

# कनिष्ठ अभियंता संयुक्त सीधी भर्ती परीक्षा-2020

(क) कनिष्ठ अभियन्ता (सिविल) (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 :- सिविल 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 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>

### 1. Building Technology And Construction Management

**Building Materials:** stones, bricks, steel, Timber, lime, cement, sand, aggregates for cement concrete, paints, distempers, use of pozzolana manufacturing of lime concrete, cement concrete for plain, reinforced and pre-stressed concrete work.

**Road Materials:** Coarse aggregate, screenings and binding materials for WBM, Bricks for soling, Coarse and fine aggregate for bituminous roads, IRC standard size aggregates, Tars and Asphalt, Asphaltic concrete, Asphaltic emulsions, Mastic Asphalt and Minerals fillers

**Construction Management:** Plants and equipments, planning for construction using network analysis CPM and PERT techniques

### 2. Fluid Mechanics

**Fluids :** Definition, Ideal fluids, real fluids, Newtonian and Non-Newtonian fluids.

**Properties of Fluids:** Units of measurement, Mass density, Specific weight, Specific volume, Specific Gravity, Viscosity, Surface tension and Capillarity, Compressibility and Elasticity.

**Hydrostatics:** Pressure at a point in a static fluid; pressure variation in an incompressible static fluid; atmospheric pressure, Gauge pressure, vacuum pressure, absolute pressure, Manometers Bourdon pressure gauge.

**Buoyancy:** Forces acting on immersed plane surface. Centre of pressure, forces on curved surfaces. Conditions of equilibrium for floating bodies, meta-center and met centric height experimental and analytical determination of met centric height.

**Equilibrium of Fluid particles and flow:** Fluid mass subjected to horizontal and vertical acceleration and uniform rotation.

**Hydro-kinematics:** Types of Flows: Steady and unsteady, uniform and non-uniform, stream lines, path lines, stream tubes, principles of conservation of mass, equation of continuity, acceleration of fluid particles local and connective, Rotational and irrotational motions, free and forced vortex, circulation and vorticity velocity potential and stream function, elementary treatment of flow net. Euler's equations of motion and integration of Euler's equations, Bernoulli's equation for incompressible Fluids, assumptions in Bernoulli's equation, Energy correction factor.

**Applications of Bernoulli's equation:** Pitot tube, Venturi meter, orifice meter, orifices & mouth pieces, time of emptying of tanks by orifices, sharp edged rectangular, triangular and trapezoidal notches, Francis formula. Velocity of approach. End contractions Cippoletti Weir, time of emptying reservoirs by weirs.

**Momentum Equation and its Application:** Development of momentum equation by control volume concept, Momentum correction factor, applications—Borda's mouth pieces, sudden enlargement of flow, pressure on flat plates, Nozzles.

**Flow Through Pipes:** Laminar flow, Reynolds experiment, transition from laminar to turbulent flow. Turbulent Flow: Laws of fluid friction, friction factor Moody's diagram, loss of head due to friction and other causes. Hydraulic gradient, total energy line Chezy's, Darcy's and Manning's formula, flow through parallel pipes and pipes in series, flow through branched pipes. Flow along a bypass. Power transmission through pipe, condition for maximum power. Elementary water hammer concept.

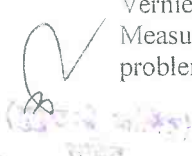
### 3. Surveying, Estimating Costing & Field Engineering

**Introduction:** Importance of surveying to engineers, Plane and geodetic surveying, methods of location of points, principle of surveying from whole to part, conventional signs.

**Measurement of Distances:** Different types of chains, tapes and their uses. Sources of error and precautions, corrections to tape measurements. Field problems in distance measurement. Advance techniques of distance measurement.

**Measurement of Angles & Direction:** Different types of direction measuring instruments and their uses. Reference meridians, Bearing and azimuths, magnetic declination and its variation. Use and adjustment of surveyors and prismatic compass.

Vernier and micro optic theodolite, temporary and permanent adjustment of vernier theodolite Measurement of horizontal and vertical angle by different methods. Application of theodolite in field problems.

