

# **COURSE STRUCTURE & SYLLABUS OF BACHELOR OF TECHNOLOGY (B.TECH)**

*In*

**Mechanical**

**Course Structure**

**Second Year**

**Third Semester**

<b>Paper Code</b>	<b>Subject</b>
BSM1	Mathematics III
BSM2	Thermodynamics
BSM3	Fluid Mechanics
BSM4	Workshop Processes
BSM5	Electrical Machine

**Syllabus**

## **BSM1 : MATHEMATICS III**

### **1 PARTIAL DIFFERENTIATION AND PARTIAL DIFFERENTIAL EQUATION**

Introduction, Limit , Partial derivatives , Partial derivatives of Higher orders, Which variable is to be treated as constant, Homogeneous function, Euler's Theorem on Homogeneous Functions, Introduction, Total Differential

Coefficient, Important Deductions, Typical cases, Geometrical Interpretation of  $\frac{dz}{dx}, \frac{dz}{dy}$ , Tangent plane to a

surface, Error determination, Jacobians, Properties of Jacobians, Jacobians of Implicit Functions, Partial Derivatives of Implicit Functions by Jacobian, Taylor's series, Conditions for F(x,y) to be of two variables maximum or minimum, Lagrange's method of undermined Multipliers.

### **2 PARTIAL DIFFERENTIAL EQUATIONS**

Partial Differential Equations, Order, Method of Forming Partial Differential Equations, Solution of Equation by direct Integration, Lagrange's Linear equation, Working Rule, Method of Multipliers, Partial Differential Equations non- Linear in p,q , Linear Homogeneous Partial Diff. Eqn., Rules for finding the complimentary function, Rules for finding the particular Integral, Introduction, Method of Separation of Variables, Equation of Vibrating Strain, Solution of Wave Equation, One Dimensional Heat Flow, Two dimensional Heat Flow.

### **3 FOURIER SERIES**

Periodic Functions, Fourier Series, Dirichlet's Conditions, Advantages of Fourier Series, Useful Integrals, Determination of Fourier constants (Euler's Formulae), Functions defined in two or more sub spaces, Even Functions, Half Range's series, Change of Interval, Parseval's Formula, Fourier series in Complex Form, Practical Harmonic Analysis.

## 4 LAPLACE TRANSFORMATION

Introduction, Laplace Transform, Important Formulae, Properties of Laplace Transforms, Laplace Transform of the Derivative of  $f(t)$ , Laplace Transform of Derivative of order  $n$ , Laplace Transform of Integral of  $f(t)$ , Laplace Transform of  $t.f(t)$  (Multiplication by  $t$ ), Laplace Transform of  $\frac{1}{t}f(t)$  (Division by  $t$ ), Unit step function, second shifting theorem, Theorem, Impulse Function, Periodic Functions, Convolution Theorem, Laplace Transform of Bessel function, Evaluation of Integral, Formulae of Laplace Transform, properties of Laplace Transform, Inverse of Laplace Transform, Important formulae, Multiplication by  $s$ , Division of  $s$  (Multiplication by  $1/s$ ), First shifting properties, second shifting properties, Inverse Laplace Transform of Derivatives, Inverse Laplace Transform of Integrals, Partial Fraction Method, Inverse Laplace Transform, Solution of Differential Equations, Solution of simultaneous equations, Inversion Formulae for the Laplace Transform.

## 5 NUMERICAL TECHNIQUES

Solution of Ordinary Differential Equations, Taylor's Series Method, Picard's method of successive approximations, Euler's method, Euler's Modified formula, Runge's Formula, Runge's Formula (Third only), Runge's Kutta Formula (Fourth order), Higher order Differential Equations.

## 6 NUMERICAL METHODS FOR SOLUTION OF PARTIAL DIFFERENTIAL EQUATION

General Linear partial differential equations, Finite-Difference Approximation to Derivatives, Solution of Partial Differential equation (Laplace's method), Jacobi's Iteration Formula, Gauss-Seidal method, Successive over-Relaxation or S.O.R. method, Poisson Equation, Heat equation (parabolic equations), Wave equation (Hyperbolic Equation).

