

## SYLLABUS

### 3MH1-01ADVANCED ENGINEERING MATHEMATICS-I

<b>B.TECH. (Mechatronics Engineering)</b>	<b>Max. Marks: 150(IA:30, ETE:120)</b>
<b>L3+T 0+PO</b>	<b>End Term Exam.: 3 Hours</b>

#### Contents

**Numerical Methods-1:**

Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

**Numerical Methods-2:**

Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predictor-corrector methods.

Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.

**Laplace Transform:**

Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method.

**Fourier Transform:**

Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only).

**Z-Transform:**

Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.

**3MH1-02/4MH1-02 : TECHNICAL COMMUNICATIONS**

**Credit :2**

**Max. Marks: 100(IA:20, ETE:80)**

**L2+T0+P0**

**End Term Exam.: 2 Hours**

**Contents**

**Vocabulary Building.**

Concept of Word Formation. Affixes. Synonyms and Antonyms.

**Grammar**

Words and Sentences. Verbs and Tenses. Questions and Question Tags. The Infinitive and the ‘...ing’ form.

**Grammar**

Nouns and Articles. Determiners. Adjectives and Adverbs. Relative clauses.

**Identifying Common Errors in Writing**

Subject- Verb Agreement. Noun-Pronoun Agreement. Articles. Prepositions.

**Composition**

Précis Writing. Essay Writing. Comprehension of Passage.

**3MH1-03/4MH1-03 : MANAGERIAL ECONOMICS AND  
FINANCIAL ACCOUNTING**

<b>Credit :2</b>	<b>Max. Marks: 100(IA:20, ETE:80)</b>
<b>L2+T0+P0</b>	<b>End Term Exam.: 2 Hours</b>

**Contents**

**Basic economic concepts-**

Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.

**Demand and Supply analysis-**

Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.

**Production and Cost analysis-**

Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.

**Market structure and pricing theory-**

Perfect competition, Monopoly, Monopolistic competition, Oligopoly.

**Financial statement analysis-**

Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.

### 3MH3-04 : ELECTROMAGNETIC PROPERTIES OF MATERIALS

<b>Credit :2</b>	<b>Max. Marks: 100(IA:20, ETE:80)</b>
<b>L2+T0+P0</b>	<b>End Term Exam.: 2 Hours</b>
<b>Contents</b>	
<p><b>Dielectrics Materials-</b> Introduction, Polarization, Polarizability, Different types of polarization, Electronic, ionic, Orientation and space polarization, frequency and temperature dependence of different polarization, Dielectric loss and loss tangent, energy store and loss in dynamic polarization, Phenomenon of spontaneous polarization and ferroelectricity, Ferroelectric hysteresis loop, Piezoelectricity, piezoelectric materials: Quartz, Rochelle salt and PZT, Applications of dielectrics.</p> <p><b>Magnetic Materials-</b> Introduction, magnetization, theory of Dia, Para, Ferro-Ferrimagnetism and antiferromagnetism, Weiss field and magnetic domains, BH hysteresis loop, soft and hard magnetic materials and their applications, magnetic energy. Magnetostriction, giant magnetostriction resistor (GMR) and engineering applications of it. Magnetic spin, new electronic devices based on magnetic spin.</p> <p><b>SemiConductor Materials-</b> Introduction, Energy band gap structures of semiconductors, Classifications of semiconductors, Degenerate and non-degenerate semiconductors, Direct and indirect band gap semiconductors, Electronic properties of Silicon, Germanium, Compound Semiconductor, Gallium Arsenide, Gallium phosphide &amp; Silicon carbide, Variation of semiconductor conductivity, resistance and band gap with temperature and doping. Thermistors, Sensors.</p> <p><b>Conductive &amp; Superconductive Materials</b> -Electrical properties of conductive and resistive materials. Energy band gap structures of metals, resistivity of conductors and multiphase solids, Matthiessen's rule, Important characteristics and electronic applications of specific conductor &amp; resistance materials, Superconductor phenomenon, Type I and Type II superconductors. Theory of superconductors, High temperature superconductors and their applications.</p> <p><b>Nanomaterials-</b> Introduction, Change in band structure at nano-stage. Structure of Quantum dots (nano-dots) &amp; Quantum wires, Fabrication &amp; Characterization of nanomaterials, Structure of single wall and multi-wall carbon nanotube (CNT), Change in electrical, Electronic and optical properties at nano stage, Potential applications of nanomaterials.</p>	

