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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