## BSM7 : THERMODYNAMICS

### 1. Combustion of Fuel

Introduction, Mass fraction and Mole Fraction, Symbols for Elements and Compounds, Combustion Equations of Gaseous Fuels, Theoretical or Minimum Mass of Air Required for Complete Combustion, Theoretical or Minimum Volume of Air required for Complete Combustion, Excess Air Supplied, Air Fuel ratio, Analysis of products of combustion, Combustion Equations, Volumetric analysis of products, Conversion of volumetric analysis to gravimetric analysis, Volume Fraction, Conversion of volumetric Analysis into Mass Analysis or Gravimetric Analysis, Conversion of Mass Analysis into Volumetric Analysis, Mass of Carbon in Fuel Gases, The analysis of Fuel Gas, The Orsat Apparatus.

### 2. Entropy

Introduction, Entropy as a property, The Second Law, Analysis for Entropy, Clausius Inequality, Change of entropy in an irreversible process, Change of Entropy for Ideal Gas and Pure Substance, Change of Entropy of a perfect gas during Various Thermodynamics Processes, Change of Entropy during Constant Process (or Isobaric Process), Change of Entropy during Constant Temperature Process (or Isothermal process), Change of Entropy during Reversible Adiabatic Process (or Isentropic Process), Change of Entropy during Polytropic Process ( $pv^n = \text{Constant}$ ).

### 3. Air Compressor

Introduction, Uses of Compressed air for industries, Types of Air Compressors, Capacity Control of Compressor, Types of compressor valves, Work done by Reciprocating Air Compressor with Clearance Volume, Effect of Clearance on volumetric efficiency, Condition for maximum efficiency in two stage compression with intercooling.

### 4. IC Engine

Introduction, Classification of I.C. Engines, Fuel Supply System for S.I. and C.I. Engine, Ignition Systems of Petrol Engines, Fuel Injection system for Diesel Engines, Cooling Systems for I.C. Engines, Lubrication System for I.C.

Engines, Governing of internal combustion engines, Main Components of I.C. Engines, Reciprocating Internal Combustion Engines, Four-Stroke cycle, Two-stroke cycle.

**5. IC Engine Testing & Performance**

Indicated Power, Measurement of friction power, Indicated mean Effective Pressure, Measurement of fuel consumption, Energy balance of an I.C. Engine, Determination of mechanical, Thermal and Relative efficiency.

**6. Steam Process**

Introduction, Thermodynamics Processes of Vapour, Enthalpy – Entropy or H-S Chart or Mollier Diagram, Measurement of dryness-fraction of steam, Bucket or Barrel Calorimeter, BOILER, Introduction, Classification of Boilers, Boiler Mountings and Accessories, Equivalent Evaporation, Boiler Efficiency, Heat Losses in a Boiler, Heat Balance Sheet, Boiler Draught.

**7. Vapour Power Cycle**

Introduction, The Carnot cycle, The ideal Rankine Cycle, Factors affecting the performance of Rankine cycle.

**8. Air Standard Cycle**

Introduction, Otto Cycle, Diesel Cycle, Dual Combustion Cycle, Comparison of Otto, Diesel Dual Cycle, Air and Fuel-vapour mixtures Concept of air fuel Cycle.

**BSM3 : FLUID MECHANICS**

**1. INTRODUCTION**

Introduction, Classification of Fluid, Fundamental Units, S.I. (International System of Units), Presentation of Units and their Values, Rules for S.I. Units, Liquids and their properties, Density of Water, Specific weight of Water, Specific Gravity of Water, Compressibility of Water, Surface tension of water, Capillarity of Water, Viscosity of Water.

**2. HYDROSTATICS**

Introduction, Total Pressure, Total Pressure on an Immersed Surface, Total Pressure on a Horizontally Immersed Surface, Total pressure on a Vertically Immersed Surface, Total Pressure on inclined surface, Centre of pressure, Pressure on a curved Surface.

**3. EQUILIBRIUM OF FLOATING BODIES**

Introduction, Archimedes Principle, Buoyancy, Centre of Buoyancy, Metacentre, Metacentric Height, Analytical Method for Metacentric Height, Conditions of Equilibrium of a floating Body, Stable Equilibrium, Unstable Equilibrium, Unstable Equilibrium, Neutral Equilibrium, Maximum Length of Vertically Floating Body, Conical Buoys Floating in Liquid, Experimental method for Metacentric Height, Time of Rolling (Oscillation) of a floating body.

**4. BERNOULLI'S EQUATION AND ITS APPLICATIONS**

Introduction, Energy of a liquid in Motion, Potential Energy of a liquid particle in Motion, Kinetic Energy of a liquid particle in Motion, Pressure Energy of a liquid particle in Motion, Total Energy of a liquid particle in Motion, Total Head of a liquid particle in Motion, Bernoulli's Equation, Euler's Equation for Motion, Limitations of Bernoulli's Equation, Practical Applications of Bernoulli's Equation, Venturimeter, Discharge through a Venturimeter, Inclined Venturimeter, Orifice Meter, Pitot Tube.

**5. FLOW THROUGH ORIFICES**

Introduction, Types of Orifices, Jet of Water, Vena Contracta, Hydraulic Coefficients, Coefficient of Velocity, Coefficient of Discharge, Coefficient of Resistance, Experimental Method for Hydraulic Coefficients, Discharge through a small Rectangular Orifice, Discharge through a large Rectangular Orifice, Discharge through a Submerged or Drowned Orifice, Discharge through a Wholly Drowned Orifice, Discharge through a Partially Drowned Orifice, Discharge through a Drowned Orifice under Pressure.

## **6. FLOW THROUGH MOUTHPIECES**

Types of mouthpieces, Loss of a Head of a Liquid Flowing in a pipe, Loss of Head due to Sudden Enlargement, Loss of Head due to sudden contraction, Loss of Head at entrance to pipe, Discharge through a Mouthpiece, Discharge through an External mouthpiece, Discharge through an Internal mouthpiece (Re-entrant or Borda's mouthpiece), Discharge through a Convergent Mouthpiece, Discharge through a Convergent-divergent Mouthpiece (Bell-mouthpiece), Pressure in a mouthpiece, Pressure in an External mouthpiece, Pressure in an internal mouthpiece, Pressure in a Convergent Mouthpiece, Pressure in a Convergent-divergent Mouthpiece.

## **7. FLOW THROUGH SIMPLE PIPES**

Introduction, Loss of Head in Pipes, Darcy's Formula for loss of Head in pipes, Chezy's Formula for Loss of Head in Pipes, Graphical Representation of Pressure Head and Velocity Head, Hydraulic Gradient Line, Total Energy Line, Transmission of Power through Pipes, Time of Emptying a Tank through a Long Pipe, Time of Flow from One Tank into Another through a Long Pipe.

## **8. UNIFORM FLOW THROUGH OPEN CHANNELS**

Introduction, Chezy's Formula for Discharging through an Open Channel, Values of Chezy's Constant in the formula for Discharge through an Open Channel, Bazin's Formula for Discharge, Kutter's Formula for Discharge, Manning's Formula for Discharge, Discharge through a Circular Channel, Channels of Most Economical Cross-sections, Condition for Maximum Discharge through a Channel of Rectangular Section, Condition for Maximum Discharge through Channel of Trapezoidal Section, Condition for Maximum Velocity through a Channel of Circular Section, Condition for Maximum Discharge through a Channel of Circular Section, Measurement of River Discharge, Area of Flow, Simple Segments Method, Simpson's rule, Average Velocity of Flow, Floats, Pitot Tube, Chemical Method for the Discharge of a River.

## **9. VISCOUS FLOW**

Viscosity, Newton's Law of Viscosity, Effect of Viscosity on Motion, Units of Viscosity, Effect of Temperature on the Viscosity, Kinematic Viscosity, Classification of Fluids, Ideal Fluid, Real Fluid, Newtonian Fluid, Non-Newtonian Fluid, Ideal Plastic fluid, Classification of Viscous Flows, Laminar Flow, Turbulent Flow, Reynold's Experiment of Viscous Flow, Reynold's number, Hagen-Poiseuille Law for Laminar Flow in Pipes, Distribution of Velocity of a Flowing Liquid over a Pipe Section, Loss of Head due to Friction in a Viscous Flow.

## **10. IMPACT OF JETS**

Introduction, Force of Jet Impinging Normally on a fixed Plate, Force of Jet Impinging on an Inclined Fixed Plate, Force of Jet Impinging on a Curved Plate, Force of Jet Impinging on a Moving Plate, Force of Jet Impinging on a Series of Moving Vanes, Force of Jet Impinging on a Fixed Curved Vane, Force exerted by a Jet of water on a series of vanes.

## **11. JET PROPULSION**

Introduction, Pressure of Water due to Deviated Flow, Principle of Jet Propulsion, Conditions for maximum efficiency, Propulsion of Ships by water Jets, Propulsion of Ships Having Inlet Orifices at Right Angles to the Direction of its Motion (i.e. Orifices Amidship), Propulsion of Ships Having Inlet Orifices Facing the Direction of Flow.

## **12. WATER WHEELS**

Introduction, Hydroelectric Power Plant, Heads of Turbine, Classification of Hydraulic Turbines, Water Wheels, Pelton

## **13. IMPULSE TURBINES**

Introduction, Pelton Wheel, Runner and Buckets, Casing, Braking Jet, Work Done by an Impulse Turbine, Design of Pelton Wheels, Governing of an Impulse Turbine (Pelton Wheel), Other Impulse Turbines.

## **14. CENTRIFUGAL PUMPS**

Introduction, Types of Pumps, Centrifugal Pump, Types of casings for the impeller of a Centrifugal Pump, Volute Casing (Spiral Casing), Vortex Casing, Volute Casing with Guide Blades, Work done by a Centrifugal Pump, Efficiencies of a Centrifugal Pump, Manometric Efficiency, Mechanical Efficiency.

#### **15. PUMPING DEVICES**

Introduction, Hydraulic Ram, Air Lift Pump, Rotary Pump.

#### **16. HYDRAULIC SYSTEMS**

Introduction, Hydraulic Press, Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Crane, Hydraulic Lift, Direct Acting Hydraulic Lift, Suspend Hydraulic Lift, Hydraulic Coupling, Hydraulic Torque Converter.

### **BSM4 : WORKSHOP PROCESSES**

#### **1. MILLING MACHINES**

Introduction; classification and types; Size and specifications; Accessories attachment; Milling cutters; Classification and types of milling cutter; Nomenclature of cutter; Setup-operation ; Method of feeding work piece; Operation on milling machine; Indexing (simple compound, differential angular) ; Helical milling cam milling ; Cutting speed & ledge ; Machining time calculation; Milling operation compound with other operations

#### **2. THE LATHE**

Introduction, Functions, Types, Descriptions & Functions of Lathe Parts, Lathe Accessories & attachments, lathe Operations.

#### **3. GRINDING MACHINE**

Introduction.; Types of Grinding machines (Floor stand, Precision. Plain, cylindrical, universal centrals Internal, surface disc); Special grinding machine, (Tool and cutter grinder, cam and and shape grinders); Shape of grinding wheel; Grinding wheel designation as per- IS -551 -19-54; Grinding wheels ; Grinding wheel elements (abrasives - its types, Grain sizes, Grade, structure, bonding material etc.); Diamond wheel; Grinding wheel section; Allowances for grinding wheel; Mounting of Grinding wheel; Dressing and cursing, of grinding wheel

#### **4. BORING, BROACHING AND SAWING MACHINE**

Introduction to Boring machines ; Types of Boring machine ; Boring haps and heads; Various operations using boring heads; Boring operations using end supports; Introduction to Broaching machine ; Types of Broaching machine; Broaching tool nomenclature; Types of Broaches; Broaching options compared with other process (advantages & limitations.); External; Lubrication and cooling; Application of Broaching

#### **5. GEAR MANUFACTURING**

Gear tooth element; Materials for Gears; Different methods of Gear manufacturing ; Gear generating methods; Gear milling ; Gear shaping (Working principal of machine tool required Gear shaping cutters etc.) ; Gear Hibbing (Working principal of machine tool required Gear hobbing operation) ; Gear finishing process ( Gear sharing burnishing, grinding honing lapping

#### **6. METAL FINISHING PROCESS**

Introduction; Honing; Description and construction of honing tool.; Application of honing process; Lopping; Description of Lapping compound and tool; Application of Lapping ; Super finishing process Burnishing - Polishing - Buffing ; Application of super finishing operations.

#### **7. PATTERN MAKING**

Introduction, Pattern Materials, Pattern Making Tools, Pattern Allowances, Types of Patterns, Solid or Single Piece Pattern, Split Pattern, Match Plate Pattern, Cope and Drag Pattern, Loose Piece Pattern, Gated Pattern, Sweep

Pattern, Skeleton Pattern, Shell Pattern, Segmental Pattern, Follow Board Pattern, Lagged-up Pattern, Left and Right hand Pattern, Core Boxes, Colour coding for Pattern and Core Boxes.

## **8. MOULDING AND CORE MAKING**

Introduction, Moulding Materials, Moulding Sand, Sand Binders, Sand Additives, Properties of Moulding Sand, Classification of Moulding Sand, Grain Shape and Size of Sand, Preparation of Moulding Sand, Types of Moulding Sand, Moulding Processes, Types of Moulds, Methods of Moulding, Methods of Green Sand Mould by Turn Over Method, Gates and Risers, Types of Gates, Moulding Methods with Typical Patterns, Cores, Types of Cores, Core Binders, Core Making, Core Setting, Core Shifting and Chaplets.

