



**राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर**  
**NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR**  
(Institute of National Importance)  
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## **DEPARTMENT OF MECHANICAL ENGINEERING**

### **SYLLABUS**

Name of the Subject	Engineering Graphics	Subject Code	0020211 (ME)
Semester	I & II	Board of Studies	Mechanical Engg.
Maximum Marks	ESE-70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
2	0	4	4

#### **Unit I – Scales & Curves**

**a) Introduction to Engineering Drawing**, Scales: Representative Fraction, Types of Scale, Plain and Diagonal Scale, Scale of chords.

**b) Engineering Curves**: Conic sections, Ellipse, Parabola, Hyperbola, Cycloidal Curves: Cycloid, Epicycloids, Hypocycloid, Involute, Helix, Spiral.

#### **Unit II – Projection of Points & Lines**

**a) Projection**: Introduction, Principle of Projection, Method of projection, Planes of projection, Four quadrant, First and Third angle projection, Reference line, symbols for methods of projection, Orthographic projection.

**b) Projection of Point**: Introduction, Projection of Point situated in first, second, third & fourth quadrant.

**c) Projection of lines**: Introduction, Line parallel to One or both the planes, Line contained by one or both the planes, Line perpendicular to one of the planes, Line inclined to one plane and parallel to other. Line inclined to both the planes, True length.

#### **Unit III – Projection of Planes & Solids**

**a) Projection of Planes**: Introduction, Types of planes, Projection of planes, Projection of planes perpendicular to both the reference planes, Perpendicular to one plane and parallel to other plane, Perpendicular to one plane and inclined to the other plane, Inclined to both planes.

**b) Projection of solids**: Introduction, Type of solid, Projections of solids in simple position, Projection of solids with axes inclined to one of the reference planes and parallel to the other, Projections of solids with axes inclined to both H.P. and the V.P.

#### **Unit IV – Section of Solids & Development of Surfaces**

**a) Section of Solids**: Sectional Planes, Section of solids, True Shape of section.

**b) Development of Surfaces**: Introduction, Method of development, Development of lateral surfaces of right solids, Cube, Prisms, Cylinders, Pyramids & Cone.

#### **Unit V – Isometric Projection**

**Isometric Projection**: Introduction, Isometric axes, Lines & planes, Isometric scale, Isometric projection and Isometric view, Conversion of Isometric to Orthographic Projections.

**Problems from the above units should also be practiced on computer aided drafting software.**

#### **Text Books**

- “Elementary Engineering Drawing” by Bhatt, N.D., Charotar publishing Co.
- “Engineering Graphics” by K.L. Narayana and P.Kannaiah, SCITECH PUBLICATIONS (INDIA) PVT.LTD. October 2008
- “Engg. Drawing with Auto CAD 2009”- T Jeyapavan, Vikas Publishing House Pvt. Ltd.



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Basic Mech. Engg.	Subject Code	0020215 (ME/CI)
Semester	I & II	Board of Studies	Mechanical Engg.
Maximum Marks	ESE-35	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
2	1	0	3

**UNIT – I**

**Law of Thermodynamics:** Thermodynamic systems, property, control volume, work, heat as path function, first Law of thermodynamics, and its application to non-flow and flow process, equilibrium, various process, second law of thermodynamics, its corollaries, clausius inequality, entropy: point function, principle of increase of entropy, entropy change during various thermodynamic processes, Carnot cycle.

**UNIT – II**

**Air Standard Cycles:** Otto, Diesel, Dual combustion cycles their efficiencies, mean effective pressure.

**Properties of Steam:** Types of Steam, Wet, Saturated and Superheated Steam, calculation of heat value of steam of any value.

**UNIT – III**

**Mechanical Properties of engineering materials:** Hardness, Ductility, Malleability, Toughness, Brittleness, Stress–Strain Curve for ductile and brittle material etc. Normal and shear stress, Relation between Elastic Constants, Stresses in varying cross sectional area, Composite bars on axial loading.

**Introduction to manufacturing:** Types of Welding–Gas Welding, Arc Welding, Equipments used, Different types of Welded joints, Working principle, function & specification of Simple Lathe machine, Shaper.

**Text Books:-**

1. Thermodynamics – R. Yadav
2. Production Technology – Hajra & Choudhary
3. Strength of Materials – Timoshenko & Young

**Reference Books:-**

1. Engineering Thermodynamics – P.K. Nag
2. Thermodynamics – Cengel and Boles
3. Manufacturing Process – Bagman
4. Strength of Material – Ryder
5. Strength of Materials – Sadhu Singh



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## **DEPARTMENT OF MECHANICAL ENGINEERING**

### **SYLLABUS**

Name of the Subject	Mathematics	Subject Code	MA 20311 (ME)
Semester	III	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

#### **UNIT I - Fourier Series**

Euler's Formula, Functions having points of discontinuity, Change of interval, Even & Odd functions, Half range series, Harmonic analysis.

#### **UNIT II - Laplace Transform**

Definition, Transform of elementary functions, Properties of Laplace transform, Transform of derivatives & integrals, Multiplication by  $t^n$ , Division by  $t$ , Evaluation of integrals, Inverse Laplace Transform, Convolution theorem, Unit step function, Unit impulse function, Periodic function, Application to solution of ordinary differential equations.

#### **UNIT III – Partial Differential Equation**

Formation, Solution by direct integration method, Linear equation of first order, Homogeneous linear equation with constant coefficients, Non-homogeneous linear equations, Method of separation of variables.

#### **UNIT IV – Complex Variables**

Derivative, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Flow problem, Complex integration, Cauchy theorem, Cauchy integral formula, Taylor & Laurent series, Singularity, Residue, Evaluation of real definite integrals.

#### **UNIT V - Statistics**

Random variables, Discrete & continuous probability distributions, Expectation, Mean & Standard Deviation, Moments & moment generating function, Distributions-Binomial, Poisson and Normal distributions.

#### **Text Books:-**

1. Higher Engg. Mathematics by Dr. B.S. Grewal– Khanna Publishers.
2. Advanced Engg. Mathematics by Erwin Kreyszing – John Wiley & Sons.

#### **Reference Books:-**

1. Advanced Engg. Mathematics by R.K. Jain and S.R.K. Iyengar – Narosa Publishing House.
2. Applied Mathematics by P.N. Wartikar & J.N. Wartikar. Vol- II– Pune Vidyarthi Griha Prakashan, Pune.
3. Applied Mathematics for Engineers & Physicists by Louis A. Pipes- TMH.



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Numerical Techniques	Subject Code	ME 20312 (ME)
Semester	III	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT I - Error Analysis and Roots of Equations**

**Approximation and Errors:** Approximate number and significant Figures, Absolute, Relative and percentage error, Round of errors, Truncated errors, Accuracy of series approximations, Taylor's series, Exponentials series, Logarithmic series etc. Error propagation in functions of single and multiple variables.

**Roots of Equations:** Roots of algebraic, Transcendental and polynomial equation, Approximate roots, Real roots using bracketing methods, Bisection method and Regula-Falsi method, Real roots using open method, Secant method, Iterative method, Complex roots of polynomial equations.

**UNIT II - Solution of Coupled Equations**

System of coupled equations, Unique solution, Singular solution, III conditional equations, Cramer's rule, Matrix method, Method of leading coefficients, gauss elimination – pitfalls of elimination, Division by zero, Round off errors, Scaling effect, Gauss Jordan, Gauss Seidal, Convergence criteria of – Gauss, Newton Raphson's Method.

**UNIT III - Curve Fitting**

**Interpolation:** Difference Table, Interpolation, Newton's forward and backward interpolation, Newton's general interpolation formula, Lagrang's Interpolation, Gauss Central, Difference interpolation, Spline fitting–Cubic spline.

**Regression:** Regression Analysis, Least square analysis, Formation of Normal Equation, Linear Regression, Polynomial regression, Exponential Geometric and Trigonometric regression, Multiple regression.

**UNIT IV - Numerical Differentiation:**

First, Second and Higher Order Differentiation Formula.

**Numerical Integration:** Newton's Cotes Integration, Trapezoidal Rule, Simpson's one third and three eighth rule, Integration of equations, Romberg Integration, Gauss quadrature.

**Solution of Ordinary Differential Equation:** Euler's Method, Modified Euler's Method, Runge Kutta's Method Milene's Method.

**UNIT V - Solutions of Partial Differential Equations by Finite Difference Technique:**

Finite difference method, partial Difference Equation: Elliptic, Parabolic and Hyperbolic Solution of Laplace and Poisson's equation by finite difference method, Iteration and relaxation techniques.

**Computer Lab:**

All methods are to be practiced using high level programming language such as FORTRAN, C, C++.

**TEXT BOOKS**

1. Numerical Methods for Engineers by Steven C, Chapra and Raymond P. Canale, McGraw Hill International Editions.
2. Numerical Methods in Engineering and Science by Dr. B.S. Grewal.

**Reference Books :**

1. Numerical Methods Analysis by J. Scarborough.



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## DEPARTMENT OF MECHANICAL ENGINEERING

### SYLLABUS

Name of the Subject	Material Science	Subject Code	ME 20313 (ME)
Semester	III	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

#### UNIT - I

**Structure of Materials:** Crystalline structure of solid: Concept of unit cell and space lattice, Miller Indices, Crystal structure determination by X-ray diffraction, Crystal imperfections.

**Solidification of Metals and Alloys:** Mechanism of solidification, nucleus formation and crystal growth, Metal ingot structure-dendritic and columnar grains, grain boundaries, grain growth, effect of grain size on properties of metals, polytropic transformation.

#### UNIT - II

**Elastic and Plastic Deformation:** Material properties like strength, hardness, toughness, ductility, brittleness etc. and their importance in manufacturing. Quantitative evaluation of these properties with destructive testing methods. Mechanism of plastic deformation, role of dislocations, slip and twinning. Strain hardening, Season's cracking, Baushinger effect, yield point phenomena and related effects, Cold working and Hot working processes, effect on properties like recovery, recrystallization, grain growth, grain size etc.

#### UNIT - III

**Phase Diagrams:** Phase and phase equilibrium: solidification of pure metals and alloys, Phase diagrams of monotectic, eutectic, eutectoid, peritectic and peritectoid & other systems. Allotropy of iron and Fe-C diagram.

#### UNIT - IV

**Heat Treatment:** Introduction, purpose of heat treatment, T-T-T curve and micro constituents in steel heat treatment processes like hardening, tempering, annealing, normalizing, Effects of heat treatment on properties of materials. Surface treatment processes.

#### UNIT - V

**Engineering Materials:** Classification, structure, general properties and applications of Cast Iron, Steel, brass, Bronze, bearing metals, light metal alloys, sintered carbide.

#### Text Books:

1. Engineering Physical Metallurgy – Lakhtin – CBS Publishers & Distributors
2. Materials Science- Narang – CBS Publishers & Distributors

#### Reference Books:

1. Elements of Material Science & Engg. - Van Vlack. – Addison – Wesley longman, 6<sup>th</sup> Edn., New York
2. Physical Metallurgy - Clark & Varney, East West Edn., New Delhi
3. Engineering Materials - Woulf series.
4. Material Science & Engg. – A first course – V. Raghavan – PHI (P) Ltd., Delhi, 2003
5. A Text Book of Material Science & Metallurgy – O.P. Khanna – Dhanpat Rai & Sons – New Delhi
6. Physical Metallurgy Principles – Robert E Reed Hill – Affiliated East-West Press Pvt. Ltd., New Delhi, 2004



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Mechanics of Solid-I	Subject Code	ME 20314 (ME)
Semester	III	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

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**UNIT - I**

**Introduction**

Basic of stress & strain, Elastic constant, Stress-strain diagram, Hooke's law, Stresses in the components subjected to multi-axial forces, Temperature stresses, Statically indeterminate system.