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**Traversing:** Different methods of traversing; chain traverse, chain & compass traverse, transit-tape traverse. Methods of computations and adjustment of traverse; transit rule, Bowditch rule, graphical method, axis method. Gales traverse table.

**Leveling:** Definitions of various terms in leveling. Different types of leveling, sources of error in leveling curvature and refraction corrections. Temporary and permanent adjustment of dumpy and tilting levels. Computation and adjustment of level. Profile leveling L-Section and cross-sections.

**Plane Table Surveying:** Elements of plane table survey working operations, methods of plane table survey; intersection, traversing and resection, two point and three point problems.

**Contouring:** Characteristics of contours, contour interval, contour gradient, Methods of locating contours, uses of contour maps.

**Trigonometric Leveling:** Trigonometric leveling, Objects accessible and non-accessible, Determination of levels object-when.

**Field Astronomy:** Definitions of terminology used in Astronomy,

Introduction to Remote Sensing and GIS Estimation for quantities for various types of construction, Rate Analysis, Preparation of Tender & contract documents, Centre-line diagram, Building layout.

#### 4. Irrigation & Water Resources

Definition, necessity, benefits, types and methods of irrigation, Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canals, types of canal irrigation, loss of water in canals. Canal lining-types and advantages. Shallow and deep to wells, yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow. Definition of flood, causes and effects, methods of flood control, water logging, preventive measure. Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes. Major irrigation projects in India.

#### 5. Theory of Structures and Strength of Materials

Elasticity constants, types of beams – determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, Bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, Eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns. Torsion of circular section. Springs, Vibration.

#### 6. Structural Analysis

Introduction to Indeterminate structures, Degrees of freedom per node, Static and Kinematic indeterminacy (i.e. for beams, frames & portal with & without sway etc.), Releases in structures, Maxwell's reciprocal theorem and Betti's theorem, Analysis of Statically Indeterminate Structures using Slope - deflection method. Analysis of structures using Moment-distribution method applied to continuous beams and portal frames with and without inclined members. Unit load method & their applications : deflection of determinate beams and frames, analysis of determinate and redundant frames up to two degree of redundancy, lack of fit in redundant frames.

#### 7. Soil Mechanics and Foundations Engineering

Origin of soil, phase diagram, Definitions-void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses. Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart. Permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, Vane shear test, Triaxial test. Soil compaction, Laboratory compaction test,

Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, bearing capacity of soils, plate load test, standard penetration test.

## 8. Design of R.C. Concrete and Masonry Structures

RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and double reinforced beams, cantilever beams. T-beams, lintels. One way and two way slabs, isolated footings. Reinforced brick works, columns, staircases, retaining wall, water tanks (RCC design questions may be based on both Limit State and Working Stress methods)

**Concrete Technology** : Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures.

## 9. Design of Steel Structures

**Steel Design**: Steel design and construction of steel columns, beams roof trusses plate girders.

## 10. Construction Technology

**Stone and Brick Masonry**: Ashlar, course and random rubble, stone pillar, dry stone and arch masonry, brick bonds and type of walls.

**Lintels**: Plastering, pointing, flooring, Expansion and construction joints; Centering and shuttering, General Selection criteria of site, Planning and orientation of buildings.

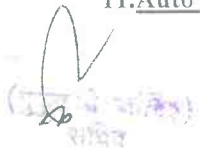
**Roofing**: Stone slab, RCC, G.C. Steel, Asbestos cement and jack arch roofing.

**Flooring**: Cement concrete, flag stone, terrazzo mosaic, Terrazzo tile, Brick on edge, timber Granolithic, linoleum and other floorings.

**Plastering**: Lime, cement sand, composite and rough coat plaster, Plaster of Paris, painting, Damp proof course, anti-termite treatment.

**Centering and Shuttering**: Centering form work, shuttering and moulds, timber & steel trestles and false work, scaffolding and shoring, under pinning.

## 11. Auto -Cad Civil Engineering Drawing



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(ख) कनिष्ठ अभियन्ता (सिविल) (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 :- सिविल 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 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>

  
(सिविल अभियन्ता)

### 1. Building Technology And Construction Management

Physical and Chemical properties, classification, standard tests, uses and manufacture/quarrying of materials e.g. building stones, silicate based materials, cement (Portland), asbestos products, timber and wood based products, laminates, bituminous materials, paints, varnishes.

