

(ग) कनिष्ठ अभियन्ता (यांत्रिक) (डिग्री):-

परीक्षा की स्कीम

प्रश्न-पत्र	अंक	अधिकतम अंक	समय
भाग-अ :- सामान्य ज्ञान (राजस्थान का इतिहास, कला एवं संस्कृति, परम्पराएँ, विरासत एवं राजस्थान का भूगोल)	40	120 अंक.	2 घण्टे
भाग-ब :- यांत्रिक अभियांत्रिकी(डिग्री)	80		

नोट :-

1. प्रश्न पत्र में बहुविकल्पीय प्रकार के प्रश्न होंगे व सभी प्रश्नों के अंक समान होंगे।
2. परीक्षा में न्यूनतम निर्धारित उत्तीर्णांक अंक 40 प्रतिशत है। इससे कम अंक प्राप्त करने वाले अभ्यर्थी नियुक्ति के लिए पात्र नहीं होंगे।

पाठ्यक्रम (Syllabus)

भाग-अ :- सामान्य ज्ञान

राजस्थान का इतिहास, कला एवं संस्कृति, साहित्य, परम्पराएँ एवं विरासत
<ol style="list-style-type: none"><li>1. राजस्थान के इतिहास के प्रमुख स्रोत</li><li>2. राजस्थान की प्रमुख प्रागैतिहासिक सभ्यतायें</li><li>3. राजस्थान के प्रमुख राजवंश एवं उनकी उपलब्धियां</li><li>4. मुगल-राजपूत संबंध</li><li>5. स्थापत्य कला की प्रमुख विशेषताएँ</li><li>6. महत्वपूर्ण किले, स्मारक एवं संरचनायें</li><li>7. राजस्थान के धार्मिक आंदोलन एवं लोक देवी-देवताएँ</li><li>8. राजस्थान की प्रमुख चित्रकलाएँ, शैलियां एवं हस्तशिल्प</li><li>9. राजस्थानी भाषा एवं साहित्य की प्रमुख कृतियां, क्षेत्रीय बोलियां</li><li>10. मेले, त्यौहार, लोक संगीत, लोक नृत्य, वाद्ययंत्र एवं आभूषण</li><li>11. राजस्थानी संस्कृति, परंपरा एवं विरासत</li><li>12. महत्वपूर्ण ऐतिहासिक पर्यटन स्थल</li><li>13. राजस्थान के प्रमुख व्यक्तित्व</li><li>14. राजस्थान की रियासतें एवं ब्रिटिश संधियां, 1857 का जन-आंदोलन</li><li>15. कृषक एवं जन-जाति आंदोलन, प्रजामंडल आंदोलन</li><li>16. राजस्थान का एकीकरण</li><li>17. राजस्थान का राजनीतिक जनजागरण एवं विकास- महिलाओं के विशेष संदर्भ में</li></ol>
राजस्थान का भूगोल
<ol style="list-style-type: none"><li>1. स्थिति एवं विस्तार</li><li>2. मुख्य भौतिक विभाग :- मरुस्थलीय प्रदेश, अरावली पर्वतीय प्रदेश, मैदानी प्रदेश, पठारी प्रदेश</li><li>3. अपवाह तन्त्र</li><li>4. जलवायु</li><li>5. मृदा</li><li>6. प्राकृतिक वनस्पति</li><li>7. वन एवं वन्य जीव संरक्षण</li><li>8. पर्यावरणीय एवं पारिस्थितिकीय मुद्दे</li><li>9. मरुस्थलीकरण</li><li>10. कृषि-जलवायु प्रदेश एवं प्रमुख फसलें</li><li>11. पशुधन</li><li>12. बहुउद्देशीय परियोजनाएँ</li><li>13. सिंचाई परियोजनाएँ</li><li>14. जल संरक्षण</li><li>15. परिवहन</li><li>16. खनिज सम्पदाएँ</li></ol>

भाग-ब :- यांत्रिक अभियांत्रिकी (डिग्री)