**UNIT - II**

**Bending of beams**

Bending of beams with symmetric section, boundary condition, Pure bending, Bending equation, traverse shear stress distribution in circular, hollow circular, I & T section.

**UNIT - III**

**Deflection of beam**

Relation between slope deflection and radius of curvature, solution of beam deflection, problem by Macaulay's method, Direct integration method, Method of super position, Moment Area Method.

**UNIT -IV**

**Torsion**

Deformation in circular shaft due to torsion, Basic assumption, Torsion equation, Stresses in elastic range, Angular deflection, hollow and stepped circular shaft.  
Spring: Closed and open coil helical spring subjected to axial load, spring in parallel & series.

**UNIT - V**

**Principle stresses and strain**

Transformation of plane stresses, Principle stresses, Maximum shear stresses, Mohr's circle for plane stresses, Plain strain and its Mohr's circle representation, Principle strains, Maximum shear strain. Combined Loading: Components subjected to bending, torsion & axial loads.

**Text Books:**

1. Elements of strength of material – Timoshenko & young- EWP press
2. Mechanics of Solids – Beer & Johnson, Tata McGraw Hill Publications.

**Refrence Books:**

1. Strength of material – Rider-ELBS
2. Introduction to Solid Mechanics – I.H.Shames-PHI
3. Strength of Materials – R.K. Rajput – Dhanpat Rai & Sons
4. Strength of Materials – Dr. Sadhu Singh – Khanna publication.



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Applied Thermodynamics	Subject Code	ME 20315 (ME)
Semester	III	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT - I Second Law Analysis**

Introduction to the second law of Thermodynamics, The Clausius inequality, Entropy, Principle of increase in entropy, T-ds relation. Availability – Second law analysis of Closed system, Second law analysis of steady-flow system, Irreversibility.

**UNIT - II Thermodynamic Relationships**

Helmholz and Gibbs functions, Coefficient of Volume expansion and isothermal compressibility, Differential relations of internal energy, Maxwell's Relation,  $C_p$   $C_v$  relations, T-ds equations, Clapreyon equation, Kelvin coefficient.

**Equation of state:**

Ideal gas equation of state, Real gas deviation with ideal gas, Vander waals equation, Evaluation of its constants, Virial expansions, Limitations of the equation. The law of corresponding states.

**UNIT – III Vapour and Vapour Power Cycle**

Properties and processes in ideal vapour, Use of steam tables and Molier's diagram in determination of steam properties, energy and entropy calculations.

Carnot and Rankine cycle as applied to steam power plants, Reheat cycle, Ideal regenerative cycle, Practical regenerative cycle, Characteristics of ideal working fluids, Binary vapour cycle.

**Unit – IV Reciprocating Air Compressors**

Classification of air compressors, Advantages, Disadvantages of reciprocating compressors, Working of reciprocating compressor, Equation of work (with & without clearance) volumetric efficiency, Multistage compressors, Efficiency of compressor, Effect of atmospheric condition on output of Compressors, Thermodynamic analysis of reciprocating compressor, Intercooler & External cooler.

**Unit – V Thermodynamics of Compressible Fluids**

Isentropic flow, Stagnation conditions, Stagnation enthalpy, Temperature, Pressure, Density, Flow through available area, Duct, Converging nozzle, Convergent divergent nozzle, Operation of convergent divergent nozzle for different back pressures. Flow with friction and heat transfer, Fanno flow, Rayleigh flow. Flow of steam through nozzle, Throat area for maximum discharge, Supersaturated Flow in nozzle.

**Text Books:**

1. Engineering Thermodynamics – P.K. Nag – TMH Publishers
2. Thermodynamics & Thermal Engineering – J. Selwin Rajadurai – New Age International Publishers

**Reference Books:**

1. Thermodynamics – C.P. Arora – TMH Pub.
2. Thermal Science & Engineering – D.S. Kumar – S.K. Kataria & Sons
3. Thermodynamics – S.C. Gupta – Pearson Education
4. Thermodynamics- An Engineering Approach – Cengel & Boles – McGraw Hill
5. Engineering Thermodynamics – K. Ramakrishna – Anuradha Agencies



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## DEPARTMENT OF MECHANICAL ENGINEERING SYLLABUS

Name of the Subject	Machine Drawing	Subject Code	ME 20316 (ME)
Semester	III	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

### UNIT - I

Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints.

**Limits, Fits and Tolerances:** General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts.

**Fasteners:** Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts.

**Riveted joints:** Forms and proportions of rivet heads, Different views of different types of riveted Lap and Butt joints.

### UNIT - II

#### Drawings of various views of

**Shaft joints:** Cotter joint and Knuckle joint. **Keys & Shaft coupling:** Muff, Flanged, Flexible, Universal and Oldhams coupling. **Shaft bearing:** Solid and bush bearing, Plummer block, Footstep bearing. **Pipe joint:** Flanged joint, Socket and Spigot joint, Hydraulic joint, Union joint, Gland & Stuffing Box, Expansion joint. **Pulley:** Belt pulley, V belt pulley, Fast and loose pulley, Speed cone pulley, Built up pulley.

**Gears:** Spur gear in mesh with approximate construction of tooth profile, Rack and pinion.

### UNIT – III

#### Assembly and detailed drawings of

**Engine Parts:** Piston, Stuffing box, cross head, Vertical & Horizontal engine, Connecting rod, Crank, Eccentric.

**Valves:** Steam stop valves, Feed check valve, Safety valves, Blow off cock.

**NOTE**–Study of assembly production drawing/blue print are to be practiced in the tutorial/practical. Few drawings are to be practiced on AutoCAD. The parts are to be shown during practice.

#### Text Books:

1. Machine drawing- N.D.Bhatt., published by R.C. Patel Charotar Book Stall Tulshi Sadan, Station Road, Annad, India.
2. Machine drawing – P.S. Gill S.K. Kataria & Sons Delhi.
3. Machine drawing – T.Jones.



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## DEPARTMENT OF MECHANICAL ENGINEERING SYLLABUS

Name of the Subject	Internal Combustion Engine	Subject Code	ME 20411 (ME)
Semester	IV	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

### UNIT - I

**Introduction :** Introduction of Internal and external combustion engine and their comparison, four stroke cycle S.I. and C.I. engine, Two stroke engine, Comparison of four stroke and two stroke engines, Comparison of S.I. and C.I. engine, Classification of I.C. engine, Valve timing diagram for S.I. and C.I. engines, Effect of valve timing and engine speed on volumetric efficiency, reasons for ignition and injection advance, Dual fuel, Multi-fuel and Wankel Rotary engine.

**Cycles:** Reasons for deviation of actual cycle from air standard cycles, Variation specific heats and cycle analysis, Fuel air cycles and their analysis, Actual cycles and their analysis, Purpose and Thermodynamic cycle of supercharging.

### UNIT - II

**Fuels:** Basic requirement of I.C. Engine fuels, Requirement of an ideal gasoline, Structure of petroleum, Effect of fuel structure on combustion, Volatility of liquid fuels, Effect of volatility on engine performance for starting, Vapour lock, Acceleration, Percolation, Carburetor icing, and Crank case dilution.

**Combustion:** Determination of stoichiometric air fuel ratio, Fuel-air and exhaust gas analysis for a given combustion process. Combustion in S.I. and C.I. engines, Detonation, Pre-ignition, Knocking, Antiknock rating of fuels Octane number, Critical compression ratio, HUCR, performance number, Cetane number, Dopes.

### UNIT – III

**Carburetor:** Properties of air-petrol mixtures, Mixture requirement, Simple carburetor, limitation of simple carburetor, Modern carburetor, Main metering system, Idling system, Economizer system, Acceleration pump and cold starting system. Nozzle lip, Venturi depression, Calculation of fuel jet and venturi throat dia for given air fuel ratio. Petrol Injection system, Electronic fuel injection, advantage and disadvantage of petrol injection, Multi point Fuel Injection System.

### UNIT – IV

**Ignition System:** Battery and magneto ignition system and their comparative study, Spark plug heat range, Electronic ignition system, Firing order, Ignition timing, Centrifugal and vacuum ignition advance.

**Injection System:** Requirement, type, Fuel pump, Type of fuel injector, Type of nozzle, Atomization, Spray penetration and spray direction, Multiple point fuel injection system.

**Cooling System:** Cooling requirement, Air cooling, liquid cooling, Type of liquid cooling system, Advantage and disadvantage of air cooling and water cooling system, Antifreeze mixture.

**Lubrication System:** Function of lubricating system, Properties of lubricating oil, Wet sump, Dry sump and mist lubrication system.

**Governing of I C Engine:** Necessity of governing, Various methods of governing.

## **UNIT – V**

**Testing and Performance:** Performance parameters, Measurements of brake power, Indicated power, Friction power, Fuel and air consumption, Exhaust gas calorimeter, Calculation of various performance parameter, Heat balance sheet. Performance current for S.I. and C.I. engine with load and speed.

**Emission and Pollution:** SI Engine and CI Engine emissions and its control and comparison. Effect of pollution on Human health and bio sphere.

### **Text Books:-**

1. A Course in Internal Combustion Engines – M.L. Mathur & R.P. Sharma – Dhanpat Rai & Sons
2. Internal Combustion Engine – V. Ganeshan – TMH

### **Reference Books:-**

1. A Course in Internal Combustion Engine – V.M. Domkundwar – Dhanpat Rai & Sons
2. Internal Combustion Engine – R. Yadav – Central Publishing House, Allahabad
3. Fundamental of Internal Combustion Engine – Paul W. Gill, James H. Smith, Eugene J. Ziurys  
Oxford and IBH Publishing Company
4. Internal Combustion Engines – R.K.Rajput – Laxmi Publications



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Fluid Mechanics	Subject Code	ME 20412 (ME)
Semester	IV	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

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**UNIT - I**

**Properties of fluid:** Fluid, ideal and real fluid, Properties of fluid: Mass density, Weight density, Specific volume, Specific gravity, Viscosity, Surface tension, Capillarity, Vapour pressure, Compressibility and bulk modulus. Newtonian and non-Newtonian fluids.

**Fluid statics :** Pressure, Pascal's law, Hydrostatic law, Pressure measurement, Hydrostatic force on submerged plane and curved surface, Buoyancy and Flotation, Liquid in relative equilibrium.

**UNIT - II**

**Fluid kinematics:** Description of fluid motion, Lagrangian and Eulerian approach, Type of fluid flow, Type of flow lines-path line, Streak line, Stream line, Stream tube, Continuity equation, Acceleration of a fluid particle, Motion of fluid particle along curved path, Normal and tangential acceleration, Rotational flow, Rotation and Vorticity, Circulation, Stream and potential function, Flow net, Its characteristics and utilities, Vortex motion .

**UNIT – III**

**Fluid dynamics:** Euler's Equation, Bernoulli's equation and its practical application, Venturimeter, Orifice meter, Nozzle, Pitot tube, Impulse momentum equation, Momentum of Momentum equation, Kinetic energy and Momentum correction factor.

**UNIT – IV**

**Laminar & Turbulent flow:** Reynold's experiment, Shear stress and pressure gradient relationship, Flow of viscous fluids in circular pipe and between two parallel plates, Couette flow, Shear stress & velocity distribution for turbulent.

**Flow through pipes:** Loss of energy in pipes, Hydraulic gradient and total energy line, pipe in series and parallel, Equivalent pipe power transmission through pipe, Water hammer in pipes.