### 2. Surveying, Estimating & Costing

Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Leveling, Definition of terms used in leveling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation, advanced surveying equipment. Estimate, glossary of technical terms, analysis of rates, methods and unit of measurement, Items of work – earthwork, Brickwork (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering. Boundary wall, Brick building, Water Tank, Septic tank, Bar bending schedule, Centre line method, Mid-section formula, Trapezoidal formula, Simpson's rule. Cost estimate of Septic tank, flexible pavements, Tube well, isolates and combined footings, Steel Truss, Piles and pile-caps. Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

### 3. Strength of Materials

Elasticity constants, types of beams – determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section.

### 4. Reinforced Concrete Design

RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and double reinforced beams, cantilever beams. T-beams, lintels. One way and two way slabs, isolated footings. Reinforced brick works, columns, staircases, retaining wall, water tanks (RCC design questions may be based on both Limit State and Working Stress methods).

### 5. Irrigation & water resources

Definition, necessity, benefits, , types and methods of irrigation, Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc.

Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies.

Different type of canals, types of canal irrigation, loss of water in canals. Canal lining – types and advantages. Shallow and deep to wells, yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow.

Definition of flood, causes and effects, methods of flood control, water logging, preventive measure. Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes. Major irrigation projects in India.

### 6. Soil Engineering

Origin of soil, phase diagram, Definitions-void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses.

Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart.

Permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement.

Shear strength of soils, direct shear test, Vane shear test, Tri-axial test.

Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test.

## 7. Auto- Cad Civil Engineering Drawing



(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 संरचनाएँ</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 epicyclic 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, Kirchoff'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.

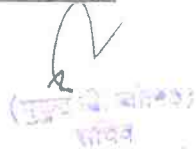
**Theories of Elastic Failures:** The necessity for a theory, different theories, significance and comparison, applications.

**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 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 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 volute 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**



(च) कनिष्ठ अभियन्ता (विद्युत) (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 :- विद्युत 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 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 :- विद्युत अभियांत्रिकी (डिग्री) :-

2  
राजस्थान  
राजस्थान

1. **ELECTRICAL CIRCUITS**

Circuit components, KCL and KVL. Network graphs, Methods of circuits analysis, Nodal and Mesh analysis, Analysis of D.C. and A.C. networks. Network theorems. Basic network theorems and applications. Network Functions: Driving point and transfer functions, poles and zeros of network functions. Response of networks to standard input signals. Two port networks, Elementary network synthesis, different type of network parameters, signal flow graphs, Fourier series, Laplace transforms and their applications. Frequency response. Resonant circuits and applications. Three phases balanced and unbalanced networks. Steady state response with sinusoidal input. Transient response: Transient analysis of RL, RC and RLC circuits.

2. **FIELD THEORY**

Electrostatic and Magnetostatics : Electrostatics and electrical fields, Magneto statics and magnetic fields, field in conductor and in magnetic material, field in dielectrics, Maxwell's equations and time varying field. Electromagnetic wave equations. Plane wave propagations in conducting and dielectric media.

3. **ELECTRICAL MATERIALS**

Classifications of materials on the basis of permanent magnetic dipoles, Electrical and electronic behaviour of materials, classification on the basis of conductivity. Behaviour of dielectric in static and alternating fields. Phenomenon of polarization. Super conductivity applications of magnetic conducting, dielectric and insulating materials.

4. **ELECTRICAL MEASUREMENT AND INSTRUMENTATION:**

General Principles of measurement: Unit and dimension, Standards error analysis. Basic methods of measurement, Measurement of circuit's parameters of bridge methods.

Measuring Instrument: Indicating Instruments, Integrating instruments, Recording instrument. Measurement of voltage, current, power, power factor, energy, resistance, inductance, capacitance and frequency.

Transducers: Strain gauge , LVDT, resistance thermometers, Thermistors, piezoelectric Measurement of non - electrical quantities (Pressure, Temperature, Flow rate, displacement, velocity, acceleration, strain etc.)

