NATIONAL INSTITUTE OF TECHNOLOGY, MIZORAM

(An Institute of National Importance under Ministry of HRD, Govt. of India)

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DEPARTMENT OF MECHANICAL ENGINEERING

3rd Semester:

SL.No	Course code	Subject	Teaching Scheme			Credits
Theory			**L**	**T**	**P**	
1.	MEL1301	Material Science	3	0	0	3
2.	MEL1302	Fluid Mechanics	2	1	0	3
3.	MEL1303	Strength of Materials	2	1	0	3
4.	MEL1304	Basic Thermodynamics	2	1	0	3
5.	MAL1301	Numerical Methods	3	1	0	4
6	MEL1305	Machine Drawing	1	0	4	3
Practical						
7.	MEP1301	Fluid Mechanics Laboratory	0	0	2	1
8.	MEP1302	Strength of Materials Laboratory	0	0	2	1
					Total	**21**

COURSE SYLLABUS

MEL1301: MATERIAL SCIENCE

1. Course Description:

Material Science introduces you to the concept of Crystallographic planes and directions, methods determining the crystal structures, atomic packing, crystal defects. Stability of phases and equilibrium, phase transition, phase equilibrium diagrams, phase rule and equilibrium, cooling curves, solid solution equilibrium diagrams, iron-iron carbide equilibrium diagram. Kinetics of phase transformation, crystallization, nucleation, homogenous nucleation, heterogeneous nucleation, crystal growth, dendritic growth. Annealing, normalizing and spheroidizing, quenching, hardenability, precipitation hardening, time temperature transformation diagram. Continuous cooling transformation diagram, effect of alloying elements.

2. Learning Outcome:

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

- Apply core concepts in Materials Science to solve engineering problems
- Interpret about material fundamental and material processing
- Distinguish the defects in crystal and its effect on crystal properties
- Figure out the different mechanical properties of material by studying differentv destructive and non- destructive testing
- Articulate and utilize corrosion prevention strategies and estimate corrosion behaviour of materials and components
- Acknowledge the importance of surface modification and study the different surface modification methods
- Perceive the basics of Powder metallurgy and application of powder metallurgy
- Select proper metal, alloys, non-metal and powder metallurgical component for specific application requirement

3. Broad Course Outline:

- Structure of solids
- Phase transformations and phase equilibrium
- Rate processes and crystallization
- Rate processes and crystallization
- Heat treatment of steels
- Diffusion
- Mechanical Properties
- Electronic Properties
- Metals and Alloys

4. Text & Reference Books:

- K.M Gupta: Materials Science: Umesh Publication.
- V Raghvan: Material Science: Prentice Hall
- Narula: Material Science: TMH
- Srivastava & Srinivasan: Science of Materials Engineering: New Age Publication
- W.D Callister: Material Science & Engineering: Addition-Wesley Publication
- Vlack Van: Elements of Material Science & Engineering: John Wiley & Sons
- Avner: Introduction to Physical Metallurgy: TMH Pub

MEL1302: Fluid Mechanics

1. Course Description:

Fluid Mechanics introduces you to the concept and definitions, properties and classification of fluids, Pascal's law of fluid pressure, measurement of pressure, forces on submerged plane and curved surfaces, buoyancy, metacenter. Scalar and vector fields, flow field and description of fluid motions, existence of flow. Conservation of mass, conservation of momentum and conservation of energy. Bernoulli's equation in irrotational flow, measurement of flow rate through pipe, flow through orifices. Concept and type of physical similarity, applications of dynamic similarity, dimensional analysis. Laminar and turbulent flows, laminar flow through a circular pipe, laminar flow between parallel plates, laminar flow through an annulus, hydrodynamic lubrication.

