe the role of Local Administration (K2).

CO5. Explain the Role andFunctioning of Election Commission (K2).

Detailed Course Content:

Unit 1 – The Constitution – Introduction

Number of Class hours:06

Learning Outcomes:

1. Describe the History of the Making of the IndianConstitution (K2)
2. Illustrate Preamble and the Basic Structure of Indian Constitution (K3)
3. Illustrate the Fundamental Rights and Duties set by Indian Constitution (K3)

Detailed content of the unit:

1. The History of the Making of the IndianConstitution
2. Preamble and the Basic Structure, and itsinterpretation
3. Fundamental Rights and Duties and theirinterpretation

4. State PolicyPrinciples

Unit 2 – **Union Government**

Number of Class hours:06

Learning Outcomes:

1. Discuss the Structure of the IndianUnion Government (K2).
2. Memorize the Role and Power of President, Prime Minister and Council of Ministers of India (K1)
3. Explain the role of Lok Sabha and RajyaSabha (K2)

Detailed content of the unit:

1. Structure of the IndianUnion
2. President – Role andPower
3. Prime Minister and Council ofMinisters
4. Lok Sabha and RajyaSabha

Unit 3 – **State Government**

Number of Class hours:06

Learning Outcomes:

1. Memorize the Role and Power of Governor, Chief Minister and Council ofMinisters of a state(K1)
2. Explain the role of StateSecretariat (K2)

Detailed content of the unit:

1. Governor – Role andPower
2. Chief Minister and Council ofMinisters
3. StateSecretariat

Unit 4 – **Local Administration**

Number of Class hours:06

Learning Outcomes:

1. Describe the role of District Administration (K2)
2. Explain the role of MunicipalCorporation (K2)

3. Discuss the role of Zila Panchayat (K2)

Detailed content of the unit:

1. DistrictAdministration
2. MunicipalCorporation
3. Zila Panchayat

Unit 5 – Election Commission

Number of Class hours:06

Learning Outcomes:

1. Explain the Role andFunctioning of Election Commission (K2)
2. Classify the role and functioning of Chief ElectionCommissioner and State Election Commissioner (K2).

Detailed content of the unit:

1. Role andFunctioning of Election commission
2. Chief ElectionCommissioner
3. State ElectionCommission

Suggested Learning Resources:

S. No.	Title of Book	Author	Publication
1.	Ethics and Politics of the In- dian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3.	Introduction to the Consti- tution of India	DD Basu	Lexis Nexis; Twenty-Third 2018

			edition

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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MAJOR PROJECT- II

Course Code	MEPR-607
Course Title	Major Project
Number of Credits	3 (L: 0, T: 0, P: 6)
Prerequisites	Nil
Course Category	Project Work (PR)

Course Outcome:-

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

C.O. 1: Demonstrate a sound technical knowledge of their selected project topic and the knowledge, skills and attitudes of a professional engineer (K2).

C.O. 2: Develop the skill of working in a Team (K3).

C.O. 3: Design engineering solutions to complex problems utilising a systems approach (K6).

C.O. 4: Design the solution of an engineering project involving latest tools and techniques (K6).

C.O. 5: Develop the skill of effective communication with engineers and the community at large in written an oral forms (K3).

Course Content:-

The major project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should provide the scope to develop the following by the students-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a major project work.

SEMINAR

Course Code	MESE608
Course Title	Seminar
Number of Credits	1 (L: 0, T: 0, P: 1)
Prerequisites	Nil
Course Category	Seminar presentation

Course Outcome:-

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

C.O.1: Demonstrate a thorough and systematic understanding of a seminar topic (K2).

C.O. 2: Identify the methodologies and professional way of documentation and communication (K3).

C.O.3: Demonstrate the ability to construct a report consistent with expectations of the topic, including an appropriate organization, style, voice, and tone (K3).

C.O.4: Develop the ability to follow discussions, oral arguments, and presentations, noting main points or evidence and tracking through different comments given by the audience (K3).
C.O.5: Developthe communication skill as a speaker (K3).

Course Content:-

The seminar topics may be any aspect of the science and technology, entrepreneurship or any contemporary social issues to be solved by specific branch of engineering and technology (For example, Water logging problems in a particular city may be a seminar topic for Civil Engineering Students) must be approved by the instructor in advance.

The course should have the following-

7) Practice speaking in front of a scientific audience.
8) Explore topics in detail.
9) Research topics and organize presentations.
10) To improve as speakers, each student will receive feedback from the fellow students and the instructor.
11) PowerPoint, Key Note or overheads are acceptable media for Visual aids. Visual aids should look professional and be readable in the entire room; use spell check and proofread for typographical errors.
12) Students have to submit a hard copy contains detailed outline (4-5 pages) of their presentation and also a brief abstract (one or two paragraphs; **250 words max.**) describing their presentation.
13) Each student will give 20-minute presentations followed by 3 minutes of question-answer session.

Proposal Seminar Format for Students:

- Introduce yourself.
- Give an introduction and background information on your topic. What relevant research has been performed previously?
- State the problem(s) that remain unanswered.
- Clearly state your objectives and give the specific hypotheses you wish to test.
- Describe the methodology you will use to test your hypotheses. Be sure you fully understand your chosen methods. Give reasons why you chose these methods over other approaches.
- Present any data you have collected thus far.
- Describe what remains to be done, and what you expect to find.

Explain the significance of your findings (or potential future findings).

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