Measurements: Digital voltmeters, Frequency counter, distortion meter. Telemetry and

Data recording and display, Data acquisition.

5. **ELECTRONICS AND COMMUNICATION:**

Solid state (semi-conductor devices) : Diodes, Zener diodes, Transistors ( Bipolar, BJT, JFET, MOSFET) Biasing and their applications. Analysis of electronic circuits , equivalent circuits, Rectifier, Filter and voltage regulators. Single stage and multistage amplifiers- gain and frequency response, Multivibrators, flip-flops and their applications.

Communications : generations and detection of AM and FM, noise behaviour of AM and FM systems.

6. **POWER ELECTRONICS:**

Power semiconductor devices, Thyristor, triac, GTO, MOSFET, Static characteristics and triggering circuits, A.C to D.C. Converters, Choppers. Controlled and uncontrolled power rectifiers, Bridge converters.

7. **CONTROL SYSTEM**

(100 marks)  
संख्या

Open and closed loop systems. Block diagrams and signal flow graphs. Response analysis time domain, frequency domain : Steady state error analysis. Root locus technique, bode plots, Routh Hurwitz and Nyquist criteria of stability. State Space analysis of linear systems.

8. ELECTRICAL MACHINES:

Constructions, Principles of operations, equivalent circuits, basic characteristics and applications of distribution and power transformers. Single phase induction motors. Three phase induction motors. Alternators, synchronous motors.

9. POWER SYSTEMS:

Generations : Thermal generations, Hydro generation, Nuclear Generations. Non - Conventional energy sources. Transmission and Distribution. Transmission line parameters - resistance, Inductance and capacitance calculation, Performance of short, medium and long lines. Neutral earthing. Underground cables. Corona, its effect and remedial measures . Basic idea of power system stability. Line insulators, Introductions of HVDC transmission.

10. SWITCHGEAR & PROTECTION

Theories of arc extinction. Comparative merits of minimum oil, bulk oil, air blast, SF<sub>6</sub> circuits breakers. Causes and consequences of dangerous currents. Currents limiting reactors. Busbar arrangement, Requirements of protective relays. Protections of lines, transformer, synchronous generators and busbars. Symmetrical components and their applications.

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(छ) कनिष्ठ अभियन्ता (विद्युत) (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 :- विद्युत अभियांत्रिकी (डिप्लोमा)	80		

नोट :-

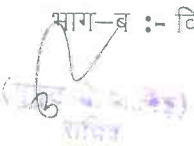
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पाठ्यक्रम (Syllabus)

भाग-अ :- सामान्य ज्ञान

राजस्थान का इतिहास, कला एवं संस्कृति, साहित्य, परम्पराएँ एवं विरासत
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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 :- विद्युत अभियांत्रिकी (डिप्लोमा) :-



1. BASIC CONCEPT:

Concepts of resistance, inductance, capacitance and various factors affecting them. Concepts of current, voltage, power, energy & their units.

2. CIRCUITS LAW

Kirchoff's law, simple circuit solution using network theorems.

3. MAGNETIC CIRCUITS

Concepts of flux, mmf, reluctance, different kind of magnetic materials, Magnetic calculations of conductors of different configuration eg. straight, circular, solenoidal etc. Electromagnetic induction, self and mutual induction.

4. AC FUNDAMENTAL:

Instantaneous, peak R.M.S. and average values of alternating waves, Representation of sinusoidal wave from, simple series & Parallel AC circuits consisting of R,L and C,

Resonance, Tank circuits. Poly system star & delta connection, 3 Phase power, DC and sinusoidal response of R-L and R-C circuit.

5. MEASUREMENT & MEASURING INSTRUMENTS:

Measurement of power ( 1 phase and 3 phase , both active and re-active) and energy, 2 altmeter method of 3 phase power measurement. Measurement of frequency and phase angle. Ammeter and voltmeter (both moving coil and moving iron type), extension of range wattmeter, Multimeter , Meggar, Energy meter AC Bridges. use of CRO, Signal Generator, CT, PT and their uses. Earth fault detection.

