Mohan Lal Sukhadia University
Udaipur

B. Tech. Program
(Effective from session 2021-2022)

Mechanical Engineering

Semesters III

Syllabus

BT3ME01-CT01: ADVANCE ENGINEERING MATHEMATICS-I

Credit: 3 Max. Marks: 150 (IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**Numerical Methods – 1:** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	**8**
2	**Numerical Methods – 2:** Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.	**8**
3	**Laplace Transform:** Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method.	**8**
4	**Fourier Transform:** Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only).	**8**
5	**Z-Transform:** Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	**8**
	Total	**40**

BT3ME02-CT02: TECHNICAL COMMUNICATION

Credit: 2 Max. Marks: 100 (IA:20, ETE:80)
2L+0T+0P End Term Exam: 2 Hours

SN	Contents	Hours
1	**Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	5
2	**Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	5
3	**Technical Writing,** - Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking,	5
4	**Grammar and Editing** Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	5
5	**Advanced Technical Writing-** Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	5
	Total	**25**

BT3ME03-CT03: ENGINEERING MECHANICS

Credit: 2 Max. Marks: 100 (IA:20, ETE:80)

2L+0T+0P End Term Exam: 2 Hours

SN	Contents	Hours
1	Statics of particles and rigid bodies: Fundamental laws of mechanics, Principle of transmissibility, System of forces, Resultant force, Resolution of force, Moment and Couples, Varignon's theorem, Resolution of a force into a force and a couple, Free body diagram, Equilibrium, Conditions for equilibrium, Lami's theorem. Plane trusses: Types of structures, Trusses, Support Conditions, Types of Loadings, Classification of trusses, Determinacy of trusses, Basic assumptions of truss analysis, Method of joints, Method of sections. Virtual work: Principle of Virtual Work, Active forces and active force diagram, Stability of equilibrium.	**6**
2	**Centroid & Moment of inertia**: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section, Polar moment of inertia, M.I of solid bodies. **Lifting machines**: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel, Single purchase winch crab, Double purchase winch crab, Screw jack, Differential screw jack.	**6**
3	**Friction**: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction. **Belt and Rope drive**: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Crowing of pulleys, Length of belt, Ratio of tensions in flat belt drive, Power transmission by belt drives, Advantage and disadvantages of V-Belt over Flat Belt.	**6**
4	**Kinematics of particles and rigid bodies**: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion. **Kinetics of particles and rigid bodies**: Newton's second law, Equation of motion in rectangular coordinate, Equation of motion in radial and transverse components, Equation of motion in plane for a rigid body, D'Alembert principle.	**6**

5	**Work, Energy and power**: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy. **Impulse and momentum**: Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body, Principle of impulse and momentum for a rigid body, Central impact, Oblique impact, System of variable mass, Rocket.	**6**
	TOTAL	**30**

BT3ME04-CT04: ENGINEERING THERMODYNAMICS

Credit: 3 Max. Marks: 150 (IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**Basic Concepts and definitions of Thermodynamics**: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	3
	Zeroth and First Law of Thermodynamics: Zeroth of Thermodynamics**,** Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	5
2	**Second Law of Thermodynamics:** Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Plank and Clausius statements. Reversible and Irreversible Processes, Carnot engine, Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausis Inequality.	4
	Entropy: Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume.	2
	Availability: Available energy, Loss in available energy, Availability Function, Irreversibility.	2
3	**Thermodynamic Properties of Fluids:** Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart	4
	Ideal Gas and Real Gas: Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures.	4
4	**Thermodynamic Relations:** Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation.	4
	Power Cycles: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and Ericsson cycle.	4
5	**Vapour power cycle:** Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle	4
	Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	4
	TOTAL	40

BT3ME05-CT06: MATERIAL SCIENCE AND ENGINEERING

Credit: 3 Max. Marks: 150 (IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	CONTENTS	Hours
1	Crystal structure – BCC, FCC and HCP, unit cell, crystallographic planes and directions, miller indices. Crystal imperfections, point, line, surface and volume defects.	4
	Frank Reed source of dislocation, Elastic & plastic modes of deformation, Bauschinger's effect, slip & twinning, strain hardening, cold/hot working recovery, re-crystallization and grain growth.	4
2	Classification of Engineering Materials: Solidification of metals and of some typical alloys, mechanism of crystallization (I) nuclear formation (ii) crystal growth, general principles of phase transformation in alloys, phase rule and equilibrium diagrams, equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, binary isomorphous alloy system, Hume- Rothery rule , binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation, equilibrium diagram of a system whose components are subject to allotropic change.	5
	Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram, eutectic, peritectic, eutectoid and peritectoid reactions and microstructures.	3
3	Isothermal transformation diagrams –cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate. (i) Formation of Austenite from Pearlite (ii) Transformation of Austenite into Pearlite.	4
	Full annealing, stress relief, spheroidizing – normalizing, hardening and tempering of steel. Hardenability, Jominey end quench test – Austempering, martempering. Case hardening, carburising, nitriding, cyaniding, carbonitriding. Flame and Induction hardening.	4
4	Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO,PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes.	4
	Constitution of alloys: Solid solutions - substitutional and interstitial. Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA steel.	4
5	Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy,	4

	fatigue and creep test.	
	Classification of steels and cast iron constitution and properties. BIS standards. Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ etc. Fiber and particulate reinforced composites and resin plastics. Introduction to Nano materials- Nano structured materials. Nano clusters & Nano crystals.	**4**
	TOTAL	**40**

BT3ME06-CT06: MECHANICS OF SOLIDS

Credit: 4 Max. Marks: 200 (IA:40, ETE:160)

3L+1T+0P End Term Exam: 3 Hours

S.No	CONTENTS	Hours
1	**Stress and Strain:** Elementary definition of stress and strain, stress-strain relationship, elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, elastic constants and their relations for an isotropic hookean material, anisotropic and orthotropic materials.	3
	Tension, compression, shearing stress and strain, thermal stresses, composite bars, equations of static equilibrium, concept of free body diagram. Strain energy due to axial loading.	5
2	**Members Subjected to Flexural Loads:** Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams.	4
	bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. Strain energy due to bending.	4
3	**Principal Planes, Stresses and Strains:** Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain.	5
	Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications.	3
4	**Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads.	4
	Stability of Equilibrium: Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.	4
5	**Transverse Deflection of Beams:** Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method.	6
	Thin-walled Pressure Vessels: Stresses in cylindrical and spherical vessels	2
	TOTAL	**40**

BT3ME07-CP01: MACHINE DRAWING PRACTICE

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+3P

SN	CONTENTS
1.	Assembly drawing with sectioning and bill of materials of the following: Lathe tail stock, shaper tool head, swivel machine vice etc (1 drawing sheet of any assembly)
2.	Detailed part drawings from assembly drawing indicating fits, tolerances and surface finish symbols by referring BIS codes: Check-valve, Junction Valve etc (1 drawing sheet)
3.	Computer Aided Drafting: Introduction to different features of the CAD Software (AutoCAD/ProE/ Creo/Solidworks). At least one drawing problem related to a. 2-D Drafting. b. 3-D Modeling. c. 3-D Advanced Modeling. d. Assembly modeling. e. Feature Modification and Manipulation f. Detailing. g. Surface Modeling