## 1. Fluid Mechanics

**Properties & Classification of Fluid:** ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids.

**Fluid Statics:** Pressure at a point .

**Measurement of Fluid Pressure:** Manometers, U-tube, Inclined tube .

**Fluid Kinematics :** Stream line, laminar & turbulent flow, external & internal flow, continuity equation.

**Dynamics of ideal fluids:** Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equation.

**Measurement of Flow rate Basic Principles:** Venturi meter, Pilot tube, Orifice meter .

## 2. Fluid Machine

**Hydraulic Turbines:** Classification of hydraulic turbines, work done and efficiencies of Pelton, Francis and Kaplan turbines, Draft tube, Specific speed and unit quantities.

**Hydraulic systems:** Hydraulic press, Hydraulic accumulator, Hydraulic Intensifier, Hydraulic Ram, Hydraulic lift, Hydraulic coupling, Hydraulic torque convertor Gear pump.

## 3. Design of Machine Components

**Materials:** Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects.

**Manufacturing Considerations in Design:** Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration forecast, forged and machined parts. Design for assembly.

**Design for Strength:** Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures.

**Design of Members subjected to direct stress:** pin, cotter and keyed joints.

**Design of Members in Bending:** Beams, levers and laminated springs .

**Design for stiffness of beam:** Use of maximum deflection formula for various end conditions for beam design.

**Design of Members in Torsion Shaft and Keys:** Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys.

**Couplings:** Design of muff coupling, flanged couplings: rigid and Flexible.

**Design of Threaded fasteners:** Bolt of uniform strength, Pre loading of bolts: Effect of initial tension and applied loads, Eccentric loading.

**Power screws like lead screw, screw jack,** Design of members which are curved like crane hook, body of C-clamp, machine frame etc.

**Design of IC Engine components:** Piston, Cylinder, Connecting Rod and Crank Shaft. Design of helical compression, tension, torsional springs, springs under variable stresses.

**Design of belt, rope and pulley drive system, Design of gear teeth:** Lewis and Bucking ham equations, wear and dynamic load considerations. Design and force analysis of spur, helical, bevel and worm gears, Bearing reactions due to gear tooth forces.

## 4. Kinematic & Dynamics of Machines

**Governors:** Comparison between flywheel and governor, Types of governor, Watt, Porter, Proell, Hartnell and spring controlled governors, sensitiveness of governors, stability of governors, isochronous and hunting, governor effort, power, controlling force diagram.

**Gyroscope:** Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on aeroplanes, ships and vehicle taking a turn, stabilization of sea vessels, stability of four wheeled vehicle moving in a curved path, curved path with banking, stability of two wheeled vehicle, gyroscopic effect on inclined rotating disc.

**Inertia force analysis:** Velocity and acceleration of slider crank and four bar mechanism, inertia force, piston thrust and forces on connecting rod, turning moment diagram, flywheel.

**Gears:** Classification, terminology, law of gearing, velocity of sliding, gear tooth profile, comparison of cycloid and involute tooth profile, standard interchangeable tooth profile, length of path of contact, arc of contact, contact ratio, interference, undercutting, minimum number of teeth on pinion in contact with gear or rack, bevel, helical and spiral gears.

**Gear Trains:** Simple, compound, reverted and epi cyclic gear trains, analytical, tabular, graphical and vector methods for finding velocity ratio, gearboxes-sliding and constant mesh, synchromesh and differential gear box.

**Balancing:** Need of balancing, Balancing of rotating masses, single plane, different planes, balancing

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of reciprocating masses, single cylinder engine, multi-cylinder in line engines, V-engines, concept of direct and reverse cranks, partial balancing of locomotives, IC engines, V engines and balancing machines.

## 5. Turbo machines

**Basic Concepts of Turbo Machines:** Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation (1<sup>st</sup> law of thermodynamics), 2<sup>nd</sup> law of thermodynamics applied to turbo machines, Newton's 2<sup>nd</sup> law of motion applied to turbo machines-Euler's pump equation and Euler's turbine equation.

Dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Range of specific speeds for various turbo machines, Dimensional analysis applied to compressible flow machines, pressure ratios a Function of temperature ratio, mass flow rate parameter and speed parameter.

**Centrifugal Compressors and Fans:** Components and description, velocities rams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compress or characteristic, surging, rotating Stall and Choking.

**Axial Flow Compressor sand Fans:** Basic constructional features, Advantages of axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, operating characteristics.

**Reciprocating Compressors:** Basic constructional features, working principle, work done calculation, single and double acting compressors.

**Centrifugal Pumps:** Main parts, work done and velocity triangles, slip and slip factor, pump losses and efficiencies, minimum starting speed, net positive suction head, performance curve.

**Axial Flow Pumps:** Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitations.

**Reciprocating Pumps:** Classification, component and working ,single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, slip, effect of friction and acceleration, theory of air vessels.

**Gas power cycles:** Idea land practical gas turbine cycle, heat exchange cycle, reheat cycle, intercooled cycle, Comparison of various cycles.

**Thermodynamic Cycles:** Advantages, disadvantages and performance characteristics of Ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, turbo fan engine, Calculation of specific thrust and efficiency

**Gas Turbines:** impulse and reaction type gas turbines, Velocity triangles and calculation of work done, efficiency etc.

## 6. Auto Cad -Mechanical Engineering drawings

Review of sectioning, Review of BIS Standard (SP 46), Fasteners –screws, bolts and nuts, riveted joints, pins, locking devices, welded joints, pipe joints, unions and valves. Assemblies involving machine elements like shafts, couplings, bearing, pulleys, gears, belts, brackets. Tool drawings including jigs and fixtures. Engine mechanisms-assembly and disassembly. Production drawings-limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Lay out drawings. Schematics, process and instrumentation diagrams, piping drawings. Structural drawings-examples for reading and interpretation. Computer aided design and use of software packages for engineering drawings.

Assembly Drawing with sectioning and bill of materials Universal Coupling, Forming punch and die, Jigs for inspecting shaft etc. (1 drawing sheet of any assembly) Lathe tail stock, shaper tool head, steams top valve, feed check-valve, swivel machine vice etc(1 drawing sheet of any assembly).

Detailed part drawings from assembly drawing indicating fits, tolerance sand surface finish symbols by referring BIS codes (1 drawing sheet) Check-valve, Junction Valve etc.

Computer Aided Drafting (4drawings)

Introduction, input, output devices, introduction to software like AutoCAD /ProE /Creo /Solid works, basic commands and development of 2D and 3D drawings of simple parts.

Free Hand Sketches: Connecting rod, crank shaft, Pipes and Pipe fittings, machine arbor and cutter, universal dividing head, jig sand fixtures, Step less drive, sliding gear box, safety valve, three way stop valve, blow-off cock, Swivel bearing, Turret Tool Post, drill-press vice, screw jack.

## 7. Thermo Dynamics

**Properties of Pure Substances:** p-v & P-T diagrams of pure substance like H<sub>2</sub>O, Introduction of steam table with respect to steam generation process; definition of saturation, wet & superheated status. Definition of dryness fraction of steam, degree of super heat of steam. h-s chart of steam (Mollier's Chart).

**1<sup>st</sup> Law of Thermodynamics:** Definition of stored energy & Internal energy, 1<sup>st</sup> Law of Thermodynamics of cyclic process, Non Flow Energy Equation, Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady Flow; Steady State Steady Flow Energy Equation.

**2<sup>nd</sup> Law of Thermodynamics:** Definition of Sink, Source Reservoir of Heat, Heat Engine, Heat Pump & Refrigerator; Thermal Efficiency of Heat Engines & co-efficient of performance of Refrigerators, Kelvin-Planck & Clausius Statements of 2<sup>nd</sup> Law of Thermodynamics, Absolute or Thermodynamic Scale of temperature, Clausius Integral, Entropy, Entropy change calculation of ideal gas processes. Carnot Cycle & Carnot Efficiency, PMM-2; definition & its impossibility.