6. ELECTRICAL MACHINES:

(a) D.C. Machine: Constructions,. Basic Principals of D.C. Motors & Generations, their characteristics, Speed control and starting of D.C motors. Method of braking motor. Losses and efficiency of D.C. Machine. (b) 1 phase and 3 phase transformers- constructions, principals of operation, equivalent circuits, voltage regulations , O.C. and S.C. Tests, Losses and efficiency. Effect of voltage, frequency and wave form on losses. Parallel operation of 1 phase / 3 phase transforms. Auto transformers.

(c) 3 Phase inductions motors, rotating magnetic field, principal of operation, equivalent circuit torque - speed characteristics starting and speed control of 3 phase induction motors Methods of braking, effects of voltage and frequency variation on torque speed characteristics.

Fractional kilowatt Motors and Signal Phase Inductions Motors: Characteristics and application.

7. SYNCHRONOUS MACHINES

Generation of 3-phase e.m.f. armature reaction, Voltage regulation, Parallel operation of two alternator, synchronizing, control of active and reactive power, starting and applications of synchronous motors.

8. GENERATION. TRANSMISSION AND DISTRIBUTION

Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations. Power factor improvement, various types of tariffs, types of faults, Short circuits current for symmetrical faults. Switchgears - rating of circuits breaker, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage/ over

current, etc. Buchholtz relay, Merz- Price system of protection of generator & transformers, protection of feeders and bus bars. Lighting arresters, various transmission and distribution system, comparisons of conductor materials, efficiency of different system.

Cable - Different type of cables, cable rating and derating factor.

9. **ESTIMATION AND COSTING**

Estimation of lighting scheme, electric installation of machines and relevant IE rules, Earthing practices and IE Rules.

10. **UTILIZATION OF ELECTRICAL ENERGY**

Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors.

11. **BASIC ELECTRONICS:**

Working of various electronic devices e.g. P N Junction diodes, Transistors ( NPN and PNP type), BJT and JFET : Simple circuits using these devices.

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(ज) कनिष्ठ अभियन्ता (यांत्रिक/विद्युत) (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/ विद्युत अभियांत्रिकी(डिग्री)	80		

नोट :-

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**पाठ्यक्रम (Syllabus)**

भाग-अ :- सामान्य ज्ञान

राजस्थान का इतिहास, कला एवं संस्कृति, साहित्य, परम्पराएँ एवं विरासत
<ol style="list-style-type: none"> <li>18. राजस्थान के इतिहास के प्रमुख स्रोत</li> <li>19. राजस्थान की प्रमुख प्रागैतिहासिक सभ्यताएँ</li> <li>20. राजस्थान के प्रमुख राजवंश एवं उनकी उपलब्धियाँ</li> <li>21. मुगल-राजपूत संबंध</li> <li>22. स्थापत्य कला की प्रमुख विशेषताएँ</li> <li>23. महत्वपूर्ण किले, स्मारक एवं संरचनाएँ</li> <li>24. राजस्थान के धार्मिक आंदोलन एवं लोक देवी-देवताएँ</li> <li>25. राजस्थान की प्रमुख चित्रकलाएँ, शैलियाँ एवं हस्तशिल्प</li> <li>26. राजस्थानी भाषा एवं साहित्य की प्रमुख कृतियाँ, क्षेत्रीय बोलियाँ</li> <li>27. मेले, त्यौहार, लोक संगीत, लोक नृत्य, वाद्ययंत्र एवं आभूषण</li> <li>28. राजस्थानी संस्कृति, परंपरा एवं विरासत</li> <li>29. महत्वपूर्ण ऐतिहासिक पर्यटन स्थल</li> <li>30. राजस्थान के प्रमुख व्यक्तित्व</li> <li>31. राजस्थान की रियासतें एवं ब्रिटिश संधियाँ, 1857 का जन-आंदोलन</li> <li>32. कृषक एवं जन-जाति आंदोलन, प्रजामंडल आंदोलन</li> <li>33. राजस्थान का एकीकरण</li> <li>34. राजस्थान का राजनीतिक जनजागरण एवं विकास- महिलाओं के विशेष संदर्भ में</li> </ol>
राजस्थान का भूगोल
<ol style="list-style-type: none"> <li>17. स्थिति एवं विस्तार</li> <li>18. मुख्य भौतिक विभाग :- मरुस्थलीय प्रदेश, अरावली पर्वतीय प्रदेश, मैदानी प्रदेश, पठारी प्रदेश</li> <li>19. अपवाह तंत्र</li> <li>20. जलवायु</li> <li>21. मृदा</li> <li>22. प्राकृतिक वनस्पति</li> <li>23. वन एवं वन्य जीव संरक्षण</li> <li>24. पर्यावरणीय एवं पारिस्थितिकीय मुद्दे</li> <li>25. मरुस्थलीकरण</li> <li>26. कृषि-जलवायु प्रदेश एवं प्रमुख फसलें</li> <li>27. पशुधन</li> <li>28. बहुउद्देशीय परियोजनाएँ</li> <li>29. सिंचाई परियोजनाएँ</li> <li>30. जल संरक्षण</li> <li>31. परिवहन</li> <li>32. खनिज सम्पदाएँ</li> </ol>