BT3ME08-CP02: MATERIALS TESTING LAB

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+3P

SN	
1	(a) Study of various crystals structures through models BCC, FCC, HCP, tetrahedral and octahedral voids. Material identification of, say, 50 common items kept in a box.
2	Specimen preparation for metallographic examination /micro structural examination-cutting, grinding, polishing, etching.
3	Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
4	Spring Test
5	Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
6	To perform Tensile/Compressive/Shear/torsion test on a given material and to determine its various mechanical properties under tensile/compression/Shear/torsional loading
7	To determine Rockwell/ Vickers/Brinell hardness of a given material
8	To perform Impact test on a given material and to determine its resilience.
9	To study and perform Fatigue test on a given material and to determine fatigue strength of the material
10	To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam.
11	Torsion test

BT3ME09-CP03: BASIC MECHANICAL ENGINEERING LAB

Credit: 1 Max. Marks: 50 (IA:40, ETE:60)

0L+0T+3P

SN	
1	Exposure to a wide range of applications of mechanical engineering through a variety of activities, including hands-on assembly and disassembly of machines, such as, bicycle, sewing machine, pumps, engines, air-conditioners, machine-tools, amongst others; observational study of complex systems via cut sections, visits, videos and computer simulations; design of simple machines/systems including specifications formulation; visits to industries.
2	Note: Student will be required to submit written report indicating the learning achieved by Hands on assembly/Disassembly.

BT3ME10-CP04: PROGRAMMING USING MATLAB

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+3P

SN	
1	1. Basics of MATLAB computer programming 2. Use of formulae and inbuilt functions 3. MATLAB scripts and functions (m-files) 4. Loops and nested loops 5. Array, vector and matrices 6. Plotting functions and vector plots 7. Solving differential equations using MATLAB 8. Reading and writing data, file handling 9. Using MATLAB toolboxes 10. MATLAB graphic functions

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Mechanical Engineering

Semesters IV

Syllabus

BT4ME01-CT01: Advance Engineering Mathematics-II

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	Fourier Series: Fourier series, even and odd functions; Half range series; Change of interval; Exponential form of Fourier series; Harmonic analysis.	6
2	Roots of Nonlinear (Algebraic and Transcendental) Equations: Bisection method, False position method, Newton Raphson method; Convergence of False position and Newton Raphson method. Complex roots of polynomials by Bairstow‟s method.	6
3	Partial Differential Equations: Classifications of partial differential equations; Method of separation of variables to solve Heat equation, Wave equation and Laplace‟s equations.	6
4	Statistics: Correlation and regression; Principle of least square method and curve fitting.	6
5	Probability Distribution Functions: Random variable; Mathematical expectations; Moment generating functions; Discrete and continuous distribution functions; Binomial, Poisson and Normal distributions.	6
	TOTAL	30

BT4ME02-CT02: MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTING

Credit: 2 Max. Marks: 100 (IA:20, ETE:80)
2L+0T+0P End Term Exam: 2 Hours

SN		Hours
1	**Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	5
2	**Demand and Supply analysis-** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
3	**Production and Cost analysis-** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
4	**Market structure and pricing theory**- Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	5
5	**Financial statement analysis-** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds- flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	5
	TOTAL	**25**

BT4ME03-CT03: Digital Electronics

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	6
2	**Combinational Digital Circuits:** Standard representation for logic functions, K- map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	6
3	**Sequential circuits and systems:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.	6
4	**A/D and D/A Converters:** Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	6
5	**Semiconductor memories and Programmable logic devices** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	6
	Total	**30**

BT4ME04-CT04: FLUID MECHANICS AND FLUID MACHINES

Credit: 4 Max. Marks: 200 (IA:40, ETE:160)
3L+1T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**Fluid Properties:** Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity.	3
	Fluid Statics and Flow Characteristics: Basic equation of fluid statics, Manometers, Force on plane areas and curved surfaces, center of pressure, Buoyant force, Stability of floating and submerged bodies. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.	5
2	**Flow Through Circular Conduits:** Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram-minor losses – Flow through pipes in series and parallel.	8
3	**Dimensional Analysis:** Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.	8
4	**Pumps:** Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.	8
5	**Turbines:** Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.	8
	TOTAL	**40**

BT4ME05-CT05: MANUFACTURING PROCESSES

Credit: 3 Max. Marks: 150 (IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	General Classification and Introduction to Manufacturing processes. **Foundry Technology**: Casting: Definition and major classification; Casting materials, Patterns: types, material and pattern allowances. Moulding sands; composition, preparation, properties and testing; Grain fineness; moisture content, clay content and permeability test. Core & core prints; Gating system: types, pouring basin, sprue, runner and risers; Melting, pouring and solidification.	3
	Principles and method of floor mould casting, shell mould casting, pit mould and loam mould casting; centrifugal casting, investment casting; Permanent mould casting. Die casting; Slush casting. Casting defects; types, causes and remedy	5
3	**Forming Processes**: Classification; Hot working and cold working principle, advantages, disadvantages and applications.	2
	Forging: Classification, drop forging and press forging methods and use; Forging dies; types, materials.	4
	Rolling: Characteristics and applications of hot rolling and cold rolling;	2
4	Extrusion; Work materials and products; Press tool works; Basic principles, system, operations and applications. Shearing; Parting, notching, trimming, nibbling, blanking and piercing,	4
	Drawing: wire drawing, tube drawing and deep drawing.	4
5	**Metal Joining Processes**: Welding, Brazing and soldering, classification of welding process, Principle, characteristics and applications of gas welding, thermit welding, electrical arc welding; Submerged arc welding; TIG and MIG welding; Resistance welding; Spot welding; Butt welding; Seam welding; Projection welding.	6
	Principles and process details of Forge welding; Friction welding; Diffusion welding; Ultrasonic welding. Explosive welding. Welding defects; Types, causes, effects and remedy. Electrodes and Electrode Coatings	2
6	**Powder Metallurgy**: Properties of Powder processed materials, Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of Powder metallurgy.	8
	TOTAL	40

BT4ME06-CT06: THEORY OF MACHINES

Credit: 4 Max. Marks: 200 (IA:40, ETE:160)

3L+1T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction to mechanism: Basic concept of machines, links, kinematic pair, kinematic chain and mechanism. Inversions of kinematic chains: four bar chain mechanisms, quick return mechanisms, inversions of double slider crank mechanisms.	4
	Velocity and acceleration in mechanism: Velocity and acceleration polygons, relative velocity and instantaneous centre method	4
2	Friction devices: Types and laws of friction. Pivots and collars. Power screws such as lead screw of the lathe.	4
	Clutches: Single and multi-plate clutches. Brakes: Band, block and band and block brakes.	4
3	Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion. Rack and pinion, Spur, helical, basic introduction of bevel, worm and worm gears.	6
	Gear Trains: Simple, compound and epicyclic gear trains.	2
4	Cams: Type of cams; displacement, velocity and acceleration curves for different cam followers; consideration of pressure angle and wear.	4
	Gyroscope: Principles of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicles taking a turn, stabilization of ship.	4
5	Balancing: Balancing of rotating masses in same and different planes, balancing of reciprocating masses, swaying couple, hammer blow and tractive effort.	8
	TOTAL	40