**Air standard Cycles for IC engines:** Otto cycle; plot on P-V, T-S Planes; Thermal Efficiency, Diesel Cycle; Plot on P-V, T-S Planes; Thermal efficiency.

## 8. Heat Transfer

**Introduction:** Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquid and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient.

**Conduction:** General 3-Dimensional conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation.

**Heat transfer from extended surfaces:** Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions.

Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart.

**Convection:** Review of Navier-Stokes and energy equation, hydro dynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate to nondimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.

**Natural convection:** Dimensional analysis, Grashof number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.

**Heat transfer with change of phase:** Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation.

**Heat exchanger:** Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.

**Thermal Radiation:** Planck distribution law, Kirchhoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.

## 9. Mechanics of Solid

**Stress and Strain:** Elementary definition of stress and strain, stress-strain relationship, elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, elastic constants and their relations for an isotropic Hookean material, an isotropic and orthotropic materials.

Tension, compression, shearing stress and strain, thermal stresses, composite bars, equations of static equilibrium, concept of free body diagram. Strain energy due to axial loading.

**Members Subjected to Flexural Loads:** Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams. bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I-Box, T-angle sections etc. Strain energy due to bending.

**Principal Planes, Stresses and Strains:** Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain.

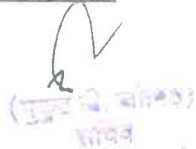
**Theories of Elastic Failures:** The necessity for a theory, different theories, significance and comparison, applications.

**Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads.

**Stability of Equilibrium:** Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.

**Transverse Deflection of Beams:** Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method.

## 10. Machine Drawings



(घ) कनिष्ठ अभियन्ता (यांत्रिक) (डिप्लोमा):-

**परीक्षा की स्कीम**

प्रश्न-पत्र	अंक	अधिकतम अंक	समय
भाग-अ :- सामान्य ज्ञान (राजस्थान का इतिहास, कला एवं संस्कृति, परम्पराएँ, विरासत एवं राजस्थान का भूगोल)	40	120 अंक	2 घण्टे
भाग-ब :- यांत्रिक अभियांत्रिकी(डिप्लोमा)	80		

नोट :-

1. प्रश्न पत्र में बहुविकल्पीय प्रकार के प्रश्न होंगे व सभी प्रश्नों के अंक समान होंगे।
2. परीक्षा में न्यूनतम निर्धारित उत्तीर्णांक अंक 40 प्रतिशत है। इससे कम अंक प्राप्त करने वाले अभ्यर्थी नियुक्ति के लिए पात्र नहीं होंगे।