भाग-ब :- विद्युत अभियांत्रिकी (डिग्री) :-

  
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100)

1. **ELECTRICAL CIRCUITS**

Circuit components, KCL and KVL. Network graphs, Methods of circuits analysis, Nodal and Mesh analysis, Analysis of D.C. and A.C. networks. Network theorems. Basic network theorems and applications. Network Functions: Driving point and transfer functions, poles and zeros of network functions. Response of networks to standard Input signals. Two port networks, Elementary network synthesis, different type of network parameters, signal flow graphs, Fourier series, Laplace transforms and their applications. Frequency response. Resonant circuits and applications. Three phases balanced and unbalanced networks. Steady state response with sinusoidal input. Transient response: Transient analysis of RL, RC and RLC circuits.

2. **FIELD THEORY**

Electrostatic and Magnetostatics : Electrostatics and electrical fields, Magneto statics and magnetic fields, field in conductor and in magnetic material, field in dielectrics, Maxwell's' equators and time varying field. Electromagnetic wave equations. Plane wave propagations in conducting and dielectric media.

3. **ELECTIRCAL MATERIALS**

Classifications of materials on the basis of permanent magnetic dipoles, Electrical and electronical behaviour of materials, classification on the basis of conductivity. Behaviour of dielectrical in static and alternating fields. Phenomenon of polarization. Super conductivity applications of magnetic conducting, dielectric and insulating materials.

4. **ELECTIRCAL MEASURMENT AND INSTRUMENTATION:**

General Principals of measurement: Unit and dimension, Standards error analysis. Basic methods of measurement, Measurement of circuit's parameters of bridge methods.

Measuring Instrument: Indicating Instruments, Integrating instruments, Recording instrument. Measurement of voltage, current, power, power factor, energy, resistance, inductance, capacitance and frequency.

Transducers: Strain guage , LVDT, resistance thermometers, Thermistors, piezoelectric Measurement of non - electrical quantities (Pressure, Temperature, Flow rate, displacement, velocity, acceleration, strain etc.)

Measurements: Digital voltmeters, Frequency counter, distortion meter. Telemetry and

Data recording and display, Data acquisition.

5. **ELECTIRONICS AND COMMUNICATION:**

Solid state (semi-conductor devices) : Diodes, Zener dioles, Transistors ( Bipolar, BJT, JFET, MOSFET) Biasing and their applications. Analysis of electronic circuits , equivalent circuits, Rectifier, Filter and voltage regulators. Single stage and multistage amplifiers- gain and frequency response, Multivibrators, flip-flops and their applications.

Communications : generations and detection of AM and FM, noise behaviour of AM and FM systems.

6. **POWER ELECTIRONICS:**

Power semiconductor devices, Thyristor, triac, GTO, MOSFET, Static characteristics and triggering circuits, A.C to D.C. Converters, Choppers. Controlled and uncontrolled power rectifiers, Brige converters.

7. **CONTROL SYSTEM**



Open and closed loop systems. Block diagrams and signal flow graphs. Response analysis time domain, frequency domain : Steady state error analysis. Root locus technique, bode plots, Routh Hurwitz and Nyquist criteria of stability. State Space analysis of linear systems.

