DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

STUDY & EVALUATION SCHEME WITH SYLLABUS

FOR

B. TECH 4th YEAR MECHANICAL ENGINEERING

ON

CHOICE BASED CREDIT SYSTEM

(EFFECTIVE FROM THE SESSION: 2019-20)
### SEVENTH SEMESTER

<table>
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<th>Sl.No.</th>
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#### DEPARTMENTAL ELECTIVE-3

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### EIGHT SEMESTER

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<td>RME082</td>
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<td>RME083</td>
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<td>RME086</td>
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<td>RME087</td>
<td>Design &amp; Transmission System</td>
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<td>RME088</td>
<td>Theory of Elasticity</td>
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<td>RME089</td>
<td>Manufacturing of Composites</td>
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SEMESTER-VII
UNIT-I:

**Principles of Computer Graphics:**
Point plotting, drawing of lines, Bresenham’s circle algorithm.

**Transformation in Graphics:**
Co-ordinate system used in Graphics and windowing, view port, views.
2D transformations – rotation, scaling, translation, mirror, reflection, shear - homogeneous transformations – concatenation.
3D Transformation – Perspective Projection – Technique (Description of techniques only).

**Geometric Modelling:**
Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG.
B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc).

UNIT-II:

**Graphics standard & Data storage:**
Standards for computer graphics GKS, PHIGS. Data exchange standards – IGES, STEP - Manipulation of the model - Model storage.

**Finite Element Modelling:**
Introduction, Mesh Generation – mesh requirements.
Fully Automatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modelling Concept.
An overview of modelling software’s like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

UNIT-III:

**CAM:**
Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

**Material handling in CAM environment:**
Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

UNIT-IV:

**Robotics:**

**Quality Function Deployment:**
UNIT-V:

Rapid prototyping:
Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.
Introduction to three representative RP techniques: Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography.

Flexible manufacturing cells:

Books and References:
UNIT-I:  
Introduction:  
Basic concepts of Automobile Engineering and general configuration of an automobile, Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination.

UNIT-II:  
Transmission System:  

UNIT-III:  
Braking System:  
General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. Antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Chassis and Suspension System:  
 Loads on the frame, Strength and stiffness, Independent front & rear suspension, Perpendicular arm type, Parallel arm type, Dead axle suspension system, Live axis suspension system, Air suspension & shock absorbers.

UNIT-IV:  
Electrical System:  
Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.

Fuel Supply System:  
Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburettore etc. MPFI.

UNIT-V:  
Emission standards and pollution control:  

Alternative Energy Sources:  

Books and References:  
3. Automobile Engineering – TTI, Pearson India.  
5. Automobile Engineering - Newton and Steeds.
6. Automobile Engineering – Ramakrishna, PHI, India.
List of Experiments: (Total EIGHT Experiments are to carried out. FOUR Experiments each from CAD and CAM.)

A. CAD Experiments:
1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modelling Software commands.
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments:
1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer line/Material handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Experiment on Mechatronics and controls.
Experiments: Say at least 8 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburettor, Fuel Injection Pump and MPFI.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Chevrolet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
UNIT-I:
Introduction:
Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT-II:
Types of Reinforcements/Fibers:
Role and Selection of reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential.

UNIT-III:
Various types of composites:
Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites.

UNIT-IV:
Fabrication methods:

UNIT-V:
Testing of Composites and Analysis:
Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc. Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Books and References:
UNIT-I:
Introduction:
Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection. Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor’s profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

UNIT-II:
Steam power plant:
General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. Different systems such as coal handling system, pulverisers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

UNIT-III:
Diesel power plant:
General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant:
Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-IV:
Nuclear power plant:
Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric and Non-Conventional Power Plant:
Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT-V:
Electrical system:
Generators and generator cooling, transformers and their cooling, bus bar, etc.

Energy Saving and Control:
Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Books and References:
2. Power Plant Engineering by Hedge, Pearson India.
6. Power Plant Engineering by Gupta, PHI India.
UNIT-I:
Introduction to Supply Chain Management, Understanding the Supply Chain.
Supply Chain Performance: Competitive and Supply Chain Strategies, achieving Strategic Fit and Scope of Strategic Fit.

UNIT-II:
Supply Chain Drivers and Metrics: Drivers of Supply Chain Performance, Framework for structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing and Pricing, Case Study: Seven-Eleven Japan Company.

UNIT-III:
Planning Demand and Supply in a Supply Chain: Demand Forecasting in a Supply Chain, Aggregate Planning in a Supply Chain.
Designing Distribution Networks and Application to E-Business- Role of distribution, factors influencing distribution network design, design options for a distribution network, E-Business and the distribution network.

UNIT-IV:
Network Design in the Supply Chain- Role of network design in the supply chain, factors influencing network design decisions, framework for network design decisions.
Role of Information Technology in supply chain, coordination in a supply chain, Bullwhip Effect, Effect on performance due to lack of coordination, obstacles to coordination in a supply chain.

UNIT-V:
Factors influencing logistics and decisions.
Benchmarking and performance measurement.