**पाठ्यक्रम (Syllabus)**

भाग-अ :- सामान्य ज्ञान

राजस्थान का इतिहास, कला एवं संस्कृति, साहित्य, परम्पराएँ एवं विरासत
<ol style="list-style-type: none"><li>1. राजस्थान के इतिहास के प्रमुख स्रोत</li><li>2. राजस्थान की प्रमुख प्रागैतिहासिक सभ्यताएँ</li><li>3. राजस्थान के प्रमुख राजवंश एवं उनकी उपलब्धियाँ</li><li>4. मुगल-राजपूत संबंध</li><li>5. स्थापत्य कला की प्रमुख विशेषताएँ</li><li>6. महत्वपूर्ण किले, स्मारक एवं संरचनाएँ</li><li>7. राजस्थान के धार्मिक आंदोलन एवं लोक देवी-देवताएँ</li><li>8. राजस्थान की प्रमुख चित्रकलाएँ, शैलियाँ एवं हस्तशिल्प</li><li>9. राजस्थानी भाषा एवं साहित्य की प्रमुख कृतियाँ, क्षेत्रीय बोलियाँ</li><li>10. मेले, त्यौहार, लोक संगीत, लोक नृत्य, वाद्ययंत्र एवं आभूषण</li><li>11. राजस्थानी संस्कृति, परंपरा एवं विरासत</li><li>12. महत्वपूर्ण ऐतिहासिक पर्यटन स्थल</li><li>13. राजस्थान के प्रमुख व्यक्तित्व</li><li>14. राजस्थान की रियासतें एवं ब्रिटिश संधियाँ, 1857 का जन-आंदोलन</li><li>15. कृषक एवं जन-जाति आंदोलन, प्रजामंडल आंदोलन</li><li>16. राजस्थान का एकीकरण</li><li>17. राजस्थान का राजनीतिक जनजागरण एवं विकास-- महिलाओं के विशेष संदर्भ में</li></ol>
राजस्थान का भूगोल
<ol style="list-style-type: none"><li>1. स्थिति एवं विस्तार</li><li>2. मुख्य भौतिक विभाग :- मरुस्थलीय प्रदेश, अरावली पर्वतीय प्रदेश, मैदानी प्रदेश, पठारी प्रदेश</li><li>3. अपवाह तंत्र</li><li>4. जलवायु</li><li>5. मृदा</li><li>6. प्राकृतिक वनस्पति</li><li>7. वन एवं वन्य जीव संरक्षण</li><li>8. पर्यावरणीय एवं पारिस्थितिकीय मुद्दे</li><li>9. मरुस्थलीकरण</li><li>10. कृषि-जलवायु प्रदेश एवं प्रमुख फसलें</li><li>11. पशुधन</li><li>12. बहुउद्देशीय परियोजनाएँ</li><li>13. सिंचाई परियोजनाएँ</li><li>14. जल संरक्षण</li><li>15. परिवहन</li><li>16. खनिज सम्पदाएँ</li></ol>

भाग-ब :- यांत्रिक अभियांत्रिकी (डिप्लोमा)

## 1. Fluid Mechanics

**Properties & Classification of Fluid :** ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids.

**Fluid Statics:** Pressure at a point.

**Measurement of Fluid Pressure :** Manometers, U-tube, Inclined tube.

**Fluid Kinematics:** Stream line, laminar & turbulent flow, external & internal flow, continuity equation.

**Hydro dynamics and Measurement of Flow:** Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equation. Venturi meter, Pilot tube, Orifice meter.

**Impact of free jet Flow through pipes, orifices.**

## 2. Fluid Machine

**Hydraulic Turbines:** Classifications, Principles.

**Centrifugal Pumps:** Classifications, Principles, Performance

**Reciprocating Pump:** Types, main components, principles

**Miscellaneous Hydraulic Machines:** Hydraulic accumulator, Hydraulic intensifier, Hydraulic press, Hydraulic coupling and torque converter

## 3. Internal Combustion Engines

**Principles of Internal Combustion Engines:**

Introduction and Classification of I. C Engines

Working principle of four stroke and two stroke cycle and their comparison

Working and special features of petrol and diesel engines and their comparison and applications

I.C. engine terms-Bore, stroke, dead centre, crank throw, compression ratio, clearance volume, piston displacement and piston speed

Valve timing diagrams (Theoretical & Actual), firing order

Super charging of I.C. engines

**Petrol Engines:**

Concept of Carburation, Air fuel ratio

Simple carburetors and its limitations

Description of Solex carburetors

Multi point fuel injection system

Mechanical and electrical feed pump

Description of coil ignition system and Magneto ignition system

**Diesel Engines:**

Description and working of Fuel feed pump

Injection of fuel, air and air less injection and fuel injectors

Introduction to swirl and open combustion chambers

**Cooling, Lubrication and Governing:**

Necessity of engine cooling

Properties of coolants

Methods of cooling and their merits and demerits

Function of Lubrication, lubrication systems of I.C. Engines

Properties of lubricants

Governing methods of I.C. Engines.

**I.C. Engines Performance:**

Introduction to basic performance parameters

Measurement of brake power by rope brake, prony brake and hydraulic dynamometer

Measurement of Indicated power by engine indicator and Morsetest method.

Energy balance sheet of I.C. engine and finding various efficiencies

Numerical problems

**Gas Turbines (No numerical problem):**

Classification and application of gas turbines

Description of constant pressure (open cycle and closed cycle) and constant volume gas



turbines.

Methods of increasing thermal efficiency of gas turbines, regeneration, inter cooling, re-heating.