**UNIT – V**

**Internal flows:** Friction factor, Darcy-Weisbach friction factor, Moody's diagram, Boundary Layer theory, Boundary layer equation, Laminar and turbulent boundary layer and its growth over flat plate. Momentum boundary layer and its solutions, separation of boundary layer and its control.

**Dimensional analysis:** Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem, Limitations, Model analysis, Dimensionless number and their significance, model laws, Reynold's model law, Froude's model law, Euler's model law, Weber's model law, Mach's Model law.

**Text Books:-**

1. Hydraulics and fluid Mechanics by Modi and Seth, 12<sup>th</sup> ed. 1998, Standard Book House, Delhi
2. Fluid Mechanics and Hydraulic machines by R.K. Bansal, 8<sup>th</sup> ed. 2002, Laxmi publication (P) Ltd.
3. Fluid Mechanics & machinery – C.P. Kotharaman & R. Rudramoorthy New Age Pub.

**Reference Books:-**

1. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
2. Fluid Mechanics by V.L. Streeter & E.B. Wylie, 1<sup>st</sup> SI metric ed. 1981, McGraw Hill Book Company.



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Mechanics of Solid - II	Subject Code	ME 20413 (ME)
Semester	IV	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

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**UNIT - I**

**Energy Methods:** Introduction, Principles of superposition, Strain energy, Reciprocal relations, Maxwell Betti theorem, Elastic strain energy in tension and compression, Strain energy in beams subjected to bending and shafts to torsion. Impact loading in tension and bending, first & second theorem of Castigliano and its applications.

**UNIT- II**

**Fixed Beams:** Fixed beam subjected to different types of loads and couples, Calculations of fixing moments and reactions at supports, deflection. Effect of sinking of support.

**Continuous beams:** Continuous beams subjected to different type of loads and couples, beams with overhang, beams with one end fixed, Clapeyron's theorem. Effect of sinking of supports.

**UNIT-III**

**Bending of curved bars:** Stresses in bars of small initial curvature, Winkler-Bach theory, Stresses in bars of large initial curvature, Deflection of Crane hooks, Chain links, circular rings, stresses in circular rings.

**UNIT-IV**

**Unsymmetrical Bending:** Introduction to unsymmetrical bending, Stresses and deflection in unsymmetric bending, Shear center for angle, Channel and I-sections.

**Columns:** Struts and Columns, Stability of columns, Euler's formula for different end conditions, Equivalent load, Eccentric loading, Rankine's formula.

**UNIT – V**

**Thin Pressure Vessel:** Thin Pressure Vessels, Circumferential and longitudinal stresses in thin cylindrical shells and thin spherical shell under internal pressure,

**Thick Pressure Vessel:** Stresses in thick and compound cylinders.

**Text Books:**

1. Advanced Mechanics of Materials–A.P. Boresi and O.M. Sidebottom–John Wiley & Sons
2. Strength of Materials – G.H. Rider – Macmillan
3. Mechanics of Material – J.M. Gere and S.P. Timoshenko – CBS publisher
4. Strength of Materials – R.K. Rajput – S.Chand & Company

**Reference Books:**

1. Mechanics of Material – F.P. Bear and E.E. Johnston – McGraw Hill
2. Strength of Material, Vol. I and II – S.P. Timo Shenko – EWP Press
3. Strength of Material – Dr. Sadhu Singh – Khanna Publishers



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Measurement and Control	Subject Code	ME 20414 (ME)
Semester	IV	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	2	4+1

**UNIT - I**

**Generalized Measurement System:** Introduction - Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, Units of measurement, Static and dynamic performance characteristics of measurement devices, Calibration, Concept of error, Sources of error, Statistical analysis of errors sensors and Transducers – Types of sensors, Type of transducers and their characteristics.

**UNIT - II**

**Measurement:** Measurement of displacement and angular velocity. Measurement of pressure: Gravitational direct acting, Elastic and indirect type pressure transducers. Measurement of very low pressure–McLeod gauge and Pirani gauge. Measurement of temperature: Measurement of temperature by thermometers, Bimetallic, Thermocouples, Thermistors and pyrometers-total radiation and optical pyrometry, Thermocouples, RTDs, Pyrometers, Pyrometric Cones.

**Measurement of Strain:** Type of strain gauges and their working, Strain gauge circuits, McLeod gauge, Pirani gauge, Temperature compensation. Strain rosettes, Analysis of strains, Measurement of force and torque.

**UNIT- III**

**Measurement of flow:** Obstruction meters, Variable head meters, Hot wire and magnetic meters, Ultrasonic flow meters. Vibration and noise measurement: Seismic instruments, Vibration pick ups and decibel meters.

**Data acquisition system:** Introduction to data acquisition systems, Single and multi channel systems, Microprocessors and PC based data acquisition systems. Input – output devices signal transmission and Processing, Devices and systems.

**UNIT- IV**

**Metrology:** Standards of measurement, Linear and angular measurement devices and systems limit gauges, Gauge blocks. Measurement of geometric forms like straightness, Flatness, Roundness and Circularity, principles and application of optical projectors, Tool makers, Microscope, Autocollimators etc. Principle and use of interferometers, Comparators, Measurement of screw threads and gears, Surface texture measurement.

**UNIT- V**

**Control:** Open Loop and Close Loop control, Transfer function, Stability Equations, Feed back systems.

**Text Books:-**

1. Measurement Systems, Application and Design – E.O. Doebelin - McGraw Hill
2. Mechanical Measurements and Control – D.S. Kumar – S.K. Kataria & Sons
3. Mechanical Measurements – G. Beckwith & Thomas G. – Pearson Education
4. Automatic Control Systems-Kuo

**Reference Books:-**

1. Engineering Metrology – K.J. Hume - MacDonald and Company
2. Engineering Metrology – I.C. Gupta - Dhanpat Rai & Sons
3. Mechanical & Industrial Measurements – R.K. Jain – Khanna Publishers.



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Manufacturing Science - I	Subject Code	ME 20415 (ME)
Semester	IV	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	2	4+1

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**UNIT – I**

**Introduction to Manufacturing Processes:** Importance of manufacturing processes, classification, economic and technological definitions of manufacturing processes.

**Foundry Practice**

**Pattern making** - Types, material, allowances, core – types, materials and its properties.

**Mould Making and Casting** - Types of sand moulding, design considerations, moulding machines & moulding procedure, moulding sand – types, properties, composition and applications. Casting defects.

**Special Casting Processes:** Investment casting, centrifugal casting, shell moulding, CO<sub>2</sub> moulding, slush casting, die casting.

**UNIT – II**

**Welding:** Principles of Welding, survey and allied processes

**Arc Welding:** TIG and MIG processes and their parameter selection, atomic hydrogen welding, welding of cast iron, welding electrode – types, composition, specification.

**Resistance Welding:** Principle, equipment and processes. Thermit Welding, brazing & soldering, Internal and external welding defects, Inspection & testing of weld.

**UNIT – III**

**Machine Tool Technology**

**Cutting Tool** – Types, requirements, specification & application

Geometry of Single Point Cutting Tool – Tool angel, Tool angle specification system, ASA, ORS and NRS

**Mechanics of Metal Cutting:** Theories of metal cutting, Chip formation, types of chips, chip breakers, Orthogonal and Oblique cutting, stress and strain in the chip, velocity relations, power and energy requirement in metal cutting.

**UNIT – IV**

**Machine Tools**

**Lathe:** Introduction, type, specification, construction, work holding devices & tools, mechanism and attachments for various operations, taper turning, thread cutting operations, capston and turret lathe.

**Shaper:** Introduction, type, specification, Quick return Mechanisms, Table feed mechanism, work holding devices, shaper operations.

**Slotter & Planner:** Introduction, specification, types of drives, types of machines.

**Milling Machine:** Introduction, specification, types, mechanisms and attachments for milling, milling operations, Indexing-simple, compound and differential.

## **UNIT – V**

**Drilling:** Introduction, drill nomenclature, types of drilling machines, other operations like counter boring, counter sinking, spot facing etc.

**Reaming:** Introduction, description of reamers, type of reaming operations.

**Boring:** Introduction, types of boring machines, boring operations, boring tools

**Broaching:** Introduction, types of broaches, nomenclature of broach, types of broaching machines.

**Surface finishing operations:** Honing, lapping, super finishing, polishing, buffing, process parameters and attainable grades of surface finish.

### **Text Books :**

1. Manufacturing Technology (Vol. – I & II) – P.N. Rao – Tata McGraw Hill, New Delhi
2. A Text Book of Production Technology(Manufacturing Processes) – P.C. Sharma – S. Chand and Company Ltd., New Delhi.

### **Reference Books :**

1. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi
2. Manufacturing Engineering and Technology – S. Kalpakjian & S.R. Schmid – Addison Wesley Longman, New Delhi
3. Production Technology – R.K. Jain – Khanna Publishers, New Delhi
4. A Text Book of Production Technology (Vol. I & II) – O.P. Khanna – Dhanpat Rai & Sons, New Delhi.
5. Shop Theory-James Anderson and Earl E Tatra, T Tata McGraw Hill, New Delhi.
6. Manufacturing Process (Vol-I&II)-H.S. Bawa-Tata McGraw Hill Pub. Company, New Delhi.



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## **DEPARTMENT OF MECHANICAL ENGINEERING**

### **SYLLABUS**

Name of the Subject	Kinematics of Machines	Subject Code	ME 20416 (ME)
Semester	IV	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

#### **UNIT-I**

**Relative velocity:** Elements, pairs, Mechanism, Four bar chain and its inversion, Velocity diagrams, Relative velocity method, Instantaneous centre method.

#### **UNIT-II**

**Relative Acceleration:** Synthesis of mechanism, Pantograph, Lower pair mechanism, Relative acceleration diagram, Kliens construction, Coroillis component of acceleration.

#### **UNIT-III**

**(a) Inertia force analysis:** Effective force and inertia force on link, Inertia force on reciprocating engine. Inertia force in four bar chain mechanism.

**(b) Turning moment diagram and flywheel:** Turning moment diagram for single and multi cylinder internal combustion engine, Coefficient of fluctuation of speed. Coefficient of fluctuation of energy, Flywheel.

#### **UNIT-IV**

**Governors:** Characteristics of centrifugal governors, Gravity controlled governors, Porter and proell. Spring controlled centrifugal governor: Hartung, & hartnell governor. Performance parameter : Sensitivity, stability, Isochoronism, Governor effort and power.

#### **UNIT -V**

**(a) Friction:** Friction in turning pair, Application of friction circle in slider crank and four mechanism, Pivot and collar friction, Thrust bearing.

**(b) Brakes and dynamometer:** Simple block and shoe brake, Band brake, Band and block brake, and internal expanding shoe brake, Absorption dynamometer, Transmission dynamometer.

#### **Text Books:**

1. Theory of machine – S.S.Ratan-Tata McGraw Hill.
2. The Theory of machine – Thomas Beven – CBS Publishers.

#### **Reference Books:**

1. Theory of mechanism and machine – A. Ghosh, A.K. Mallik –EWP Press.
2. Theory of Machine – Shigley, JE
3. Theory of Machine Jagdish Lal
4. Theory of machine – J.E. Singh – McGraw Hill.



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## DEPARTMENT OF MECHANICAL ENGINEERING

### SYLLABUS

Name of the Subject	Computer Graphics	Subject Code	ME 20511 (ME)
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

#### UNIT -1

**Display device:** Refresh Cathode ray Tubes, Random Scan and Raster Scan monitors, Colour CRT Monitors, Direct view Storage Tubes, Continuous Refresh and Storage display, LED and LCD Monitors.