Books and References:
3. Supply Chain Management – Maretin Christopher.
4. World Class Supply Management: The key to Supply Chain Management- Burt, Dobler and Straling – TMH Publication.
UNIT-I:
Introduction:
History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes: Prototyping, Manufacturing and Tooling.

UNIT-II:
Development of Additive Manufacturing Technology:
Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems. Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT-III:
Additive Manufacturing Processes:

UNIT-IV:
Design & Software Issues:
Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing, Material for AM, Engineering Design Rules for AM.
Software Issue for Additive Manufacturing: Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL file Manipulation, Beyond the STL file, Additional Software to Assist AM.

UNIT-V:
Material Design & Quality Aspects:
Applications:
Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Books and References:
DEPARTMENTAL ELECTIVE-4

OPERATIONS RESEARCH

UNIT-I:
Introduction:
Linear Programming:
Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal and dual problem sensitivity analysis.

UNIT-II:
Transportation Problem:
Methods of obtaining initial and optimum solution, degeneracy in transportation problems, unbalanced Transportation Problem.
Assignment Problem:
Methods of obtaining optimum solution, Maximization problem, travelling salesman problem.

UNIT-III:
Game Theory:
Two-person Zero sum game, Solution with/without saddle point, dominance rule, Different methods like Algebraic, Graphical and game problem as a special case of Linear Programming.
Sequencing:
Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines.

UNIT-IV:
Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy.
Simulation: Use, advantages & limitations, Monte-Carlo simulation, Application to queuing, inventory & other problems.

UNIT-V:
Queuing models: Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration.
Project management: Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

Books and References:
UNIT-I:
Bioinformatics objectives and overviews, Interdisciplinary nature of Bioinformatics, Data integration, Data analysis, Major Bioinformatics databases and tools. Metadata: Summary & references systems, finding new type of data online. Molecular Biology and Bioinformatics: Systems approach in biology, Central dogma of molecular biology, problems in molecular approach and the bioinformatics approach, overview of the bioinformatics applications.

UNIT-II:
Basic chemistry of nucleic acids, Structure of DNA, Structure of RNA, DNA Replication, Transcription-Translation, Genes- the functional elements in DNA, Analyzing DNA, DNA sequencing. Proteins: Amino acids, Protein structure, Secondary, Tertiary and Quaternary structure, Protein folding and function, Nucleic Acid-Protein interaction.

UNIT-III:

UNIT-IV:
Genome, Genomic sequencing, expressed sequence tags, gene expression, transcription factor binding sites and single nucleotide polymorphism. Computational representations of molecular biological data storage techniques: databases (flat, relational and object oriented), and controlled vocabularies, general data retrieval techniques: indices, Boolean search, fuzzy search and neighbouring, application to biological data warehouses.

UNIT-V:
Macromolecular structures, chemical compounds, generic variability and its connection to clinical data. Representation of patterns and relationships: sequence alignment algorithms, regular expressions, hierarchies and graphical models, Phylogenetics. BLAST.

Books and References:
1. D E Krane & M L Raymer,” Fundamental concepts of Bioinformatics”, Perason Education.
4. O’Reilly, “Developing Bioinformatics computer skills”, CBS.
6. Discrete event system simulation by Banks, Carson, Nelson and Nicol.
UNIT- I:
**Governing Equations and Boundary Conditions:**

UNIT -II:
**Finite Difference Method:**

UNIT- III:
**Finite Volume Method (FVM) for Diffusion:**

UNIT -IV:
**Finite Volume Method for Convection Diffusion:**
Steady one-dimensional convection and diffusion. Central, upwind differencing schemes properties of discretization schemes. Conservativeness, Boundedness, Transportivity, Hybrid, Power-law, QUICK Schemes.

UNIT- V:
**Calculation Flow Field by FVM:**
Representation of the pressure gradient term and continuity equation. Staggered grid. Momentum equations. Pressure and Velocity corrections; Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k-€) models. High and low Reynolds number models.

**Books and References:**
UNIT- I:  
**Automation:**

UNIT- II:  
**Manufacturing Automation:**
Classification and type of automatic transfer machines; Automation in part handling and feeding. Analysis of automated flow lines, design of single model, multimodel and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centres, Programmable robots, Robot time estimation in manufacturing operations.

UNIT- III:  
**Robotics:**

UNIT- IV:  
**Robot Drives and Power Transmission Systems:**
**Robot end Effectors:**
Classification of End effectors – active and passive grippers, Tools as end effectors, Drivesystem for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

UNIT- V:  
**Robot Simulation:**
Methods of robot programming, Simulation concept, Off-line programming, advantages of off-line programming.  
**Robot Applications:**

Books and References:
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
SEMESTER-VIII
DEPARTMENTAL ELECTIVE-5

NON-DESTRUCTIVE TESTING

L-T-P
3-1-0

Unit-I:
Introduction:
Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some common NDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection.

Unit-II:
Tests:
Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Test stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples and interpretation of defects.
Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results, DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications.