8. **ELECTRICAL MACHINES:**

Constructions, Principals of operations, equivalent circuits, basic characteristics and applications of distribution and power transformers. Single phase induction motors. Three phase inductions motors. Alternators, synchronous motors.

9. **POWER SYSTEMS:**

Generations : Thermal generations, Hydro generation, Nuclear Generations. Non - Conventional energy sources. Transmission and Distribution. Transmission line parameters - resistance, Inductance and capacitance calculation, Performance of short, medium and long lines. Neutral earthing. Underground cables. Corona, its effect and remedial measures . Basic idea if power system stability. Line insulators, Introductions of HVDC transmission.

10. **SWITCHGEAR & PROTECTION**

Theories of arc extinction. Comparative merits of minimum oil, bulk oil, air blast, SF6 circuits breakers. Causes and consequences of dangerous currents. Currents limiting reactors. Busbar arrangement, Requirements of protective relays. Protections of lines, transformer, synchronous generators and busbars. Symmetrical components and their applications.

  
(13/02/2023)  
2023

### 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 epicyclic 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 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 offriction 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 non-dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.

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

**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.

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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, Ranking 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

  
(पुस्तक की जाँच/लिपि)  
संदेश

(छ) कनिष्ठ अभियन्ता (यांत्रिक/विद्युत) (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/विद्युत अभियांत्रिकी (डिप्लोमा)	30		

नोट :-

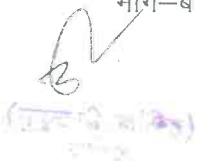
1. प्रश्न पत्र में बहुविकल्पीय प्रकार के प्रश्न होंगे व सभी प्रश्नों के अंक समान होंगे।
2. परीक्षा में न्यूनतम निर्धारित उत्तीर्णांक अंक 40 प्रतिशत है। इससे कम अंक प्राप्त करने वाले अभ्यर्थी नियुक्ति के लिए पात्र नहीं होंगे।

**पाठ्यक्रम (Syllabus)**

भाग-अ :- सामान्य ज्ञान

राजस्थान का इतिहास, कला एवं संस्कृति, साहित्य, परम्पराएँ एवं विरासत
18. राजस्थान के इतिहास के प्रमुख स्रोत 19. राजस्थान की प्रमुख प्रागैतिहासिक सभ्यताएँ 20. राजस्थान के प्रमुख राजवंश एवं उनकी उपलब्धियाँ 21. मुगल-राजपूत संबंध 22. स्थापत्य कला की प्रमुख विशेषताएँ 23. महत्वपूर्ण किले, स्मारक एवं संरचनाएँ 24. राजस्थान के धार्मिक आंदोलन एवं लोक देवी-देवताएँ 25. राजस्थान की प्रमुख चित्रकलाएँ, शैलियाँ एवं हस्तशिल्प 26. राजस्थानी भाषा एवं साहित्य की प्रमुख कृतियाँ, क्षेत्रीय बोलियाँ 27. मेले, त्यौहार, लोक संगीत, लोक नृत्य, वाद्ययंत्र एवं आभूषण 28. राजस्थानी संस्कृति, परंपरा एवं विरासत 29. महत्वपूर्ण ऐतिहासिक पर्यटन स्थल 30. राजस्थान के प्रमुख व्यक्तित्व 31. राजस्थान की रियासतें एवं ब्रिटिश संधियाँ, 1857 का जन-आंदोलन 32. कृषक एवं जन-जाति आंदोलन, प्रजामंडल आंदोलन 33. राजस्थान का एकीकरण 34. राजस्थान का राजनीतिक जनजागरण एवं विकास- महिलाओं के विशेष संदर्भ में
राजस्थान का भूगोल
17. स्थिति एवं विस्तार 18. मुख्य भौतिक विभाग :- मरुस्थलीय प्रदेश, अरावली पर्वतीय प्रदेश, मैदानी प्रदेश, पठारी प्रदेश 19. अपवाह तन्त्र 20. जलवायु 21. मृदा 22. प्राकृतिक वनस्पति 23. वन एवं वन्य जीव संरक्षण 24. पर्यावरणीय एवं पारिस्थितिकीय मुद्दे 25. मरुस्थलीकरण 26. कृषि-जलवायु प्रदेश एवं प्रमुख फसलें 27. पशुधन 28. बहुउद्देशीय परियोजनाएँ 29. सिंचाई परियोजनाएँ 30. जल संरक्षण 31. परिवहन 32. खनिज सम्पदाएँ