**Graphic primitives:** Points & Lines, Line drawing Algorithm, DDA and Bresenham's Algorithm.

#### UNIT -2

**Attributes of primitives:** Line style, Type, Width, Colour, Character Attributes, Area Filling, Antialiasing.

**Fill Algorithm:** Scan-Line Polygon Fill algorithm, Boundary Fill Algorithm, Flood Fill Algorithm, Seed fill algorithm.

#### UNIT -3

**Analytical & Synthetic curve:**  $C_0$ ,  $C_1$  &  $C_2$  Continuity, Convex hull, Parametric & non parametric representation of curves. Analytic curves: Circle, Ellipse, Parabola, Hyperbola, Splines: linear, quadratic, cubic, hermite, Bezier curves, Synthetic Curves: Circle and ellipse drawing, Parametric and Bresenham's algorithm.

#### UNIT -4

**2D Transformation:** Basic transformation- Translation, Scaling, Rotation, Reflection, Twist, Matrix Representation, Composite Transformations.

**3D Transformation:** Basic Transformations, 3D Display parallel & perspective projection.

#### UNIT -5

**Viewing:** Viewing world co-ordination system, Normalized co-ordinate system, Device/Image co-ordination system, Window definitions, View port definitions, Viewing transformation.

**Clipping:** Point clipping, Line clipping, Cohen- Sutherland clipping, Mid point clipping method, Sutherland and Hodgman Clipping.

**Note:** All the algorithms are to be practiced in the computer Programming Laboratory and practice any computer aided drafting software.

#### Text Books:

1. Computer Graphics-Donald hearn and M.Pauline Baker-Prentice Hall of India Pvt Ltd.
2. Introduction to Computer Graphics – N. Krishnamurthy - TMH Publication.

#### Reference Books:

1. Computer Graphics –Harrington S. – TMH Publication.
2. CAD-CAM Theory and Practice-Ibrahim Zeid- TMH Publication.
3. Computer Graphics - Schaum's Outline –TMH Publication



**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Finite Element Method	Subject Code	ME 20512 (ME)
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

**UNIT -I**

Matrix algebra, the basic concept of FEM, spring and Bar elements, Element stiffness equation, Assembly stiffness equation by direct and inspection approach, Treatment of boundary conditions, Variational method of approximation (Rayleigh Ritz method, method of weighted residuals), potential energy formulation.

**UNIT -II**

Basic equation in elasticity, Stresses and strains, Compatibility equations, Strain-displacement relations, One dimensional problems, Linear, Quadratic and cubic elements, Shape functions, compatibility and convergence requirements, Co-ordinate system, Numerical Integration, Gauss Legendre quadrature, Application problems.

**UNIT -III**

Finite element analysis for plane stress and plane strain problem, Strain displacement matrix for 2-D elements, Co-ordinate transformation, global, local and natural co-ordinates, Two dimensional integrals. Application problems. Scalar field problems including heat conduction and flow problems.

**UNIT -IV**

Stiffness matrix formulation for beam and frame element. Fem equations for plates and shell elements, axisymmetric solid elements, Applications and case studies of plates, shells and axisymmetric solids from structural and thermal viewpoint.

**UNIT -V**

Introduction of Dynamic analysis, Basic equations, Lagrange's equation, lumped and consistent mass matrices, Eigen-value problems and Eigen-modes.

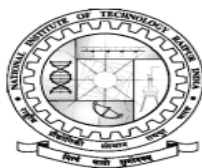
**Note: Solving case studies using user defined subroutines and FEA software – ANSYS and CAE Linux**

**TEXT BOOK**

1. Fundamentals of finite Element Analysis by David Hutton.
2. Finite element in engineering by T.R. Chandrupatla and Belegundu.

**REFERENCE BOOK**

1. Concepts and applications of Finite element analysis by Cook, Malkus, Plesha and Witt.
2. The Finite element Method, A Practical course, Liu and Quek.
3. The Finite element Method in Engineering by S.S. Rao.



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## DEPARTMENT OF MECHANICAL ENGINEERING

### SYLLABUS

Name of the Subject	Fluid Machinery	Subject Code	ME 20513 (ME)
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

#### UNIT – I

**Impact of Free Jets:** Impulse momentum principle, Force exerted by the jet on stationary flat and curved plate, Hinged plate, Moving plate and Moving curve vanes, Jet propulsion of ship.

**Flow around submerge bodies:** Force exerted by flowing fluid on a body, Drag and lift, stream lined and bluff body, Drag on sphere and cylinder, Circulation and lift on circular cylinder, Lift of an air foil.

#### UNIT – II

Introduction to turbo machinery, Basic principles, Classification, Impulse & Reaction type, Fundamental equations, Euler's equation, Introduction to hydro-electric power plants, major components, Surge tanks etc.

**Impulse Turbine:** Classification of turbine, Impulse turbine, Pelton wheel, Construction working, work done, Head efficiency and Design aspects, Governing of impulse turbine.

#### UNIT- III

**Reaction Turbine:** Radial flow reaction turbine, Francis turbine: construction, working, work done, efficiency, design aspect, advantages & disadvantages over pelton wheel.

**Axial flow reaction turbine:** Propeller and Kaplan turbine, Bulb or tubular turbine, Draft tube, Specific speed, Unit quantities, Cavitation, Degree of reaction, Performance characteristics, Surge tanks, Governing of reaction turbine.

#### UNIT-IV

**Centrifugal Pumps:** Classification of Pumps, Centrifugal pump, Construction, working, Workdone, Heads, Efficiencies, Multistage centrifugal pump, Pump in series and parallel, Specific speed, Characteristic, Net positive suction head, Cavitation.

#### UNIT – V

**Reciprocating Pumps:** Classification, Component and working, Single acting and double acting, Discharge, work done and power required, Coefficient of discharge, Indicator diagram, air vessels.

**Fluid system:** Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, Hydraulic crane, Hydraulic lift, Hydraulic Ram, Hydraulic coupling, Hydraulic torque converter, Air lift pump, Jet pump.

#### Text Books:

1. Mechanics of Fluid – Massey B.S. – English Language Book Society (U.K.)
2. Hydraulic Machines - Jagdish Lal – S.K. Kataria & Sons
3. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som & G. Biswas - TMH

#### Reference Books:

1. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd.
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons
3. Hydraulics and Fluid Mechanics – Modi P.N, Seth S.M. – Standard Book House



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Manufacturing Science - II	Subject Code	ME 20514 (ME)
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

**UNIT – I**

**Forging:** Principle, types, tools and fixture of forging, forging dies, forging machines, forging design, drop forging die design, upset forging die design, forging practice and process capability, forging defects, Inspection and testing of forged parts.

**Extrusion:** Principle, extrusion processes, process parameters, extrusion equipment, extrusion defects.

**UNIT – II**

**Rolling:** Principle, classification of rolled products, types of rolling, rolling mill train components, roll pass design for continuous mill.

**Drawing:** Wire drawing, tube drawing: Principle, setup, types.

**Press Working:** Types of presses, selection of press, components of a simple press, press working operations – shear, bending, drawing etc., types of dies, die sets, considerations in die design.

**UNIT – III**

**Machinability:** Concept and evaluation of Machinability, Mechanism of Tool failure, Tool wear mechanism, Tool life, Taylor's Tool life equation, Machinability index, factors affecting Machinability.

**Thermal Aspects in Machining and Cutting Fluid:** Source of heat in metal cutting and its distributions, temp measurement in metal cutting, function of cutting fluid, types of cutting fluid.

**Jigs & Fixtures:** Degree of freedom, principles of location and clamping, locating, clamping and indexing devices, principles of design, design of simple jigs and fixtures.

**UNIT – IV**

**Grinding:** Processes, machines, design consideration for grinding, specification of grinding wheel, process parameters, economics of grinding.

**Gear Cutting:** Principle of gear generations, Gear manufacturing by casting processes, forming processes and Metal removal processes, gear cutting on milling machines (Forming and Generation). Gear finishing processes.

**UNIT – V**

**Unconventional Machining:** Advantages, application and limitation, mechanics of metal removal, specific application of following processes - EDM, ECM, USM, EBM and LBM.

**Thread Rolling:** Principle, Processes, Types of Thread Rolling, and Grinding, advantages and disadvantages.

**TEXT BOOKS:**

1. Manufacturing Technology (Vol. - I & II) – P.N. Rao – Tata McGraw Hill Pub. Company, New Delhi
2. A Text Book of Production Technology (Manufacturing Processes & Technology) – P.C. Sharma – S. Chand and Company Ltd., New Delhi.

**Reference Books:**

1. Machine Tool Engineering – G.R. Nagpal – Khanna Publishers, New Delhi.
2. Production Technology – R.K. Jain – Khanna Publisher – New Delhi
3. Manufacturing Engineering and Technology – Serope Kalpakjian & Schmid – Pearson Education, Delhi.
4. Machine Tool Practices – Kibbe Richard R – PHI, New Delhi.
5. Principle of Metal Cutting – G.C. Sen, A. Bhattacharya – New Central Book Agency (P) Ltd. Calcutta
6. Manufacturing Processes (Vol-I&II) – H.S. Bawa- Tata McGraw Hill pub. Company, New Delhi
7. Production Technology – HMT Bangalore, Tata McGraw Hill pub. Company, New Delhi.



## DEPARTMENT OF MECHANICAL ENGINEERING SYLLABUS

Name of the Subject	Industrial Engineering	Subject Code	ME 20515 (ME)
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

### UNIT – I

**Introduction:** Definition of Industrial engineering, History & development, Objective of Industrial Engineering, Contribution of Industrial Engineering, Function of Industrial engineer, Place of Industrial engineering in an organization, Related discipline, Management, OR, Statistics, Ergonomics.

**Plant Location, Site Selection and Plant Layout :** Need for a suitable location, Urban, Suburban, Systems approach, Factors affecting location, Quantitative method for evaluation of plant location, Objectives & Principles of plant layout, Types of layout and their suitability, Software packages for layout analysis.

### UNIT – II

**Work Study:** Productivity and work study, Introduction and definition of Work-study, Prerequisites of conducting a work study.

**Method Study :** Introduction, definition, procedure, Recording techniques, Flow Process Charts, Critical examination by questioning technique, man-machine chart, Motion economy principles, Micro motion study – Therbligs.

**Work Measurement:** Definition, Objectives, Techniques of Work measurement, Selection & timing the job, Rating, Allowances, Normal and standard time determination, Work sampling.

### UNIT – III

**Industrial Engineering and Information Technology :** Role of IT/ IS in Industry, increasing value of Information Technology, IT as a New Business tool, IT as Business Enabler, IT as business driver, Internet worked enterprise, Internet, Intranet and Extranet, Globalization and IT, Competitive advantage with IT.

**Business Process Re-Engineering:** Definition, Need & characteristics, Industrial Engineering & Re-engineering, Framework for Reengineering, Process of Reengineering, Information Technology leverage in Reengineering, advantages of Re-engineering.

### UNIT IV

**Forms of Business Organization:** Types of Industrial Enterprise, Sole proprietorship, Partnership form, Joint stock company, Company's Act, The Capital and Shares, Private and Public Sector.

**Trade Union:** Meaning and Origin, Objectives of Trade Union, History of Trade Union in India, Laws related to Trade Union.

### UNIT V

**Maintenance Management:** Objectives and need for maintenance, Types of maintenance, Breakdown, Predictive and Preventive Maintenance, Condition based maintenance system.