Unit-III:
Radiographic methods:
Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photo electric effect, Rayleigh’s scattering (coherent scattering), Compton’s scattering (Incoherent scattering), Pair production, Beam geometry and Scattering factor.

Unit-IV:
Ultrasonic testing methods:

Unit-V:
Special NDT Techniques:
Eddy Current Inspection:

Books and References:
7. Practical non destructive testing by Raj, Baldev.
UNIT-I:
Introduction: Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding.

Welding Power Sources: Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators.

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow.

Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

UNIT-II:
Welding Processes:

UNIT-III:
Heat Flow Welding:
Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

UNIT-IV:
Repair & Maintenance Welding:
Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.


UNIT-V:
Weld Design:

Books and References:
7. Modern Welding Technology by Howard B Cary and Scott Helzer.
UNIT-I:
Brief history of turbo machinery, introduction to blowers, pumps, compressors, steam & gas turbines, turbojet, Review of laws of thermodynamics & SFEE in reference to turbomachinery, Energy transfer in turbo machines, Euler’s equation, Definition of various efficiencies, preheat factor, Reheat factor, Blade classification, Blade terminology, Cascade testing, Velocity diagrams for axial and radial turbomachinery and pumps.

UNIT-II:
Centrifugal compressors:
Principle of operation, work done and pressure rise, Velocity diagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, Centrifugal Compressor characteristic curves.
Axial flow compressor:
Principle of operation and working, Energy transfer, Velocity diagram for axial compressor, Factors affecting stage pressure ratio, Blockage incompressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance, Axial compressor performance characteristic curves.

UNIT-III:
Axial flow turbines:

UNIT-IV:
Steam turbines: Constructional details, working of steam turbine.
Pumps: Classification of Pumps, Main components, indicator diagram and modification due to piston acceleration, Performance characteristics, Cavitation and its control, Miscellaneous types of pumps.

UNIT-V:
Gas Turbine Starting & Control Systems: Starting ignition system, Combustion system types, Safety limits & control.
Turbine Blade coding: Different cooling techniques, Types of coolants, Comparative evaluation of different cooling techniques.
Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials.

Books and References:
5. Fundamentals of Turbomachinery, by Venkanna, PHI, India.
7. Turbines, Compressors & Fans by Yahya.
8. Fundamentals of Turbomachinery by Venkanna, PHI, India.
UNIT -I:
Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

UNIT -II:
Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

UNIT -III:
Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

UNIT -IV:
Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration & Air Conditioning systems, Cooling Towers, DG sets.

UNIT -V:
Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Books and References:
5. Energy Management and Conservation Handbook (Mechanical and Aerospace Engineering Series) by Frank Kreith and D Yogi Goswami
6. Energy Conversion and Management by Giovanni Petrecca
UNIT -I:

**Quality Concepts:**
Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.

**Control on Purchased Product:**
Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

**Manufacturing Quality:**
Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT -II:

**Quality Management:**
Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

**TQM Principles:**
Leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, SS, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT -III:

**Tools and Techniques:**
Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

**Control Charts:**
Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

UNIT -IV:

**Defects Diagnosis and Prevention:**
Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT -V:

**ISO and its concept of Quality Management:**
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits, TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

**Books and References:**
7. Total Quality Management by Mukherjee, P.N.
UNIT -I:
Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow.

UNIT -II:
Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow in variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT -III:
Non-isentropic flow in constant area ducts, Rayleigh and Fano flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT -IV:
Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT -V:
Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights.

Books and References:
DESIGN OF TRANSMISSION SYSTEMS

UNIT -I:
Flexible transmission elements:
Design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets.

UNIT -II:
Gear transmission:
Speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

UNIT -III:
Straight bevel gear:
Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

UNIT -IV:
Gear box:
Geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box - Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT -V:
Cam design, types:
Pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Books and References:
3. Design of transmission systems by Eamanamurthy and S Machandran.
5. Experimental Stress Analysis for Materials and Structures (Springer Series in Solid and Structural Mechanics)” by Alessandro Freddi and Giorgio Olmi.
THEORY OF ELASTICITY

UNIT I:
Basic Equations of Elasticity:

UNIT II:
Plane Stress and Plane Strain Problems:
Airy’s Stress Function, Bi-Harmonic Equations, Polynomial Solutions, Simple Two-Dimensional Problems in Cartesian Coordinates Like Bending of Cantilever and Simply Supported Beams.

UNIT III:
Polar Coordinates:
Equations of Equilibrium, Strain – Displacement Relations, Stress – Strain Relations, Airy’s Stress Function, Axis – Symmetric Problems, Introduction to Dunder’s Table, Curved Beam Analysis, Lame’s, Kirsch, Michell’s And Boussinesque Problems – Rotating Discs.

UNIT IV:
Torsion:
Navier’s Theory, St. Venant’s Theory, Prandtl’s Theory on Torsion, Semi-Inverse Method and Applications to Shafts of Circular, Elliptical, Equilateral Triangular and Rectangular Sections. Membrane Analogy.

UNIT V:
Introduction to Theory of Plates and Shells:

Books and References:
5. Theory of elasticity by S. Timoshenko.