### 3MH4-05 : MECHANICS OF SOLIDS

<b>Credit :4</b>	<b>Max. Marks: 200(IA:40, ETE:160)</b>
<b>L3+T1+P0</b>	<b>End Term Exam.: 3 Hours</b>
<b>Contents</b>	
<p><b>Stress and Strain:</b> Tension, compression, shearing stress and strain, Poisson's ratio, stress-strain relationship, Hooke's law, equations of static equilibrium for 2D and 3D cases, elastic constants and their relations for an isotropic Hookean material, anisotropy and orthotropic, thermal stresses, composite bars, simple elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, concept of factor of safety and permissible stress, conditions for equilibrium, concept of free body diagram, introduction to mechanics of deformable bodies.</p> <p><b>Members Subjected to Flexural Loads:</b> Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams, bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle section etc.</p> <p><b>Principal Planes, Stresses and Strains:</b> Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain.</p> <p><b>Theories of Elastic Failures:</b> The necessity for a theory, different theories, significance and comparison, applications.</p> <p><b>Torsion:</b> Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity.</p> <p><b>Stability of Equilibrium:</b> Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.</p> <p><b>Transverse Deflection of Beams:</b> Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method, method of superposition and conjugate beam method, variational approach to determine deflection and stresses in beam.</p> <p><b>Elastic Strain Energy:</b> Strain energy due to axial, bending and torsional loads, stresses due to suddenly applied loads, use of energy theorem to determine deflection of beams and twist of shafts, Castigliano's theorem, Maxwell's theorem of reciprocal deflections.</p>	

### 3MH4-06 : ENGINEERING THERMODYNAMICS

<b>Credit :3</b>	<b>Max. Marks: 150 (IA30, ETE:120)</b>
<b>3L+0T+0P</b>	<b>End Term Exam.: 3 Hours</b>
<b>Contents</b>	
<p><b>Basic Concepts of Thermodynamics:</b> Thermodynamics system, control volume, properties, state, processes and cycle, equality of temperature, zeroth Law of thermodynamics, temperature scale, laws of perfect gas, pure substances, vapour-Liquid-solid-phase equilibrium in a pure substance, thermodynamics surfaces.</p> <p><b>Work and Heat:</b> Law of conservation of mass and energy, first law of thermodynamics, steady state processes, second law of thermodynamics, heat engine, Carnot cycle, thermodynamic temperature scale, entropy, change of entropy for different processes, equivalence of Kelvin, Planck and Clausius statements, Clausius inequality.</p> <p><b>Available and Unavailable Energy:</b> Availability of a non flow and steady flow system, Helmholtz and Gibbs functions, thermodynamic Relations, Important mathematical relations, Maxwell relations, Tds Relations, Joule-Thomson coefficient, Clapeyron relation.</p> <p><b>Air-Standard Power Cycle:</b> Brayton cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycle and Atkinson cycle, Mean effective pressure and efficiencies, Four stroke petrol and diesel engine, Two stroke petrol and diesel engine.</p> <p><b>Properties of Steam:</b> Phase change process, use of steam table and Mollier chart, Rankine cycle, Reheat cycle, Regenerative cycle, cogeneration vapour compression refrigeration cycle.</p>	

### 3MH4-07: MANUFACTURING PROCESS

<b>Credit :3</b>	<b>Max. Marks: 150 (IA30, ETE:120)</b>
<b>3L+0T+0P</b>	<b>End Term Exam.: 3 Hours</b>
<b>Contents</b>	
<p>Importance of manufacturing, economic and technological definition of manufacturing, survey of manufacturing processes.</p> <p><b>Foundry Technology:</b> Patterns practices, Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands, properties and sand testing, grain fineness, moisture content, clay content and permeability test, core materials and core making, core print, core boxes, chaplets, gating system design, Moulding practices, green, dry and loam sand moulding, pit and floor moulding, shell moulding, permanent moulding, carbon dioxide moulding.</p> <p><b>Casting practices:</b> Fundamental of metal casting, sand casting, shell-mould casting, mold casting (plaster and ceramic), investment casting, vacuum casting, permanent mould casting, slush casting, pressure casting, die casting, centrifugal casting, continuous casting, squeeze casting, casting alloys, casting defects, design of casting, gating system design, and riser design, melting furnaces - rotary, pit electric, tilting and cupola.</p> <p><b>Metal Joining Processes:</b> Principle of welding, soldering, brazing and adhesive bonding, Survey of welding and allied processes, Arc welding, power sources and consumables, Gas welding and cutting, Processes and equipments. Resistance welding, principle and equipment, spot, projection and seam welding process, Atomic hydrogen, ultrasonic, plasma and laser beam welding, electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, welding defects. Electrodes and Electrode Coatings</p> <p><b>Forming and Shaping Processes:</b> Metal working, elastic and plastic deformation, concept of strain hardening, hot and cold working, rolling, principle and operations, roll pass sequence, forging, forging operations, extrusion, wire and tube drawing processes. Forging, Method of forging, forging hammers and presses, principle of forging tool design, cold working processes - shearing, drawing, squeezing, blanking, piercing, deep drawing, coining and embossing, metal working defects, cold heading, riveting, thread rolling bending and forming operation.</p> <p><b>Powder Metallurgy:</b> Powder manufacturing, mechanical pulverization, sintering, electrolytic process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of P/M.</p> <p><b>Rapid Prototyping Operations:</b> Introduction, subtractive processes, additive processes, virtual prototyping and applications.</p> <p><b>Plastic Technology:</b> Introduction, classification of plastics, Ingredients of moulding compounds, general properties of plastics, plastic part manufacturing</p>	

processes such as compression moulding, transfer moulding, injection moulding, extrusion moulding, blow moulding, calendaring, thermoforming, slushmoulding, laminating.