**Equipment replacement policy:** Reasons for replacement, Deterioration, Obsolescence, Depreciation, Methods for depreciation calculation.

**Value Engineering & Value Analysis:** Definition, Objectives & use of value analysis, Application & techniques.

### Text Books:

1. Introduction to Work Study : International Labour Organization Geneva
2. Industrial Engineering and Production Management - Martand Telsang – S Chand & Company

### Reference Books:

1. Industrial Engineering & Management –A new perspective, Philip E Hicks, Mcgraw Hill
2. Comprehensive Industrial Engineering- N.J. Manek --- Laxmi Publication (P) Ltd.
3. Industrial Engineering and Management Systems – S. Dalela, Mansoor Ali: Standard Publishing Distributors.



## DEPARTMENT OF MECHANICAL ENGINEERING SYLLABUS

Name of the Subject	Machine Design - I	Subject Code	ME 20516 (ME)
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

### UNIT – I

**General Considerations:** Selection of Materials, Design Stress, Factor of Safety, Stress concentration factor in tension, bending and torsion, Theories of failures. Notch sensitivity, Design for variable and repeated loadings, Fatigue stress concentration factor, Endurance diagrams, Introduction to fracture mechanics.

### UNIT – II

**Basic Elements Design:** Types of keys and Splines, Design of Socket-Spigot, Cotter joint, Sleeve and Cotter joint, Gib and Cotter joint, Design of Knuckle joint, Design of Splines.

**Couplings:** Types of couplings, Design of flange and flexible couplings, Compression coupling, Muff coupling.

**Shaft and Axles:** Transmission shaft, Design against static load, Design for strength, Rigidity and stiffness, Design under continuous loading for fatigue.

### UNIT- III

**Threaded fasteners:** Geometry of thread forms, Terminology of screw threads and thread standards, Specifications of steel bolts, Initial tension, Relation between bolt tension and torque, Design of statically loaded tension joints, Design of bolted joints due to eccentric loading.

**Power Screws:** Power screws, Force analysis for square and trapezoidal threads, Collar friction, Stresses in screw, Coefficient of friction, Efficiency of thread, Design of power Screw.

### UNIT – IV

**Riveted Joints:** Types of rivet heads, Types of riveted joints, Failure of riveted joint, Strength of rivet joint, Efficiency of riveted joint, Design of riveted joint, Eccentrically loaded riveted joint.

**Welded joint:** Types of welded joints, Stresses in butt and fillet welds, Strength of welded joints, Location and dimension of weld design, Eccentrically loaded joint, Welded joint subjected to bending moment, Design procedure, Fillet welds under varying loads, Stress relieving techniques.

### UNIT – V

**Pulley & Flywheel:** Flywheel Inertia, Stresses in Flywheel and pulleys, failure criterion.

**Chain Drives:** Chain drives, Roller chains, Geometric relationships, Dimensions of chain components, Polygonal effect, Power rating of roller chains, Selection of Chain drives.

**Belt & Rope Drive:** Design of Flat and Round belt drives, V-Belt, Timing belt, Wire Rope.

#### Text Books:

1. Machine Design by-J.E. Shigly-McGraw Hill Publications.
2. Design of Machine Elements from V.B. Bhandari, TMH Publications.

#### Reference Books:

1. Machine Design – P.C.Sharma & D.K. Agrawal-Kataria & Sons Publications.
2. Principles of Mechanical Design - R. Phelan – McGraw Hill Pub.
3. Machine Design - An Integrated Approach Robert-L-Norton Published by Addison Wesley Longman (Singapore)
4. Machine Design – M. F. Spott – PHI
5. Machine Design, Theory & Practice – J. Michels Walter, E. Wilson Charles – Add MacMilan Publishers, New York.



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Dynamics of Machines	Subject Code	ME 20611 (ME)
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT- I**

**Cams:** Classification of cams and followers, Nomenclature of a radial cam, Description of follower movement, Displacement diagrams, Uniform and modified uniform motion, Simple harmonic motion, Uniform acceleration motion and its modifications, Cycloidal motion, Synthesis of cam profile by graphical approach, Considerations of pressure angle.

Cams with specified contours: Circular arc cam & tangent cam.

**UNIT – II**

**Gear:** Types of gears, Gear terminology, Law of gearing, Gear tooth forms, Involute and Cycloid tooth profile, Interference and Undercutting of Involute teeth, Minimum number of teeth on pinion to avoid interference.

**Gear trains:** Simple, Compound, Reverted, and Epicyclical gear trains, computation of velocity ratio in gear trains by different methods.

**UNIT - III**

**Balancing:** Balancing of rotating masses, Static and dynamic balancing, Determination of balancing masses in two plane balancing, Balancing of internal combustion engines, Balancing of in-line engines, Firing order, Balancing of V-twin and radial engines, Forward and reverse crank method, Balancing of rotors.

**UNIT- IV**

**Gyroscope:** Gyroscopic forces and couple, Gyroscopic effect in Airplanes, Ship motion and Vehicles moving on curved path.

**UNIT- V**

**Mechanical Vibrations:** One dimensional longitudinal, Transverse, and torsional vibrations, Natural frequency, Effect of damping on vibrations, Different types of damping. Forced vibration, Forces and displacement, Transmissibility, Vibration Isolation, Vibration sensors: seismometer and Accelerometers, Whirling of shafts with single rotor.

**Text Books:**

1. Theory of Machine- S.S.Rattan - Tata McGraw Hill
2. The Theory of Machines - Thomas Bevan, - CBS/ Cengage Publishers
3. Theory of Machines – J. E. Shigley – McGraw Hill

**Reference Books:**

1. Theory of Mechanisms and Machines- A. Ghosh, A. K. Mallik – EWP Press .
2. Theory of Machine – P.L. Ballaney – Khanna Publishers .



## DEPARTMENT OF MECHANICAL ENGINEERING

### SYLLABUS

Name of the Subject	Turbo Machinery	Subject Code	ME 20612 (ME)
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

#### UNIT – I

**Impulse Turbine:** Steam turbine– Principal of operation of steam turbine, Types, Impulse turbine compounding of steam turbine- pressure compounded velocity compounded and pressure – velocity compounded impulse turbine, Velocity diagram for impulse turbine, Force on the blade and work done, Blade or diagram efficiency, Gross stage efficiency. Influence of ratio of blade to steam speed on blade efficiency in a single stage impulse turbine. Efficiency of multi-stage turbine, Impulse blade sections, Choice of blade angle. Blade height in velocity compounded impulse turbine.

#### UNIT – II

**Impulse Reaction Turbine:** Velocity diagram, Degree of reaction, Impulse-reaction turbine with similar blade section and half degree of reaction (Parson's turbine), Height of reaction Turbine blade section, Internal losses in steam turbine Nozzle, Losses, Blade friction losses, Disc friction losses, Blade windage losses or partial admission losses, Gland leakage or clearance losses, Leaving velocity or residual loss, Carry loss.

#### UNIT – III

**State Point Locus and Reheat Factor:** Factor-Stage, Efficiency of impulse turbines, Stage point locus of an impulse turbine, State point locus for multistage turbine reheat factor. Internal efficiency, Overall Efficiency, Relative efficiency, Governing of steam turbine. Throttle governing, Nozzle governing, Bypass governing, Combination of throttle and nozzle, Governing and combination of bypass and throttle governing. Effect of governing on the performance of steam turbine.

#### UNIT – IV

**Gas Turbine:** Classification of gas turbine, Simple open cycle gas turbine, Ideal and actual cycle (Brayton Cycle) for gas turbine, Optimum pressure ratio for maximum specific output in actual gas turbine, Regeneration, Reheat and inter cooling and effect of these modification on efficiency and output, Closed cycle gas turbine.

#### UNIT – V

**Turbo Compressors:** Introduction, Classifications of Centrifugal compressors – components, Working, Velocity diagrams, Calculations of power and efficiencies, Slip factor, Surging and choking power and efficiencies.

**Axial Flow Compressor:** Construction and working, Velocity diagram, Calculation of power and efficiencies, Degree of reaction, Work done factor, Stalling, Comparison of centrifugal and axial flow compressor.

#### Text Books:

1. Steam and Gas turbine – By R. Yadav - Central Publishing House, Allahabad.
2. Gas Dynamics with Application: S.K. Kulshrestha.

#### Reference Books:

1. Turbine compressors and Fans – S.M. Yahya – TMH
2. Gas Turbine – V. Ganeshan – TMH



## DEPARTMENT OF MECHANICAL ENGINEERING

### SYLLABUS

Name of the Subject	Energy Conversion System	Subject Code	ME 20613 (ME)
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

#### UNIT- I

**Boilers:** Classification of boilers, Boiler Mountings & Accessories, Draught & its classification, chimney height & diameter calculation, efficiency of a chimney, Draught Losses.  
Modification of boilers, High Pressure Boilers – La-Mont, Benson, Velox and Super Critical Boiler, Fluidized Bed Boiler.

#### UNIT – II

**Steam Condensers:** Function & Various types of condenser, their efficiency, vacuum efficiency and measurement. Source of air leakage, Effect of air leakage & removal, Thermodynamic analysis.

#### UNIT – III

**Direct Energy Conversions:** Tidal Energy conversion, OTEC, MHD Power System, Geothermal Energy Conversion Technique, Thermo-electric effects, Thermo-electric & thermionic converters

#### UNIT – IV

**Jet Propulsive Devices:** Types of jet engines, Principal and operation, thrust, energy flow through jet and variation of pressure and temperature, and velocity of fluid, Thermodynamics of turbo jet, efficiency and performance, Turbo prop, Ram jet, Pulse jet, Comparison of various propulsive devices.

#### UNIT – V

**Rocket Propulsion:** Types of rocket engines, Basic theory, Physics equations, Classifications, Liquid propellant rockets, Its advantage, Efficiency and performance, Rocket projection and escape velocity.

#### Text Books:

1. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion – S.M. Yahya – New Age International Publishers
2. Thermal Engineering – R.K. Rajput.
3. Thermodynamics & Heat Engines – R. Yadav – CPH.

#### Reference Books:

1. Fundamental of Compressible Fluid Dynamics – P. Balachandran – PHI
2. Gas Turbine Theory & Jet Propulsion – J.K. Jain – Khanna Publishers
3. Fundamentals of Engineering Thermodynamic – R. Yadav – CPH.



## DEPARTMENT OF MECHANICAL ENGINEERING

### SYLLABUS

Name of the Subject	Industrial Management	Subject Code	ME 20614 (ME)
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

#### UNIT – I

**Basic Concepts and Functions of Management:** Definition, Management, Science or art? System approach to Management, Social responsibility of Manager, Social responsibility and Social responsiveness, ethics and management, Functions of Management.

**Management of Organizations:** Nature and purpose of organizing, Formal and informal organization, Types of organization structure- Line and Staff concept, Functional design, Multi divisional form, Conglomerate form and Matrix form of organizations. Mechanistic and Organic structure, Flat and Tall Structure, Span of Control, Differentiation and Integration, Centralization and Decentralization. Fayol's guidelines for effective management: Division of Labour, Unity of Command, Unity of direction, Authority, Discipline, Initiative.

#### UNIT – II

**Human Resource Management:** Nature and Scope of Human Resource Planning, Training and Development, Recruitment and Selection, Career Growth, Grievances, Motivation and its types, Need for Motivation, Reward and Punishment, Need want satisfaction chain, Maslow's hierarchy of needs. Quality of working life, Job enrichment and Job enlargement.

**Financial Management:** Functions of Financial Management, Book keeping and accounting, Financial statement Analysis, Financial Ratios, Capital Budgeting, Break-Even Analysis.