BT4ME07-CP01: DIGITAL ELECTRONICS LAB

Credit: 1 Max. Marks: 50 (IA:20, ETE:30)

0L+0T+2P

SN	
1	To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3 & 4 inputs using gates with 2, 3, & 4 inputs).
2	To verify the truth table of OR, AND, NOR, Ex-OR. Ex-NOR realized using NAND & NOR gates.
3	To realize an SOP and POS expression.
4	To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables.
5	To realize a 4-bit ripple adder/ Subtractor using basic half adder/ Subtractor & basic Full Adder/ Subtractor.
6	To verify the truth table of 4-to-l multiplexer and l-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8-to-1 multiplexer and l-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demulriplexer.
7	Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -3 I 2 seven-segment display.
8	Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table.
9	Construct a divide by 2, 4 & 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.
10	Perform input/output operations on parallel in/parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.

Note: As far as possible, the experiments shall be performed on bread board. However experiment Nos. l-4 are to be performed on bread board only

BT4ME08-CP02: FLUID MECHANICS LAB

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+4P

SN	
1	Determination of Meta-centric height of a given body.
2	Determination of Cd, Cv & Cc for given orifice.
3	Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate.
4	Determination of velocity of water by Pitot tube.
5	Verification of Bernoulli's theorem.
6	Calibration and flow rate determination using Venturimeter & Orifice meter and Nozzle meter
7	Determination of head loss in given length of pipe.
8	Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.
9	Determination of Coefficient for minor losses in pipes.
10	To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
11	To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
12	Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump.
13	Conducting experiments and drawing the characteristic curves of reciprocating pump.
14	Conducting experiments and drawing the characteristic curves of Pelton wheel.
15	Conducting experiments and drawing the characteristics curves of Francis turbine.
16	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

BT4ME09-CP03: PRODUCTION PRACTICE LAB

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+4P

SN	
	Turning Shop
1	To study lathe machine construction and various parts including attachments, lathe tools cutting speed, feed and depth of cut.
2	To perform step turning, knurling and chamfering on lathe machine as per drawing.
3	To cut multi-start Square/Metric threads on lathe machine.
4	Boring using a boring bar in a centre lathe and cut BSW/Metric internal threads on lathe machine.
5	To perform taper turning using compound rest.
	Machine shop
1	To study the milling machine, milling cutters, indexing heads and indexing methods and to prepare a gear on milling machine.
2	To machine a hexagonal /octagonal nut using indexing head on milling machine.
3	To study of single point cutting tool geometry and to grind the tool as per given tool geometry.
4	To study shaper machine, its mechanism and calculate quick return ratio. To prepare a job on shaper from given mild steel rod.
5	Cylindrical grinding using grinding attachment in a centre lathe
	Demonstration and study
1	Demonstration for job by eccentric turning on lathe machine.
2	Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
3	Demonstration on milling machine for generation of plane surfaces and use of end milling cutters.
4	Grinding of milling cutters and drills.
	Foundry Shop
1	To prepare mould of a given pattern requiring core and to cast it in aluminium.
2	To perform moisture test and clay content test.
3	To perform permeability test
4	A.F.S. Sieve analysis test.
5	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
	Welding Shop
1	Hands-on practice on spot welding.

BT4ME10-CP04: THEORY OF MACHINES LAB

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+4P

SN	
1	To study inversions of four bar chain and slider crank mechanism and their practical applications.
2	To study Steering Mechanisms: Davis and Ackerman.
3	Study of quick return mechanism and its practical applications.
4	Study of inversion of Double slider chain: Oldham Coupling, Scotch Yoke and Elliptical Trammel.
5	Study of various cam-follower arrangements. To plot displacement v/s angle of rotation curve for various cams
6	To determine co-efficient of friction using two roller oscillating arrangement.
7	Study of various types of dynamometers, Brakes and Clutches.
8	Study of differential gear box.
9	To verify the torque relation for gyroscope.
10	To perform wheel balancing. To perform static and dynamic balancing on balancing set up.
11	Study of a lathe gear box, sliding mesh automobile gear box, planetary gear box.

Mohan Lal Sukhadia University
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B. Tech. Program
(Effective from session 2021-2022)

Mechanical Engineering

Semesters V

Syllabus

BT5ME01-CT01: MECHATRONIC SYSTEMS

Credit: 2 Max. Marks: 100(IA: 20, ETE:80)

2L+0T+0P End Term Exam: 2 Hours

SN	CONTENTS	Hours
1	Overview of Mechatronics: Historical perspective, Definition, Applications, Block diagram of Mechatronic system, Functions of Mechatronics Systems, Systems Engineering, Verification Vs Validation, Benefits of mechatronics in manufacturing.	3
	Electrical and Electronic Systems: Electrical circuits and Kirchhoff's laws, Network Theorems and AC circuit Analysis, Transformers, Analog Devices, Signal Conditioning, Digital Electronics, Data Acquisition systems.	3
2	Modeling, Analysis and Control of Physical Systems: Basics of System Modeling: LTI and LTV systems, Need for modeling, Types of modeling, Steps in modeling, Building blocks of models, Modelling of one and two degrees of freedom systems, Modeling of Electro- mechanical systems, Mechanical Systems, Fluid systems, Thermal systems; Dynamic Responses, System Transfer Functions, State Space Analysis and System Properties, Stability Analysis using Root Locus Method, Stability Analysis using Bode Plots, PID Controllers(withandwithoutTimeDelay)	6
3	Sensors and Actuators: Static characteristics of sensors and actuators, Position, Displacement and Proximity Sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors, Actuators: Electrical Actuators (Solenoids, Relays, Diodes, Thyristors, Triacs, BJT, FET, DC motor, Servo motor, BLDC motor, AC motor, Stepper motors), Hydraulic and Pneumatic actuators, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys	6
4	Microprocessors, Microcontrollers and Programmable Logic Controllers: Logic Concepts and Design, System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Synchronous and Asynchronous Sequential Systems, Architecture, Microcontrollers.	6
5	Programmable Logic Controllers (PLCs): Architecture, Number Systems Basics of PLC Programming, Logics, Timers and Counters, Application on real time industrial automationsystems.	3
	Case Studies: Design of pick and place robot, Car engine management system, Automated manufacturing system, Automatic camera, Automatic parking system, Safety devices and systems.	3
	TOTAL	**30**

BT5ME02-CT02: HEAT TRANSFER

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	CONTENT	HOURS
1	Introduction: Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient.	4
	Conduction: General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation	4
2	Heat transfer from extended surfaces: Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions.	3
	Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart.	2
	Convection: Review of Navier – Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.	3
3	Natural convection: Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.	4
	Heat transfer with change of phase: Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation.	4
4	Heat exchanger: Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.	8
5	Thermal Radiation: Plank distribution law, Krichoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.	8
	TOTAL	**40**