2. Learning Outcome:

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

- Understand basic knowledge of the definition and the fundamental concepts of fluid mechanics including continuum, velocity field , surface tension,flow visualization etc
- Apply the basic equation of fluid statics to determine forces on planer and curved surfaces that are submerged in a static fluid.
- Use conservation laws in integral form and apply them to determine forces and moments on surfaces of various shapes and simple machines
- Use Eulers and Bernoullis equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and in viscid fluids
- Design simple pipe systems to deliver fluids under specified conditions and also the loosed during the flow of the fluid
- Understand the mechanics of viscous flow about immersed boundaries, as it relates to flow separation, profile drag, drag coefficients and the detrition of drag forces
- apply these basics in the designing of the Power Plant, Hydraulic Pneumatic Systems and in simulation softwares to solve various critical problems related to fluid flows

3. Broad course outline:

- Introduction
- Kinematics of Fluids
- Conservation Equations
- Applications of Equations of Motion and Mechanical Energy
- Principles of Physical Similarity and Dimensional Analysis
- Laminar and Turbulent Flows

4. Text & Reference Books:

- R.K Bansal: Fluid Mechanics: Laxmi Publications
- R.K Rajput: Fluid Mechanics: Laxmi Publications
- P.N Modi and S.H Seth: Hydrualics and Fluid Machines: Standard Book House
- S.K Agarwal: Fluid Mechanics & Machinery: TMH
- Vijay Gupta and S.K Gupta: Fluid Mechanics and its Applications: Wiley Eastern Ltd, 1984
- S Narasimhan: First Course in Fluid Mechanics: University Press
- S.K Som & G Biswas: Introduction of fluid mechanics & Fluid Machines: TMH, 2000, 2nd Edition
- M. M Das: Fluid Mechanics & Turbomachines: Oxford University Press
- R.J Garde: Fluid Mechanics through Problems: New Age International Pvt. Ltd, New Delhi, 2nd Edition
- Rouse Hunter: Elementary Mechanics of Fluids: John Wiley & Sons. OMC
- I.H Shames: Mechanics of Fluids: McGraw Hill, Int. Student, Education

MEL 1303: Strength of Materials

1. Course Description:

Strength of Materials introduces you to the concept of simple stress, types of stresses and strains, hook's law, principle of superposition, Elastic constants, bars of varying section, uniformly tapered bars, elongation of bar due to self-weight, compound bars, Indeterminate structures, Thermal stresses in uniform bars. Strain energy, impact loading. Theory and assumptions of Pure Bending, Stresses in Beams Under Different Types of Loads, Beam of uniform strength, Direct shear stresses in beams. Torsion of Circular shafts, design of shaft, Non-uniform torsion, stress and strain in pure shear, Statically indeterminate torsional member, strain energy in torsion. Plane stress, principle planes, principle stresses and maximum shear stresses, Mohr's circle for plane stress, hook's law for plane stress, tri-axial stress, transformation equations for plane stress, plane strain. Rankine's theory, St. Venent theory, Guest's theory, Haigh's theory, Maximum distortion energy theory, graphical representation and their comparison. Slope and Deflection of Statically Determinate Beams Using Macaulay's Method, Area-Moment and Energy Methods, Castigliano's Theorem, Statically Indeterminate Beams Under Different Types of Loads. Euler's Theory of Buckling of A Column, Middle-Third and Middle Quarter Rules, End Conditions For Columns, Different Empirical

Formulae For Columns. Stresses and Strains in Thin and Thick Cylinders and Spheres Subjected to Internal and External Pressures.

2. Learning Outcome:

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

- Predict mechanical behavior of the member by determining the stresses, strains and deflections produced by the loads up to the elastic limit
- Solve the stresses in determinate and indeterminate, homogeneous and composite bars under concentrated loads, self weight and thermal loads
- Construct Shear Force and Bending Moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple
- Determine bending and shear stresses in machine elements
- Evaluate Slope and Deflection of Statically Determite beams subjected to concentrated load, uniformly distributed load, uniformly varying load and couple and also strain energy in members subjected to Gradual, sudden and impact loads
- Estimate stresses, strain and deformations in determi0te shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment also critical load of columns under various end conditions.