**Air Compressors (No numerical problem):**

Classification of compressors, uses of compressed air

Description of single stage and multistage reciprocating compressors

P.V. diagram of single and multi stage reciprocating compressor with inter cooling

Description of rotary and centrifugal compressors

**4. Strength of Materials**

**Simple Stress and Strain:**

Various mechanical properties

Concept of stress and strain

Hook's law

Working stress and factor of safety

Stress and strain calculations

Temperature stresses

Shear stresses

Poisson's ratio and volumetric strain

Relationship between elastic constants

**Compound Stress:**

Stress components on an inclined plane

Mohr's circle:

Principal stresses and planes

**Strain Energy:**

Strain energy from stress-strain diagram

Proof resilience

Types of loading-gradual, sudden, impact

**Bending Moment and Shear Force:**

Basic concept, Types of support, Types of beam, Types of load

Shear force and bending moment

Bending moment and shear force diagrams (for point loads, U.D.L. and their combinations)

**Moment of Inertia:**

Concept of moment of Inertia

Radius of gyration

Moment of Inertia of various section

Moment of inertia of unsymmetrical section like: T-section, channel section, L-section etc.

**Bending Stresses in Beams:**

Concept of bending stress

Theory of simple bending

Design criterion and section modulus

**Shear Stress in Beams:**

Concept

Shear stress distribution diagram of various sections

**Deflection:**

Concept of deflection of a beam

Use of standard formula for calculating deflection (for point loads, U.D.L. and their combination)

**Columns and Struts:**

Concept of column and struts

Modes of failure

Types of column; long and short

Buckling loads

Slenderness ratio

Euler's formula (without proof)

Rankine's formula

**Torsion of Shaft:**

Concept of torsion, Relation between power and torque, Combined stress due to bending





and torsion in solid and hollow shaft

**Springs:**

Introduction and classification of springs, Flat carriage springs, Close lycoiled helical springs:

**Thin Cylindrical Shells:**

Use of cylinders, Stresses due to internal pressure, Design of thin cylinders-calculation of the various dimensions of a thin cylinder

**Combined Direct and Bending Stress:**

Effect of eccentricity, Stress due to eccentric load, Middle third rule, Quarter rule

**5. Theory of Machines**

**Simple Mechanism:**

Introduction to link, kinematic pair, kinematic chain, structure, mechanism, machine

Slider crank mechanism and its inversion

Double slider crank chain

Example of mechanism with higher pairs

**Velocity and Acceleration in Mechanism:**

Velocity diagrams of four bar and single slider crank mechanisms by relative velocity method and instantaneous centre method

Acceleration diagram off our bar chain and reciprocating engine mechanism, coriolis components

**Dynamics of Reciprocating Parts:**

Analytical method for velocity and acceleration of piston

Piston effort, crank pin effort, turning moment diagrams

Fluctuation of energy and speed, Energy of a fly wheel

Calculating the weight of fly wheel.

**Friction:**

Friction of collars and pivots, Friction clutches-plate clutch and centrifugal clutch, Friction in journal bearings, Rolling friction

**Transmission of Power:**

Flat and V-belt drives

Velocity ratio of belt drives, slip in belt, and creep in belt.

Length of open and cross belt drives

Power transmitted by a belt

Ratio of driving tension, centrifugal tension, Condition for the maximum power transmission, initial tension in the belt.

Chain drives-types of chain drives roller chain and inverted tooth chain.

Gear drives-Types of gear wheels, proportions of gear tooth

Gear trains-Simple gear train, compound gear train, reverted gear train and simple epicyclical gear train.

**Balancing:**

Static and dynamic balancing, need of balancing

Balancing of single rotating mass by a single mass in the same plane, by two masses rotating in different planes.

Partial primary balancing of a single cylinder reciprocating engine

**Vibration:**

Causes of vibrations in machine, their effects and method of reducing them

Free or natural vibration

Forced vibration

Damped vibration.