#### UNIT – III

**Strategic Management:** Concept of Strategy and Strategic Planning, Corporate strategy, Objectives, Goal, policies, Mission and Vision, SWOT analysis, Framework for Strategy, Porter's Framework for Industry Analysis, BCG Matrix, McKinsey's 7S Framework, Formulation, decision Making and Implementation of Strategy.

#### UNIT – IV

**Management Information System:** Role of information in decision making, Definition of MIS, computer based user machine system, integrated system, MIS v/s Data processing, subsystem of an MIS, MIS, DSS and Expert system. Evolution and effectiveness of Information system.

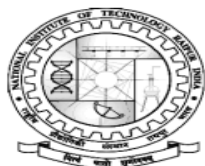
**Enterprise Resource Planning:** Introduction to ERP, Brief history of ERP, Importance and advantages of ERP to a company, Risks and benefits of ERP, ERP Implementation Strategies, Common ERP Packages.

#### UNIT – V

**Flexible Systems Management:** Definition of Flexibility, Connotation of flexibility, Systematic concept of flexibility, Foundation of flexible system management, Types of flexibility and its applications in management of modern organizations. Flexy tools, SAP-LAP Analysis.

**Text Books:**

1. Essential of Management: H. Koonz and h. Weihrich.
2. MIS conceptual foundation, structure and development, G B Davis & M H Olson.
3. Flexibility in Management, Sushil, Vikas publication, New Delhi.
4. Strategic Management– John a Pearce, Richard B Robinson: Tata McGraw-Hill Publishing Co. Ltd.
5. Organizational Behavior Concepts, Controversies Applications - Stephen, P. Robbins- Prentice Hall, Englewood Cliffs, New Jersey.
6. Financial Management – M.Y. Khan and P.K. Jain - Tata Mc-Graw Hill.
7. Competitive Advantage - Porter Michael - The Free Press.
8. Competitive Strategy - Porter Michael - The Free Press, 1985.
9. Fundamentals of Business Organizations and Management – Y.K. Bhusan – S. Chand and Sons.
10. Enterprise Resource Planning: Alexis Leon – Tata Mc-Graw Hill Publishing Co. Ltd. Strategic Management – S C Bhattacharya: Wheeler Publishing, New.



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Automobile Engineering	Subject Code	ME 20615 (ME)
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT-I**

**Chassis & Frame:** Layout of chassis & its main components, Types of frames, Conventional frames & unitized Chassis.

**Springs :** Purpose, Types namely leaf, Coiled, Rubber, Air, Torsion bar, Stabilizer, Telescopic damper.

**Suspension system:** Objects & principles of suspension, system, Types, Rigid axle & Independent suspension for front & rear ends, Simple & double arm parallel & perpendicular type of suspension system, Gas filled suspension system.

**UNIT – II**

**Clutches:** Characteristics, Functions, Principles of operation of clutch, *Friction clutch:* Single plate, Multi plate, Centrifugal clutch, Positive clutch, clutch lining materials. Torque transmitted and related problems.

**Fluid flywheel:** Characteristics, Construction, principles of working.

**UNIT – III**

**Gear Box:** Object of Gear Box, Air, Rolling & Gradient resistance, *Necessity of Gear Box:* Tractive effort variation with speed, *Types of Gear Boxes :* Sliding mesh, Constant mesh, Synchromesh, Automatic transmission, Overdrive, Lubrication of gear box. **Torque converter:** Principles of working, characteristics, Torque converter with direct drive, Testing of automobiles.

**UNIT – IV**

**Universal Joint,** Types, propeller shaft, slip joint.

**Differential:** Functions, Single & double reduction differential, Limited slip differential.

**Front Axle:** Live & dead axle, Stub axle.

**Back Axle:** Hotch kiss drive, Torque tube drive.

**Tyres:** Types specification, Causes of tyre wear & rim.

**Brakes & Braking system:** Purpose, Principles, Layout of braking system. Classification: mechanical, Hydraulic brakes, Master cylinder, Tandem master cylinder, wheel cylinder, Self energizing & self adjusting brakes, Disc brakes, Antiskid brakes. Power operated brakes.

**UNIT – V**

**Steering system:** Types of steering gears, Reversibility of steering, Center point steering, ~~Steering~~ geometry namely castor, Camber, King pin inclination, Toe in, Toe out, cornering power, Under & over steer; power steering, effect of shimmy, Condition of true rolling, Calculation of turning radius. Correct steering equation and related problems.

**Electrical System:** Battery construction, Maintenance, Testing and charging, Cutout, Lighting circuit, Horn, Signals.

**Text Books:**

1. Automobile Engineering – Vol I and II - Kripal Singh – Standard Publications
2. Automotive Mechanics – Heitner
3. Automobile Engineering – G.B.S. Narang – Khanna Publishers
4. Motor Vehicle – Newton & Steeds – Life & Sons Limited.

**Reference Books:**

1. Automobile Engineering - Dr. N. K. Giri – Khanna Publishers
2. Automobile Engineering – K. R. Govindan – Anuradha Agencies



**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Air Pollution Control (Elective – I)	Subject Code	
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

**UNIT - I**

**Air Pollution: Introduction**

Air Pollution, sources & classification of air pollutants, aerosols, Primary & secondary air pollutants, Photochemical Air pollution, Effect of air pollution on human health, vegetation and materials, Pollutant concentration, types, relationship between different concentration

Air pollution indices, determination of index, Air pollution legislation & regulations (1981 & 1986)

**UNIT - II**

**Air pollution: Transportation & Major Industries**

Air pollution due to automobiles, types of emission from IC Engines, Effect of various operating variables on exhaust emission, control of emissions from IC Engines.

Air pollution from major industries: Fe & Steel Industry, Thermal Power Plants Cement Industries.

Smoke, measurement of smoke and its control.

**UNIT – III**

**Meteorological Aspects of Air pollutant Dispersion**

Temperature Lapse rates & stability, wind velocity and turbulence, Plume Behaviour, Dispersion of air pollutants, the Gaussian Plume Model.

**UNIT – IV**

**Air Pollution Sampling & Measurement**

Types of pollutant sampling techniques and measurement, Ambient Air Sampling, collection of gaseous air pollutants and particulate pollutants, stack sampling techniques, analysis of air pollutants.

**UNIT – V**

**Air Pollution control methods & Equipment**

Air pollution source correction methods: Process changes, equipment modification/ machinery replacement etc.

Gases/Odour control: Combustion, Absorption, Adsorption.

Control equipments: Objectives and choice of control equipment, Settling chamber, Inertial separators, Cyclones, filters, Electrostatic Precipitator, Scrubbers.

**Text Books:**

1. Air Pollution- M.N. Rao, H.V.N. Rao, Tata McGraw Hill Company.
2. Air Pollution control Theory- Martin Crawford, Tata McGraw Hill Company.
3. Environmental Pollution Control Engineering - C.S. Rao, New Age International Limited Publishers.



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Robotics (Elective – I)	Subject Code	
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

**UNIT – I**

**Introduction:** Fixed & Flexible Automation, Evolution of Robots and Robotics, Laws of Robotics, Progressive, Advancement in Robots, Manipulator Anatomy, Arm Configuration & work space, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Actuators, Sensors and Vision, Programming of Robots, Applications – Material Handling, Processing Applications, Assembly Applications, Inspection Applications etc.

**UNIT – II**

**Coordinate Frames, Mapping and Transforms:** Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices. Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modeling of the Manipulator, Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation matrix.

**UNIT – III**

**Kinematic Modeling of Robots:** Position analysis – Direct and Inverse Kinematic Models of Robotic Manipulators, Various examples. Velocity Analysis – Jacobian matrix.

**UNIT – IV**

**Robotic Sensors and Vision:** Sensors in Robotics, Classification, Characteristics, Internal Sensors – position, velocity, acceleration sensors, Force sensors, External sensors – proximity, touch and slip sensors. Robotic vision, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Components of Vision System, Image Representation, Image Processing.

**UNIT – V**

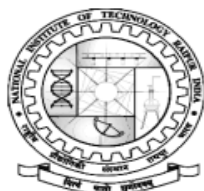
**Motion Planning and Control of Robot Manipulators:** Trajectory planning of Robotic Manipulator: Joint Space and Cartesian Space techniques. Open and Close Loop control, Linear control schemes, Examples of Control models.

**Text Books:**

1. Robotics & Control – R.K. Mittal & I.J. Nagrath – TMH Publications.
2. Introduction to Robotics Analysis, Systems Applications by Saged B. Niku, Pearson Education.

**Reference Books:**

1. Kinematics and Synthesis of linkages – Hartenberg and Denavit – McGraw Hill.
2. Robotics Control Sensing, Vision and Intelligence – K.S. Fu, McGraw hill Book co.
3. Robotic Engineering – An Integrated Approach by R.D. Klafter – PHI Ltd. Delhi.
4. Introduction to Robotics by S.K. Saha – Mc Graw Hill.
5. Introduction to Robotics – Mechanics and Control by John J. Craig – Pearson Education.



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Heat & Mass Transfer	Subject Code	ME 20711 (ME)
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT-I**

**Introduction:** Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzman's Law, Combined modes of heat transfer, Thermal transfer, Thermal diffusivity, Overall heat transfer coefficient.

**Conduction:** The thermal conductivity of solids, Liquids and gases, Factors influencing conductivity measurement. The general differential equation of conduction, One dimensional steady state conduction, Linear heat flow through a plane and composite wall, Tube and sphere, Critical thickness of insulation, Effect of variable thermal conductivity, Conduction with heat generation in slab and cylinders, Spheres.

**UNIT-II**

**Fins:** Conduction convection system, Extended surfaces rectangular, Triangular, Circumferential and pin fins, General conduction analysis, Fins of uniform and non-uniform cross sectional area. Heat dissipated by a fin. Effectiveness and efficiency of fins, Approximate solution, Design of fins for maximum heat transfer, Solution for different boundary condition, Use of fin analysis for measuring temperature error of Thermometer.

**Transient/Unsteady State Heat Conduction:** System with negligible internal resistance, Lumped capacity method and its Validity. Unsteady state conduction through finite and semi- infinite slab without surface resistance, convection boundary conditions. Solution through Heisler's chart.

**UNIT-III**

**Forced Convection:** Physical Mechanism of Forced Convection, Dimensional analysis for forced convection, velocity and Thermal Boundary layer, Flow over plates, Flow across cylinders and spheres, Flow in tubes, Reynold's analogy.

**Natural Convection:** Physical Mechanism of Natural Convection, Dimensional analysis of natural convection; Empirical relationship for natural convection.

**UNIT-IV**

**Two Phase Heat Transfer:** Boiling heat transfer, Pool boiling, Boiling regimes and boiling curve, Next transfer correlations in pool boiling, Condensation heat transfer, Film condensation, Derivation for the average heat transfer coefficient 'h' for the case of laminar film condensation over vertical plate, Heat transfer correlation for inclined plates, Vertical tubes, Horizontal bank tubes.

**Heat Exchangers:** Different types of heat exchangers; Determination of heat exchanger performance, Heat exchanger transfer units, Analysis restricted to parallel and counter flow heat exchanger (LMTD and NTU method)

## **UNIT-V**

**Thermal Radiation:** Introduction, absorption and reflection of radiant energy, Emission, Radiosity and irradiation, Black and non black bodies, Kirchoff's law, Intensity of radiation, Radiation exchange between black surface, Geometric Configuration factor. Grey body relation exchange between surface of unit configuration factors, Electrical analogy to simple problems. Non-luminous gas radiation. Errors in temperature measurement due to radiation.