3. Broad course outline:

- Stress and Strain
- Simple Bending of Beams
- Simple Bending of Beams
- Compound stress and strain
- Theories of Elastic failures
- Slope and Deflection of Beams
- Columns
- Pressure Vessels

4. Text & Reference Books:

- L.S Shrinath: Mechanics of Solids: Tata McGraw Hill Publication
- M. Gere James: Mechanics of materials: Cenage Learning
- B.C. Punamia: Mechanics of materials: Laxmi Publication
- G.H Ryder: Strength of Materials: MacMillan Publishers
- Timoshenko and Young: Strength of Materials: Affiliated East-West
- Beer and Johnson: Mechanics of Material: McGraw Hill Publication
- F.L Singer and Harper Pytel: Strength of Materials: Row Publication

MEL 1304: Basic Thermodynamics

1. Course Description:

Basic Thermodynamics introduces you to Macroscopic and Microscopic concepts, System and its Classification. Thermodynamic State. Properties, Process and Cycles, Thermodynamic Equilibrium, Concept of Temperature, Temperature Scale, Energy Interactions (Work Transfer and its Different Modes, Heat Transfer). First Law applied to Non Flow as well as Flow Processes, Concepts of internal Energy, Enthalpy, Specific Heats, PMMI, Energy Equations for Flow Systems, and Application of Energy Equations to different Engineering Components. Need of the Second Law, Preliminary definitions, Different statements of the Second Law of Thermodynamics and their equivalence, Reversibility and Irreversibility, Causes of Irreversibility, Reversible Cycles, Carnot Theorem, Absolute Thermodynamic Temperature Scale, Third law of Thermodynamics. Clausius Theorem and Inequality, Entropy Principle, Entropy and Disorder, Evaluation of Entropy change during various processes, T-S and H-S diagrams, Concept of Third Law of Thermodynamics. Gases-Equation of state of an Ideal Gas, Specific Heats, Internal Energy, Enthalpy and Entropy change of Ideal Gases. Equation of state of Real Gases, Principle of corresponding state, Compressibility Factor. Definition of Sensible Heat, Latent Heat, Saturation Temperature, Quality, Evaluation of Properties from Steam Table and Mollier Diagram.

2. Learning Outcome:

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

- explain the basic principles and applications of the thermody0mics to the various real life systems
- describe fundamental laws of thermodynamics
- apply the concepts such as Entropy, Energy Balance also the calculations of heat, work and other important thermodynamic properties for various ideal gas processes. estimate performance of various thermody0mic gas power cycles and gas refrigeration cycle and availability in each case
- examine the condition of steam and performance of vapour power cycle and vapour compression cycle.
- understand Stoichiometric air required for combustion, performance of steam generators and natural draught requirements in boiler plants.
- use Psychometric charts and estimate various essential properties related to Psychrometry and processes

3. Broad course outline:

- Concepts of Thermodynamics
- First Law of Thermodynamics
- Second Law of Thermodynamics
- Entropy
- Properties of Substances

4. Text & Reference Books:

- P. K Nag: Engineering Thermodynamics: TMH, and India
- R Yadav: "Thermodynamics and Heat Engines", Vol I & II (Sl Edition) :Central Publishing House Allahabad
- G.J VaWylen. & R.E Sonnlog: Fundamentals of classical thermodynamics: John Wiley & Sons, Inc. NY
- Wark Wenneth: Thermodynamics: McGraw Hill book Co. NY
- R Joel: Basic Engineering Thermodynamics: Addison Wesley

MEL 1305: Machine Drawing

1. Course Description:

Machine Drawing introduces you to the concept of Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views. Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangements of nuts, Foundation bolts. Types of keys, Cotter joint or Knuckle joint. Rigid Coupling or Flexible coupling. Types of rivet heads, Types of riveted joints, Boiler joint. Engine parts-stuffing box, cross head, Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod safety valve etc. Free hand sketching of foundation bolts, studs, pulleys, couplings, helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc. Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc. Introduction, input, output devices, introduction to software like AutoCAD, Pro-E, basic commands and development of 2D and 3D drawings of simple parts.