### 3MH4-21: MACHINE DRAWING

<b>Credit :1.5</b>	<b>Max. Marks: 75 (IA45, ETE:30)</b>
<b>OL+0T+3P</b>	<b>End Term Exam.: 2 Hours</b>
<b>List of Experiments</b>	
<b>Detaildrawings:</b> <b>Couplings:</b> Pin-type flexible coupling etc, IC. Engine parts: connecting rod, crank shaft, etc, Boiler Mountings: Steam stop valve / feed check-valve / safety valve / three way stop valve blow off cock. <b>Bearings:</b> Swivel bearing Machine Tool Parts: Shaper tool head, Lathe Tail Stock, Turret Tool Post, Turret Bar feeding Mechanism / Universal Dividing Head, Swivel machine vice. <b>Miscellaneous:</b> Screw jack and drill-press vice. <b>Free Hand Sketches:</b> Pipes and Pipe fittings, clutches, bearings, bearing puller, valve gear mechanisms, machine arbor and cutter, universal dividing head, jigs and fixtures, Stepless drives sliding gearbox.	

### 3MH4-22: THERMAL ENGINEERING LAB-I

<b>Credit :1.5</b>	<b>Max. Marks: 75 (IA45, ETE:30)</b>
<b>OL+OT+3P</b>	<b>End Term Exam.: 2 Hours</b>

#### **List of Experiments**

1. Comparativestudyoffourstrokedieselandpetrolengines.
2. Comparativestudyoftwostrokepetrolanddieselengines.
3. Studiesoffuelsupplysystemsofdieselandpetrolengines.
4. Studyofcooling,lubricationandignitionsystemindieselandpetrolengines.
5. TostudyvarioustypesofBoilersandtostudyBoilermountingandaccessories.
6. TostudyvarioustypesofDynamometers.
7. TostudyMultiStageAirCompressors.
8. TofindtheBHP,Thermalefficiencyoffourstrokedieselengine.
9. StudyofBrakes,Clutches,andTransmissionSystem.
10. Toprepareacomparisonsheetofvariousautomobiles(4 Wheelerand2Wheeler).

### 3MH4-23 : PRODUCTIONENGINEERINGPRACTICE

<b>Credit :1.5</b>	<b>Max. Marks: 75 (IA45, ETE:30)</b>
<b>OL+OT+3P</b>	<b>End Term Exam.: 2 Hours</b>

#### **List of Experiments**

##### **MachineShop:**

1. Studyoflathemachine,lathetoolscuttingspeed,feedanddepthofcut.
2. Toperformstepturning, knurlingandchamferingonlathemachineasperdrawing.
3. Taperturningbytailstockoffsetmethodasperdrawing.
4. Tocutmetricthreadasperdrawing.
5. Toperformsquarethreading,drillingandtaperturningbycompoundrestasper drawing.
6. Tostudyshapermachine,itsmechanismandcalculatequickreturnratio.

##### **FoundryShop:**

7. Topreparemouldofagivenpatternrequiringcoreandtocastitinaluminium. Moisturetestandclaycontenttest.
8. StrengthTest(compressive, Tensile, ShearTransverseetc. ingreenanddry conditions)andHardnessTest(MouldandCore).
9. PermeabilityTest.
10. A.F.S. SieveanalysisTest.

### 3MH4-24: MATERIAL SCIENCE LAB

<b>Credit :1.5</b>	<b>Max. Marks: 75 (IA45, ETE:30)</b>
<b>OL+OT+3P</b>	<b>End Term Exam.: 2 Hours</b>

#### **List of Experiments**

1. Study of Engineering Materials and crystals structures. Study of models BCC, FCC, HCP and stacking sequence, tetrahedral and octahedral voids.
2. To calculate the effective number of atoms, co-ordination number, packing factors, c/a ratio for HCP structure.
3. Study of brittle and ductile fracture.
4. To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope.
5. Study of the following Micro structures: Hypo, Hyper and Eutectoid Steel, Grey, White, Nodular and Malleable Cast Iron.
6. Annealing of Steel -Effect of annealing temperatures and time on hardness.
7. Study of Microstructure and hardness of steel at different rates of cooling.  
Microstructure examination of white cast iron.
8. Hardening of steel, effect of quenching medium on hardness.
9. Effect of Carbon percentage on the hardness of Steel.
10. Study of various crystal structures and dislocations through models.
11. Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.