**Governors (No derivation & numerical):**

Introduction and classification

Methods of governing (Quality, Quantity and hit and miss governing)

Dead wt governors (watt, porter and prowl)

Spring control governors (hart Nell and Wilson hart Nell)

Concept of sensitivity, stability, isochronisms, hunting, effort and power.

**Brakes and Dynamometer:**

Introduction, function, capacity of brakes:

Block and shoe brake

Band brake

Internal expanding brake

Functions of dynamometer, Prony brake, Rope brake and Froude's hydraulic dynamometer.

## **6. Auto Cad -Mechanical Engineering drawings**

### **Machining Symbols and Tolerances:**

Introduction of limits, fits, tolerances.  
Machining symbol  
Tolerancing

### **Working Drawing:**

Piston and Connecting rod  
Crankshaft  
Bush bearing, ball bearing and roller bearing  
Lathe spindle

### **Assembly Drawing:**

Drilling jigs, milling jigs  
Stepped pulley, fast and loose pulley, V-belt pulley,  
Foot step bearing, Plummer block and Universal coupling  
Lathe tail stock and Shaper tool head  
Fuel injector and Fuel injection pump (jerk type)  
Machine vice and screw jack

### **Gear tooth profile**

Gear types and gear nomenclature (spur, helical and bevel gears)  
Drawing in involute tooth profile (spur gear only) by- Approximate method  
Prof. Unwin's method

### **Cam profile**

Types of cams and followers  
Types of follower motions  
Construction of disc cam profile with knife edge follower

### **Computer Graphics:**

Application software:-Introduction of CAD and similar software, application like CATIA, Pro/Engineer and other, Getting Started-I, Getting Started-II, Draw Commands, Editing Commands, Drawing Aids, Creating Text, Basic Dimensioning, Inquiry Commands, Editing Dimensions, Hatching, Blocks, Plotting Drawings in Auto CAD, Draw isometric views of simple objects. Introduction of 3D modeling, Wire frame and surface modeling

## **7. Thermo Dynamics**

### **Basic Concept and Gas Laws:**

Thermodynamics, property-Intensive and Extensive, system-open, closed and isolated  
Energy-Internal energy, potential energy, kinetic energy, heat, work, specific heat, enthalpy,  
Boyle's law, Charle's law, Joule's law, Characteristics gas equation, gas constant, mol,  
universal gas constant and molar specific heats, Simple numerical problems

### **Laws of Thermo dynamics:**

Zeroth law of thermo dynamics  
First law of thermo dynamics.  
Second law of thermo dynamics Concept of entropy  
Constant volume, constant pressure, isothermal, adiabatic poly tropic processes, throttling  
and free expansion, work done during these processes.  
Simple numerical problems

### **Availability:**

Available and unavailable energy  
Effectiveness  
Irreversibility inflow and non-flow process.

### **Formation of Steam and its Properties:**

Generation of steam at constant pressure, various stage of steam-wet steam, dry steam  
saturated steam, dryness fraction, super heated steam, degree of superheat.  
Critical point, triple point, thermo dynamic properties of steam-specific volume, specific  
enthalpy, specific internal energy, specific entropy.  
Steam property diagram: temperature-entropy diagram, enthalpy-entropy diagram,  
pressure-enthalpy diagram  
Heating and expansion of steam during thermo dynamic processes, Change of internal  
energy and entropy of steam during processes  
Simple numerical problems Use of steam tables and Mollier charts.

### **Steam Generators:**



Definition of boiler according to I.B.R., classification of boilers, Comparison of water tube and fire tube boilers.

Special characteristics of high-pressure boilers

Introduction to Indian Boiler Act.

**Boiler Performance:**

Actual evaporation, Equivalent evaporation, Factor of evaporation, Boiler efficiency

Heat losses in boiler plants, Boiler power, Energy balance sheet of boiler.

Simple numerical problems

**Gas Power Cycles:**

Otto cycle, Diesel cycle, Dual combustion cycle, Atkinson cycle, Joule/ Bray ton cycle

Air standard efficiency

Effect of compression ratio on efficiency

**8. Machine Drawings**