BT5ME03-CT03: MANUFACTURING TECHNOLOGY

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Classification of metal removal process and machines: Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS. Concept of orthogonal and oblique cutting.	4
	Type of chips, Mechanics of metal cutting; interrelationships between cutting force, shear angle, strain and strain rate. Thermal aspects of machining and measurement of chip tool interface temperature.	4
2	Concept of machinability, machinability index, factors affecting machinability, Different mechanism of tool wear. Types of tool wear (crater, flank etc), Concept of tool life.	4
	Taylor's tool life equation. Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods.	4
3	Basic machine tools: Constructional configuration, estimation of machining time on lathe, drilling, shaping, milling, grinding, Gear cutting on milling, Gear hobbling.	4
	Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines, operational planning and turret tool layout, sequence of operations.	4
4	Introduction to Grinding and different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications. Honing, lapping, super-finishing.	8
5	High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.	8
	TOTAL	40

BT5ME04-CT04: DESIGN OF MACHINE ELEMENTS – I

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Materials: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects.	4
	Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.	4
2	Design for Strength: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures.	4
	Design of Members subjected to direct stress: pin, cotter and keyed joints.	4
3	Design of Members in Bending: Beams, levers and laminated springs. Design for stiffness of beam: Use of maximum deflection formula for various end conditions for beam design.	8
4	Design of Members in Torsion Shaft and Keys: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys.	5
	Couplings: Design of muff coupling, flanged couplings: rigid and flexible.	3
5	Design of Threaded fasteners: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading.	4
	Power screws like lead screw, screw jack.	2
	Design of members which are curved like crane hook, body of C-clamp, machine frame etc.	2
	TOTAL	**40**

BT5ME05-CT05: PRINCIPLES OF MANAGEMENT

Credit: 2 Max. Marks: 100(IA:20, ETE:80)
2L+0T+0P End Term Exam: 2 Hours

SN	Contents	Hours
1	Basic concepts of management: Definition – Need and Scope – Different schools of management thought – Behavioural, Scientific, Systems, and Contingency	2
	Contribution of Management Thinkers: Kautilya, Taylor, Fayol, Peter Drucker and C.K. Prahlad.	4
2	Functions of Management: Planning: Essentials of Planning and Managing by Objectives; Strategies, Policies and Planning Premises; Decision making.	3
	Organizing The Nature of organizing, Entrepreneuring, and Reengineering; Organizational Structure, Departmentation; Line/staff authority, empowerment, and decentralization; Effective organizing and organization culture;	3
3	Staffing Human resource Management and Selection; Performance Appraisal and Career Strategy; managing change through Manager and Organization Development.	6
4	Leading Human Factors and Motivation; Leadership: Committees, Terms, and Group Decision making; Communication.	3
	Controlling The system and process of controlling; Control Techniques and Information Technology; Productivity, Operations Management and Total Quality Management.	3
5	Management practices of: Dhirubhai Ambani, Narayan Murthy, Premji, Ratan Tata, Steve Jobs, Bill Gates.	2
	Studying organizational structures of any 10 companies and classifying them into different types of organizations which are studied above and justifying why such structures are chosen by those organizations.	2
	Preparing the leadership profiles of any 5 business leaders and studying their leadership qualities.	2
	TOTAL	30

BT5ME06-CT06A: STEAM ENGINEERING

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Steam generators: Classification of Boilers, water and fire tube boilers, High pressure boilers, Advantages of high pressure Boilers, Natural and forced circulation boilers, Water wall.	4
	Steam drum internal, steam super heaters, Economizers, air preheater, induced, forced and balanced draught boilers, Fluidized bed boilers.	4
2	Definition and type of nozzle and diffuser equation of continuity, sonic velocity, mach no. and stagnation properties, the steady flow energy equation for nozzles, momentum energy equation for flow through steam nozzles nozzle efficiency, effect of friction, nozzle for uniform pressure drop, throat pressure for maximum discharge or chock flow, critical pressure ratio, design of nozzle and diffuser.	8
3	Steam Turbines: Principle and working of steam turbines, type of turbines, compounding for pressure and velocity. Overview and difference of various type of turbine, different types of governing of turbines.	3
	Impulse turbine: The effect of blade friction on velocity diagram. Force, work and power, Blade or diagram efficiency, Gross stage efficiency, steam speed to blade, speed ratio for optimum performance, turbine performance at various loads.	5
4	Impulse reaction turbine: Velocity diagram and work done, degree of reaction, Parson turbine, blade efficiency, gross stage efficiency comparison of enthalpy drop in various stages, size of blades in impulse reaction turbines for various stages of impulse reaction and impulse turbine.	4
	Regenerative Feed Heating Cycles: Introduction, Ideal regenerative feed heating cycle, Regenerative heating cycles and their representation on T-s and h-s Diagram, Representation of actual process on T-s and h-s Diagram Regenerative cycles, types of feed heating arrangements, Optimum feed water temperature and saving in Heat Rate. direct contact and surface heaters.	4
5	Reheating of steam: Practical reheating and Non- reheating cycles, advantage and disadvantages of reheating, reheat regenerative cycle, regenerative water extraction cycles.	4
	Process heat and by product power cycle, pass out turbine, Binary vapour cycle. Condensers.	4
	TOTAL	40

BT5ME06-CT06B: AUTOMOBILE ENGINEERING

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Frame & Body: Layout of chassis, types of chassis frames and bodies, their constructional features and materials.	3
	Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Brakes: Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials.	5
2	Gear Boxes: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter;	4
	Drives: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive.	4
3	Wheels and Tyres: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre,	2
	Steering system: steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types.	3
	Suspension system: objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers.	3
4	Automotive Electrical System: Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification.	4
	Ignition System: Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.	4
5	Automotive Air Conditioning: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis.	4
	Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)	4
	TOTAL	**40**

BT5ME06-CT06C: NON DESTRUCTIVE EVALUATION AND TESTING

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**ACOUSTICAL METHODS: Ultrasonic testing**- Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes- Straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media.	**4**
	ULTRASONIC TESTS: Transmission and pulse echo methods, A-scan, B-scan, C-scan, F- scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echo's and noise. Ultrasonic flaw evaluation.	**4**
2	**ELECTRO-MAGNETIC METHODS**- magnetic particle inspection-introduction to electrical impedance, principles of eddy current testing, flaw detection using eddy currents.	**8**
3	**RADIOGRAPHIC METHODS**: Introduction to x-ray radiography, the radiographic process, X-ray and Gamma ray sources, Geometric principles, Factors governing exposure, radio graphic screens, scattered radiation, arithmetic of exposure, radiographic image quality and detail visibility, industrial X-ray films.	**4**
	X-RAY RADIOGRAPHY PROCESES: Fundamentals of processing techniques, process control, the processing room, special processing techniques, paper radiography, sensitometric characteristics of X-ray films, film graininess signal to noise ratio in radiographs. The photographic latent image, radiation protection.	**4**
4	**OPTICAL METHODS**: holography-Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.	**8**
5	**APPLICATIONS:** NDT in flaw analysis of Pressure vessels, piping NDT in Castings, Welded constructions, etc., Case studies.	**8**
	TOTAL	**40**

BT5ME07-CP01: MECHATRONICS LAB.