भाग-ब :- विद्युत अभियांत्रिकी (डिप्लोमा) :-





1. **BASIC CONCEPT:**

Concepts of resistance, inductance, capacitance and various factors affecting them. Concepts of current, voltage, power, energy & their units.

2. **CIRCUITS LAW**

Kirchoff's law, simple circuit solution using network theorems.

3. **MAGNETIC CIRCUITS**

Concepts of flux, mmf, reluctance, different kind of magnetic materials, Magnetic calculations of conductors of different configuration eg. straight, circular, solenoidal etc. Electromagnetic induction, self and mutual induction.

4. **AC FUNDAMENTAL:**

Instantaneous, peak R.M.S. and average values of alternating waves, Representation of sinusoidal wave from, simple series & Parallel AC circuits consisting of R,L and C,

Resonance, Tank circuits. Poly system star & delta connection, 3 Phase power, DC and sinusoidal response of R-L and R-C circuit.

5. **MEASUREMENT & MEASURING INSTRUMENTS:**

Measurement of power ( 1 phase and 3 phase , both active and re-active) and energy, 2 altmeter method of 3 phase power measurement. Measurement of frequency and phase angle. Ammeter and voltmeter (both moving coil and moving iron type), extension of range wattmeter, Multimeter , Meggar, Energy meter AC Bridges. use of CRO, Signal Generator, CT, PT and their uses. Earth fault detection.

6. **ELECTRICAL MACHINES:**

(a) D.C. Machine: Constructions,. Basic Principals of D.C. Motors & Generations, their characteristics, Speed control and starting of D.C motors. Method of braking motor. Losses and efficiency of D.C. Machine. (b) 1 phase and 3 phase transformers- constructions, principals of operation; equivalent circuits, voltage regulations , O.C. and S.C. Tests, Losses and efficiency. Effect of voltage, frequency and wave form on losses. Parallel operation of 1 phase / 3 phase transforms. Auto transformers.

(c) 3 Phase inductions motors, rotating magnetic field, principal of operation, equivalent circuit torque - speed characteristics starting and speed control of 3 phase induction motors Methods of braking, effects of voltage and frequency variation on torque speed characteristics.

Fractional kilowatt Motors and Signal Phase Inductions Motors: Characteristics and application.

7. **SYNCHRONOUS MACHINES**

Generation of 3-phase e.m.f. armature reaction, Voltage regulation, Parallel operation of two alternator, synchronizing, control of active and reactive power, starting and applications of synchronous motors.

8. **GENERATION. TRANSMISSION AND DISTRIBUTION**

Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations. Power factor improvement, various types of tariffs, types of faults, Short circuits current for symmetrical faults. Switchgears - rating of circuits breaker, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage/ over

current, etc. Buchholtz relay, Merz- Price system of protection of generator & transformers, protection of feeders and bus bars. Lighting arresters, various transmission and distribution system, comparisons of conductor materials, efficiency of different system.

Cable - Different type of cables, cable rating and derating factor.

9. **ESTIMATION AND COSTING**

Estimation of lighting scheme, electric installation of machines and relevant IE rules, Earthing practices and IE Rules.

10. **UTILIZATION OF ELECTRICAL ENERGY**

Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors.

11. **BASIC ELECTRONICS:**

Working of various electronic devices e.g. P N Junction diodes, Transistors ( NPN and PNP type), BJT and JFET : Simple circuits using- these devices.

Handwritten signature and a purple stamp.

## 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 land 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

3

Internal expanding brake  
Functions of dynamometer, Prony-brake, Rope brake and Froude's hydraulic dynamometer.  
Gyroscope—Introduction and principle, Gyroscopic couple

## 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, Charles'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, thermodynamic 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**