**Introduction to Mass Transfer:** Mass and mole concentrations, Molecular diffusion, Eddy diffusion, Molecular diffusion from an evaporating fluid surface, Introduction to mass transfer in laminar and turbulent convection Combined heat and mass transfer, the wet and dry bulb thermometer.

### **Text Books:**

1. Heat Transfer – S.P. Sukhatme – Tata McGraw Hill
2. Heat Transfer – J.P. Holman – Tata McGraw Hill
3. Heat transfer- C P Arora, Tata McGraw Hill

### **Reference Books:**

1. Heat & Mass Transfer – K. Kannan – Anuradha Agencies
2. Heat Transfer – A Practical Approach–Yunus A. Cengel – McGraw Hill
3. Heat Transfer – Ghosh, Dastudhar – Oxford University Press
4. Heat & Mass Transfer – D.S. Kumar – S.K. Kataria & Sons.



DEPARTMENT OF MECHANICAL ENGINEERING  
SYLLABUS

Name of the Subject	Operation Research	Subject Code	ME 20712 (ME)
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

**UNIT I**

**Introduction:** Definition and Development of Operations Research, Necessity and scope of OR in Industry, Operations Research in Decision making, Models in OR, Fields of application, Difficulties and Limitation of OR.

**General Linear Programming Problems:** Introduction, Maximization and minimization of function with or without Constraints, Formulation of a linear programming problem, Graphical method and Simplex method, Big M method, Degeneracy, Application of Linear Programming (LPP) in Mechanical Engineering.

**UNIT – II**

**The Transportation Problems:** Mathematical formulation, Stepping stone method, Modified Distribution Method, Vogels Approximation Method, Solution of balanced and unbalanced transportation problems and case of Degeneracy.

**The Assignment Problems:** Mathematical formulation of assignment problems, Solution of assignment problems, Traveling salesman problems, Air crew Assignment problems.

**UNIT - III**

**Waiting Line Theory:** Basic queuing process, Basic structure of queuing models, Some commonly known queuing situations, Kendall's notation, Solution to M/M/1:  $\infty$  /FCFS models.

**Network Analysis:** CPM/PERT, Network Representation, Techniques for drawing network, Resource smoothing and levelling, Project cost, Optimum project duration, Project crashing, Updating, Time estimation in PERT

**UNIT – IV**

**Decision Theory and Game Theory:** Decision making, Steps in decision theory approach, Decision making under certainty, Uncertainty and under condition of risk, Decision Tree, Theory of Games, Two person zero sum game, Methods for solving two person zero sum game.

**Simulation:** Basic concept of simulation, Applications of simulation, Merits and demerits of simulation, Monte Carlo simulation, Simulation of Inventory system, Simulation of Queuing system.

**Text Books:**

1. Operation Research , Sasien Yaspan
2. Operation Research – N. D. Vohra – TMH
3. Operation Research– Hira & Gupta – S. Chand & Co.
1. Operation Research – H. Gillette – TMH, New Delhi
2. Operations Research – M. Taha – TMH, New Delhi
3. Fundamentals of Operation Research – Ackof Sasieni – Dhanpat Rai & Sons
4. Quantitative Approach to Management – Lovin and Krit Patrick – TMH
5. Operation Research– S.D. Sharma – S. Chand & Com. New Delhi.



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Website: [www.nitr.ac.in](http://www.nitr.ac.in)

DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Refrigeration and Air Conditioning	Subject Code	ME 20713 (ME)
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT-I**

Refrigeration and second law of thermodynamics, Reversed Carnot Cycle. Its practical limitations, Standard Vapor compression Refrigeration System and its performance analysis. Effect of evaporator and condensing temperatures. Modifications, its effects, Liquid-to-Suction heat exchanger, Effect of Superheat and criteria For optimum superheat, Actual vapor compression refrigeration systems, Limitations of single stage.

**UNIT-II**

**Multi-stage systems:** Concept of flash gas removal using flash tank, inter cooling, with flash gas removal and inter cooling, use of flash tank for flash gas removal only, limitations of multi-stage systems.

**Multi-Evaporator systems:** Applications, Comparison, advantages, Systems using single compressor and a pressure reducing valve with: Individual expansion valves & multiple expansion valves, Systems with multi compression, inter cooling and flash gas removal, with individual compressors and multiple expansion valves, Cascade systems.

**UNIT-III**

**Gas Cycle Refrigeration:** Limitation of Carnot and reversed Carnot Cycle, Modified Cycle, Reversed Bell-Colemann, Actual Bell-Colemann Cycle, Application of Aircraft Refrigeration, Different methods: Simple, Evaporative, Boot Strap, Boot Strap with evaporative, Reduced ambient, Regenerative and comparison of different air cooling system in Air Craft.

**Cooling Tower:** Types and performance evaluation, efficient system operation, Flow control strategies and energy saving opportunities, Assessment of cooling towers.

**UNIT-IV**

Psychrometry, estimating properties of moist air, psychrometry chart, Straight line law, adiabatic saturation and thermodynamic wet bulb temperature, psychrometer and the precautions, psychrometric processes and their representation, various psychrometric processes, equations for heat and mass transfer rates, Concept of SHF, By pass factor and ADP, Air washer and its use.

**UNIT-V**

**Inside and Out Side Design Condition:**

Fixing suitable indoor and outdoor design conditions, criteria, thermal comfort, metabolic rate, heat balance equation, equations for all modes of heat losses from the skin, thermo-regulatory mechanism. Factors affecting thermal comfort, thermal indices, presents ASHRE comfort chart, Concept of Predicted Mean Vote (PMV) and percent of people Dissatisfied(PPD), criteria used for selecting outside design conditions and present typical summer design conditions.

Psychrometric calculations, Simple summer air conditioning system with 100% re-circulated air, various Summer air conditioning systems with ventilation and with zero and non zero by pass factor, with re-heat for high latent cooling load applications, Selection guidelines for supply air conditions.

**Text Books:**

1. Refrigeration And Air Conditioning by C.P. Arora, Tata McGraw-Hill
2. Refrigeration And Air Conditioning by R.K. Rajput Kaston Publication
3. Refrigeration And Air Conditioning by Arora & Domkundwar, Dhanpat raj Sons

**Reference Books:**

1. Refrigeration And Air Conditioning by stooker W.F.
2. Refrigeration And Air Conditioning by ahmadaul Ameen, PHI publication
3. Hand book of Air Conditioning and Refrigeration by Shan K. Wang, Tata McGraw-Hill



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DEPARTMENT OF MECHANICAL ENGINEERING  
SYLLABUS

Name of the Subject	Power Plant Engineering (Elective-II)	Subject Code	
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT-I**

General Sources of power, Importance of Central Power Stations, Types of power stations – steam, Nuclear, Diesel and hydro – Elements of modern power stations (Steams only) brief layout and arrangement of elements and complements, Sitting of different power stations, Foundation, Elements of Electric power systems primary and secondary distribution substations (in brief).

**UNIT – II**

**Steam Power Plant:** Steam power plants selection of working medium, Heat Balance in steam cycles, Heat rates, Comparison of efficiencies gas loop, Fuels and fuel handling System and Ash handling System, Air pre-heater, Feed water pre-heaters, Steam re-heaters, Dearators, Feed water treatment, Pumping and regulation water walls, Modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output.

**UNIT – III**

**Hydro Electric power station** – Potential power with reference to rainfall and catchments area, Water storage, Equipment used in hydro electric power stations, Characteristics of hydraulic turbines, Comparison of the factors governing the cost of hydro steam and diesel power stations.

**Diesel power station** – Application of Diesel in power field, Suitability of diesel engines for bulk power, Layout of Diesel Power Plant, Advantages and limitations of diesel, Power stations, Performance Characteristics.

**UNIT – IV**

**Nuclear Power Station:** Evolution of nuclear energy from atoms by fission and fusion, Chain reactions, Fission materials, Types of reactors, gas cooled, Boiling water liquid, Metal cooled and fast reactor, Arrangements of various elements in a nuclear power station, Steam cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods.

**UNIT – V**

**Variable load problems:** Idealized and realized load curves, Effect of variable load on plant design and operation variable load operation and load dispatch.

**Power station Economics:** Source of income, Cost of plant and production, Elements of cost, depreciation and replacement theory of rates.

**Text Books:**

1. Power Plant Engineering, 2nd Edn. – P.K. Nag – Tata McGraw-Hill Pub. Com., New Delhi, 2004
2. A Text Book of Power Plant Engineering – R.K. Rajput – Laxmi Publications
3. A Course in Power Plant Engineering – Arora, Domkundwar – Dhanpat Rai & Co., 2005

**Reference Books:**

1. Power Plant Engineering – F.T. Morse Affiliated East – West Press Pvt. Ltd., New Delhi.
2. Power Plant Technology – M.M. El – Wakil – McGraw Hill, International Edition 1984
3. Power Plant Engineering – G.R.Nagpal – Khanna Publishers.
4. Fundamental of Power Plant Engineering-R.Yadav-Central Publishing House Allahabad,2011



DEPARTMENT OF MECHANICAL ENGINEERING  
**SYLLABUS**

Name of the Subject	Computer Aided Design and Manufacturing	Subject Code	ME 20811 (ME)
Semester	VIII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT-I**

**Introduction:** Introduction of CAD/CAM, Definition of CAD & CAM Tools, CAD/CAM Tools based on their constituents and their implementation in a design environment, Benefits of CAD/CAM. 2D & 3D Transformations, Perspective and Parallel Projection, Hidden surface Removal.

**Geometric Modeling of Curves:** Parametric and Non parametric, Explicit and Implicit, Representation of curves. **Analytical Curve:** Line, Circle, Conics. **Synthetic curve:** Hermite Cubic Splines, Bezier Curves, B-Spline Curves.

**UNIT –II**

**Representation of Surface:** Parametric Representation of surfaces, Equation of surface, Tangent vector, Normal vector, Twist vector, Parametric patches and surfaces, Analytical surfaces: Ruled surface, surface of revolution, Tabulated cylinder. Synthetic surface: Hermit bi-cubic surface, Bezier bi-cubic surface, B-spline bi-cubic surface, Coon's surface.

**Solid Modeling:** Solid modeling techniques, Geometric and Topology, Valid solid, Types of solid modeling, Algorithms, Basic set theory, Solid Representation Schemes. CSG representation, 3D base primitives, Unary Operation, Boolean's Operation, Sweeping Operation and CSG tree.

**UNIT-III**

**Numerical Control:** Introduction to numerical control, Basic component of an NC System, The NC Procedure, NC coordinate systems, NC motion control system, Application of NC, Introduction to Computer Control in NC, Problem with Conventional NC, Computer Numerical control, Direct Numerical control, Combined DNC/CNC System, Adaptive control system. NC Part Programming, Introduction to NC Part programming, Manual Part Programming, Computer assisted part programming APT language, G&M codes and examples, Introduction to Rapid Prototyping.

**UNIT IV**

**Group Technology:** Introduction to group technology, Part families, Part and classification, Three Parts Classification & Codes system, Group technology Machine cell design, Benefits and Limitation of Group technology.

**Data base Management:** Design Database concept, Objective, Data structures, Creation of Data Files in application Program and relational Database management system.

**UNIT-V**

**Computer Aided Design of Planer Mechanism:** Kinematic synthesis, Type, Number, **Dimension Synthesis:** Function generation, Path generation, Motion generation, Approximate synthesis and Tchebyshev's spacing of accuracy points, Freudenstein's equation for four bar link mechanism and slider crank mechanism by displacement method and vector method; Angular velocities and acceleration, coupler curves.