Credit: 1 Max. Marks: 50(IA:20, ETE:30)
0L+0T+2P

SN	NAME OF EXPERIMENT
1	Using Transducers Kit :- • Characteristics of LVDT • Principle & Characteristics of Strain Gauge • Characteristics of Summing Amplifier • Characteristics of Reflective Opto Transducer
2	Mobile Robot • Program for Operating Buzzer Beep • Program for Operating Motion control • Program for Operating Direction control • Program for Operating White line follower for the given arena
3	PLC PROGRAMMING • Ladder programming on Logic gates ,Timers & counters • Ladder Programming for digital & Analogy sensors • Ladder programming for Traffic Light control, Water level control and Lift control Modules
4	MATLAB Programming • Sample programmes on Mat lab • Simulation and analysis of PID controller using SIMULINK
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation of sessional component shall include 30% weight age to mini project. • Mini project can be integration of sensor, actuator and transduction units for various home and office applications.

BT5ME08-CP02: HEAT TRANSFER LAB.

Credit: 2 Max. Marks: 100(IA:40, ETE:60)
0L+0T+4P

SN	NAME OF EXPERIMENT
1	To Determine Thermal Conductivity of Insulating Powders.
2	To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3	To determine the transfer Rate and Temperature Distribution for a Pin Fin.
4	To Measure the Emissivity of the Test plate Surface.
5	To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
6	To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
7	Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation.
8	To Determine Critical Heat Flux in Saturated Pool Boiling.
9	To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
10	To Find the Heat transfer Coefficient in Forced Convection in a tube.
11	To study the rates of heat transfer for different materials and geometries
12	To understand the importance and validity of engineering assumptions through the lumped heat capacity method.
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist ofmaximum five students. Final evaluation sessional component shall include 30% weight age to mini project. • Heat exchanger design for different applications, designing for thermal insulation, Use of relevant BIS codes for designing.

BT5ME09-CP03: PRODUCTION ENGINEERING LAB.

Credit: 2 Max. Marks: 100(IA:20, ETE:30)
0L+0T+4P

SN	NAME OF EXPERIMENT
1	Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges.
2	Measurement of angle and width of a V-groove by using bevel protector..
3	(a) To measure a gap by using slip gauges (b) To compare & access the method of small-bore measurement with the aid of spheres.
4	Measurement of angle by using sine bar.
5	(a) Measurement of gear tooth thickness by using gear tooth vernier caliper. (b) To check accuracy of gear profile with the help of profile projector.
6	To determine the effective diameter of external thread by using three- wire method.
7	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
8	To check the accuracy of a ground, machined and lapped surface – (a) Flat surface (b) Cylindrical surface.
9	Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
10	Forces measurements during orthogonal turning.
11	Torque and Thrust measurement during drilling.
12	Forces measurement during plain milling operation.
13	Measurement of Chip tool Interface temperature during turning using thermocouple technique.
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Fabrication of an assembly in which parts shall be machined and standard parts shall be procured.

BT5ME10-CP04: MACHINE DESIGN PRACTICE - I

Credit: 1 Max. Marks: 50(IA:20, ETE:30)

0L+0T+2P

SN	Sessional Work
1	Material selection and relevant BIS nomenclature
2	Selecting fit and assigning tolerances
3	Examples of Productionconsiderations
4	Problems on:
	(a) Knuckle & Cotter joints
	(b) Torque: Keyed joints and shaft couplings
	(c) Design of screw fastening
	(d) Bending: Beams, Levers etc.
	(e) Combined stresses: Shafts, brackets, eccentric loading.
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Design and analysis of simple mechanical systems/products

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Mechanical Engineering

Semesters VI

Syllabus

BT6ME01-CT01: MEASUREMENT and METROLOGY

Credit: 2 Max. Marks: 100(IA:20, ETE:80)
2L+0T+0P End Term Exam: 2 Hours

SN	Contents	Hours
1	Concept of measurement: General concept of measurement, Need for measurement, Generalized measuring system, Units, Standards, Sensitivity, Readability, Range of accuracy, Precision, Accuracy Vs precision, Uncertainty.	3
	Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Calibration, Interchangeability.	3
2	Linear and angular measurements: Linear measuring instruments: Vernier caliper, Micrometer, Interval measurements:- Slip gauges, Checking of slip gauges for surface quality, Optical flat, Application of limit gauges	3
	Comparators:- Mechanical comparators, Electrical comparator, Optical comparator, Pneumatic comparator;	1
	Sine bar, Use of sine bar, Limitations of sine bars, Sources of error in sine bars, Bevel protractor, Applications of bevel protractor.	2
3	Form measurement: Introduction, Screw thread measurement, Thread gauges, Measurement of gears: Gear errors.	3
	Surface finish measurement:-Introduction, Elements of surface texture, Analysis of surface finish, Methods of measuring surface finish, Straightness measurement, Flatness testing, Roundness measurements	3
4	Coordinate measuring machine (CMM):-Types of CMM, Features of CMM, Computer based inspection,	3
	Measurement of power, flow and temperature related properties Measurement of force, Accelerometer, Load cells, Bourdon tube. Torque measurement: Torque measurement using strain gauges, Torque measurement using torsion bars, Mechanical dynamometers.	3
5	Measurement of flow: Variable area meters – rotameter, Hot wire anemometer, Pitot tube. Temperature measurement, Bimetallic strip, Thermocouples (Thermo electric effects), Thermistors, Pyrometers	6
	TOTAL	**30**

BT6ME02-CT02: COMPUTER INTEGRATED MANUFACTURING SYSTEMS (CIMS)

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction to CIM: Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background,	3
	Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system.	5
2	NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification.	8
3	Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards.	4
	Group Technology: Introduction, part families, part classification and coding, coding system and machining cells.	4
4	Computer Aided Production Management Systems: Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control.	6
	Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing.	2
5	Computer Aided Material Handling; Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly.	2
	Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS).	4
	Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.	2
	TOTAL	**40**

BT6ME03-CT03: MECHANICAL VIBRATIONS

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction to Sound: Frequency dependent human response to sound, Sound pressure dependent human response, Relationship among sound power, sound intensity and sound pressure level.	2
	Introduction to Noise: Auditory and Non auditory effects of Noise, Major sources of the noise, Industrial noise sources, Industrial noise control strategies.	3
	Introduction to Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition.	3
2	Undamped Single Degree of Freedom System: Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion.	3
	Damped vibrations of single degree of freedom systems: Viscous damping, under-damped, critically damped and over-damped systems, Logarithmic decrement.	3
	Vibration characteristics of Coulomb damped system and Vibration characteristics of Hysteretic damped systems.	2
3	Forced Vibrations of Single Degree of Freedom Systems: Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support.	4
	Vibration Isolation and Transmissibility: Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation.	4
4	System with Two Degrees of Freedom: principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber	5
	Critical Speed of Shaft: Critical speed of a light shaft without damping, critical speed of shaft having multiple discs, secondary critical speed.	3
5	Many Degrees of Freedom Systems (Exact analysis): Equation of Motion, The matrix method, Eigen Values and Eigen Vectors, Method of influence Coefficients and Maxwell's reciprocal theorem. Torsional vibrations of multi rotor system, vibrations of geared system, Generalized coordinates and coordinate coupling Many Degrees of Freedom Systems (approximate methods): Rayleigh's, Dunkerley's, Stodola's and Holzer's methods	5
	Vibrations of continuous systems: Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.	3
	TOTAL	**40**

