S Y L L A B U S

Screening Test (OMR based) for recruitment to the post of **Assistant Engineer (Mechanical) under joint cadre of Public Works Roads (PWRD) and Public Works (Building & National Highway) Department [PW (B & NH) D]**

(ADVT. NO 34/2023 dated 18th December, 2023)

PAPER-I
Subject: Mechanical Engineering

(Multiple Choice Question Type)

Marks: 100   **Time: 2 Hours**

Sl.No.	Subject	Topics
1	**Engineering Mechanics**	**Equilibrium of Rigid Bodies** : Introduction, Free body diagram (FBD), Types of supports and their reactions, System of forces, Resultant of coplanar concurrent forces and non-concurrent force systems, Conditions of equilibrium, (i) Concurrent forces in space (ii) Non- concurrent forces in space. **Analysis of Structures**: Method of joint, method of sections, graphical methods. **Friction:** Introduction, laws of Coulombs friction, equilibrium of bodies involving dry friction; inclined plane, ladder friction, wedge friction. **Centre of Gravity and Moment of Inertia:** (i) Centre of gravity and centroid; location of centroid and centre of gravity (ii) Moment of inertia of plane area, Parallel axis theorem, perpendicular axis theorem, mass moment of inertia, polar moment of inertia, radius of gyration, product of inertia, M.I. of simple and composite bodies. **Lifting Machines:** Introduction, Principles of machines, reversibility of machines, lever, pulley, simple wheel and axle. **Virtual Work and Energy**. Introduction, virtual displacement, principle of virtual work, application of virtual work. **Impulse, Momentum, Work and Energy**: Linear impulse and momentum, Principle of work- energy conservation.
2.	**Electrical Technology**	**D C Machines :** i) Basic Constructional features, E M F equation of D.C. generator, Elementary Idea of DC machine winding- winding pitch, Lap and Wave windings. Types of generators. Characteristics of DC generator – the OCC and the load characteristics. The shunt generator – condition for voltage builds up. Load characteristics. Losses in a DC generator, Efficiency, Applications, Compound generators. ii) Working principle of DC motor. Back EMF Calculation of torque and power. Types of DC motors. Characteristics curves. Losses and Efficiency. Speed equation. Method of speed control. Method of starting. **Transformer:** Physical description of transformer. Elementary theory of the ideal transformer, EMF equation, Voltage and current transformation ratio. No load and load phasor diagrams. Transformer reactance and impedances. Equivalent resistance & reactance. Simplified equivalent circuit, open and short circuit tests. Losses and

		efficiency. Condition for maximum efficiency. All day efficiency. Voltage regulation. The auto transformer, basic working principle. **Induction motor:** Constructional features of 3 – ph induction motor- principle of rotating magnetic field (mathematical treatment not required) Principle of operation of the 3- ph induction motor speed. Rotor emf, current and rotor cu loss, Torque, Starting torque. Maximum torque. Condition for maximum torque. Torque slip curves. Necessity of a starter. Methods of starting of squirrel cage and the slip – ring induction motors. Introduction to single phase induction motor. Nature of a field and torque produced in single phase induction motors (details of double revolving field not required). Types of motors- split phase, capacitors motors. **A.C. