

**COURSE STRUCTURE & SYLLABUS OF  
BACHELOR OF TECHNOLOGY (B.TECH)  
Mechanical/ Electrical/ Electronics/ Computer/ Civil**

**Course Structure First Year  
(Common for all streams)**

**First Semester**

Paper Code	Subject
BF1	Mathematics – I
BF2	Chemistry
BF3	English for Communication
BF4	Electrical Technology
BF5	Mechanics
BF6	Introduction to Manufacturing Process

**SYLLABUS**

**BF1 : MATHEMATICS I**

**1 : LIMITS AND CONTINUITY OF A FUNCTION.**

**2 : DIFFERENTIATION.**

Definition, Derivative by first principle, Differentiation of implicit functions, Differentiation of trigonometric functions, Differentiation of inverse trigonometric functions, Transformation, Differentiation of exponential and Logarithmic Functions, Hyperbolic functions, Derivatives of the inverse hyperbolic functions, Differentiation with respect to a function, Differentiation of Parametric Equations.

**3 : SUCCESSIVE DIFFERENTIATION**

Calculation of nth derivative, Leibnitz's theorem.

**4 : GENERAL THEOREMS, EXPANSION OF FUNCTIONS.**

Rolle's Theorem, Mean value theorem (Lagrange's form), Increasing and Decreasing functions, Mean value theorem (Cauchy's form).

**Expansion of functions;**

Taylor's expansion theorem, Maclaurin's theorem, Taylor's and Maclaurin's infinite series.

**5 : INDETERMINATE FORM**

L' Hospital's rule, Evaluation of  $\frac{0}{0}$  form, Evaluation of  $\frac{\infty}{\infty}$  form, Evaluation of  $\infty - \infty$  form, Evaluation of  $0^0$ ,  $1^\infty$ ,  $\infty^0$  form.

**6 : CURVATURE**

Radius of curvature, Special formula for parametric equations, Radius of curvature at the origin.

**7 : MAXIMA AND MINIMA**

Maximum and Minimum values of a function.

**8 : ELEMENTARY INTEGRATION**

Table of elementary integrals, Simple examples.

**9 : INTEGRATION BY SUBSTITUTION**

Introduction, Change of independent variable in  $\int f(x)dx$ , Working rule to evaluate  $\int f(x)dx$  by the substitution, Four important integrals, standard forms, Integrals of  $\tan x$ ,  $\cot x$ ,  $\sec x$ ,  $\operatorname{cosec} x$ .

#### 10 : INTEGRATION BY PARTS

$\int u.vdx$ ,  $\int e^x [f(x) + f'(x)]dx$ , Important integrals.

#### 11 : INTEGRATION BY PARTIAL FRACTIONS

Non-repeated linear factor, Repeated linear factor, Linear and quadratic factors (non-repeated) Quadratic (repeated), Integration of rational fraction by substitution.

#### 12 : INTEGRATION OF IRRATIONAL ALGEBRAIC FUNCTIONS

Integration of rational functions, integral of the type  $\int \frac{dx}{x\sqrt{y}}$

#### 13 : INTEGRATION OF TRIGONOMETRIC FUNCTIONS

$\int \sin^m x \cos^n x dx$ , Reduction formula method, Integration of positive even integral, Integrals of rational functions of  $\sin x$  and  $\cos x$ .

#### 14 : REDUCTION FORMULA

$\int \sin^n x$ ,  $\int_0^{\pi/2} \sin^n x dx$ ,  $\int \sin^p x \cos^q x$ ,  $\int_0^{\pi/2} \sin^p x \cos^q x dx$ ,  $\int \tan^n x dx$ ,  $\int \sec^n x dx$ ,  
 $\int \operatorname{cosec}^n x dx$ ,  $\int \cot^n x dx$ .

#### 15 : DEFINITE INTEGRALS

Definition, Properties of definite integrals, Examples base on properties.

#### 16 : AREAS OF PLANE CURVES

#### 17 : VOLUMES AND SURFACES OF SOLIDS OF REVOLUTION

#### 18 : LENGTHS OF PLANE CURVES

Arc Formulae, Arc formulae for polar equations.

#### 19 : SIMPSON'S RULE

### **BF2 : CHEMISTRY**

#### **1. WATER TREATMENT:**

Introduction, Sources of Water, effect of Water on Rocks and Minerals, Types of Impurities Present in water, Effects of Impurities in Natural Waters, Methods of Treatment of Water for Domestic and International Purposes, Removal of Dissolved Salts: Softening of Water, Boiler Feed Waters, Boiler Troubles.

#### **2. FUELS**

Introduction, Classification of Fuels, Solid Fuel (Coal), Classification of Coal by Rank, Analysis of Coal, Pulverized Coal, Metallurgical Coke, Manufacture of Metallurgical Coke, Liquid Fuels, Petroleum, Refining of Petroleum, Synthetic Petrol, cracking, Polymerisation, Synthetic Method, Refining Gasoline, Reforming, knocking, Gaseous Fuels, Natural gas, Producer Gas, Water Gas or Blue Gas, Bio-gas, Fuel gas.

#### **3. LUBRICANTS**

Introduction, Functions of Lubricant, Requirements of a Lubricant, Mechanism of Lubrication, Classification of Lubricants, Properties of Lubricating oils, Glossary, Questions.

#### **4. POLYMERS AND PLASTICS**

Introduction, Polymerisation, Classification of Polymers, Tacticity, Functionality of Polymer, Polymerisation Process, Mechanism of Addition Polymerisation, Effects of Structure on Polymer Properties, Plastics, Compounding of Plastics, Thermoplastics resins, Silicones resins, Elastomers or rubber, Adhesives, Glossary,

Questions.

### **5. THERMODYNAMICS**

Introduction, Laws of Thermodynamics, Isothermal and adiabatic Processes, Thermochemistry, System, Glossary, Questions.

### **6. CORROSION**

Introduction, Characteristics of Corrosion, Mechanism of Corrosion of iron, Types of Corrosion, Corrosion and redox Process, Factors Which influence Corrosion, Corrosion Control, Glossary, Questions.

### **7. ENVIRONMENTAL POLLUTION CHEMISTRY**

Introduction, Important definitions, Air Pollution, Water Pollution, Soil Pollution, Pollution by heavy metals, Glossary, Questions.

### **8. METALLIC BOND AND SEMICONDUCTORS**

Introduction, Nature of Metallic bond: Theories, Mechanism of thermal Conduction, Mechanism of electrical conduction, Ductility and malleability, Thermal conductivity, Electrical Conductivity, Photoconductors, Semiconductors, Glossary, Questions.

## **BF3 : ENGLISH FOR COMMUNICATION**

### **1. THE COMMUNICATION EVENTS**

Nature Of Communication, Objective, Definition Of Communication, Situation For Communication, Need Of Communication, Types Of Communication, Verbal Or Oral Communication, Elements Of Communication , Modes Of Communication (Verbal And Non-Verbal), Charts And Graphs, Flow Process Chart, Written Communication , Oral Communication, Media: Channels Of Communication, Message : Form And Content, Communication Process, Effective Communication, Barriers Of Communication, Summary

### **2. SUMMARIZATION**

Summary Writing

### **3. COMPREHENSION AND VOCABULARY**

Comprehension, Vocabulary [(A) Synonyms And Antonyms, (B) Homonyms, (C) Same Word Used As Different Parts Of Speech, (D)One Word Substitution], Word Formation, Root

### **4. PRINCIPLE OF LANGUAGE GRAMMAR AND USAGES**

The Sentence Elements, Words, Phrases, Clauses Sentences, Sentence, The Word, Noun, Verb, Tenses And Their Usages, The Verb : Person And Number, Agreement Of The Verb With The Subject, The Infinitive, Adverbs, Adjectives, Preposition, Relations Expressed By Prepositions, Conjunction, Clauses, Determiners And Modifiers, Sentence Connectives, The Compound And Complex Verb Phrase, Complementation And Subordination, Sentences, Change Of Voice, Change Of Degree, Affirmative And Negative Sentences, Direct And Indirect Speech, Conversion Of Compound Sentences Into Simple Sentences, Conversion Of Complex Sentences Into Compound Sentences, Punctuation

### **5. BASIC OFFICIAL CORRESPONDENCE**

The Process Of Formal Written Communication, The Qualities Of Good Writing, Principles Of Message Organization, Mechanics Of Writing, Elements Of Structure, Forms Of Layout, Styles Of Presentation, Types Of Letters ,Enquiry Letter, Making Claims, Offering Adjustments, Communication Core, Importance And Function, Drafting The Application, Elements Of Structure, Preparing The Resume, Job Offer, Resignation Letter, Communication Core

### **6. TECHNICAL WRITING**

Framing Definitions, Classification And Description Of Objects, Instructions, Types Of Instructions

## **BF4 : ELECTRICAL TECHNOLOGY**

### **1. BASIC CONCEPTS & UNITS:**

Force, Weight, torque, work, energy, Power, Electric charge, Electric Current, EMF, Voltage, Potential Difference Concepts of Ac/Dc Voltage/current.

### **2. ELECTROSTATICS:**

Coulomb's Law, Electric Field, Electric Flux, Electric Field Intensity, Electric Flux Density, Electric Displacement, Charge Density, Permittivity, Dielectric Constant, Electric Potential, Gauss Law, Capacitor, Capacitance of parallel Plate Capacitor, Energy Stored in Capacitor, Capacitors in Series & Parallel, Capacitance of a Multiplate Capacitor, Force of Attraction between plated of Capacitor, Insulation Resistance of Cable.

### **3. ELECTRIC CIRCUIT ELEMENTS:**

Resistance, Specific Resistance, Resistance in Series & Parallel, Open Circuit and Short Circuit, Temperature Coefficient of Resistance, Linear & Non-linear Resistance, Inductance, Energy Stored in Inductance, Inductance in Terms of Flux Linkage Per Ampere, Inductance in Series & Parallel, Linear & Non-linear Inductances.

### **4. ELECTROLYSIS & STORAGE CELL:**

Electrolysis, Faraday's law of Electrolysis, Primary & Secondary Cells, Equivalent Circuit of Cell, Rating of Cell, Cells in Series & parallel, Lead Acid Battery, Nickel Cadmium Cell, Zinc Carbon Cell.

### **5. ELECTROMAGNETISM:**

Magnetic Field, Electromagnetism, Magnetic & Non-Magnetic Materials, Permanent & Temporary magnets, Magnetic flux Density, MMF, Magnetic Field Strength, Force on a Conductor Carrying Current in a Magnetic Field, Biot Savart Law, Ampere's law, Permeability, Force between parallel Conductors, Definition of Ampere, magnetic Shielding, B-H Curve, Magnetisation Curve, Hysteresis, Hysteresis Loss, Modern Theory of Magnetism, Electromagnetic Induction, Fleming Right Hand Rule, Lenz's law, Dynamically Induced e.m.f., Statically induced e.m.f., Eddy Currents, Eddy current loss, Self & Mutual Inductance, Coefficient of Coupling.

### **6. SINGLE PHASE AC CIRCUITS:**

Alternating Voltage & Current, Phase Angle, Phase Difference, Average Value of Sinusoid, Root mean Square or Effective Value, Representation of Sine Wave by Phasor, Alternating Current and Power in Resistive Circuit, Alternating Current and power in Capacitive Circuit, Alternating Current in Series RL Circuit, Apparent, Active & Reactive Power & Power Factor, Alternating Current & Power in RC Circuit, Alternating Current & Power in RLC Series Circuit.

## **BF5 : MECHANICS**

### **1 INTRODUCTION**

Introduction to Mechanics, Definitions, Idealisation in Mechanics, Basic Concepts, Fundamentals Principles, System of Units, Dimensional Analysis, Methods of Solution, Vector Algebra, Summary.

### **2 STATICS OF PARTICLES CONCURRENT FORCES IN PLANE**

Introduction, Resultant of Forces, Resolution and Components of Force, Resultant of Several Concurrent Forces, Equilibrium of a Partical, Equation of Equilibrium, Application of Statics of Particles, Summary.

### **3 STATICS OF PARTICLES CONCURRENT FORCES IN SPACE**

Introduction, Components of Forces in Space, Resultant of Several Concurrent Forces, Equilibrium of a Particle in Space, Application of Statics of Particle, Summary.

### **4 STATICS OF RIGID BODIES\_\_\_ NON – CONCURRENT FORCES IN PLANE**

Introduction, Moment of Force about a Point, Varignon's Theorem, Moment of Couple, Resolution of a Given Force into a Force, Resultant of Coplanar Non-Concurrent System, Application of Statics of Rigid Bodies, Method of Minimum Potential Energy- Stable Equilibrium, Summary.

### **5 STATICS OF RIGID BODIES-NON-CONCURRENT FORCES IN SPACE**

Introduction, Moment of Force about a Point, Moment of Force about a Given Axis, Couples in Space, Resolution of Force into Force and Couple, Resultant of Non-concurrent, Non-coplanar System, Equilibrium of Rigid Body in Three Dimensions, Summary.

## **6 FRICTION**

Introduction, Characteristics of Dry Friction, Laws of Friction, Angle of Friction, Angle of Repose, Cone of Friction, Applications, Summary.

## **7 CENTROID AND CENTRE OF GRAVITY**

Introduction, Centroid of Area, Line and Volume, Centroid of a Line, Centroid of Area, Centroid of Composite Area, Theorems of Pappus and Guldinus, Centroid of Volume, Centre of Gravity, Centre of Mass, Summary.

## **8 MOMENT OF INTERIA AND MASS MOMENT OF INTERIA**

Introduction, Second Moment of Area, Moment of Inertia of Plane Area by Integration, Moment of Inertia of Composite Section, Principle Axes and Principle Moments of Inertia of a Thin Rectangular Plate, Mass Moment of Inertia, Summary.

## **9 SIMPLE STRESSES AND STRAINS SSS-1**

General Meaning of Stress, Unit of Stress, Simple Stresses, Strain, Stress Strain Relation, Nominal Stress and True Stress, Behaviour of Materials Under Repeated Loadings, Factor of Safety, Hooke's Law, Extension/Shortening of a bar, Bars With Cross-Sections Varying in Steps, Bars With Continuously Varying Cross-Sections, Bars Subjected to Varying Loads, Indeterminate Structural Problems, Compounds Bars, Temperature Stresses, Simple Shear, Poisson's Ratio, Volumetric Strain, Elastic constant, Relationship between Modulus of Elasticity and Modulus of Rigidity, Relationship between Modulus of Elasticity and Bulk Modulus, Strain Energy due to Direct Stresses and Impact Loads, Strain Energy due to Shear Stresses.

## **10 SHEAR FORCE AND BENDING MOMENT DIAGRAMS IN STATICALLY DETERMINATE BEAMS SFB-1**

Shear Force and Bending Moment, Sign Convention, Relationship between Load Intensity, Shear Force and Bending Moment Diagrams, SF and BMD For Standard Cases, FD and BMD for Beams Subjected to Various Loads, Short Cut Procedure.

## **BF6 : INTRODUCTION TO MANUFACTURING PROCESSES**

### **UNIT I :**

#### **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 Grading 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; Lapping; 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.

## **UNIT 2 : ( ONLY FOR BF6 STUDENTS )**

## **12. FOUNDRY TOOLS AND EQUIPMENTS**

Introduction, Foundry Tools and Equipments, Foundry Hand Tools, Moulding Boxes (Flasks), Moulding Machines, Melting Equipment, Pouring Equipment.

## **13. HOT AND COLD WORKING PROCESS**

Introduction, Objectives, Hot Working Process, Hot Rolling, Types of Rolling Mills, Hot Forging, Hot Spinning, Hot Extrusion, Hot Drawing or Cupping, Hot Piercing, Cold working process, Cold Rolling, Cold Forging, Cold Spinning, Cold Extrusion, Cold Drawing, Cold Bending, Shot Peening.

## **14. POWDER METALLURGY**

Introduction, Objectives, Characteristics of Metal Powders, Preparation of Metal Powders, Process used for Manufacturing parts from Metal Powders, Primary Processes, Secondary Processes, Advantages of Powder Metallurgy, Limitations of Powder Metallurgy, Design Considerations for Powder Metallurgy, Typical Applications of Powder Metallurgy.

## **15. PLASTIC MANUFACTURING PROCESS**

Introduction, Objectives, Types of Plastics - Thermosetting Resins & Thermoplastic Resins, Synthetic Rubber or Elastomers, Moulding Compounds, Fabrication of Plastics, Machining of Plastics, Joining of Plastics.

### **UNIT 3 : (ONLY FOR BSM5 STUDENTS)**

#### **1. Metal Cutting and Cutting Tools**

#### **2. Drilling Machines**

#### **3. Shaper, Planner and Slotting Machine**

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

## **Course Structure**

### **First Year**

### **Second Semester**

<b>Paper Code</b>	<b>Subject</b>
BF7	Mathematics - II
BF8	Applied Physics
BF9	Programming and Data Structure
BF10	Basic Electronics
BF11	Engineering Drawing and Graphics
BF12	Environmental Studies

## **SYLLABUS**

### **BF7 : MATHEMATICS - II**

#### **1. MATRICES**

Definition, Elements of matrix , Types of matrices ,Algebra of matrices , Properties of matrix multiplication, Method of finding the product of two matrices, Transpose of matrix , Symmetric and Skew-symmetric matrix , Theorem, Adjoint of a matrix, Inverse of matrix, Theorem , Adjoint of a matrix, Inverse of matrix, Elementary Transformation of a matrix, Rank of matrix , Solution of simultaneous linear Equation, consistency of equation, characteristics roots or Eigen values, Caley- Hamilton Theorem, Question Bank, Examination papers.

#### **2. FINITE DIFFERENCE & DIFFERENCE EQUATION & NUMERICAL METHODS:**

Finite Difference: Operators, Difference table, Newton's formula , Lagrange's interpolation formula, Difference Equation: Introduction , Solution of a difference equation, Question Bank: Difference Equation, Numerical methods: Newton Raphson method , Method of false position, Iteration method.

#### **3. DIFFERENTIAL EQUATIONS:**

Definition, Order and degree of differential equation, Formulation of Differential Equation, Solution of a differential equation, Differential Equation of first order and first degree , variable separable, Homogeneous Differential Equations , Equation Reducible to homogeneous form, Linear differential equation,. Equation Reducible to the linear form, Exact differential equation, Equation of first order and higher degree, Complete Solution = C.F. + P.I., Method of finding the complementary function, Rules to find particular integrals.

**Application of Differential Integrals:** Physical applications of linear equations.

#### **4. FUNCTIONS OF COMPLEX VARIABLE:**

Introduction, Complex variable, Functions of complex variable, Limit of a complex variable, Continuity, Differentiability, Analytic function, The necessary condition for  $f(z)$  to be analytic, Sufficient condition for  $f(z)$  to be analytic, C-R equation in polar form, Harmonic functions, Method to find the conjugate function, Milne Thomson method, Mapping of transformation, Bilinear transformation, Schwarz-Christoffel transformation.

**Complex Integration:** Cauchy's integral theorem, Cauchy's integral formula, Cauchy's integral formula for the derivative of an analytic function, Taylor's theorem, Laurent series, Singularity if a function, Residues, Cauchy's Residue theorem.

## **BF8 : APPLIED PHYSICS**

### **UNIT – I**

Interference, Interference of wave , Interference due to thin films of uniform thickness, Interference due to thin films of non-uniform thickness, Newton's ring, Michelson's Interferometer, Engineering applications of Interference, Relativity, Relativity of mass: Time dilation, length contraction, mass and energy, Doppler's effect.

### **UNIT-II**

#### **A. Diffraction:**

Diffraction of wave, Classes of diffraction, Fraunhofer diffraction at a single slit, Condition for maxima and minima, Diffraction at a circular aperture, Plane diffraction grating, Conditions for Principle maxima and minima , Resolving Power, Rayleigh's Criterion for resolution of two Point objects, R.P of grating, R.P at Telescope, X-ray diffraction, Law spots, Bragg's Law, Bragg's X-ray spectrometer,

#### **B. Ultrasonics:**

Ultrasonic waves, Piezo electric effect, Production of U.Waves by P. electric, Magnetostriction effect, Production of U. Waves and its uses, Flow detection.

#### **C. Polarisation:**

Polarisation by reflection, Brewster's law, Double refraction, Positive and negative crystal , Nicol Prism, Law of Malus, Elliptical and Circular Polarisation, Quarter and half wave Plates, Production of Polarised light, analysis of light.

### **D. NUCLEAR PHYSICS**

### **UNIT-III.**

#### **A.Wave Particle Quality:**

Concept of group velocity, Phase velocity, Wave nature of matter, De- broglie waves, Derivation of De-broglie's formula by analogy with radiation. Wave length of matter waves, Electron diffraction, Davisson and Germer's experiment, Heisenberg uncertainty.

#### **B. Wave Equation:**

Concept of wave function and probability interpretation, Schrodinger's time –dependent and time independent wave equations, Physical significance of wave function, Application of Schrödinger's time- independent wave equation, Tunneling effect, Tunnel Diode.

### **UNIT-IV**

#### **A. Laser**

#### **B.Magnetism**

### **UNIT-V**

#### **A. Semiconductor Physics:**

#### **B. Modern Physics:**

Motion of an electron in electric and magnetic field, Specific charge of an electron, electrostatic and magnetostatic focusing, Electron microscope, Bainbridge mass spectrograph, Positive ray, Scanning electron microscope.

## **BF9 : PROGRAMMING AND DATASTRUCTURE**

1. **Introduction To Computers:** Introduction to Computers, its evolutions. First, second, third, fourth, fifth generation of computer. Basics of data, information, and data processing.
2. **Number System:** Number System , Representation of information , Positional Number System , Non positional number system, bit ,byte ,radix , floating point, The Binary Number Base Systems, Binary-Decimal, decimal–binary conversion. Octal, Hexa- Decimal Number system. Simple problems for conversion of Hexadecimal, Octal to other number system etc. Binary Coded Decimal, Extended Binary Coded Decimal Interchange Code ASCII notations –advantages disadvantages.
3. **Binary Arithmetic :** Binary Addition, Binary Subtraction, Multiplication, Division and their simple examples. Logic gates : AND ,OR ,NAND, NOR gates.
4. **Computer Software :** Software System- application Software and their Examples in real life. Operating System and their usage. Multitasking –Multiprogramming- Multiprocessing Operating System. An overview of WWW and its Software. Flow charts and simple problems on flow chart.
5. **Computer Hardware :** Hardware :Basic PC Components, Monitors, Keyboard, Storage devices :Hard Disk ; Storage related simple problems, CD, Mother-board, Printers its classification etc, OCR, OMR, BAR Code etc.
6. **Memory Hierarchies :** Main Memory ,Secondary Memory , RAM ROM , PROM, EPROM, EEPROM etc.
7. **Processing Unit :** CPU ;ALU, Components of CPU ; Register, Accumulator, IR, etc Concepts of vector Processing, Array Processing.
8. **Elements Of Programming Languages Fortran & C:** Introduction to programming logic , algorithm , simple types of real integer variables in FORTRAN and C. Mathematical representations of C and FORTRAN functions. Simple programs in C programming language.

## **BF10 : BASIC ELECTRONICS**

### **1. ELECTRONIC COMPONENTS**

(1) Passive Components :-

- (i) Resistors :- Types, Rating, Colour Code, Tolerance, Fixed Value, Variable (Potentiometer), Thermistor, Negative & Positive temperature Coefficient, Basic Construction of Various types of Resistors.
- (ii) Capacitors :- Types (air, paper, ceramic, mica, electrolyte), Fixed Value & Variable, Rating , Basic Construction.
- (iii) Inductors :- Types, Inductors of high frequency application.

(2) Active Components :-

- (i) Voltage & Current Source
- (ii) Ideal and Practical Voltage Source & Current Source, equivalent circuit, Conversion of Voltage Source into current source and vice-versa.

### **2. SEMICONDUCTOR THEORY AND P-N JUNCTION**

Insulator, Intrinsic and Extrinsic Semiconductors, Energy bar diagrams, Doping, Conduction in Semiconductors, P-N junction, Forward and Reversed biased p-n junction, V-I characteristics of p-n junction diode.

### **3. SPECIAL PURPOSE DIODE**

Zener diodes, Tunnel diodes, Varactor diodes, Schottky diodes, Light emitting diode (LED's), Diodes for High Frequency applications.

### **4. P-N-P AND N-P-N TRANSISTORS**

Base, Common Emitter and Common Collector (CB, CE, & CC) Configuration, Biasing of transistors, methods of Transistor Biasing, Base Resistor Method, Biasing with flb resistors,

Voltage divider bias method, Transistor action & Characteristics, Comparison of CB,CC & CE configuration, Application of CB, CE, & CC configuration.

**5. FIELD EFFECT TRANSISTOR (FET):-**

Construction, Operation & characteristic of FET, FET as a switch, Typical application of FET, MOSFET-Working Principle of MOSFET.

**6. INTEGRATED CIRCUITS (IC'S):-**

OP-AMP Characteristics, inverting & non-inverting OP-AMP, Differential Op-Amp's, Common Mode Rejection, application of OP-AMP (Adder, Subtractor, Voltage follower, Integrator, Differentiator)

**BF11 : ENGINEERING DRAWING AND GRAPHICS**

**1. FUNDAMENTAL OF ENGINEERING DRAWING:**

Introduction, Use of Different Drawing Instruments, Dimensioning, Scales, Geometrical constructions.

**2. ENGINEERING CURVES:**

Introduction, Conic sections, Different methods of constructions of Cycloidal Curves, Cycloid , Epicycloid, Hypocycloid, Involute, Spiral , Helix.

**3. ORTHOGRAPHIC PROJECTIONS:**

Introduction, First Angle Method of Projections, Third angle method of projections.

**4. ORTHOGRAPHIC SECTIONAL VIEWS:**

Introduction, Full Screen , Sectional side view, Horizontal Section, Offset section, Ribs in section, cutting planes/section planes.

**5. ISOMETRIC PROJECTIONS:**

Isometric projection and Isometric Axes, Isometric scale, None – Isometric Lines, Angles, Curves and Circles in Isometric.

**6. PROJECTIONS OF STRAIGHT LINES:**

Introduction, Line parallel to two principle planes and perpendicular to the third , Line parallel to one principle plane and inclined to the other , oblique line, Traces of Lines.

**7. PROJECTION OF PLANES:**

Types of planes, various positions of planes, Traces of planes, planes parallel to one reference plane, planes perpendicular to one reference plane and inclined to the other oblique planes, projections on Auxiliary planes.

**8. PROJECTION OF SOLIDS:**

Types of Solids, Frustums and truncated solids, Various positions of Solids, Axis of Solid is perpendicular to one reference plane, Axis of the solid is parallel to one reference plane and inclined to the other, Oblique solid axis inclined to both the H.P and V.P.

**9. SECTIONS OF SOLIDS:**

Introduction , section plane, portion of solid assumed to be removed ,section, section lines, Apparent section, True shape of section, sectional view.

**10. DEVELOPMENT OF SURFACES:**

Introduction, Application of Development of surfaces in Engineering products, method of Development concepts of points and lines, Development of prisms, Development of cylinder, Development of pyramid, Development of cone.

**11. FREE –HAND SKETCHES:**

Introduction, Terminology used in the screw threads, V or triangular threads, ISO –metric screw threads, screw fastenings, Hexagonal Nut, Square nut, Flanged nut capnut, Domet, capstan nut, Ring nut, wing nut, washers, Bolts, Hexagonal Headed bolts, Square headed bolt, cheese or cylindrical headed bolt, cup headed bolt, cheese or cylindrical headed bolt, cup headed or round headed bolt, T-headed bolt, counter sunk headed bolt, Hook bolt, Eye bolt, different types of studs, screws, Locking arrangement for nut, foundation bolts, Rivets and Rivetted Joints.

## **BF 12 : ENVIRONMENTAL STUDIES**

### **UNIT 1**

**General Concepts** : Definition, Scope and importance, need for public awareness, multidisciplinary nature of environmental studies, management of environment.

### **UNIT 2**

**Natural Recourses** : Forest Resources : Use and over-exploitation, deforestation, Water Resources : Use and over-utilization of surface and ground water Mineral Resources : Use and exploitation. Food Resources : World food problem & changes.

### **UNIT 3**

**Ecosystems** : Concept, structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow, food chain, food webs and ecological pyramids, forest, grassland and desert ecosystem.

### **UNIT 4**

**Environmental Pollution** : Definition, causes, effects, air, water, soil and noise pollution. Environmental Protection Act. Environmental problem and planning.

### **UNIT 5**

**Human Population and the Environment** : Population explosion, value education, role of information technology. Visit to a local area to document environmental assets and polluted site – urban / rural / industrial / agriculture etc

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

*In*

**Mechanical**

**Course Structure**

**Second Year**

**Third Semester**

Paper Code	Subject
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 order), 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, 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 Convertor.

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

*In*

**Mechanical**

**Course Structure**

**Second Year**

**Fourth Semester**

Paper Code	Subject
BSM6	Society, Environment, Engineering
BSM7	Dynamics
BSM8	Solid Mechanics
BSM9	Heat Transfer-I
BSM10	Theory of Machine

## Syllabus

### **BSM6 : SOCIETY, ENVIRONMENT & ENGINEERING**

#### **1.DEFINITION AND SCOPE OF SOCIOLOGY:**

Introduction, History of Sociology, Meaning of Sociology, Definition of Sociology, Nature of Sociology, Scope of Sociology, Specialistic OR Formalistic School, Synthetic School of Thought, Conclusion on Scope of Sociology, Differences between Social Sciences and Physical Sciences, Sociology and Other Social Sciences, Sociology and Psychology, Sociology and Anthropology, Sociology and Political Science, Advantages of Study of Sociology, Utility of Study of Sociology to Engineers, Study of Sociology and Democracy, Study of Sociology in India, Methods of Predicting: Preferred and Expected Future.

#### **2. BASIC SOCIOLOGICAL CONCEPT:**

Introduction, Society, Basic Characteristics of Society, Factors affecting Social Life of a man, Social factors, Biological factors, External factors, Industrial societies/Technological society, Community, Characteristics of a Community, Comparison between Society and Community, Association, Characteristics of Association, Comparison between Association and Community, Institution, Characteristics of Institution, Significance of Institution, Distinction between Institution and Community, Customs, Difference between Institution and Customs, Customs in Indian Society, Habit, Types of Habits, Difference between Customs and Habits, Folkways, Mores. Distinction between Folkways and Mores, Fashions, Social Utility of Fashion, Factor which cause Fashion to spread in Modern Society, Crowd, Characteristics of Crowd, Theories of Crowd behaviour, Comparison between Crowd and Public, Audience, Mob, Social groups, Classification of Social group, 'Cooley's' classification:- Primary v/s Secondary group, Difference between Primary and Secondary group, Social Structure, Role Systems, Role Conflict and Role Strain, Tribe.

#### **3. SOCIAL INSTITUTION:**

Introduction, Types of social institution, Origin of society, Theory of Divine origin, Force theory, Patriarchal and Matriarchal theories, theory of social contract, Organic theory, Group mind theory modern theory, Socialization, Types of socialization process of socialization, Factors responsible to socialization, Advantages of socialization. Family characteristics of a family, classification of family, Functions of family, changing characteristic of modern family, future of family, joint family, characteristics of joint family, Advantages of joint family, Disadvantages of joint family system. Future of joint family, Nuclear family or conjugal family, Marriage forms of marriage, Advantages of monogamy, selection of marriage. Partners. Divorce Reasons for Divorce, Marriage system in India, Hindu marriages Act. Divorce under marriage act 1955. Marriage and family in India – some recent trends, dowry, how to curb this customs, religion, characteristics of religion, Religion and morality, Distinction between Religion and morality. Education functionalist aspects of Education – Role of

social control. Challenges to Education, Reforming Educational system – practical measures to remove illiteracy. Measures to reduce illiteracy – full Literacy, Multiplicity of Language – 3 language formula. Write in diversity.

#### **4.SOCIAL CHANGE**

Factors of social change, social movements, Types of social movements. Theories of social change, Resistance to social change. General continues responsible for social change. Causes responsible for opposition to social changes. When are changes favoured ? Conflicts, causes of conflict, forms of conflict, co-operation social advantages of co-operation. Conflict and co-operation, competition, Distinction between competition and conflict, social progress, social invention, social evolution, characteristics of social evolution, difference between social evolution & social progress, social evolution & social change, Effects of conflict in social change, role of sociologists in Promoting social change, Social disorganization, Causes of social disorganization, Symptoms of social disorganization, Difference between social organization and Disorganization.

#### **5.SOCIAL CONTROL:**

Social control and self control necessity of social control , means of social control informal means of social control formal methods of Social control . Agencie of social control , person's views about systems, cybernetic communication and control

#### **6. SOCIAL PROBLEMS:**

Deviance , social problems classification of social problems, causes of social problems some important social problem , major social problems.

#### **7. CULTURE:**

What culture is ? , characteristics of culture. Concept connected with culture characteristics of lag, causes of culture lag , civilization .

Difference between culture and civilization .Acquired behaviour, culture Diffusion.

#### **8. CAPITALISM , MARXISM AND SOCIALISM:**

Some important features of capitalism. Advantages of capitalism , Disadvantages of capitalism , communism or Marxism. Basic features of communism, Difference between capitalism of communism , socialism, silent features of socialism. Difference between socialism and communism.

#### **9.SOCIOLOGY AND TECHNICAL CHANGES:**

Science and society , Advantages of science and technology in the economic Development , Technology and women , Influence of Technology on social Insitutions , Influence of family systems, Demerits, Influence of technology on religion influence of technology on rural life. Influence of Technology on Urban life, social effects of technology, Technology and planning process of nation.

#### **10. HISTORICAL PERSPECTIVE:**

Introduction , phases in development of Technology , Science & technology in India after independence . Technology policy statement 1983. Role of Science and technology in development.Super conductivity programme , Instrument development program. Natural resources date management systems , Nuclear power program, Indian space program.Technology. Development in Electronics , Results of planning , science policy resolution of 1958, manpower Development , Impact of Science & Technology in various sectors.

#### **11.TECHNOLOGY ASSESSMENT AND TRANSFER:**

Introduction , meaning of Technology Assessment and Transfer what Technology is information Technology , Technology Assessment , Importance of Technology, Technology forecasting and upgradation, Appropriate. Technology , criteria for success of Technology Transfer, Transfer of technology from laboratory to field.

#### **12.CYBERNETICS:**

Introduction, what cybernetics is ? control system

#### **13.ENGINEER IN SOCIETY:**

Introduction , optimisaiton , Limitations of optimization , concepts of optimisation . Advantages of optimisation , Methods of optimisation operation research , optimisation of Human Resources . Important of Human Resources , Human Resources planning, Needs and strategies for Human Resources planning, factors affecting

manpower planning . Responsibility for Human Resource planning , work rules , wage , factors affecting wages , methods of wage fixation optimum use of capital resources, capital , Types of capital , capitalisation , Banking *Classification of bank:* Credit instruments optimum utilization of material resources , material Handling , Principles & functions of materials Handling material Handling Devices , manual handling , mechanical handling, conveying equipment , Transportation and transferring equipment , Lifting, lowering or elevating equipment , Productivity , Labour productivity, importance of productivity, Benefits of productivity measures of increase of productivity, Automation , formulation of problem , formulation of problems and alternative solution. Strategies, Alternative solution strategies ; The principle of limiting factor, the basic process of Evaluation; maintenance of Public system, Defence & Security requirements.

#### **14.INFLATION AND POVERTY:**

Inflation, causes of Inflation in India, measures to control inflation and deflation; poverty, Industrialisation of country; conclusion.

#### **15.ENVIRONMENTAL DEGRADATION AND CONTROL:**

Meaning of Environment ; Environment pollution, pollution, classification of pollutants; Effects of pollution on Living systems, causes of Environmental pollution , Kinds of pollution, suggestion for improving , atmospheric pollution , Environmental control monitoring of environmental pollution , Air pollution, classification of air pollutants, sources of Air pollutants, Geographical factors affecting air pollution , Effects of Air pollution ,prevention and control of Air pollution, water pollution, sources of water pollution, Effect of water pollution , water Analysis, waste water; its treatment and Enviroments, waste water treatment , stages of waste , water treatment , treatment and disposal of sewage, treatment of sewage. Industrial waste treatment and Disposal , Treatment of Effluent, Standards for drinking water, water treatment process, some suggestions for reducing water pollution , Role of Engineer in Environmental protection , Ecological imbalance and its Effects,

#### **16.PLANT LAYOUT AND SITE SELECTION:**

Introduction , Nature of location decisions, choice of site for location, Urban Area, selection of Site in Rural Area, Suburban Area, Comparison of site for location of facilities , models of location of service facilities, Economic survey for site selection , plant layout , Advantages of good layout , Principles of plant layout, Types of pant layout , Fixed position Layout process layout, product layout, combination layout, Selection of space requirement in layouts.

#### **17. PERSONAL MANAGEMENT:**

Defination of personnel management, importance of personnel management,principle of personnel management objectives of personnel management functions of personnel management , Recruitment and selection of employees. Manpower planning ; objectives of manpower planning , Types of manpower planning , steps in manpower planning , Procedure of appointing an employee in a factory , Training and Development, principles of Training ,methods of Training , Industrial safety , Accident Human causes, Effect of accidents, Effect to the Industry , Effect on worker, cost of society, Types of Accidents , Safety procedures.

Ways to prevent or minimize Accidents , Accident reporting and Investigation, Investigation of causes Precautionary measures for maintaining . Industrial Health, Incentives premium OR Incentive Bonus system, Essential s of a Good Incentive systems, Understanding duties of other officials in Department. Duties of Maintenance Engineer. Duties of safety officer, Duties of Security officer.

#### **18.INDUSTRIAL ACTS:**

Introduction, Indian Boiler Act 1923, The Indian factories Act 1948, Health provisions. Important provisions of the factory Act regarding safety of workers, welfare provisions , penalties for breach of provisions of the act, Indian Electricity Act, Supply & Use of Energy, The Employee's State Insurance Act 1948, Workmen's compensation Act, The Industrial Dispute Act,1947, Strikes and Lockouts, The payment of wages Act 1936 , The Indian Trade Union Act, 1926 , Minimum Wages Act 1948.

#### **19.STANDARDS:**

Indian standard Institution, BIS Publications, ISO-9000 Quality systems.

#### **20.FUNCTIONS OF MANAGEMENT:**

Difference between Management , Administration, Organisation, Functions of management , Planning , Production planning and control , steps in production planning and control , Routing procedure of Routing , Scheduling & Loading scheduling and loading , Advantages of planning. Management by objectives, forecasting , Types of forecasting , organizing , meaning of organization,purpose of organizing, Advantages of

organization. Classification of organization , Hierarchy systems of organization, Advantages & Disadvantages of scalar systems , Types of organization structures, functional organization, communication objectives of communication, communication process model superior subordinate communication , Types of communication systems , Advantages of oral communication systems , Disadvantages of oral communication systems, written communication, Directing , Nature of Directing, Principles of Direction, controlling , characteristics of Good control systems, co-ordination, Tools of co-ordination, Types of co-ordination, principles of co-ordination, co-ordination Vs co-operation. Motivation Importance of motivation, Techniques of motivation, Methods of participation, Extent of worker's participation in management, worker's participation in Indian Industries, Human needs, Importance of fulfillment of needs, Maslow's theory of motivation, Leadership, leadership Style.

## **BSM7 :DYNAMICS**

### **INTRODUCTION TO DYNAMICS AND BASIC**

Introduction, Mechanics , History Of Mechanics , Basic Concepts And Principles , Laws Of Mechanics , Units And Dimensions , Scalars And Vectors, Basic Vector Operations , Vectorial Representation Of Forces, Vectorial Representation Of Moments, Procedure For Solving Problems In Mechanics

#### **1. KINETICS OF PARTICLES**

Introduction, Objective, Rectilinear Motion Of Particles \_ Displacement, Velocity And Acceleration, Determination Of The Motion Of A Particle, Uniform Rectilinear Motion, Uniformly Accelerated Rectilinear Motion, Relative Motion, Curvilinear Motion, Position Vector, Velocity And Acceleration, Derivatives Of Vector Functions, Rectangular Components Of Velocity And Acceleration

#### **2. KINETIC OF PARTICLES: NEWTON'S SECOND LAW**

Introduction, Objective, Newton's Second Law Of Motion, Equation Of Motion, Angular Momentum Of A Particle, Equations Of Motion In Terms Of Radial And Transverse Components, Motion Under A Central Force-Conservation Of Angular Momentum

#### **3. KINETICS OF PARTICLE: ENERGY & MOMENTUM METHODS**

Introduction, Objective, work of a force, kinetic energy of a particle : principle of work and energy, Power and efficiency, potential energy, conservative forces, conservation of energy, motion under a conservative central force – application to space mechanics, principle of impulse and momentum, impulsive motion, impact of elastic bodies, direct centre impact, oblique central impact

#### **4. SYSTEM OF PARTICLES**

Introduction, Objective, Application Of Newton's Laws To The Motion Of A System Of Particles, Linear Angular Momentum Of A System Of Particles, Motion Of The Mass Centre Of A System Of Particles, Conservation Of Momentum For A System Of Particles, Work-Energy Principle: Conservation Of Energy For A System Of Particles, Principle Of Impulse And Momentum For A System Of Particles

#### **5. KINETICS OF RIGID BODIES**

Introduction, Objective, Definition Of Terms, Translation Fixed Rotation, Equations Defining The Rotation Of Rigid Body About A Fixed Axis- Velocity And Acceleration, Absolute And Relative Motion Methods For Plane Motion Analysis, Relative Velocity In Plane Motion, Instantaneous Centre Of Rotation In Plane Motion, Relative Acceleration In Plane Motion, Rate Of Change Of A Vector With Respect To A Rotating Frame, Plane Motion Of A Particle Relative To A Rotating Frame – Coriolis Acceleration

#### **6. KINETICS OF RIGID BODIES**

Introduction, Objective, equation of motion for a rigid body, moment of momentum equations, plane motion of rigid body- D'alembert's principle, systems of rigid bodies, constrained plane motion and rotational of rigid body, work of forces active on rigid body, kinetic energy of a rigid body in plane motion, principle of work and energy for a rigid body, systems of rigid bodies

#### **7. IMPACT OF TWO BODIES**

Introduction, Objectives , Concepts Of Impact, Coefficient Of Restitution, Coefficient Of Restitution, Observations And Calculations, Plane Central Collision, Collision Of A Small Body With A Massive Body

#### **8. CENTRE FORCE MOTION**

Introduction, Objectives, Basic Concepts, Acceleration Due To Gravity, Trajectories For Central Force Motion , Parabolic Trajectory, Elliptical Orbit, Hyperbolic Trajectory , Energy Expended For Different Trajectories Launching Of Satellites At An Angle , Astronomical Facts And Laws Of Kepler

### **BSM8 : SOLID MECHANICS**

#### **1. ANALYSIS OF STRESS**

Introduction, stress, complementary shear stress, simple shear, the state of pure shear, principal stresses and principal planes, sign convention, Mohr's circle for biaxial stresses, Mohr's circle.

#### **2. ANALYSIS OF STRAIN**

Introduction, Strain On An Oblique Plane, Mohr's Circle Of Strain, Compatibility Equations

#### **3. STRESS – STRAIN RELATIONS FOR LINEARLY ELASTIC SOLIDS**

Introduction, Hooke's Law, Poisson's Ratio, Differential Equation Of Equilibrium, The Stress Function-Plane Stress

#### **4. THEORY OF FAILURE**

Introduction, Maximum Principal Stress Theory, Maximum Shearing Stress Theory, Maximum Strain Theory, Significance Of Theories Of Failure, Factor Of Safety

#### **5. ELASTIC STABILITY**

Introduction, Failure Of A Column Or Strut , Euler's Column Theory , A Sign Conventions , Limitation Of Euler's Formula , Empirical Formula For Columns, Rankine's Formula For Columns, Euler's Formula

### **BSM9 : HEAT TRANSFER**

#### **1.PRINCIPLES OF HEAT TRANSFER:**

Introduction, Modes of Heat Transfer, Fourier Law of Heat Conduction, Newton's Law of Cooling for Convection, Thermal Radiation , Electrical Analogy, Heat Transfer by Combined Modes and Through Composite Bodies.

#### **2.GENERAL HEAT CONDUCTION EQUATION:**

Introduction, General Heat Conduction Equation for an Anisotropic Materials in Cartesian Co- ordinates, General Heat Conduction Equation in Cylindrical Co- ordinates, General Heat Conduction Equation in Spherical Co- ordinates, Thermal Diffusivity, Initial and Boundary Conditions.

#### **3. STEADY –STATE CONDUCTION:**

Introduction, Heat flow through a Slab or a Plane Wall, Heat flow through Radial Systems – Cylinders Heat Flow Through Radial Systems, Spheres, Heat Flow through Composite Wall , Overall Heat Transfer Coefficient, Heat Flow through Wall with Variable Thermal Conductivity, Critical Thickness of Insulation, Steady state Conduction with Internal Heat Generation, Steady – state Conduction – Two Dimension.

#### **4. STEADY –STATE CONDUCTION WITH HEAT DISSIPATION TO ENVIRONMENT:**

The Controlling Coefficients, A Thin Rod, The Rectangular Fin, The Circular Fin, Fin Efficiency and Effectiveness, Condition for Using Fins.

#### **5. UNSTEADY STATE CONDUCTION:**

Unsteady – State Process, Solids of Infinite Thermal Conductivity- Lumped Heat Capacity Analysis, Solution of Unsteady – State One Dimensional Heat Conduction Equation.

#### **6. FORCED CONVECTION:**

Convection, Hydrodynamic Boundry Layer, Thermal Boundry Layer, Determination of Dimensionless Correlation for Forced Convection, Empirical Correlations for Flow Inside Tubes, Empirical Correlation for Flow Outside Tubes, Differential Equations, of Boundry Layer on a Flate Plate, Solution of Differential Equations of Boundry Layer, The Integra; Equations of the Boundry Layer, Analogy between Fluid Friction

and Heat Transfer , Heat Transfer in Laminar Flow in Tubes, Solution for Constant Wall Temperature, Heat Transfer in Turbulent Flow in Tubes.

### **7. FREE OR NATURAL CONVECTION:**

Characteristic Parameters in Natural Convection, Determination of Dimensionless Correlation for Free Convection, Empirical Correlations for Free convection, Momentum and Energy Equations for Laminar, Free Convection Heat Transfer on a Vertical Plate, Integral Equations for Momentum and Energy on a Flat Plate.

### **8. THERMAL RADIATION:**

Thermal Radiation in Electromagnetic Spectrum , Radiation Properties, Planck's Law for Monochromatic Thermal Radiation of a Black Body, Emissive Power and Radiation Intensity, Monochromatic Emissive Power of a Black Body, Stefan- Boltzman Law of Black Body Radiation, Heat Exchange by Radiation between Black Surfaces, Radiation Shape Factor and Reciprocity Theorem , Heat Exchange between Non- black Bodies, Heat Exchange by Radiation between Gray Surfaces , Radiation Shields, Radiation from Gases and Vapours.

### **9. MASS TRANSFER BY MOLECULAR DIFFUSION:**

Introduction to Mass Transfer, Fick's Law of Diffusion, Definitions of Quantities, Fick's Law in Terms of Mass and Mole Fractions , Equivalence of Diffusion in Stationary- Media - Species Conservation Equation, Diffusion in Binary Gas mixture.

## **BSM10 : THEORY OF MACHINES**

### **1. ANALYSIS AND SYNTHESIS OF MACHINES:**

Machine, Scope of Theory of Machines, Branches of Theory of Machine, Kinematics of Machines, Dynamic of Machines, Static's and Kinetics, Resistant Bodies, Link of Element Machine, Frame, Kinematic Pair and its Classification , Different Types of Kinematic Pairs – Unclosed Pairs, Rollin, Screw or Helical and Spherical , Lower and Higher Pairs, Closed and Unclosed Pairs, Motion and its Types, Constrained Motion, Completely Constrained , Partially or successfully Constrained and Incompletely Constrained , Kinematic Chain, Mechanism , Well known Kinematic Chains and their Inversions, Quadric Cycle Chain, Beam Engine, Coupled Wheels, of Locomotives, Watt Parallel Motion, Slider Crank Chain and its Inversion- Pendulum pump, Oscillatory Cylinder Engine, Quick Return Motion (Crank and Slotted Lever Type and Whitworth Type), Gnome Engine, Double Slider Crank Chain and its Inversions- Oldham's Coupling, Elliptical Trammel, Donkey Pump Machine, Difference between Machine and Mechanism.

### **2. VELOCITY AND ACCELERATION OF LINKS IN MECHANISMS:**

Displacement , Velocity and Acceleration, Representation of Linear Velocity and Acceleration by Vector, Motion of a Link of a Machine, Determination of Velocities of Links of a Mechanism , Relative Velocity Method of Determination of Velocities of Links of Mechanism, Velocity of Any Point in Link, Application of Relative Velocity Method – Four Bar linkage, Stone Crusher Mechanism, Reciprocating Pump Mechanism, Velocity Diagram for Quick Return Motion of Crank and Slotted Lever Type , Determination of Ratio of Times and Maximum Velocities for Quick Return Motion – Crank and Slotted Lever Type, Instantaneous Centre Method, Application of Instantaneous Centre Method, Four Bar Linkage, Reciprocating Engine Mechanism , Sewing Machine Needle Box Mechanism , Toggle Machine Mechanism , Another Simpler Method to find Piston Velocity of Reciprocating Engine Mechanism , Velocity Diagram of Mechanism for Feeding Paper Wrapping Machine , Velocity Diagram of four Bar Linkage by Simple Method , Total Acceleration of a Point in Rigid Link, Absolute Acceleration of a Point in a Rigid Link, Method of Drawing an Acceleration Diagram of a Given Mechanism, Acceleration Centre of Link, Klein's Construction of Reciprocating Engine Mechanism , Acceleration Diagram of a Four Bar Linkage , Acceleration Diagram of Four Bar Linkage by Klein's Construction , Coriolis Acceleration, Determination of Magnitude of Coriolis Component.

### **3. LOWER PAIRS:**

Introduction , Pantagraph, Straight Line Motion, Copied and Generated Straight Line Motion, Peaucillier Mechanism , Hart Mechanism , Scott- Russel Mechanism including Modified Form, Elliptical Trammel, Scott-Russel Mechanism, General Case , Grasshopper Mechanism, Watt Mechanism, Tchebicheff Mechanism, Kemp's Translation Linkages, Parallel Linkages, Parallel Rules, Universal Drafting Machine, Lazy Tongs, Engine Pressure Indicators, Simplex Indicator, Crosby Indicator, Richard Indicator, Thomson Indicator, Dobbie – McIlonnes Indicator, Automobiles Steering Gear, Davis Steering Gear, Ackermann Steering Gear, Hooke's Joint or Universal Coupling, Determination of Velocity Ratio of Driving and Driven Shafts, Salient Features of Driven Shaft Speed, Angular Acceleration of Driven Shaft , Double Hooke's Joint.

#### **4.GYROSCOPIC AND PRECESSIONAL MOTIONS:**

Angular Acceleration and Its Vector Representation , Definition : Axis of Spin , Gyroscopic Effect, Precession, Axis of Precession and Gyroscope, Gyroscope Couple of a Plane Disc, Gyroscopic , Effect on the Movements of a Naval Ship, Ship Stabilization , Stability of Automobile or Locomotive taking a Turn, Effect of Precession by a body Fixed Rigidly at a Certain Angle to a Revolving Shaft.

#### **5.DYNAMIC OF RECIPROCATING PARTS:**

Introduction , Displacement, Velocity and Acceleration of Reciprocating Parts in a Reciprocating Engine, Fourier Series for Velocity and Acceleration of Reciprocating Parts of an Engine , Angular Displacement , Velocity and Acceleration of Connection , Piston Effort, Equilibrium of Forces at Crosshead Pin or Gudgeon, Crank Effort for any Crank Position, Graphical Construction for Determination of Crank Effort for any Crank Position, Crank Effort, Diagrams , Method of Drawing Crank Effort Diagrams, Turning Moment Diagram for a Double Acting Vertical Steam Engine , Turning Moment Diagram for a Four Stroke Cycle Internal Combustion Engine, Turning Moment Diagram for a Multicylinder Engine, Use of Crank Effort Diagram, Flywheel, Types of Flywheels, Size of Flywheels.

#### **6.GOVERNORS:**

Distinction between Functions of a Flywheel and a Governor , Types of Governors- Centrifugal and Inertia Governors, Pendulum and Dead Weight Type Centrifugal Governor , Simple Watt Governor, Simple Watt Governor with Consideration of Weight of Arm, Open and Crossed Arm Type Watt Governor, Limitations of a Simple Watt Governor, Determination of Speed of Porter Governor by Method, of Resolution of Forces, determination of Speed of Porter Governor by Instantaneous Centre Method, Effect of Friction and Functioning of a Governor , Proell Governor , Spring Loaded Governor, Hartnell Governor, Principle of Action of Hartnell Governor, Wilson- Hartnell Governor, Governor with Gravity and Spring Control , Hartung Governor, Pickering Governor, Derivation of Equilibrium Speed for Pickering Governor , Inertial Governor , Controlling Forces , Quality of Governor , Sensitiveness , Insensitiveness due to Friction, Stability, Isochronous Governor and Hunting of Governor , Effort of Governor, Power of Governor.

#### **7.BELTS , ROPES AND CHAINS:**

Higher Pairs, Types of Drive with Higher Pairs, Flexible or Wrapping Connectors, Types of Flexible Connectors , Belts and Ropes , Material of Belts, Neutral Section and Pitch Surface , Types of Drive, Parallel Drive with Open & Crossed Belts, Idler Pulley, Intermediate or Countershaft Pulley, Angle of Right Angle Drives, Quarter Turn Drive, Velocity Ratio , Large Velocity Ratios, Crowning of Pulleys, Loose and Fast Pulleys, Slip, Determination of Belt Length – Exact Length of Open Belt, Approximate Length of Open Belt and Length of Crossed Belt, Stepped or Cone Pulley's ,Design of Stepped Pulleys , Open and Crossed Belts, V-Belts, Advantages of V- Belt over Flat Belt, Ratio of Friction Tension on Tight and Slack Sides of Belts , Horse Power Transmitted , Angle of Contact , Centrifugal Tension, Initial Tension , Creep, Determination of Creep.

#### **8.BRAKES AND DYNAMOMETERS:**

(A) Brakes

Brakes and Dynamometers, Types of Brakes, Block or Shoe Brake, Band Brake, Band and Block Brake, Internal Expanding Shoe Brake, Determination of Pressure and Torque of Internal Expanding Shoe Brake , Effect of Braking.

(B) Dynamometers.

Types of Dynamometer- Absorption and Transmission Types, Prony Brake Dynamometer, Determination of Brake Test Curves, Rope Brake Dynamometer , Critical Speed of Pulley, Advantages , Tesla Fluid Friction Dynamometer , Froude Water Vortex Dynamometer , Swinging , Field , Electrical Dynamometer, Absorption and Transmission Types, Electrical Dynamometer, Bevis- Gibson Flash - Light Torsion Dynamometer , Amsler Torsion Dynamometer.

#### **9.CAMS:**

Cam Mechanism and its Uses, Types of Cams and Followers, Definition , Base Circle and Least Radius , Lift Angles of Ascent, Dwell , Descent and Action, Main Consideration Affecting Choice of Cam Profiles, Pressure Angle , Base Circle Diameter, Kinematic Study of Cams, Usual Motions for Followers , Simple Harmonic Motion for the Followers, Displacement , Velocity and Acceleration Diagram, Uniformly Accelerated and Decelerated Motion for the Follower, Uniform Velocity Motion for the Follower , Sine Acceleration or Cycloidal Motion for the Follower, Profile of a Cam Operating a Roller Follower , Profile of an Offset Cam Operating a Roller Follower , Profile of a Cam Operating on Oscillating Roller Follower ,Profile of a Cam Operating Flat- Faced Follower , Common Profiles of Cams , Tangent Cam with a Roller Follower , Graphical

Construction for Tangent Cam with a Roller Follower ,Circular Cam Operating a Flat – Faced Follower , Determination of Motion of a Follower Operated by a Cam of any Profile.

### **10.TOOTHED GEARS.**

Toothed Gears and their Uses, Types of Toothed Gears , Spur Gears, Internal Spur Gears, Spur Rack, Bevel Gears, Helical Gears, Double Helical Gears, Worm Gears, Definition, Pitch Circle Diameter, Pitch Surface , Pitch Point, Pitch: Circular Pitch, Diameter Pitch, Module, Addendum, Dedendum, Clearance, Addendum Circle, Outside Diameter, Internal Diameter, Dedendum Circle, Root Diameter , Root Diameter for Internal Gears . Base Circle Diameter, Base Pitch, Centre Distance, Centre Distance for Internal Gears, Backlash, Face to Tooth, Circular Width of Tooth Space, Flank of Tooth, Full Depth of Tooth , Circular Thickness of Tooth, Fillet, Angle of Obliquity or Pressure Angle, Path of Contact, Arc of Contact, Arc of Approach, Arc of Recess, Condition for Correct Gearing and Resulting Velocity of Sliding , Forms of Teeth, Cycloid and its Variants, Epicycloid and Hypocycloid , Cycloidal Teeth, Path of Contact of Cycloidal Gears, Involute, Method of Drawing and Involute , Involute Function, Main Characteristics of Involute Teeth, Interference in Involute Gears , Minimum Number of Teeth on a Gear Wheel, Length of Arc of contact, Gauging of Straight Spur Gear Teeth , Comparison of Involute and Cycloid Gear Systems , Helical Teeth , Definition , Helical Gear, Axial Pitch, Normal Pitch, Lead, Helix Angle, Spiral Gears, , Expression for Centre Distance Between Two Shafts Connected by Spiral Gears, Efficiency of a Pair of Spiral Gears in Mesh, Worm and Worm Gears, Methods of Manufacturers of Gears, Forming by Means of Rotary Disc Cutter, Cutting of Teeth by a Hob , Correction of Spur Gear Teeth or Methods of Avoiding Interference , Stub – Teeth , Increase of Pressure Angle of Gears , Increase of Centre Distance of Gears , Positive and Negative Correction.

### **11.GEAR TRAINS:**

Introduction, Train Value, Limitations in Design of Gear Train, Types of Gear Trains , Simple Gear Train, Compound Gear Train, Reverted Gear Train, Sliding Gear Box for Automobile, Epicyclic Gear Train , Methods of Finding Train Value or Velocity Ratio of an Epicyclic Gear Train, Torques and Tooth Loads in Epicyclic Gear, Trains , Inertia Effects in Epicyclic Gearing, Sun and Planet Gear, Pre- Selective Gear Box , Differential Gear on an Automobile.

### **12.BALANCING:**

Balancing and its Classification , Need for Balancing , Balancing of a Single Rotating Weight by another Rotating Weight in the Same Plane , Balancing on a number of Weights Rotating in One Plane by Another Weight Rotating in the same Plane, Balancing a Number of Weights Rotating in Different Planes, Balancing of Reciprocating Parts, Partial Balancing of Primary Forces. Balancing of Locomotives , Effect of Partial Balancing of Primary Forces, Balancing of Locomotives , Effect of Partial Balancing of Reciprocating Parts of Two Cylinder Locomotive- Variation of Tractive Force,Swaying Couple Hammer blow, Coupled Parts of a Engine, Balancing of In-Line Engines , Two Cylinder and Four Cylinder In- Line Engines, Balancing of Higher Harmonics in High Speed Engines with Identical Reciprocating Parts, Balancing of V- Engines.

### **13. VIBRATIONS:**

Introduction, Types of Vibration , free or Natural , Forced, Undamped and Damped, Longitudinal , Tranverse and Torsional , Definitions, Periodic, Period, Cycle, Frequency, Degree of Freedom, Principle Mode of Vibration, General Expression for Vibratory Motion Considering , Actuating Force, Free or Natural Undamped vibration , Free Damped Vibration (Viscous Damping), Forced Undamped Vibration, Forced Damped Vibration , Differential Equations Method, Forced Damped Vibration, vector Method, Vibration when Support is Flexible and Executes, Undamped , Damper Grounded and Damper Connected to Spring , Vibration Isolation, Multidegree Freedom System, Two Degree Freedom System, Undamped Vibration Absorber, Pendulum Absorber, Transverse, General Expression for Transverse Vibration Carrying Distributed Load, Frequency of Transverse Vibration of Simply Supported Shaft Carrying Uniformly Distributed Load, Frequency of Transverse Vibration Carrying Several Loads, Dunkerly Method, Energy or Raleigh's Method , Whirling of Shaft, Critical Speed, Torsional Vibration, Determination of Equivalent Inertia of Rotating and Reciprocating Parts of Engine , Reducing a Bent Crankshaft to an Equivalent Straight Shaft, Torsionally Equivalent Shaft, Torsional Vibration of Two Rotor System , Torsional Vibration of Three Rotar Systems when Diameter and Length of Various Portions of Shaft are Given, Torsional Vibration of three Rotor System when Stiffness of Various Portions of Shaft Given , Analytical Method, Tabular Method for Torsional Vibration of Geared System , Equating Strain Energy in Extreme Positions, Equating Kinetic Energy in Mean Position, Multifilar System, Bifilar and Trifilar Suspensions , Equivalent Spring System, Vibration Absorbers, Metallic and Organic Absorbers. Vibration Instrumentation, Amplitude, Frequency, Velocity and Acceleration Measuring Instruments.



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

*In*

## Mechanical Engineering

### Course Structure

#### Third Year

#### Fifth Semester

Paper Code	Subject
BTM1	Metal Cutting and Tool Design
BTM2	Control System
BTM3	Computer Graphics
BTM4	CNC Programming
BTM5	Operation Research

#### **BTM1 : METAL CUTTING AND TOOL DESIGN**

##### **1 METAL MACHINING**

Introduction

##### **2 MECHANICS OF METAL CUTTING**

Chip formation. Shear Zone. Shear Plane angle: Different Theories. Friction in Metal Cutting. Chip Flow Velocity. Shear Strain.

##### **3 MEASUREMENT OF CUTTING FORCES**

Dynamometer Requirements. Classification of Cutting Force Dynamometers. Mechanical Type Hydraulic and Pneumatic Type. Optical Type. Inductance Type. Piezoelectric Type. Strain, Gauge Dynamometers. Lathe Tool Dynamo-meter. Drill Dynamometer, Milling Dynamometer. Grinding Dynamometer.

##### **4 HEAT IN METAL CUTTING**

Heat Sources in Metal Cutting. Temperature in Chip Formation. Temperature Distribution. Factors Effecting the Temperature-Work Material, Cutting Variables, Tool Geometry, Cutting Fluid.

##### **5 FAILURE OF CUTTING TOOLS**

Tool Wear and Tool Life; Premature failure. Gradual Wear. Crater Wear. Flank Wear, Grooving Wear, Chip notching, Wear Mechanisms in Metal Cutting, Abrasive Wear, Diffusion Wear. Adhesion, Oxidation Wear. Tool Life, Taylor's Tool Life Equation. Woxen's Equation. Cutting Conditions for Limiting Tool Life Conditions. T-V-he Tool Life Plots. Cutting Rate- Tool Life Characteristics Curve.

##### **6 TOOL WEAR MEASUREMENT**

Optical Methods; Flank Wear, Crater Wear Measurement. Radioactive Methods. Electron Probe Micro Analyser-EPMA. Energy\_ Dispersive X-ray Analysis-EDXA. Augur Electron SpectroScopy -AES.

##### **7 TOOL MATERIALS**

Requirements of Tool Material. Classification. Tool Steels. H.S.S. Coated H.S.S. Powder Metallurgy H.S.S. Cast Cobalt Alloys-Stellite, Cemented Carbides; Tungsten Carbide Manufacture of Powder, Blending, Briquetting, Sintering, Hot Isostatic Pressing, Properties. Multi Carbide Tools; Properties. Coated Carbide tools; Coating Techniques; PVD Process, CVD Process. Performance of coated Tools. Oxicoated Tools. TiN coated Tools. ALON coated Tools.

- 8 CEMENTED TITANIUM CARBIDE TOOL**  
Properties, Microstructure Performance, Crater Wear Propagation. Diffusion Wear in CTC tools. Mechanisms of Wear in CTC tools. Ledge Formation, TiC coated CTC Tools. Microstructure. Performance.
- 9 CERAMIC CUTTING TOOLS**  
Manufacture; Powder Preparation, Sintering. Additives, Properties. Performance. SIALON tools. Cubic Boron Nitride (CBN) tools; Properties, Applications. Synthetic Diamond tools; Properties; Performance.
- 10 TOOL GEOMETRY**  
Tool Nomenclature. Basic Tool Angles, Effect of Basic Angles. Tool Nomenclature Systems; British System, American Standard Association System, German System, ISO System. Geometrical Relationship of True Rake Angle, Angle of Inclination.
- 11 CUTTING FLUIDS**  
Functions of Cutting Fluid, Lubrication in Metal Cutting; Cooling Properties of Cutting Fluids. Types of Cutting Fluids; Petroleum Based, Emulsified, Synthetic Type. Additives, Selection and Application of Cutting Fluids.
- 12 ECONOMICS OF MACHINING**  
Production Cost. Economic Tool Life. Optimum Cutting Speed for Maximum Production. Tool Life for Maximum Profit.
- 13 CUTTING TOOL DESIGN**  
General Considerations.
- 14 DESIGN OF SINGLE POINT TOOL**  
Tool Strength and Rigidity. Design of Form Tools. Types of Form Tools. Circular Form Tool. Profile Design; Geometrical Method. Analytical Method. Flat Form Tool Design. Grinding the Form Tool. Profile for a Tapered Surface. Tangential Type of Form Tool.
- 15 DESIGN OF DRILL**  
Twist Drill Construction. Drill Diameter. Flute Angle. Web Thickness and Chisel Edge. Land Width Margin. Shape of Flute Section. Flute Length, Shank. Geometry of the Cutting Edge, Rake Angle, Relief Angle, Angle of Inclination.
- 16 DESIGN OF MILLING CUTTER**  
Types of Milling Cutters, Profile Sharpened, Form Relieved Milling Cutters. Design of Profile Sharpened Milling Cutters. Design of Form Relieved Milling Cutters.
- 17 DESIGN OF BROACH**  
Design Elements of Broach. Number of Teeth, Tooth, Pitch and Chipspace. Rear Pilot Length of Broach, Strength of Broach.
- 18 CUTTING TOOL MANUFACTURING**  
Single Point Tool Production. Twist Drill Production, Manufacture of Broach. Manufacture of Milling Cutter.
- 19 GEAR CUTTING TOOLS**  
Gear Form Cutting Tools. Gear Generation Cutting Tools. Design of a Gear Cutting Hob. Profile in the Normal Section. Diameter of the Hob. Hob Length. Relief Angle. Cam Relief. Pitch Cylinder Diameter. Gear Shaper Tools.
- 20 THREAD CUTTING TOOLS**  
Thread Cutting Dies. Thread Rolling Tools. Design of Thread Cutting Taps.
- 21 DESIGN OF REAMER**  
Reamer Design. Length. Flutes. Rake Angle and Relief Angle. Grinding of Reamer.

## **BTM2 : CONTROL SYSTEM**

- 1 INTRODUCTION TO CONTROL SYSTEM**  
Classification Of Systems, Open-Loop Control System, Closed-Loop Control Systems, Elements Of Automatic Or Feedback Control System, Requirement Of Automatic Control Systems
- 2 MATHEMATICAL MODELS OF CONTROL SYSTEM**  
Representation Of a Control System, Description Of Some Of Typical Physics System, Tachnogenators, Potentiometers, LVDT and Synchros, Synchros, Hydraulic Actuation
- 3 BASIC PRINCIPLES OF FEEDBACK CONTROL**  
The Control Objectives, Feedback Control System Characteristics, Proportional Mode Of Feedback Control, Integral Mode Of Feedback Control, Derivative Mode Of Feedback Control

4

#### **TIME DOMAIN ANALYSIS AND FREQUENCY RESPONSE**

Standard Test Signals, Static Accuracy, Computation Of Steady State Errors, Transient Response: First Order System, Transient Response: Second Order System, Transient Response Specification, Conclusion, Frequency Response, Frequency Domain Specifications, Magnitude And Phase Angle Characteristics Plot, Frequency Response Specification, Representation Sinusoidal Transfer Function

#### **5 CONCEPTS OF STABILITY AND THE ROUTH STABILITY CRITERION**

Bounded-Input Bounded-Output Stability, Zero-Input Stability, The Routh Stability Criterion

#### **6 NYQUIST STABILITY CRITERION**

Stability Margin, Phase Margin

#### **7 BODE PLOTS**

#### **8 ROOT LOCUS**

The transfer function of a second order control system, General Rules

### **BTM3 : COMPUTER GRAPHICS**

#### **1. INTRODUCTION**

Overview Of Computer Graphics, Representing Pictures, Preparing Pictures For Presentation, Presenting Previously Prepared Pictures

#### **2. GRAPHICS HARDWARE AND DISPLAY DEVICES**

Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh Graphics Displays, Cathode Ray Tube Basics, Color Crt Raster Scan Basics, Video Basics, Interactive Devices

#### **3. GRAPHIC PRIMITIVES – DRAWING LINES & CURVES**

Introduction, Scan-Converting A Point, Scan-Converting A Straight Line, Scan-Converting A Circle, Scan-Converting An Ellipse, Scan-Converting Arcs And Sectors , Scan-Converting A Rectangle, Boundary Block Transfer (Bitblt) Or Raster Operational Graphics , Side Effects Of Scan Conversion

#### **4. 2D AND 3D TRANSFORMATIONS**

2d Transformations, Homogeneous Coordinates And Matrix Representation Of 2d Transformations, Composition Of 2d Transformations, The Window-To-Viewport Transformation, Efficiency, Matrix Representation Of 3d Transformations

#### **5. SEGMENTS AND THEIR APPLICATIONS**

Polygon Surfaces, Polygon Tables, Curved Lines And Surfaces, Quadric Surfaces, Superquadrics, Blobby Objects, Spline Representations, Cubic Spline Interpolation Methods, Bezier Curves And Surfaces, B-Spline Curves And Surfaces, Beta-Splines, Rational Splines, Conversion Between Spline Representations, Displaying Spline Curves And Surfaces, Sweep Representations

#### **6. GEOMETRIC MODELLING**

Geometric Models, Hierarchy In Geometric Models, Interconnections, Characteristics Of Retained-Mode Graphics Packages, Defining And Displaying Structures

#### **7. BOUNDARY REPRESENTATIONS, CONSTRUCTIVE SOLID GEOMETRY AND SPATIAL DATA STRUCTURES**

Polyhedra And Euler's Formula, The Winged-Edge Representation, Boolean Set Operations, Spatial-Partitioning Representations, Constructive Solid Geometry, Comparison Of Representations, User Interfaces For Solid Modeling

#### **8. HIDDEN SURFACE AND LINE ELIMINATION**

Classification Of Visible-Surface Detection, Back-Face Detection, Depth-Buffer Method, A-Buffer Method, Scan-Line Method, Depth - Sorting Method, Bsp-Tree Method, Area-Subdivision Method, Octree Methods, Ray-Casting Method, Curved Surfaces, Wireframe M'ethods, Visibility-Detection Function

#### **9. RENDERING**

Light Sources, Basic Illumination Models, D)isplaying Light Intensities, Halftone Patterns And Dithering

Techniques, Polygon-Rendering Method, Ray-Tracing Methods, Radiosity Lighting Model, Environment Mapping, Adding Surface Detail, Modeling Surface Detail Polygon

## **10. VIDEO GAMES AND COMPUTER ANIMATION**

Conventional And Computer-Assisted Animation, Animation Languages, Methods Of Controlling Animation, Basic Rules Of Animation, Problems Peculiar To Animation

### **BTM4 : CNC PROGRAMMING**

#### **1 LITERATURE SURVEY**

Chronological Development of CNC Machine, Machining Time , Non-machining Time , Loading and Unloading Time

#### **2 INTRODUCTION TO CNC MACHINE**

Definition, Classifications of Numerical Control System, Advantages of CNC Machine, Principle of Operation of CNC Machine , Open Loop CNC System , Closed Loop CNC System, Distance Measurement, Axis Arrangement of CNC Machines , Types of CNC Machines, Configuration Of CNC Machines, Parts Construction of CNC Machines ,Coordinate Systems, Grid System, Reference Points, Machine Origin, Part Origin, Program Origin, Coding System, CNC Syntax , Computer Word Address Format, End of Block Code , Accuracy and Repeatability of CNC Machine

#### **3 CONSTRUCTION FEATURES OF CNC MACHINES**

Constructional Features of CNC Machines, Structure , Slide Ways, Spindle Drive , Feed Drive, Position Measuring Devices, Selection of CNC Machine , Selection Guidelines , Choosing a Machining Center, Comparison Chart of Specification and Features of a Horizontal Spindle Machining Center, Typical Specifications for a Horizontal Spindle Machining Center, Typical Format for Comparison of CNC System.

#### **4 CNC MACHINE OPERATING SYSTEM**

FANUC Operating System , Flow Chart of Automatic Operation, Sinumerik/hinumerik Operating System, List of Operating Switches.

#### **5 PROGRAMMABLE LOGIC CONTROLLER (PLC) CHARACTERISTICS**

G-function (Preparatory Function), G-Codes , Cutter Compensation Function , Incremental Programming , Main Program ,Subprogram ,List of G-Function , List of M-function , Other Functions ,

#### **6 SETTING THE MACHINE**

Home Position , Coordinate System Preset, Tool Offset Consideration , Tool Length Offset , Tool Offset Adjustment, Setting up Tools on the Lathe , Imaginary Tool Tip Method , CNC Turning Centre , Setting Work Coordinate System , Tool Offset , Tool data , Setting up Tools on the Machining Centre .

#### **7 CNC PROGRAMMING**

CNC Machining Centre, CNC Turning Centre , Automatically Programmed Tools (APT) Language , Motion Statements ,

#### **8 CNC METAL CUTTING TOOLS**

Characteristics of Tool Materials, Cutting Tool Materials , Cutting Tool Material Chart ,Calculation Formulae for Turning , Calculation formulae for Milling , ISO Designation of Tool, ISO Designation for Round Shank Tools, ISO Designation for Cartridges , Widax -gw Full Form, ISO Designation for Indexable inserts , Chart for Determining Spindle Speeds , Recommended Machining Parameters, Nomogram, For Power/Machining Parameters , Widalon/Widadur/Widia Grades for Machining, Grades for Machining .

#### **9 TROUBLE SHOOTING OF MACHINING PROCESSES**

Drilling, Tapping, Reaming, Spot Facing, Turning, Boring, Milling

#### **10 INTRODUCTION TO FMS, CIM SYSTEM AND ROBOTS**

Flexible Manufacturing System (FMS), Computer Integrated Manufacturing (CIM), Robots

## **BTM5 : OPERATION RESEARCH**

1. **CLASSIFICATION OF O.R. MODELS**  
Physical Models, Symbolic Models, Advantages Of A Model, Limitations Of The Model, Scope Of Operations Research In Management
2. **LINEAR PROGRAMMING FORMULATION & GRAPHICAL METHOD**  
Introduction, Basic Requirements, Basic Assumptions, Advantages Of Linear Programming, Limitations Of Linear Programming, Application Areas Of Linear Programming, Formulation Of Linear Programming Models
3. **TRANSPORTATION**  
Example, Agriculture, General Mathematical Formulation Of Linear Programming Problem, Definitions
4. **SOME SPECIAL CASES**  
Multiple Optimal Solutions, Infeasible Solution, Contradictory Constraints, Unbounded Solution
5. **LINEAR PROGRAMMING**  
The Simplex Method, Introduction, Standard Form Of Linear Programming Problem, Slack And Surplus Variables, Slack Variable
6. **STEPS OF THE SIMPLEX METHOD**  
Steps of the Simplex Method (Maximization Case), Flow Chart of the Simplex Method, Simplex Method (Minimization Case), Steps of the Simplex Method (Minimization Case), Maximization Case (Constraints of Mixed Type), Resolution of Degeneracy
7. **LINEAR PROGRAMMING, DUALITY**  
Introduction, Formulation Of Dual Problem, Interpreting Primal-Dual Optimal Solutions, Solving The Primal-Dual Problem, Dual Of A Primal With Mixed Constraints, Important Primal-Dual Results, Advantages Of Duality, The Dual Simplex Method
8. **TRANSPORTATION PROBLEM**  
Methods For Finding Initial Solution, North-West Corner Method (NWCM), Least Cost Method (LCM), Vogel's Approximation Method (VAM), Stepping-Stone Method, The Dual of Transportation Problem, Alternative Optimal Solutions, Unbalanced Transportation Problems, Supply Exceeds Demand, Demand Exceeds Supply, Degeneracy in the Transportation Problem, Prohibited Routes, Profit Maximization in a Transportation Problem, Trans-shipment Problem, Time-Cost Trade-of in the Transportation problem
9. **HUNGARIAN METHOD OF ASSIGNMENT PROBLEM**  
Minimization Case, Variations Of The Assignment Problem, An Application--Airline Crew Assignment, Travelling Salesman Problem
10. **NETWORK MODELS : PERT & CPM**  
Objectives of network analysis, Application of network models, Advantages of network models, Project network, Difference between PERT and CPM, Activities, Events, Estimating Activity Times, Effect of Introducing a Dummy Activity in a Network, Probability Statements or Project Duration, Probability of completing the project on or before a specified time, PERT algorithm
11. **FLOAT OF AN ACTIVITY**  
Introduction, Optimization of Project Time and Cost in a PERT Network, Limitations of PERT/CPM
12. **QUEUING MODELS**  
Basic Components of the Queuing System, Input Source, Queue Discipline, Service Mechanism, Classification of Queuing Systems, Characteristics of Model I, II, III
13. **INVENTORY CONTROL MODELS**  
Principal Categories of Inventories and Their Functions, Structure of Inventory Management System, The Basic Deterministic Inventory models, Multiple Item Deterministic Models, Limitation set up by capital restriction, Aggregate resource limitations, Selective Inventory Control, Application of ABC analysis, Inventory Control Systems, Reorder level, Probabilistic Models
14. **SYSTEM TERMINOLOGY**  
System and Simulation models, Random Variable and Random Numbers, Monte-Carlo Simulation, Generation of Random Numbers, Simulation and Inventory Control, Simulation and Queuing System, Simulation and Capital Budgeting , Limitations of Simulation, Simulation Languages, Simulation Applications

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

## ***In* MECHANICAL**

### **Course Structure**

#### **Third Year**

#### **Sixth Semester**

<b>Paper Code</b>	<b>Subject</b>
BTM6	Strength of Materials
BTM7	Industrial Engg. & Production Management
BTM8	Design of Machine Elements
BTM9	Hydraulic Machines
BTM10	Industrial Economics & Management

#### **BTM6 : STRENGTH OF MATERIALS**

##### **CHAPTER 1 : INTRODUCTION**

- Interdisciplinary
- Brief Historical Review
- Organization of the book

##### **CHAPTER 2: SIMPLE STRESSES AND STRAINS**

- General Meaning of stress
- Unit of stress
- Simple Stresses
  - Normal stress
  - Shear stress
- Strain
- Stress Strain Relation
  - Behaviour in Tensions
  - Behaviour of Materials under compression
- Nominal stress and true stress
- Behaviour of Materials under Repeated Loadings
- Factor of Safety
- Hooke's Law
- Extension / Shortening of a bar
- Bars with cross-sections varying in steps
- Bars with continuously varying cross-sections
- Bars subjected to varying loads
- Indeterminate structural problems
- Compound Bars
- Temperature stresses
- Simple Shear
- Poisson's Ratio
- Volumetric Strain
- Elastic Constants

- Relationship between Modulus of Elasticity and Modulus of Rigidity
- Relationship between Modulus of Elasticity and Bulk Modulus
- Strain Energy due to Direct Stresses and Impact Loads
- Strain Energy due to shear Stresses

### **CHAPTER 3 : SHEAR FORCE AND BENDING MOMENT DIAGRAMS IN STATICALLY DETERMINATE BEAMS**

- Shear Force and Bending Moment
- Sign Convention
- Relationship between load Intensity, Shear Force and Bending Moment
- Shear Force and Bending Moment Diagrams
- SFD and BMD for Standard Cases
- SFD and BMD for beams subjected to various loads
- Short Cut procedure

### **CHAPTER 4 : STRESSES IN BEAMS**

- Theory of Simple Bending
- Moment carrying capacity of a section
- Composite beams/flitched beams
- Beams of Uniform strength
- Leaf Springs
- Shearing Stresses in Beams
- Shear Stresses across a few Standard Sections
- Shear Stresses in Built Up Sections
- Limitation of Theory Developed

### **CHAPTER 5: DEFLECTIONS OF BEAMS BY DOUBLE INTEGRATION METHOD**

- Differential Equation for Deflection
- Other Useful Equations
- Double Integration Method
- A few General Cases
- Macaulay's Method

### **CHAPTER 6: TORSION**

- Introduction
- Pure Torsion
- Assumptions in the Theory of pure Torsion
- Derivation of Torsional Equations
- Polar Modulus
- Power Transmitted
- Torsional rigidity/ Stiffness of Shafts
- Stepped shafts and Composite Shafts
- Shear Keys
- Coupling
- Torsion of a Tapering Shaft
- Strain Energy in Torsion
- Closed Coiled Helical Springs
- Torsion of shafts of Non-circular sections

### **CHAPTER 7: COMPOUND STRESSES**

- Stresses on an Inclined Plane
- Mohr's Circle of Stress
- Compound Stresses in Beams
- Shafts Subjected to combined Bending and Torsion
- Shafts subjected to Combined Action of Bending, Torsion and Axial Thrust

### **CHAPTER 8: THIN AND THICK CYLINDERS AND SPHERES**

- Stresses in Thin Cylinders
- Changes in Dimensions of Cylinder
- Riveted Cylinders
- Wire Wound Cylinders
- Thin Spherical shells
- Thick cylinders
- Compound Cylinders
- Shrinkage Allowance
- Thick spherical shells

#### **CHAPTER 9: COLUMNS AND STRUTS**

- Short columns subjected to Axial Loads
- Eccentrically loaded masonry columns
- Euler's Theory for Axially Loaded Elastic long columns
- Effective Length
- Limitations of Euler's theory
- Rankine's Formula
- Formula used by Indian Standard Code

#### **CHAPTER 10: THEORIES OF FAILURES**

- Maximum Principal Stress Theory
- Maximum Shear Stress Theory
- Maximum Strain Theory
- Maximum Strain Energy Theory
- Maximum Distortion Energy Theory

### **BTM7 : INDUSTRIAL ENGINEERING AND PRODUCTION MANAGEMENT**

#### **Chapter 1: Introduction to Industrial Engineering:**

Definition, History and Development of Industrial Engineering, Contributions of Industrial Engineering, Activities of Industrial Engineering, Industrial Engineering Approach, Objectives of Industrial Engineering, Function of an Industrial Engineer, Techniques of Industrial Engineering, Place of Industrial Engineering in an Organisation, Industrial engineering in Service Sector.

#### **Chapter 2: Productivity :**

Introduction, Concept, Definitions of Productivity, Production and Productivity, Expectation from Productivity, Benefits from Productivity, Dynamics of Productivity Change, Productivity Measures, Advantages and Limitations of Productivity Measures, Productivity Measurement Models, Factors Influencing Productivity, Productivity Improvement Techniques, Levels of Productivity Measurements.

#### **Chapter 3: Work Study :**

Introduction, Importance of Work-Study, Advantages of Work-Study, Work-Study Procedure, Work-Simplification and Work-Study, Human Considerations in Work-Study, Work-Study and the Management, Work-Study and supervisor, Work-Study and the Workers, Work-Study Man, Influence of Methods and Time Study on Production Activities, Concept of Work Content, Reasons for Excess Work Content, Techniques to Reduce Work Content, Work-Study as Tool to Improve Productivity.

#### **Chapter 4: Method Study :**

Introduction, Objectives of method Study, Scope of Method Study, Steps Involved in Method Study, Selection of the Job for Method Study, Recording Techniques, Micro Motion Study, Memo Motion Study, Cycle Graph and Chronocycle Graph, Critical Examination, Development and Selection of New Method, Principles of Motion Economy, Installation of the Proposed Method, maintain the Proposed Method.

#### **Chapter 5: Work Measurement :**

Definition, Objectives of Work Measurement, Techniques of Work Measurement, Types of Elements, Time Study Equipments, Performance Rating, Allowances, Computation of Standard time, Comparison of Various Techniques, Work Sampling, Synthetic Data, Predetermined Motion Time Analysis.

**Chapter 6:Plant Location:**

Introduction, Need for Selecting a Suitable Location, Plant Location Problem, Advantages of Urban, Suburban, Rural Locations, Importance of Location, Systems View of Location, Location Factors, Comparison between Urban and Rural Locations, Factors Influencing Plant Location, Quantitative Method for Evaluation of Plant Location

**Chapter 7:Plant Layout**

Definition, Plant Layout Problem, Objectives of Plant Layout, Principles of Plant Layout, Factors influencing Plant Layout, Type of Manufacturing System, Types of Layout, Material Flow Patterns, Symptoms of Bad Layout, Plant Layout Procedure, When to Use Process, Products and Fixed Position Layout, Tools and Techniques of Plant Layout, Computer Packages for Layout Analysis, Factory Building,

**Chapter 8:Introduction to Production/Operations Management**

Production / Operation Functions, Production Systems, Objectives of Production Management, History and Development of Production management, Functions and Scope of Production Department, Production Management Frame Work, Type of Production, Classification of Production System, Production Interface with Sub Functional Areas of Production, Organisation Structure for Production Function

**Chapter 9:New Product Design :**

Introduction, Product Life-Cycle, Product Policy of an Organisation, Selection of a Profitable Product, Product Design Process, Product Analysis

**Chapter 10:Demand Forecasting :**

Introduction, Forecasting and Prediction, Need for Demand Forecasting, Long Term and Short term Forecasts, Classification of Forecasting Methods, Judgmental Techniques, Time Series Analysis, Time Series Analysis, Least Square Methods of Forecasting, Moving Average forecasting, Exponential Smoothing Method, Forecast Error, Costs and Accuracy of Forecasts

**Chapter 11:Production Planning and Control :**

Introduction, Need for PPC, Production Planning and Production Control, Objectives of PPC, Functions of PPC, Comparison between Production Planning and Production Control, Information Requirement of PPC, Production Procedure, Organisation for PPC, Manufacturing Methods and PPC, Problem of Production Planning and Control

**Chapter 12:Material requirement Planning (MRP)**

Introduction, MRP Objectives, Functions Served by MRP,MRP Terminology, MRP system, MRP Outputs, MRP Logic, Management Information from MRP, Lot Sizing Considerations, Manufacturing resource Planning, Capacity Requirements Planning (CRP)

**Chapter 13:Production Control**

Introduction, Outline of Production Control, Loading, Sequencing and Scheduling, Loading, Priority Sequencing, Sequencing Problems, Assignment Model, Scheduling, Dispatching, Progressing

**Chapter 14:Inventory Control**

Introduction, Meaning of Inventory, Types of Inventories, Reasons for Keeping Inventories, Inventory Control, Objectives of Inventory Control, Benefits of Inventory Control, Costs Associated with Inventory, Inventory Control-Terminology, Inventory Cost Relationships, Inventory Cost Relationship, Inventory Models, Safety Stock, Inventory Control System, Selective Control of Inventory.

**BTM8 : DESIGN OF MACHINE ELEMENTS****Chapter 1:Introduction:****Chapter 2: Procedure in Machine Design :**

Design Process, Relation of designer with other disciplines, Classification of design work, Qualities required in a designer, Design procedure, Standardization,

### **Chapter 3: Materials:**

Introduction, Factors determining the choice of materials , Properties and testing of materials, Cast Iron

### **Chapter 4: Manufacturing Considerations in Machine Design:**

Important points to be observed while designing for casting, Important points to be observed while designing for heat for easier machining.

### **Chapter 5: Important points to be observed while designing for heat treatment, Limits, Fits, and surface finish :**

Introduction, Indian Standard (IS 919-1963), Definitions, Types of tolerances, Geometrical tolerances, Interchangeable manufacture and selective assembly , Types of fits, Surface Finish, Surface roughness, Information to be given in the statement of surface roughness,

### **Chapter 6: Fasteners:**

Threaded fasteners, Non-threaded fasteners.

### **Chapter 7: Shafts :**

Introduction, Materials, Design consideration, Determination of shaft sizes on the basis of strength, Shaft sizes based on shaftings, effect of keyways, Critical speeds on shafts,

### **Chapter 8: Flywheels :**

Introduction, Turning Moment diagram, Maximum fluctuation of energy, Design of flywheels,

### **Chapter 9: Couplings:**

Introduction , Rigid couplings, Flexible Couplings, Slip Couplings,

### **Chapter 10: Clutches:**

Introduction, Rigid body clutches , Friction clutches, Centrifugal clutches, Friction clutches, Centrifugal clutches, Electromagnetic Friction clutches, Eddy current clutches, Slip Clutches, Magnetic Particles Clutches,

### **Chapter 11: Brakes:**

Introduction, Friction Materials, Band brakes, Differential band brakes, Band and block Brakes, Block brakes, Self-Energizing and self-locking brakes, Automotive shoe brakes,

### **Chapter 12: Ball and Roller Bearings:**

Introduction, Construction and classification of ball bearings, Types of roller bearings, Bearing life, Bearing Series, Static Load Capacity, Methods of evaluation Static load rating of rolling (ball and roller (bearing ) , Equations for calculating basic load rating ( $C_0$ ) (kg), Equations for calculating Static equivalent Load ( $P_0$ ), Dynamic load capacity, Equivalent dynamic load, Basic Dynamic Load Rating  $C$  , Spur, Helical.

### **Chapter 13: Bevel and Worm Gears :**

Introduction, Involute Curve, Terminology of gear Teeth, Interference in Gears, Gear Materials, Sources of errors in manufacturing gears, Design of gears, Design of gears considering hardness, AGMA bending equation, Gear Wheel Design, Internal Gears, Approximate Method of Design of spur gears, Method of calculating the rating of machine cut spur and helical gears, Gear Boxes , Helical Gears, Bevel Gears, Worm Gears

## **BTM9 : HYDRAULIC MACHINES**

### **Chapter 1: Impact of free jets :**

Introduction, Force exerted on a Stationary Flat Plate Held Normal to the Jet, Force Exerted on a Stationary Flat Plate Held Inclined to the Jet, Force Exerted on a Stationary Curved Plate, Force Exerted on a Moving Flat Plate Held Normal to Jet, Force Exerted on a Moving Plate Inclined to the Direction of Jet, Force Exerted on a Curved Vane when the Vane is moving in the Direction of Jet, Jet Striking a Moving Curved Vane Tangentially at One Tip and Leaving at the Other, Jet Propulsion of Ships, Highlights, Objective Type Questions, Theoretical Questions, Unsolved Examples.

### **Chapter 2: Hydraulic Turbines:**

Introduction, Classification of Hydraulic Turbines, Impulse Turbines – Pelton wheel, Construction and working of Pelton wheel/turbine, work done and efficiency of a Pelton wheel, Definitions of heads and efficiencies, Design aspects of Pelton wheel, Reaction Turbine, Francis turbine, work done and efficiencies of a Francis turbine, working proportions of a Francis turbine, Design of a Francis turbine runner, Advantages and disadvantages of Francis turbine over a Pelton wheel, Propeller and Kaplan turbines-Axial flow reaction turbines, Propeller turbine, Kaplan turbine, Kaplan versus Francis turbine, Deriaz turbine, Tabular or bulb turbines, Runaway Speed, Draft Tube, Draft tube theory, Types of draft tubes, Specific Speed, Unit Quantities, Model Relationship, Scale Effect, Performance Characteristics of Hydraulic Turbines, Main or constant head characteristic curves, Operating or constant speed characteristic curves, Constant efficiency or ISO-efficiency or Muschel curves, Governing of Hydraulic Turbines, Governing of reaction turbines, Cavitations, Selection of Turbines, Surge Tanks, Highlights.

### **Chapter 3: Centrifugal Pumps:**

Introduction, Classification of Pumps, Advantages of centrifugal Pump over Displacement (Reciprocating) Pump, Component Parts of a Centrifugal Pump, Work done by the Impeller (or Centrifugal Pump) on Liquid, Head of a Pump, Losses and Efficiencies of a Centrifugal Pump, Losses in centrifugal Pump, Effect of outlet vane angle on manometric efficiency, Minimum speed for starting a Centrifugal Pump, Effect of variation of Discharge on the Efficiency, Effect of Number of Vanes of Impeller on Head and efficiency, Working Proportions of Centrifugal Pumps, Multi-stage Centrifugal Pumps, Pumps in series, Pumps in parallel, Specific speed, Model Testing and Geometrically similar Pumps, Characteristics of Centrifugal Pumps, Net Positive Suction Head (NPSH), Cavitations in Centrifugal Pumps, Priming of a Centrifugal Pump, Selection of Pumps, Operational Difficulties in Centrifugal Pumps, Highlights,

### **Chapter 4: Reciprocating Pumps:**

Introduction, Classification of Reciprocating Pumps, Main Components and Working of a Reciprocating Pump, Discharge, work done and power required to drive reciprocating Pump, Single-acting reciprocating pump, Double-acting reciprocating Pump, Co-efficient of Discharge and slip of Reciprocating Pump, Co-efficient of discharge, slip, Effect of Acceleration of Piston on Velocity and Pressure in the Suction and Delivery Pipes, Indicator Diagrams, Ideal indicator diagram, Effect of acceleration in suction and delivery pipes on indicator diagram, Effect of friction in suction and delivery pipes on indicator diagram, Effect of friction and acceleration in suction and delivery pipes on indicator diagram, Air vessels, Highlights.

### **Chapter 5: Miscellaneous Hydraulic Machines :**

Introduction, Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Press, Hydraulic Crane, Hydraulic lift, Hydraulic Ram, Hydraulic Coupling, Hydraulic Torque converter, Air Lift Pump, Jet Pump, Highlights.

### **Chapter 6: Water Power Development:**

Hydrology, Definition, Hydrologic cycle, Measurement of run-off, Hydrograph, Flow duration Curve, Mass Curve, Hydro-power Plant, Introduction, Application of hydro-electric power plants, Advantages and disadvantages of hydro-electric power plants, Average life of hydro-plant components, Hydro-plant controls, Safety measures in hydro-electric power plants, Preventive maintenance to hydro-plant, Calculation of available hydro-power, Cost of hydro-power plant, Hydro-power development in India, Combined hydro and steam power plants, Comparison of hydro-power station with thermal power stations, Highlights.

## **BTM10: INDUSTRIAL ECONOMICS AND MANAGEMENT**

**Chapter 1 : Nature and Significance of Economics :** Science, Engineering and Technology and their relationship with economics development, appropriate technology for development countries

**Chapter 2 : Demand and Supply Analysis :** Elasticity, Competition, Monopoly, Oligopoly, Monopolistic competition, Price Discrimination, Equilibrium of firm .

**Chapter 3 : Function of Money :** Supply and Demand for money, Inflation, Black Money.

**Chapter 4: Functions of Commercial Bank :** Multiple credit creation, Banking systems in India.

**Chapter 5 : Central Banking :** Functions of Central Banking, monetary policy.

**Chapter 6: Sources of Public Revenue :** Principles of taxation, Direct and Indirect taxes , reform of tax system.

**Chapter 7: Theory of International Trade :** Balance of trade and payment, Theory of protection, Exchange control, Devaluation.

**Chapter 8: New Economics Policy :** Liberalization, Extending , Privatization, Globalization, Market- Friendly state, Export led growth.

**Chapter 9: Causes of Underdevelopment :** Determinants of economic development, stages of economics growth, Strategy of development, Critical minimum effort strategy .

**Chapter 10: Management Functions :** Developments of management thought, Contribution of F.W. Taylor, Henri Fayol, Elton-Mayo, System Approach to Management .

**Chapter 11: Nature of Planning :** Decision making process, MBO.

**Chapter 12: Organization :** Line and Staff relationships, Decentralization of delegation of authority .

**Chapter 13: Communication Process :** Media Channels and barriers to effective communication .

**Chapter 14: Theory of Motivation :** Maslow, Herzberg and McGregor Theory of motivation, McClelland's achievement theory.

**Chapter 15 : Production Management :** Production Planning and control, inventory control, quality control, total quality management.

**Chapter 16 : Project Management :** Project Development life cycle, project feasibility, CPM, PERT.

**Chapter 17: Cost Accounting and Finance :** Techniques of Financial Control, Financial Statements Financial Ratios, Break-even analysis, Budgeting and budgetary control.

**Chapter 18 : Marketing Functions :** Management of Sales and advertising, Marketing research .

**Chapter 19: Human Resource Management :** Functions, Selection, Training.

**Chapter 20 : Engineering Economics :** Investment Decisions, Payback time .

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

*In*  
**MECHANICAL**

**Course Structure**

**Fourth Year**

**Seventh Semester**

Paper Code	Name of the Subject
BEME1	CAD/ CAM (Application ) & Automation
BEME2	Meteorology & Quality Control
BEME3	I.C. Engines & Automobile Engineering
BEME4	Finite Elements Methods in Engineering
BEME5	Elective-I
BEME2P	Meteorology & Quality Control Practical
BEME4P	I.C. Engines & Automobile Engineering Practical

**BEME1: CAD/CAM (APPLICATION) & AUTOMATION**

**CAD/CAM System**

Introduction To CAD / CAM, Product Cycle and CAD / CAM, Advantages of CAD / CAM, Hardware in CAD, Types of Input Devices, CPU and Output Devices, Software for CAD / CAM, Functions of a Graphics Software, Selection of CAD / CAM Systems

**Computer Graphics**

Geometric Transformations, Homogeneous Coordinates, Inverse Transformations, Concatenation or Composite Transformations, Coordinate Transformations, Three Dimensional Transformations, Solved Examples, Standardisation in Graphics Software, CAD / CAM Data Exchange, Shape Based Format, Product Data Based Format, Exercises.

**Geometrical Modeling**

Introduction, Model Structure Organisation, Database Creation, Wire Frame Modeling, Wire Frame Representation, Real Objects and Wire Frame Models, Surface Modeling, Kinds of Surfaces, Solid Modeling, Representation Schemes for Solid Models, Applications of Solid Modeling, Parametric Solid Modeling, Solved Examples, Exercises.

**NC – CNC – DNC Machine Tools**

Numerical Control of Machine Tools, Elements of NC Manufacturing System, Coordinate System and Machine Motions, Types of NC Systems, Position and Motion Control in an NC System, Structure, Drives and other Devices, Steps in NC Manufacturing, Applications of NC Machine Tool, Advantages and Disadvantages of NC Technology, Limitations of Conventional NC, Computer Numerical Control (CNC) Technology, CNC controllers, Features and Advantages of CNC, Adaptive Control, Advantages of Adaptive Control, Direct Numerical Control (DNC), Types of DNC, Advantages and Disadvantages of DNC, New Trends in CNC, DNC.

**Part Programming**

Manual Part Programming, Principles of an NC Program, Word Address Format (WAF), Machining Formulas, Solved Examples (2 Axes-Drilling and Milling), Tool Length and Cutter Diameter Compensation, Canned Cycles for Milling and Drilling, Solved Examples (2 1/2 Axes – Drilling and Milling), Subprogram or Subroutines, DO Loop, Macros, Solved Examples, CNC Lathes, Diameter Versus Radius Programming, Solved Examples, Canned Cycles on Lathes, Solved Examples,

Computer Assisted Part Programming, Languages in Computer Assisted Programming, Structure of APT, Repetitive Programming using APT, Solved Examples, CAD / CAM Systems for Part Programming, Exercises.

### **Automation**

Concepts in Manufacturing Systems, Definition of Automation, Types of Automation, Advantages and Limitations of Automation, Strategies in Automation, Group Technology, Merits and Demerits of Group Technology, Concept of a Machine Cell, Flexible Manufacturing System (FMS), Elements of FMS, Workpiece Handling, Workpiece Transport using Automated Guided Vehicle System (AGVS), Applications of FMS, Planning and Implementation of FMS, Merits and Demerits in FMS, Computer Integrated Manufacturing (CIM).

## **BEME2: METEOROLOGY & QUALITY CONTROL**

- 1) **Measurements:** International standards of length-Line and end measurement, Need of measurement, possible errors in measurement, slip gauges.
- 2) **Tolerances and gauging:** unilateral and bilateral tolerances, Limits, Fits, Types of Fits, IS specifications of limits. Importance of limits, System in mass production, limit gauges used for plain and taper works.
- 3) **Magnification:** Principles and characteristics of measuring instruments, Mechanical, Optical, electrical, Pneumatic method of magnification, different types of Verniers, Micrometers, Dial gauges, Mechanical and pneumatic, Types of comparators. Use of comparators in inspection.
- 4) **Measurement of angles, tapers and radius:** Bevel Protractor, Spirit level, Clinometers, angle Decker, standard balls and rollers for angle measurement, angle slip gauges, radius measurement of circular portion, measurement of concave and convex surface radius.
- 5) **Interferometry:** Principle of Interferometry and application in checking of flatness, angle and height.
- 6) **Straightness and Flatness:** Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate(Theoretical treatment only)
- 7) **Surface finish:** Types of textures obtained during machine operation, range of C.L.A. value in different operations in numerical assessment of surface finish(B.I.S. Specifications of C.L.A. value)-sample length of different machining operations. Direction of lay, texture,symbols , instruments used in surface finish assessment. (03)
- 8) **Measurement of External Threads:** Different errors in screw threads, measurement of forms of thread with profile projector, pitch measurement, measurement of thread diameter with standard wire, screw thread micrometer.
- 9) **Measurement of Spur Gears:** Run out checking, Pitch measurement, profile checking, backlash checking, tooth thickness measurement, alignment checking, errors in gears, checking of composite errors.
- 10) **Quality control :-**
  - A) Concept of Quality and quality control, elements of quality and its growth, purpose, setup, policy and objective,factors controlling and quality of design and conformance, balance between cost and quality and value of quality. Specification of quality ,planning through trial lots and for essential information.
  - B) Introduction to topic such as in process quality,quality circles,quality management,total quality control,ISO 9000 and equivalent Indian standards.
- 11) **Statistical Quality Control-**Importance of statistical method in quality control, measuring of statistical control variables and attributes. Measurement/inspection, different types of control charts(X Bars, R, P. charts) and their constructions and their application.
- 12) **Acceptance Sampling-** Sampling inspection and percentage inspection, basic concept of sampling inspection, operating characteristic curves, conflicting interests of consumer and producer, producer and consumers risks, AWQL, LTPD,ADGL, single and double sampling plans.
- 13) **Recent trends in quality Control-**
  - 1) CAQC
  - 2) Six Sigma
  - 3) Zero defect
  - 4) T.Q.M.
  - 5) T.Q.C.
  - 6) Non-contact inspection
  - 7) Q.F.D.

- 8) C.M.M.
- 9) QUIZEN
- 10)D.O.P.(Case study)

### **BEME3: I.C. ENGINES & AUTOMOBILE ENGINEERING**

#### **Unit – 1**

1. Historical Developments and modern trends in I.C. Engines
2. Engine Components
3. Engine classification
4. Fuel-air cycle analysis
5. Comparison of P-V Diagram of air-standard cycles
6. Fuel-air cycle and actual cycle
7. Effect of variables on performance

#### **Unit – 2**

1. Carburetion, Mixture requirements, Carburetor types
2. Construction and Working of fuel pump and fuel injector, Types of fuel injectors
3. Fuel distribution systems
4. M.P.F.I. system for modern automobile engines

#### **Unit – 3**

1. **Ignition system:**  
Battery and coil ignition system, Magneto ignition system, Electronic ignition system, Advantage over mechanical contact breaker point system
2. **Engine Cooling system:**  
Air Cooling, Water cooling, Thermostatic Radiators
3. **Lubrication system:**  
Dry sump Lubrication, Wet sump lubrication – Fully pressurized, oil filters
4. **Governing system:**  
Quality governing, Quantity governing, Hit & Miss governing

#### **Unit – 4:**

1. **Testing & Performance of I.C. Engine:** Determination of brake power, indicated power, friction power. Determination of brake thermal efficiency, mechanical efficiency, volumetric efficiency. Energy Balance. Performance characteristics. Supercharging & Turbo charging methods and limitations. (Only descriptive treatment)

#### **Unit – 5:**

1. **Combustion in S.I. Engines:**
  - a. Stages of Combustion. Concept of combustion quality
  - b. Effect of engine variable on ignition lag and flame propagation. Abnormal Combustion: Theories, effects and controlling measures, Combustion chambers for S.I. engines
2. **Combustion in C.I. Engines:**
  - a. Stages of Combustion
  - b. Diesel knock and its control
  - c. Combustion chambers for C.I. engines

#### **Unit – 6**

1. Standards for emission of pollutants from motor vehicles as per CMV rules
2. PUC norms requirements for automotive applications
3. Hybrid vehicles

### **BEME4: FINITE ELEMENTS METHODS IN ENGINEERING**

#### **17. INTRODUCTION**

Introduction. Historical Background. Design Considerations. Need Of Finite Element Method. The Process Of Finite Element Method, Field And Boundary Conditions, Steps Involved In Fem, The Standard Discrete System , Transformation Of Co-Ordinates.

**18. FINITE ELEMENTS OF ELASTIC CONTINUUM DISPLACEMENT APPROACH**

Introduction, Direct Formulation Of Finite Element Characteristic, Generalized Nature Of Displacements, Strains, And Stresses, Generalization To The Whole Region--Internal Nodal Force Concept Abandoned, Displacement Approach As A Minimization Of Total Potential Energy, Convergence Criteria, Discretization Error And Convergence Rate, Displacement Functions With Discontinuity Between Elements--Non-Conforming Elements And The Patch Test, Bound On Strain Energy In A Displacement Formulation, Direct Minimization.

**19. GENERALIZATION OF THE FINITE ELEMENT CONCEPTS WEIGHTED RESIDUAL AND VARIATIONAL APPROACHES**

Introduction, Weighted Residual Methods, Approximation To Integral Formulations: The Weighted Residual Method, Virtual Work As The 'Weak Form' Of Equilibrium Equations For Analysis Of Solids Or Fluids, Variational Principles, Establishment Of Natural Variational Principles For Linear, Self-Adjoint Differential Equations, Maximum, Minimum, Or A Saddle Point, Constrained Variation Principles, Lagrange Multipliers And Adjoin Functions.

**20. STRAIN PLANE STRESS AND PLANE**

Introduction, Element Characteristics, Some Practical Applications, Special Treatment Of Plane Strain With An Incompressible Material.

**21. AXI-SYMMETRIC STRESS ANALYSIS**

Introduction, Element Characteristics, Some Illustrative Examples.

**22. THREE – DIMENSIONAL STRESS ANALYSIS**

Introduction, Tetrahedral Element Characteristics.

**23. ELEMENT SHAPE FUNCTIONS SOME GENERAL FAMILIES OF  $C_0$  CONTINUITY**

Introduction, Two – Dimensional Elements, Completeness Of Polynomials, Rectangular Elements – Lagrange Family, Rectangular Elements – 'Serendipity' Family, Triangular Element Family, One-Dimensional Elements, Three-Dimensional Elements, Other Simple Three-Dimensional Elements.

**24. CURVED, ISOPARAMETRIC ELEMENTS AND NUMERICAL INTEGRATION**

Introduction, Parametric Curvilinear Co-Ordinates, Geometrical Conformability Of Elements, Variation Of The Unknown Function With In Distorted, Curvilinear, Elements, Continuity Requirements, Transformations, Element Matrices, Area And Volume Co-Ordinates, Convergence Of Elements In Curvilinear Co-Ordinates, Numerical Integration.

**25. SOME APPLICATIONS OF ISOPARAMETRIC ELEMENTS IN TWO- AND THREE-DIMENSIONAL STRESS ANALYSIS**

Introduction, A Computational Advantage Of Numerically Integrated Finite Elements.

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

*In*  
**MECHANICAL**

**Course Structure**

**Fourth Year**

**Seventh Semester**

**ELECTIVE - I**

Paper Code	Name of the Subject
BEME5- I	Mechatronics
BEME5- II	Concurrent Engineering
BEME5- III	Management of Technology
BEME5- IV	Machine Vibration Analysis

**BEME5-I:MECHATRONICS**

**1 INTRODUCTION**

What is Mechatronics? , Scope of Mechatronics, Key Issue

**2 INTRODUCTION TO MODERN CNC MACHINES AND MANUFACTURING SYSTEMS**

Introduction, Advantages of CNC Machines, CNC Machining Centre Developments, Turning Centre Developments, Tool Monitoring on CNC Machines, Other CNC Developments, Advanced Manufacturing Systems, Benefits of an FMS, Trends in Adoption of FMSs

**3 ELECTRONICS FOR MECHANICAL ENGINEERS**

Introduction, Conductors, Insulators and Semiconductors, Passive Components used in Electronics, Transformers, Semiconductors, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC) , Digital Circuits

**4 DESIGN OF MODERN CNC MACHINES AND MECHATRONIC ELEMENTS**

Introduction, Machine Structure, Guideways, Feed Drives, Spindle/Spindle Bearings, Measuring Systems, Controls, Software and User Interface, Gauging, Tool Monitoring System

**5 DRIVES AND ELECTRICALS**

Drives, Spindle Drives , Feed Drives , DC Motors , Servo-principle , Drive Optimisation ,Drive Protection , Selection Criteria for AC Drives , Electric Elements , Wiring of Electrical Cabinets Power Supply for CNC Machines , Electrical Standard , Electrical Panel Cooling (Air Conditioning)

**6 CNC SYSTEMS**

Introduction , Configuration of the CNC System ,Interfacing , Monitoring , Diagnostics , Machine Data , Compensations for Machine Accuracies , PLC Programming , Direct Numerical Control (DNC)

**7 PROGRAMMING AND OPERATION OF CNC MACHINES**

Introduction to Part Programming , Coordinate System ,Dimensioning ,Axes and Motion nomenclature

,Structure of a Part Program , Word Addressed Format , G02/G03 Circular Interpolation , Tool Compensation , Subroutines (Macros) , Canned Cycles (G81-G89), Mirror Image, Parametric Programming (User Macros) and R-Parameters , G96 S... Constant Cutting Speed and G97 Constant Speed ,Machining Cycles , Programming Example for Machining Centre ,Programming Example for Turning Centre.

## **8 INDUSTRIAL DESIGN, AESTHETICS AND ERGONOMICS**

Introduction, Elements of Product Design , Ergonomic Factors for Advanced Manufacturing Systems

## **9 INTRODUCTION TO COMPUTERS AND CAD/CAM**

Introduction to Computers, CAD/CAM Systems,

## **BEME5-II: CONCURRENT ENGINEERING**

### **1. INTRODUCTION TO PRODUCT DESIGN : ASIMOW'S MODEL**

Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-Consumption Cycle, The Morphology of Design (The Seven Phases), Primary Design Phases and Flowcharting – The 25 Steps, Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly, Summary of Detailed Design Phase.

### **2. PRODUCT DESIGN PRACTICE AND INDUSTRY**

Introduction, Product Strategies, Time to Market, Analysis of the Product, The Three S's, Standardization, Renard Series (Preferred Numbers), Simplification, The Designer and His Role, The Designer : Myth and Reality, The Industrial Design Organization, Basic Design Considerations, Problems faced by Industrial Designer, Procedure adopted by Industrial Designer, Types of Models designer by Industrial Designers, What the Designer contributes, Roles of Aesthetics in Product design, Functional Design Practice

### **3. STRENGTH CONSIDERATION IN PRODUCT DESIGN**

Principal Stress Trajectories (Force-Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression

### **4. DESIGN FOR STIFFNESS AND RIGIDITY**

Pure Struts and Pure Columns, Structure involving both Tension and Compression members,, Mapping of Principal Stress, Buckling and Instability, Theory of Long Columns, Hollow Columns, Plastic Design, Practical Ideas for material Saving in design, Ribs, Corrugations, Laminates and Membranes

### **5. PRODUCTION PROCESSES**

Introduction, Primary Processes, Machining Processes, Non-traditional Machining Processes.

### **6. DESIGN FOR PRODUCTION – METAL PARTS**

Producibility Requirements in the Design of the Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design of Powder Metallurgical Parts, Expanded Metals and Wire Forms

### **7. OPTIMIZATION IN DESIGN**

Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method of Optimum Design

### **8. ECONOMIC FACTORS INFLUENCING DESIGN**

Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in Relation to Design, Economic Analysis, Profit and Competitiveness, Break-even Analysis, Economics of a New Product Design (Samuel Eilon Model)

### **9. HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN**

Introduction, Human Being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Control, The Design of Displays, Man/Machine Information Exchange.

#### **10. VALUE ENGINEERING AND PRODUCT DESIGN**

Introduction, Historical Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis job plan, Creativity, Steps to Problem – solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Check list, Cost reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering.

#### **11. ROLE OF COMPUTER IN PRODUCT DESIGN, MANUFACTURING AND MANAGEMENT**

CAD/CAM: Some Definitions, Product Cycle and CAD/CAM, Role of Computer in Manufacturing, Role of Computer in Design Process, Creation of a Manufacturing Database, Computer Integrated Manufacturing, Communication Networks, Group Technology, Production Flow Analysis (PFA), Computer Aided Process Planning (CAPP), Material Requirement Planning (MRP), Moving Towards Total Automation: Role of Artificial Intelligence, Flexible Manufacturing Systems, Just-In-Time (JIT) Manufacturing

#### **12. MODERN APPROACHES TO PRODUCT DESIGN**

Concurrent Design, Quality Function Development (QFD), Rapid Prototyping

#### **13. QUALITY ASSURANCE IN PRODUCT DESIGN AND MANUFACTURING**

Evolution of Quality Concepts and Applications, Quality and Design Spiral, Theory of Sampling Inspection, Control Charts and In-process Monitoring of Quality, Quality of Performance: Reliability and Allied Topics Taguchi Method of Robust Design of Products, Six-Sigma Quality Concepts.

### **BEME5-III: MANAGEMENT OF TECHNOLOGY**

#### **1. NATURE OF ORGANIZATION**

Introduction, objectives, the need for corporate objectives, the mission statement, managing by objectives, the legal establishment of organizations., companies, franchising, strategies for survival, strategic marketing, simultaneous engineering , manufacturing strategies

#### **2. FUNCTIONS OF ORGANIZATION**

Introduction, objectives, purchasing, the role of the purchasing function, organization of the purchasing function, activities in purchasing, management activities in the operations area, organization of manufacturing, market research, customers and markets, sales, finance, organization of the finance department, Activities of the finance department, product development, Activities of the product development function, organization of the product development function, research , quality, quality systems, management activities in the quality function, organization of the quality function, personnel, manpower planning, employee appraisal, recruitment and selection, company operation and the role of engineers.

#### **3. PRODUCT DEVELOPMENT**

Introduction, objectives, customer and product development, product life cycles and gap analysis, gap analysis , the ideal product development process, managing the product development process, models of the process, pugh, pahl and beitz, company structure for product development, research, development, engineering and manufacturing (rdem), project approach, matrix, finance and product development, management techniques in product development, identifying customer needs, product design specification (pds), decision making, drawings and drawing management, drawing in practice, the drawing office, preparation, drawing release, drawing modification, design reviews, intellectual property rights, trade marks.

#### **4. OPERATIONS MANAGEMENT**

Introduction, objectives, organization of manufacturing, job production, batch production, flow production, group technology, production planning and control, part specifications., product data, economic batch quantity, the schedules, materials management, purchasing, centralization and decentralization of purchase department, purchasing procedure, stores, material requirement planning (mrp), terms used in material requirements planning., dependent demand, lumpy demand, lead time, how mrp uses lead time information, master production schedule (mps), bill of material (bom) file, inventory

status file., output of mrp, benefits of mrp, drawbacks of mrp, just in time (jit) in production system, push system vs pull system, kanban and pull system, calculation for number of kanban, an analogy to jit, requirements for implementing jit, preliminaries to jit production, jit production process, evaluation of jit production.

#### **5. QUALITY MANAGEMENT**

Introduction, objectives, inspection and test, quality control, quality assurance and iso 9000, total quality management (tqm), what is quality, dimensions of quality, total quality management (tqm), quality gurus, deming's approach to tqm, joseph m. Juran, principal objectives of tqm principal objectives of tqm, management in tqm, elements of tqm, Customer satisfaction evaluation, seven qc tools for improvement, implementation of tqm, iso 9000, iso 9000 vs tqm, standards indian standard institution, bis publications.

#### **6. PROJECT PLANNING AND MANAGEMENT .**

Introduction, objectives, projects and management, network analysis, finding the critical path, project float, gantt charts, resource analysis, planning under uncertainty

#### **7. PERSONNEL MANAGEMENT.**

Introduction, objectives, structure of organizations, methods of company organization, deployment of personnel, factors that affect company organization, product and manufacturing system, functions and expertise, definition of personnel management, principles of personnel management , functions of personnel management, recruitment and selection of employees manpower planning, types of manpower planning, steps in manpower planning, procedure of appointing an employee in a factory, training and development, organisation of training programme, principles of training, method of training operating employees, methods of training foreman and supervisors, methods of training executives or managerial executive development, appraisal of employees, the aims of an appraisal scheme, formal appraisal schemes, the appraisal form, the appraisal interview, two- interview appraisals, the implications of an appraisal system, motivation, human needs, maslow's theory of motivation, leadership introduction, different styles of leadership are as follows.

#### **8. TEAM WORKING AND CREATIVITY**

Introduction, objectives, overview, team working, holistic teams, group dynamics, the needs of the group, meeting these needs –group dynamics, norms, group culture, managing the creative process., planning innovation, planning techniques for the innovative process, problem solving, brainstorming., decision making, start with objectives

#### **9. COMMUNICATION SKILL**

Introduction, objective, communication in the workplace, the purpose of a communication system., communication methods and aids., information gathering, sources of information, assimilation and organizing information ,written communication, factor affecting written communication, preparation of creative writing, specific writing techniques, using a computer for written communication, oral communications, factors that affect oral communications, active listening, oral presentations, making the presentation, interviews, negotiations, the telephone, managing meetings

#### **10. THE VOCATION OF ENGINEERING MANAGEMENT.**

Introduction, objectives, the cu100 project at oxford lasers ltd, customer requirements, recruitment, the design report, detailed design and manufacture, problems and delays, disconnection safety, testing, epilogue, the cu 100 project debrief, communication skills.

### **BEME5-IV: MACHINE VIBRATION ANALYSIS**

#### **1. OSCILLATORY MOTION**

Harmonic Motion, Periodic Motion, Vibration Terminology.

#### **2. FREE VIBRATION**

Vibration Model, Equations of Motion – Natural Frequency, Energy Method, Rayleigh Method : Effective Mass, Principle of Virtual Work, Viscously Damped Free Vibration, Logarithmic Decrement, Coulomb Damping.

**3. HARMONICALLY EXCITED VIBRATION**

Forced Harmonic Vibration, Rotating Unbalance, Rotor Unbalance, Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent Viscous Damping, Structural Damping, Sharpness of Resonance, Vibration Measuring Instruments.

**4. INTRODUCTION TO MULTI-DEGREE OF FREEDOM SYSTEMS**

Normal Mode Vibration, Co-ordinate Coupling, Forced Harmonic Vibration, Digital Computation, Vibration Absorber, Centrifugal Pendulum Vibration Absorber, Vibration Damper.

**5. PROPERTIES OF VIBRATING SYSTEMS**

Flexibility Matrix, Stiffness Matrix, Stiffness of Beam Elements, Eigenvalues and Eigenvectors, Orthogonal Properties of the Eigenvectors, Repeated Roots, Modal Matrix P, Modal Damping in Forced Vibration, Normal Mode Summation.

**6. LAGRANGE'S EQUATION**

Generalized Co-ordinates, Virtual work, Lagrange's Equation, Kinetic Energy, Potential Energy, and Generalized Force.

**7. NORMAL MODE VIBRATION OF CONTINUOUS SYSTEMS**

Vibrating String, Longitudinal Vibration of Rods, Torsional Vibration of Rods, Euler Equation for Beams, Effect of Rotary Inertia and Shear Deformation.

**8. APPROXIMATE NUMERICAL METHODS**

Rayleigh Method, Dunkerley's Equation, Rayleigh-Ritz Method, Method of Matrix Iteration, Calculation of Higher Modes.

**9. NUMERICAL PROCEDURES FOR LUMPED MASS SYSTEMS**

Holzer Method, Digital Computer Program for the Torsional System, Myklestad's Method for Beams, Coupled Flexure- Torsion Vibration, Transfer Matrices, Systems with Damping, Geared System, Branched Systems, Transfer Matrices for Beams, Difference Equation.

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

*In*  
**MECHANICAL**

**Course Structure**

**Fourth Year**

**Eighth Semester**

<b>Paper Code</b>	<b>Name of the Subject</b>
BEME6	Refrigeration & Air- Conditioning
BEME7	Machine Tool Design
BEME8	Jigs and Fixture design
BEME9	Project
BEME6P	Refrigeration & Air-conditioning Practical

**BEME6 : REFRIGERATION AND AIR-CONDITIONING**

**CHAPTER 1: REFRIGERATION**

1. Theory of Refrigeration machines
2. Reversed carnot cycle
3. Cold air refrigeration machine
4. Co-eff. of performance
5. Applications of air cycles for cooling aircraft cabins
6. Vapor compression machines
7. Refrigeration effects per kg of working substance-primary and secondary refrigerants
8. Multistage compression and expansion systems, with flash inter cooling
9. Cascade system of refrigeration
10. Vapor absorption machine
11. Commercial ice making plant
12. Household refrigerators, cryogenics
13. Liquefaction of gases, manufacturing of dry ice

**CHAPTER 2: AIR-CONDITIONING**

1. Thermodynamic properties of air-water vapor mixtures
2. Psychrometry, use of psychrometric charts of various types, study of heating, cooling, humidification and dehumidification
3. Processes on air-water-vapor mixtures
4. Adiabatic mixing of air streams
5. Reheating and bypassing of air
6. Room apparatus dew point, coil apparatus dew point
7. Sensible heat factor, coil bypass factor, inside and outside design, comfort air conditioning, comfort zone, effective temperature
8. Air conditioning load calculations

**CHAPTER 3: AIR DISTRIBUTION**

1. High and low velocity ducts
2. Duct design, zoning, fans and blowers (applications only)

#### **CHAPTER 4: COLD STORAGES**

1. Cold storages-load calculations
2. Optimum insulation
3. Design conditions for storage of various commodities
4. Air circulation
5. Types of evaporators
6. defrosting
7. Controls in air conditioning plants
8. refrigerant feed control
9. safety controls
10. H.P. and L.P. switches
11. Oil pressure failure switch
12. Interlocking control
13. Humidity and temperature measurement and control
14. Air velocity measurement
15. Electric, pneumatic circuits for refrigeration plant used in air-conditioning

#### **CHAPTER 5:**

1. Construction, Layouts, operation and maintenance of air-conditioning plants
2. Noise and vibration control, fault location, causes and remedies, preventive maintenance

#### **CHAPTER 6:**

1. Application of summer, winter and weather air-conditioning plants
2. Testing of air conditioning plants

#### **BEME7 : Machine Tool Design**

Metal Cutting; Machine Tools; Mechanism for Transmissions of Motions in Machine Tools; Mechanical Drives for Providing Rotational Movements; Strength and Rigidity of Machine Tool Structure; Analysis of Spindle Bearings, Slides and Guides; Automatic Drives for Machine Tools; Economics of Machine Tool Selection; Trends of Developments of Future Machine Tools.

#### **BEME8 :- JIG AND FIXTURES DESIGN**

##### **Section I**

##### **BASIC TYPES AND FUNCTIONS OF JIGS AND FIXTURES**

##### **1 PURPOSE OF TOOL DESIGN**

Objectives, Tool Design, Tool Design Objectives, Tool Design in Manufacturing, Planning the Design, Challenges to the Tool Designer Requirements to become a Tool Designer

##### **2 TYPES AND FUNCTIONS OF JIGS AND FIXTURES**

Objectives, Jigs and Fixtures, Classes of Jigs, Types of Jigs, Types of Fixtures, Classification of Fixtures

##### **3 SUPPORTING AND LOCATING PRINCIPLES**

Objectives, Referencing, Basic Rules for Locating, Planes of Movement, Locating the Work

##### **4 CLAMPING AND WORKHOLDING PRINCIPLES**

Objectives, Workholders, Basic Rules of Clamping, Types of Clamps, Non-Mechanical Clamping, Special Clamping Operations, Clamping Accessories

##### **5 BASIC CONSTRUCTION PRINCIPLES**

Objectives, Tool Bodies, Preformed Materials, Drill Bushings, Set Blocks, Fastening Devices

## **Section II**

### **CONSIDERATIONS OF DESIGN ECONOMICS**

#### **6 DESIGN ECONOMICS**

Objectives, Considerations of Design Economics Design Economics, Design Economy:  
Economic Analysis, Comparative Analysis

#### **7 DEVELOPING THE INITIAL DESIGN,**

Objectives, Predesign Analysis, Designing Around the Human Element, Previous Machining Operations,  
Developing Tooling Alternatives

#### **8 TOOL DRAWINGS**

Objectives, Tool Drawings versus Production Drawings, Simplified Drawings, Making the Initial Drawing,  
Dimensioning Tool Drawings, Millimeter and Inch Dimensioning  
Geometric Dimensioning and Tolerancing, Supplementary Symbols, Geometrically Dimensioned and  
Toleranced Tool Drawings, Computers in Tool Design

## **Section III**

### **DESIGNING AND CONSTRUCTING JIGS AND FIXTURES**

#### **9 TEMPLATE JIGS**

Objectives, Template Jigs, Variations of Template Jigs, Design Procedures, Tool Design Application

#### **10 VISE-HELD AND PLATE FIXTURES**

Objectives, Vise-Held Fixtures, Designing a Vise-Held Fixture, Plate Fixtures, Designing a Plate Fixture,  
Calculating Cam Clamps, Tool Design Application Cam Design Application

#### **11 PLATE JIGS**

Objectives, Plate Jigs, Designing a Plate Jig, Designing a Table Jig, Designing a Sandwich Jig or a Leaf  
Jig, Tool Design Application

#### **12 ANGLE-PLATE JIGS AND FIXTURES**

Objectives, Variations and Applications, Designing an Angle-Plate Jig, Designing an Angle-Plate Fixture,  
Tool Design Application

#### **13 CHANNEL AND BOX JIGS**

Objectives, Channel Jigs, Designing a Channel Jig, Box Jigs, Designing a Box Jig Tool Design

#### **14 VISE-JAW JIGS AND FIXTURES**

Objectives, The Machine Vise, Locating Work in Vise-jaw Workholders, Designing a Vise-jaw Jig,  
Designing a Vise-jaw Fixture, Tool Design Application

## **Section IV**

### **SPECIALIZED WORKHOLDING TOPICS**

#### **15 POWER WORKHOLDING**

Objectives, Types of Power- Workholding Systems, Basic Operation of Power- Workholding Systems,  
Benefits of Power Workholding

#### **16 MODULAR WORKHOLDING**

Objectives, Modular Fixturing Systems, Modular Fixturing Applications

**17 WELDING AND INSPECTION TOOLING**

Objectives, Tooling for Welding Operations, Modular Fixturing for Welding, Inspection Fixtures

**18 LOW-COST JIGS AND FIXTURES**

Objectives, Chucks and Chucking Accessories, Collets and Collet Accessories Vises and Vise Accessories, Specialty Clamps and Workholding Devices

**19 TOOLING FOR NUMERICALLY CONTROLLED MACHINES**

Objectives, Introduction, Basic N/C Operation, The Cartesian Coordinate System Incremental and Absolute Programming, Types of N/C Systems, Tooling Requirements for Numerical Control, Types of Workholders

**20 SETUP REDUCTION FOR WORKHOLDING**

Objectives, Benefits of Setup Reduction, The Setup Reduction Process

**21 TOOL MATERIALS**

Objectives, Properties of Tool Materials, Ferrous Tool Materials, Nonferrous Tool Materials, Nonmetallic Tool Materials, Designing with Relation to Heat Treatment

## **Project Guideline**

### **Thinking up a Project**

You are expected to come up with your own idea for a project. A wide range of topics is acceptable so long as there is substantial computing content and project is predominantly of a practical, problem-solving nature. You might take up an interest which you already have in your stream of engineering. You may do your project in any reputed organization or a department. Individually or a group of maximum 4 students can take up a project. The project is a vehicle for you to demonstrate the required level of competence in your chosen field of Bachelors.

Start thinking about your project right in the beginning. If you want to do the project in industrial environment start your correspondence fairly early to find an organization, which is ready to accept you. You must submit an outline of your project (two or three pages) to your guide within one month of start of the project work. This must include the Title, Objective, Methodology (main steps to carry out a project), expected output and organization where you intend to carry out the project.

## **a Guide**

When you have an idea of your project, even a tentative one, approach a suitable person who has interest and expertise in that area. The Guide may be a person with M.E. / M.Tech or a B.E./ B.Tech having a working experience of 3 years in relevant field.

## **with the Guide**

The Guide's role is to provide support and encouragement to direct the student's attention to relevant literature, to provide technical assistance occasionally, to read and comment on the draft report and to give guidance on the standard and amount of work required. The Guide is not responsible to teach any new skills and language required for project work or for arranging any literature or equipment. . Rest you can workout your own arrangement. The students, who are content to carry out their work largely without supervision, should keep their Guide in touch with what they are doing. A student should not remain silent for months and then appear with a complete project work unknown to supervisor. In such circumstances, the Guide cannot be counted on to give an automatic seal of his approval. If a project produces a piece of software, the Guide would normally expect to see a demonstration of the software in action.

The main purpose of the report is to explain what you did in your project. The reader should be able to see clearly what you set out to do and what you achieved. It should describe the problem addresses and explain why you tackled it in the way you did. It should include your own assessment of how successful the project was.

Resist temptation to include pages of padding. If the project consists of developing an application in area with which a computer scientist would not be familiar – such as chemical testing, stock & shares – it might be necessary to include some explanatory company/ organization profile for whom you have done the work must not appear in chapters and must go to appendix part.

The work that is presented for examiners should be your own. The presentation of another person's work, design or program as though they are your own is a serious examination offence. Direct quotation form the work of others (published or un published) must always be clearly identified as such by being placed in quotation marks, it is essential that reader should be able to see where the other work ends and your begins.

Sometimes a project containing good work is marred by a report, which is turgid, obscure and simply ungrammatical. In such cases, it is very difficult to find out the work done during the project. An examiner cannot be kind enough to look properly on a project that is almost unreadable.

### **Some important points for carrying out a project**

- The organizations or companies offer you a placement for project work out of good will or to get some useful work done. Usually the companies do not provide you everything required by you. You must settle this right in the beginning of the project with the business that what will you get from them and what you have to arrange yourself.
- Some times a complication arises due to the fact that some aspect of your project work is considered confidential by the company. If this is so, it is your responsibility to get whatever clearance is necessary from the organization right in the beginning as essential parts like system analysis and design, flow charts etc. can not be missing from a project report.
- Make sure you allow enough time for writing report. It is strongly recommended that do some writing work as you carry out the project rather than leaving write up until the end. You must allow at least a month to finally write the report. There has to be enough time for the supervisor to read and comment on it and for student to make changes (sometimes extensive) on the basis of the comments. You may have to

prepare two or three drafts before the final submission. Remember that it is mainly the project reports that get examined. An external supervisor receives a pile of project reports written by people who he does not know. If a project produced some software he even may not get time to see it running. In most cases he forms his judgment purely on the basis of the report. Please make your report as readable as possible content wise as well as presentation wise.

1.       **Introduction:** This must contain background, any previous work done in the area of your project, your objective and other relevant material that may be helpful to further explain your project work.
2.       **The existing system:** The study of the present system; problems in existing system.
3.       **System design:** The proposed system; Any specific problem encountered at how you handled them.
4.       **Implementation of the system:** Implementation issues and their justification.
5.       **Conclusions:** Any shortcoming; your assessment of your work; comparison of your work with similar works; silent features of your work any feature modification. Real times applications of your project work.

References must be given at the end following any standard way of giving references.

For example:

Langdrof, ‘Theory of Alternating Current Machinery’ Tata McGraw Hill, July 2003.

Finally, your project work is your brainchild and nobody knows about it more than you. Be confident to explain your work at the time of viva and be honest to accept any short falls.