BT6ME04-CT04: DESIGN OF MACHINE ELEMENTS- II

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Fatigue Considerations in Design: Variable load, loading pattern, endurance stresses, Influence of size, surface finish, notch sensitivity and stress concentration.	3
	Goodman line, Soderberg line, Design of machine members subjected to combined, steady and alternating stresses.	3
	Design for finite life, Design of Shafts under Variable Stresses, Bolts subjected to variable stresses.	2
2	Design of IC Engine components: Piston, Cylinder, Connecting Rod and Crank Shaft.	8
3	Design of helical compression, tension, torsional springs, springs under variable stresses.	4
	Design of belt, rope and pulley drive system,	4
4	Design of gear teeth: Lewis and Buckingham equations, wear and dynamic load considerations.	4
	Design and force analysis of spur, helical, bevel and worm gears, Bearing reactions due to gear tooth forces.	4
5	Design of Sliding and Journal Bearing: Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium.	4
	Selection of anti-friction bearings for different loads and load cycles, Mounting of the bearings, Method of lubrication.	4
	TOTAL	**40**

BT6ME05-CT05: QUALITY MANAGEMENT

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	The meaning of Quality and quality improvement dimensions of quality, history of quality methodology, quality control, Quality of design and quality of conformance, Quality policy and objectives, Economics of quality.	5
	Modeling process quality: Describing variation, frequency distribution, continuous and discrete, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance.	3
2	Statistical Quality Control: Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, analysis of patterns on control charts. The magnificent seven.	4
	Control chart for variables,: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts.	4
3	Control chart for attributes: control chart for fraction non conforming P- chart, np-chart, c-chart and u-chart. Demerit systems, choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma.	8
4	Quality Assurance: Concept, advantages, field complaints, quality rating, quality audit.	2
	Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ.	4
	Introduction to Quality systems like ISO 9000 and ISO 14000.	2
5	Reliability and Life Testing- Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability	4
	Introduction to Taguchi Method of Design of Experiments, Quality loss function.	4
	TOTAL	40

BT6ME06-CT06A: REFRIGERATION AND AIR CONDITIONING

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. Vapour Compression Refrigeration System: Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions	5
	Multiple Evaporator and compressor system: Application, air compressor system, Individual compressor, compound compression, cascade system. Application, air compressor systems, individual compressor, compound compression, cascade system.	3
2	Gas Cycle Refrigeration: Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger.	4
	Air cycle for air craft: Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle.	4
3	Other refrigeration systems (description only): Vapour absorption refrigeration system, Electrolux refrigerator, Lithium Bromide – Water system, Water vapour refrigeration system, Vortex tube refrigeration system, thermo electric refrigeration system.	4
	Refrigerants: Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. Refrigeration Equipments: Compressor, condenser, evaporator, expansion devices, types & working.	4
4	Psychrometry: Psychrometric properties, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass factor, Apparatus Dew point temperature and air washers.	5
	Human Comfort: Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.	3
5	Cooling load calculations: Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling.	5
	Selection of air conditioning: Apparatus for cooling and dehumidification, Air conditioning system, year round air conditioning.	3
	TOTAL	**40**

BT6ME06-CT06B: NON CONVENTIONAL MACHINING METHODS

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process.	4
	Abrasive finishing processes: AFM, MAF (for Plain and cylindrical surfaces).	4
2	Mechanical advanced machining process: Introduction, Mechanics of metal removal, process principle, Advantages, disadvantages and applications of AJM, USM, WJC.	8
3	Thermo electric advanced machining process: Introduction, Principle, process parameters, advantages, disadvantages and applications about EDM, EDG,	4
	LBM, PAM, EBM	4
4	Electrochemical and chemical advanced machining process: ECM, ECG, ESD, Chemical machining,	4
	Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process.	4
5	Introduction to Micro and nanomachining,	8
	TOTAL	40

BT6ME06-CT06C: MICRO ELECTRO AND MECHANICAL SYSTEMS (MEMS) and MICROSYSTEMS

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Over view of MEMS and Microsystems: Microelectromechanical Systems (MEMS) and Microsystems, Typical MEMS and Microsystem products, Evaluation of Microfabrication, Microsystem and microelectronics, the multidisciplinary nature of microsystem design and manufacture, Microsystems and miniaturization, Application of Microsystems in the automotive industry, applications of Microsystems in other industries.	4
	Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.	4
2	Engineering Science for Microsystem Design and Fabrication: Introduction, atomic structure of matter, ions and ionization, moleculat theory of matter and intermolecular forces, doping of semiconductors, the diffusion process, plasma physics, electrochemistry, quantum physics.	4
	Engineering Mechanics for Microsystem design: Introduction, static bending of thin plates, mechanical vibration, thermomechanics, fracture mechanics, thin-film mechanics, overview of finite element stress analysis.	4
3	Thermofluid Engineering and Microsystem design: Introduction, overview of the basics of fluid mechanics in Macro and mesoscales, Basic equations in continuum fluid dyanimics, laminar fluid flow in circular conduits, computational fluid dynamics, Incompressible fluid flow in microconduits, fluid flow in submicrometer and nanoscale, overview of heat conduction in solids, heat conduction in multilayered thin films, heat conduction in solids in submicrometer scale.	4
	Scaling laws in Miniaturization: Introduction to scaling, scaling in geometry, scaling in rigid-body dynamics, scaling in electrostatic forces, scaling in electromagnetic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer.	4
4	Materials for MEMS and Microsystems: Introduction, substrate and wafers, active substrate materials, silicon as a substrate material, silicon compounds, silicon piezoresistors, gallium arsenide, quartz, piezoelectric crystals, polymers, packaging materials.	4
	Microsystem Fabrication Processes: Introduction, Photolithography, Ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition- sputtering, deposition by epitaxy, etching.	4
5	Overview of Micro manufacturing: Introduction, bulk micro manufacturing, surface micromachining, LIGA.	4
	Microsystem Design: Introduction, design consideration, process design, mechanical design, mechanical design using finite element method, design of a silicon die for a micropressure sensor, design of microfluidic network systems, design case: capillary electrophoresis network system.	4
	TOTAL	**40**

BT6ME07-CP01: CIMS LAB.

Credit: 2 **Max. Marks: 100(IA:40, ETE:60)**

0L+0T+4P

SN	NAME OF EXPERIMENT
1	To prepare part programming for plain turning operation.
2	To prepare part program for turning operations using turning cycle.
3	To prepare part program for threading operation.
4	To prepare part program for gear cutting using mill cycle.
5	To prepare part program for multiple drilling in X and Z axis using drilling cycle.
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Engraving of students' name, manufacturing of a part.

BT6ME08-CP02: VIBRATION LAB

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+4P

SN	NAME OF EXPERIMENT
1	To verify relation T = 2π□ (l/g) for a simple pendulum.
2	To determine radius of gyration of compound pendulum.
3	To determine the radius of gyration of given bar by using bifilar suspension.
4	To determine natural frequency of a spring mass system.
5	Equivalent spring mass system.
6	To determine natural frequency of free torsional vibrations of single rotor system. i. Horizontal rotor ii. Vertical rotor
7	To verify the Dunkerley's rule.
8	Performing the experiment to find out damping co-efficient in case of free damped torsional vibration
9	To conduct experiment of trifler suspension.
10	Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
11	Study of Vibration measuring instruments.
12	Perform study of the following using Virtual Lab http://www.vlab.co.in/
13	Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.
14	Harmonicaly Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio.
15	Perform study of the following using Virtual Lab http://www.vlab.co.in/
16	Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.
17	Harmonicaly Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio.
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Design of vibration system, measurement of vibration, FFT analysis using

	MATLAB

BT6ME09-CP03: MACHINE DESIGN PRACTICE – II

Credit: 2 **Max. Marks: 100 (IA:40, ETE:60)**

0L+0T+4P **End Term Exam: 3 Hours**

SN	SESSIONAL WORK
	Problems on:
	Use data hand book by Mahadevan and Reddy
1	Fatigue loading.
2	Helical compression, tension and torsional springs design.
3	Curved Beams.
4	Preloaded bolts and bolts subjected to variable stresses.
5	Belt, Rope and Chain drivesystem.
6	Gear Design.
7	Sliding contact bearing design.
8	Anti-friction bearing selection
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Design of assembly (mechanical systems) using various BIS codes/data book

BT6ME10-CP04 THERMAL ENGINEERING LAB-1

Credit: 2 **Max. Marks: 100(IA:40, ETE:60)**

0L+0T+4P

SN	Name Of Experiment
1	Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models
2	Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.
3	To draw valve timing diagram for a single cylinder diesel engine.
4	Study of various types ofboilers.
5	Study of various types of mountings and accessories.
6	Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
7	Study of braking system with specific reference to types of braking system, master cylinder, brake shoes.
8	Study of transmission system including clutches, gear box assembly and differential box
	Important Note: • Study also includes Assembly and disassembly of above systems • It is mandatory for every student to present a term paper. Term paper shall be a group activity. A group shall consist of maximum two students. Final evaluation shall include 30% weight age to term paper. Term paper shall cover study or survey of new technologies in above systems.

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Mechanical Engineering

Semesters VII

Syllabus

BT7ME01-CT01A: I. C. Engines

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**History of IC engines:** Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel- air cycles, Actual cycles. **Testing & Performance:** Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission.	**4** **4**
2	**Fuel & Combustion:** Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber. **Alternative Fuels:** Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.	**5** **3**
3	**Engine Systems & Components:** Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburettors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations. **CI engine:** Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors. **Ignition system:** Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs.	**4** **2** **2**
4	**Engine Friction & Lubrication:** Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	**8**

5	**Supercharging:** Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines. **Dual & Multi fuel engines:** Principle, fuels, Combustion, performance Advantages, Modification in fuel system. **Special Engines:** Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.	**4** **2** **2**
	Total	**40**

BT7ME01-CT01B: OPERATIONS RESEARCH

Credit:3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**Overview of Operations Research** **Linear Programming**: Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis. Transportation Model and Assignment Model including travelling salesman problem.	**1** **4** **3**
2	**Integer Linear Programming:** Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming. **Replacement Models:** Capital equipment replacement with time, group replacement of items subjected to total failure.	**5** **3**
3	**Queuing Theory**: Analysis of the following queues with Poisson pattern of arrival and exponentially distributed service times, Single channel queue with infinite customer population, Multichannel queue with infinite customer population,	**4**
	Competitive Situations and Solutions: Game theory, two person zero sum game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy, approximate solution, and simplified analysis for other competitive situations. Application of linear programming	**4**
4	**Theory of Decision making:** Decision making under certainty, risk and uncertainty. Decision trees. **Deterministic Inventory control models:** functional role of inventory, inventory costs, model building, Single item inventory control model without shortages, with shortage and quantity discount. Inventory control model with uncertain demand, service level, safety stock, P and Q systems, two bin system. Single period model. Selective Inventory control techniques.	**4** **4**
5	**Probabilistic Inventory control models:** Instantaneous demand without setup cost and with setup cost, Continuous demand without setup cost **Simulation**: Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of Normal Random numbers. Use of random numbers for system simulation. , Monte Carlo simulation, simulation language ARENA, Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems	**4** **4**
	Total	**40**

BT7ME01-CT01C: TURBOMACHINES

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**Basic Concepts of Turbo Machines:** Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation(1st law of thermodynamics),2nd law of thermodynamics applied to turbo machines, Newton's 2nd law of motion applied to turbo machines - Euler's pump equation and Euler's turbine equation Dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Range of specific speeds for various turbo machines, Dimensional analysis applied to compressible flow machines, pressure ratio as a Function of temperature ratio, mass flow rate parameter and speed parameter	**4** **4**
2	**Centrifugal Compressors and Fans:** Components and description, velocity diagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stall and Choking	**8**
3	**Axial Flow Compressors and Fans:** Basic constructional features, Advantages of axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, operating characteristics	**8**
4	**Reciprocating Compressors:** Basic constructional features, working principle, work done calculation, single and double acting compressors **Centrifugal Pumps:** Main parts, work done and velocity triangles, slip and slip factor, pump losses and efficiencies, minimum starting speed, net positive suction head, performance curve.	**4** **4**
5	**Axial Flow Pumps:** Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitation. **Reciprocating Pumps:** Classification, component and working, single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, slip, effect of friction and acceleration, theory of air vessels.	**4** **4**
	Total	**40**

BT7ME03-CP01: FEA LAB

Credit: 1 Max. Marks: 50(IA:20, ETE:30)

0L+0T+2P

SN	List of Experiments
1	Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems
A: by using FE packages such as NASTRAN/ANSYS/SIMULIA/ABAQUS	
2	Introduction of GUI of the software in the above mentioned areas' realistic problems.
3	Analysis of beams and frames (bending and torsion problems)
4	Plane stress and plane strain analysis problems
5	Problems leading to analysis of axisymmetric solids
6	Problems leading to analysis of three dimensional solids (a) Heat transfer problems (b) Modal analysis problem
B: by writing own code for finite element analysis using MATLAB for:	
7	Plane stress and plane strain analysis problems
8	Modal Analysis problem

BT7ME04-CP02: Thermal Engineering Lab-II

Credit: 2 Max. Marks: 100 (IA:40, ETE:60)

0L+0T+4P

SN	List of Experiments
1	To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power and heat balance sheet.
2	To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine. (Morse Test)
3	Analysis of engine exhaust gases using Orsat apparatus /Engine gas analyzer.
4	Determination of coefficient of performance of Refrigeration cycle and tonnage capacity of refrigeration unit.
5	To determine the COP and tonnage capacity of a Mechanical heat pump.
6	To study various controls used in Refrigeration and Air conditioning system.
7	Study of commercial Refrigeration equipments like cooling towers, hermetically sealed compressors, automotive swash plate compressor etc.
8	To study automotive air conditioning system.
9	Determination of dryness fraction of steam.
10	Study and Performance of Simple Steam Turbine
11	Performance characteristics of Hydraulic turbines.
12	Study and Performance of Gas Turbine Plant.
13	Performance characteristics of variable and rated speed centrifugal pump.