## **9. CASTING PROCESSES**

Introduction, Permanent Mould Casting, Semi-permanent Mould Casting, Slush Casting, Die Casting, Centrifugal Casting, Investment Casting, Shell Moulding Process, Continuous Casting, Defects in Casting, Cleaning of Castings, Inspection of Castings, Design of Castings.

## **10. WELDING**

Introduction, Weldability, Advantages and Disadvantages of Welded Joints, Types of Welded Joints, Cold Pressure Welding, Types of Welded Joints, Fillet Welded Joints, Edge Preparation and Applications, Welding Positions, Black Smith's Forge Welding, Electric Resistance Welding, Types of Electric Resistance Welding, Spot Welding, Roll Spot and Seam Welding, Projection Welding, Butt Welding, Percussion Welding, Arc Welding, Polarity in Arc Welding, Comparison Between A.C. and D.C. Arc Welding, Types of Arc Welding, Electrodes for Arc Welding, Arc Welding Equipment, Precautions in Arc Welding, Arc Welding Processes, Carbon Arc Welding, Metal Arc Welding, Metallic Inert-gas (MIG) Arc Welding, Tungsten Inert-gas (TIG) Arc Welding, Atomic Hydrogen Welding, Stud Welding, Submerged Arc Welding, Plasma Arc Welding, Flux Cored Arc Welding, Electro-slag Welding, Electro-gas Welding, Thermit Welding, Solid State Welding, Modern Welding Processes, Basic Weld Symbols, Supplementary Weld Symbols, Elements of a Welding Symbol, Standard Location of Elements of a Welding Symbol, Gas Welding, Equipment for Oxy-acetylene Gas Welding, Welding Rods, Fluxes, Gas Flame, Gas Welding Technique, Gas or Oxygen Cutting of Metals, Cutting Machines, Oxygen Lance Cutting, Arc Cutting, Oxygen Arc Cutting Process, Welding of Various Metals, Testing of Welded Joints, Braze Welding, Soldering, Brazing.

## **11. RECENT DEVELOPMENT IN MANUFACTURING PROCESS**

Introduction, Working of NC Machines tools, Classification of NC Machines, Programming for NC Machines, Methods of Listing the Co-ordinates of points in NC System, Application of NC Machine, Advantages & Disadvantages, Computer Numerical Control & Direct Numerical Control.

## **13. METAL CUTTING AND CUTTING TOOLS**

Introduction, Types Of Cutting Tools, Measurement Of Forces, Types Of Chip, The Cutting Action Of Hand Tools, Tool Life And Wear, Machinability, Cutting Tool Materials, Cutting Fluid

## **14. DRILLING MACHINES**

Introduction, Types Of Drilling Machines, Tools Holding Devices, Drilling Machine Operations, Types Of Drills, Twist Drill Nomenclature, Drill Material, Reamer

## **15. SHAPER, PLANNER AND SLOTTING MACHINE**

Introduction, principal parts, planner, planning machine parts, shaper vs. Planner, slotting machines, Slotting machine parts, slotter operations, slotter tools

## **BSM5 : ELECTRICAL MACHINES**

### **1 INTRODUCTION**

Basic concept of Electrical Engineering; Resistance  
Inductance  
Capacitance

Resistance connected in series and Parallel  
Capacitance connected in series and parallel  
Concept of AC/DC currents and AC/DC Voltages,  
EMF  
Potential difference, Work, Power and Energy.

## **2 DC NETWORKS**

Kirchhoff's Laws,  
Node voltage and Mesh current Methods  
Delta – Star and Star - Delta Conversion  
Superposition principle  
Thevenin's and Norton's Theorems

## **3 TRANSFORMER**

Construction and principle of X'Mers  
EMF equation  
Ideal X'Mer  
Shell type & Core type X'Mer  
Phasor Diagrams  
Equivalent Circuits,  
Regulation and Efficiency of X'Mer,  
Capacity of X'Mer, and Losses,  
Introduction to Auto X'Mer

## **4 DC MACHINES**

Construction and Principle of DC generation and DC Motor,  
Back emf of DC Motor,  
Types of DC Motor,  
Reversal of Direction of Rotation of DC Motor,  
Starting of DC Motor,  
Characteristics of DC Motor,  
Uses of DC Motor, Losses in DC Machine.

## **5 ALTERNATOR**

Construction and Working principle of Alternator,  
Application of Alternators.

## **6 SYNCHRONOUS MOTORS**

Principle of Operation,  
Application of Synchronous Motors  
Comparison between Synchronous Motor and Induction Motors

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