**Text Books:**

1. CAD/CAM Theory and Practice-Ibrahim Zeid-Tata McGraw Hill Publications
2. CAD/CAM-Milkell P. Groover, Emory W.Zimmer-Pearson Education
3. Theory of mechanism and Machine-Ghosh and Malik-EWP

**Reference Books:**

1. Computer numeric control-T.Jeyapoovan, Robert Quesada-Pearson Education
2. Kinematic Synthesis of linkages-Richard S Hartenberg, Jacques Denavit-McGraw Hill
3. CAM/CAD principle & Applications-P.N.Rao- Tata McGraw Hill Publications.



DEPARTMENT OF MECHANICAL ENGINEERING  
SYLLABUS

Name of the Subject	Machine Design - II	Subject Code	ME 20812 (ME)
Semester	VIII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4+2

**UNIT-1**

**Spur gears:** Introduction, Types of failure, design requirements, gear terminology, design analysis, stress concentration, dynamic load, surface compressive stress, beam strength, plastic deformation, gear materials, design procedure, design as recommended by AGMA. Gear Lubrication.

**UNIT-2**

**Helical Gears:** Terminology of Helical Gears, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength, Effective Load on gear tooth, design procedure.

**Bevel Gears:** Terminology of Bevel Gears, Force Analysis, Beam strength, effective load on gear tooth, design procedure, design as recommended by AGMA.

**UNIT-3**

**Rolling Contact Bearings:** Types of ball and roller bearing, Selection of bearing for radial and axial load, Bearing life, design procedure, mounting and lubrication.

**Plain or Journal Bearings:** Types of lubrication, Viscosity, Hydrodynamic theory of lubrication, Sommerfeld number, Heat balance, design procedure. Self-contained bearings, bearing materials.

**UNIT-4**

**Spring:** Spring Materials and their Mechanical Properties, Equation for stress and deflection, Helical coil springs of circular section for tension, compression and torsion, Dynamic loading, Fatigue loading, Wahl line. Leaf spring and disc springs.

**UNIT-5**

**Brakes:** Introduction, Block Brake, design procedure, Internal Expanding Shoe Brake, design procedure, Band brakes, design procedure, Disc brake, design procedure.

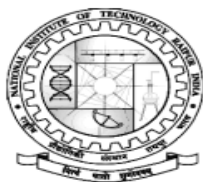
**Clutches:** Introduction, Friction materials, Torque transmitting capacity, Single & Multiple plate clutch, Centrifugal clutches, Cone clutch.

**Text Books :-**

1. Machine Design by T.V. Sunderarajamoorthy and N. Shanmugam – Anuradha Agencies.
2. Mechanical Engineering Design by J.E. Shigley – Mc Graw Hill Publication.
3. Machine Design by P.C. Sharma and D.K. Agrawal – Kataria & Sons Publications.

**Reference Books :**

1. Machine Design An Integrated Approach, Robert L –Norton published by Addison Wesley Longman (Singapore)
2. Design of Machine elements by V.B. Bhandari, Tata McGraw Hill Publications.
3. Machine Design by Mobin – Mir Publishers.



DEPARTMENT OF MECHANICAL ENGINEERING  
SYLLABUS

Name of the Subject	Production Management	Subject Code	ME 20813 (ME)
Semester	VIII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

**UNIT-I**

**Production Management:** Definition, Objectives, Scope, Benefits, Functions of production management, Place of production management in an organization, Types of production system, Product life cycle, Product design and development, production cycle.

**Costing and Cost Analysis:** Elements of costs, Break even analysis, Incremental costs, make or buy decision.

**Sales Forecasting:** Purposes, Methods – Delphi, Linear regression, Economic indicators, Time-series analysis, Adjustment for seasonal variations, Moving average, Exponential smoothing.

**UNIT-II**

**Material Management:** Objectives and functions of materials management, Organization of materials management, MRP I and MRP II.

**Procurement:** Objectives of purchase department, Purchase responsibilities and organization, Types of purchasing, Purchase procedures, Import and Export.

**Stores Keeping:** Stores management, Functions of stores, Classification of materials, Standardization of materials, Identification and maintenance of layout of stores, Physical control of materials, Pricing of stores, Issuing of stores.

**UNIT-III**

**Production Planning and Control :** Functions, Organization, Master Scheduling, Aggregate planning and strategies, Materials requirement planning, Product structure tree, Routing, Loading, Scheduling – forward and backward, Dispatching – priority rules, Sequencing, Johnson’s algorithm for n jobs and two machines, Gantt’s chart, Bar chart, Flow process chart.

**Materials Handling:** Principles of materials handling, Unit load, Types of materials handling equipment, Relation between materials handling and plant layout.

**UNIT – IV**

**Inventory Control:** Objective, Scope and functions of inventory control, Inventory control techniques, Economic ordering quantity, Periodic ordering quantity, A.B.C. analysis, General idea regarding inventory control under risk and uncertainty.

**Supply Chain Management:** Introduction, Definition of supply Chain, Major drivers of supply chain, Supply Chain Strategies, A model for strategy formulation in SCM. Information Systems in supply chain.

**UNIT – V**

**Quality Control :** Difference between inspection and quality control, Acceptance sampling, Procedure’s risk and Consumer’s risk, Operating characteristic curve for single sampling plan, AOQL Quality of conformance, Quality of design, Economics of quality, SQC charts for variables and attributes.

**Text Books:**

1. Production and operation Management – By P. Ramamurty – New Age International Publication.
2. Industrial Engineering & Production Management – Martand Telsang – S. Chand & Co.,
3. Supply Chain Management – R.P. Mohanty & S G Deshmukh, SBiztantra Publications.

**Reference Book:**

1. Production and operation Management – By R. Mayer – Tata McGraw Hill publication.
2. Quality Planning and Analysis, Juran and Gryna
3. Production and operations Management by – Adam and Ebert – PHI –
4. Production planning and Control – By Samuel Eilon, Navneet Prakashan Ltd., Bombay.



**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	RAC System Design (Elective –III)	Subject Code	
Semester	VIII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

**UNIT-I**

**Cooling and Heating Load Calculations: Estimation of Solar Radiation**

Solar radiation, Constant and irradiation, geometry, Latitude, all basic and derived angles, vertical and tilted surfaces, Calculation of direct, diffuse and reflected radiation using ASHRAE solar radiation model.

**Solar radiation through fenestration Ventilation and Infiltration**

Need, effects of fenestration, Estimation of heat transfer rate, Solar heat Gain Factor(SHGF) and Shading Coefficient, external shading, shaded area of fenestration, heat transfer rate through windows with overhangs, ventilation, Infiltration, heat transfer rate due to infiltration and ventilation.

**UNIT-II**

**Heat Transfer through Buildings – Fabric Heat Gain/Loss**

One-dimensional, steady state heat transfer through homogeneous, non-homogeneous walls, air spaces, composite walls of the buildings, unsteady heat transfer through opaque walls and roofs, analytical method to solve the 1-D, transient heat transfer problem, numerical methods used to solve the transient heat transfer problem, semi-empirical method based on Effective temperature, Difference or Cooling Load Temperature difference CLTD.

**UNIT-III**

**Selection of Air Conditioning Systems**

Thermal distribution systems and their functions, Selection Criteria for air conditioning systems, Classification of air conditioning systems, Working principles, Advantages, Disadvantages and applications of all air systems, namely: Single duct, (constant volume, single zone systems, multi zone systems, variable air volume (VAV) systems), Dual duct, constant volume and variable volume systems, Outdoor air control in all air systems, all water systems, air-water systems, unitary refrigerant based systems.

**UNIT-IV**

**Transmission of Air in Air Conditioning Ducts**

Air Handling Unit (AHU) and its functions, need, airflow through ducts, Bernoulli and modified equations, Static, dynamic, datum and total head, Fan Total Pressure (FTP) and power input, pressure loss, frictional pressure drop, dynamic pressure drop in various types of fittings, Static regain.

**Design of Air Conditioning Ducts**

Requirements, Rules for duct design, Classification, Commonly used methods, Principle of velocity, equal friction, and static regain methods, Performance of duct systems, System balancing and optimization, fans and fan laws, Interaction between fan and duct.

## **UNIT-V**

### **Space Air Distribution**

Requirements, Performance Index and space Diffusion Effectiveness Factor, Design buoyancy effects, deflection of air jets, Behavior of free-stream jets, Definitions of drop, throw, Spread and entrainment ratio, Behavior of circular jets, rectangular jets, Characteristics of different types of air distribution devices, Return air inlets, Airflow pattern inside conditioned spaces.

### **Ventilation for cooling**

Use, comparison between natural and mechanical ventilation, Characteristics of natural ventilation, airflow rate due to wind and stack effects, general guidelines, forced ventilation using electric fans, interior air movement, unit ventilators, whole house fans and solar chimneys.

### **Text Books:**

1. Refrigeration and Air Conditioning by C. P. Arora, TMH Publication.
2. Refrigeration and Air Conditioning by R.K. Rajput Katson Publication.
3. Refrigeration and Air Conditioning by Arora & Domkundwar, Dhanpat Rai and Sons.

### **Reference Books:**

1. Refrigeration and Air Conditioning by Stooker W.F.
2. Refrigeration and Air Conditioning by Ahmadul Ameen, PHI Publication
3. Hand Book of Air Conditioning and Refrigeration by Shan K. Wang , Tata McGraw Hill Publications.



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**DEPARTMENT OF MECHANICAL ENGINEERING**  
**SYLLABUS**

Name of the Subject	Non Conventional Sources of Energy	Subject Code	
Semester	VIII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	0	5

**UNIT-I**  
**FUNDAMENTAL OF ENERGY**

Energy sources, classification, importance of non-conventional energy sources, advantages and disadvantages of non-conventional energy sources, environmental aspect of energy, energy storage-necessity of energy storage, energy storage methods.

**UNIT II**  
**SOLAR ENERGY**

Extraterrestrial radiations and terrestrial radiations, depletion of solar radiation, air mass, solar radiation geometry, solar time, solar day length, solar radiation measurement on horizontal and inclined surfaces.

Solar thermal system-solar collectors, classification, performance indices. Liquid flat plate collector-their component, efficiency, solar thermal system applications.

Solar photovoltaic systems: solar cell fundamentals, solar cell, module, panel and array construction and Application.

**UNIT III**  
**BIOMASS ENERGY**

Photosynthesis process, biomass resources.

Biofuels: biofuel classification, biofuel production process.

Energy farming: advantages and dangers of energy farming,

Biogas: anaerobic digestion for biogas, digester sizing.

**UNIT IV**  
**CHEMICAL ENERGY SOURCES**

Fuel cells: design, principle, classification, types, advantages and disadvantages.

Hydrogen energy: properties, methods of hydrogen production, Storage, advantages and disadvantages and application.

**UNIT V**  
**WIND ENERGY**

Definition, origin of wind, factor affecting the distribution of wind on the surface of the earth, nature of wind, wind turbines, components of wind turbine, wind energy conversion, wind energy conversion systems.

Introduction: Tidal energy, Wave energy, Ocean thermal energy.

**Text Book:**

1. B.H. Khan: Non Conventional Energy Source-Tata Mc Graw-Hill, New Delhi.
2. J.W. Twidell & A.D. Weir: Renewable Energy Sources- The University Press, Cambridge In Great Britain.

**Reference Books:**

1. S.P. Sukhatme: Solar Energy – Tata Mc Graw-Hill, New Delhi.
2. H.P. Garg & J. Prakash: Solar Energy Fundamental and Applications – Tata Mc Graw-Hill, New Delhi.