BT7ME05-CP03: Quality Control Lab

Credit: 1 Max. Marks: 50(IA:20, ETE:30)

0L+0T+2P

SN	List of Experiments
1	Case study on X bar chart and R chart of an industrial process output and process capability analysis of the process. The charts are to be drawn and calculations of process capability analysis to be reported.
2	p Chart: (a) To verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) To plot a p -chart by taking a sample of n=20 and establish control limits
3	Case study on C-chart of a product and establish control limits.
4	Operating Characteristics Curve: (a) To plot the operating characteristics curve for single sampling attribute plan for n = 20; c = 1, 2, 3. Designate the red ball as defective. (b) To compare the actual O.C. curve with theoretical O.C. curve using approximation for the nature of distribution
5	Distribution Verification: (a) To verify Normal Distribution using the experimental setup. (b) To find the distribution of numbered cardboard chips by random drawing one at a time with replacement. Make 25 subgroups in size 5 and 10 find the type of distribution of sample average in each case. Comment on your observations
6	To carry out verification of Poisson distribution using experimental set up.
7	Central Limit Theorem: (a) To show that a sample means for a normal universe follow a normal distribution (b) To show that the sample means for a non normal universe also follow a normal Distribution.
8	Solve quality control problems using SPC software like STATGRAPHICS/MINITAB/SIGMA XL /SYSTAT/EXCEL etc.
	Important Note: It is mandatory for every student to undertake a Case Study. The case study shall be of real problem involving quality issues preferably from local industry whose quality issues shall be solved using seven magnificent tools of SQC and other techniques of quality control. Case study shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to case study.

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Semesters VIII

Syllabus

BT8ME01-CT01A: Hybrid and Electric Vehicles

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	**Introduction to Hybrid Electric Vehicles:** History of hybrid and electric vehicles, environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **Conventional Vehicles:** Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.	**4** **4**
2	**Hybrid Electric Drive-trains:** Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. **Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.	**4** **4**
3	**Electric Propulsion unit:** Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives	**8**
4	**Energy Storage:** Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.	**8**
5	**Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology	**8**
	Total	**40**

BT8ME01-CT01B: SUPPLY AND OPERATIONS MANAGEMENT

Credit: 3 Max. Marks: 150(IA:30, ETE:120)

3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity Demand Forecasting: components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Time series data. Associative forecasting techniques, Accuracy and control of forecasts, Selection of forecasting technique.	**4** **4**
2	Product and Service design, Process selection, Process types, Product and process matrix, Process analysis. Capacity Planning: Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.	**4** **4**
3	Facility Location: Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; line balancing. Material Handling	**8**
4	Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning. Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning capacity requirements, Introduction to ERP Techniques of production control in job shop production, batch production and mass production systems. sequencing: priority rules, sequencing jobs through two work centers, scheduling services	**4** **4**
5	Introduction to Just-in-time (JIT) and Lean Operations: JIT production, JIT scheduling, synchronous production, Lean operations system Supply Chain Management (SCM): Need of SCM, Bullwhip effect, Elements of SCM, Logistics steps in creating effective supply chain, Purchasing and supplied management.	**4** **4**
	Total	**40**

BT8ME01-CT01C: ADDITIVE MANUFACTURING

Credit: 3 Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P End Term Exam: 3 Hours

SN	Contents	Hours
1	Overview of Rapid Product Development (RPD): Need for the compression in product development, history of RP systems, Definition of RPD; Components of RPD. Rapid Prototyping (RP); Principle of RP; Technologies and their classifications. **Stereo Lithography Systems**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application **Selective Laser Sintering& Fusion Deposition Modelling:** Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.	**2** **2** **4**
2	**Solid Ground Curing**: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application. Selection of RP process; Issues in RP; Emerging trends.	**4** **2**
3	**Rapid Tooling (RT):** Introduction to RT, Indirect RT process- Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Cast kirksite, 3Q keltool, etc. **Direct RT processes**: Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting),	**4** **4**
4	Emerging Trends in RT, Reverse Engineering: Geometric data acquistion, 3D reconstruction, Applications and Case Studies, Engineering applications, Medical applications.	**8**
5	Processing Polyhedral Data: Polyhedral B-Rep modeling, STL format, Defects and repair of STL files, Introduction to software for RP : Brief overview of Solid view, magics etc.	**4** **4**
	TOTAL	**40**

BT8ME03-CP01: INDUSTRIAL ENGINEERING LAB

Credit: 1 Max. Marks: 50(IA:20, ETE:30)

0L+0T+2P

SN	List of Experiments
1	Determination of time standard for a given job using stopwatch time-study.
2	Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3	Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4	To perform ABC analysis for the given set of inventory data.
5	To develop Bill of Materials/Product structure tree and calculate planned order release (POR) using MRP format
6	To solve the operations research problems on Linear programming/Transportation/Assignment etc. using OR software's like TORA/LINGO/LINDO/SAS/EXCEL SOLVER etc.
7	Simulation of inventory system/Queuing system/production system using Monte-Carlo method.
8	To perform case study on sales forecasting.
9	To perform case study on project management using PERT/CPM.
10	To perform a case study on plant location and layout planning.
11	To perform a case study on capacity planning.

Important Note:

It is mandatory for every student to undertake a Mini project. The mini project shall involve a detailed project report of establishing a factory in which plant location, plant layout, capacity planning, selection of processes, ergonomically designing of equipments and other facilities are to be installed. Mini project shall be a group activity. A group shall consist of maximum five students. Final
evaluation shall include 30% weight age to mini project.

BT8ME04-CP02: METROLOGY LAB

Credit: 1 Max. Marks: 50(IA:30, ETE:20)

0L+0T+2P

SN	List of Experiments
1	Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges.
2	Measurement of angle and width of a V-groove by using bevel protector..
3	To measure a gap by using slip gauges
4	Measurement of angle by using sine bar.
5	Study and use of surface roughness instrument (Taylor Hobson make) Inspection of various elements of screw thread by Tool makers microscope and optical projector.
6	Measurement of gear tooth thickness by using gear tooth vernier caliper.
7	To check accuracy of gear profile with the help of profile projector.
8	To determine the effective diameter of external thread by using three-wire method.
9	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
10	To plot the composite errors of a given set of gears using composite gear tester.
11	Measurement of coating thickness on electroplated part and paint coating on steel and non-ferrous material using coating thickness gauge.
12	Study and use of hardness tester for rubber and plastics.
13	To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface.
14	To compare & access the method of small-bore measurement with the aid of spheres.