2. Learning Outcome:

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

- Introduction and uses of drawing instruments, Different types of lines, Engineering Lettering
- Standard practices and principles of dimensioning. Concept of scale, use of diagonal scale and scale of chord
- Geometrical Constructions: Regular polygons, conic sections, spirals, Sine Curve, Involutes, Rolling Curves
- Principles of orthographic projection: planes of projection (principal & auxiliary), object & viewer, lines of projection etc., angles of projection.Projections of points, lines and solids
- Orthographic projection drawing of simple objects: prisms, pyramids & sphere with and without auxiliary views
- Orthographic projection of combination of simple objects with and without auxiliary views
- Orthographic projection of machine parts
- Isometric projection: Isometric scale, Isometric drawings
- Third view development
- Sectional views

3. Broad course outline:

- Orthographic Projections
- Screwed fasteners
- Keys, Cotter Joint and Pin joint
- Shaft Couplings Riveted joints Assembly Drawing
- Free hand sketching
- Production Drawing
- Computer Aided Drafting

4. Text & Reference Books:

- N. D. Bhatt: Machine Drawing: Charotor Publishing House.
- Ajeet Singh: Machine Drawing, 2/e: Tata Mc Graw Hill Publishing.
- K.L. Narayana, P. Kannaiah & K. Venkata Reddy: Production Drawing: New Age International Publisher.
- R.K. Dhawan: A Text Book of Machine Drawing: S. Chand & Company Publishing House

MEP 1302: Fluid Mechanics Laboratory

1. **Course Description:**

The Lab sessions would include experiments on:

- Measurement of viscosity
- Study of Pressure Measuring Devices
- Stability of Floating Body
- Hydrostatics Force on Flat Surfaces/Curved Surfaces
- Verification of Bernoulli's Theorem
- Venturimeter
- Orifice meter
- Impacts of jets
- Flow Visualization -Ideal Flow
- Length of establishment of flow
- Velocity distribution in pipes
- Laminar Flow

2. Learning Outcome:

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

- Calibrate flow measuring devices used in pipes, tanks and channels
- Measure discharge in pipes
- Determine fluid and flow properties
- Characterize laminar and turbulent flows

3. **Broad Course Outline:**

- Calibration of Venturimeter, Orifice meter (discharge measuring device in pipes)
- Calibration of Orifice and Mouthpiece (discharge measuring device in Tanks).
- Calibration of Triangular Notch and Rectangular notch (discharge measuring device in Channels)
- Measurement of Viscosity of water
- Determination of Darcy Friction Factor, relative roughness for laminar and turbulent flows.
- Determination of minor losses

MEP 1303: Strength of Materials Laboratory Course Description:

1. **Course Description:**

The Lab sessions would include experiments on:

- To study the Brinell hardness testing machine and the Brinell hardness test
- To study the Rockwell Hardness testing machine and perform the Rockwell hardness test
- To study the Impact Testing machine and Perform Izod impact test
- To study the Impact Testing machine and Perform charpy impact test
- To study the UTM and perform the tensile test
- To perform compression test on UTM
- To perform the bending test on UTM
- To perform the shear test on UTM
- Torsion test on mild steel rod

2. **Learning Outcome:**

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

- Understand the concept of principal stresses and strains at a point
- Determine deflection of a beam for various loading conditions with different support conditions
- Analyze the stresses of different compression members subjected to different load
- Understand the concept of shear centre, shear flow, thin and thick cylinders
- Know the behavior of springs under loading
- Know the different failure theories

3. **Broad Course Outline:**

- Principal Stresses and Strains at a Point
- Columns and Struts
- Shear Centre
- Thin and Thick Cylinder
- Springs
- Failure Theories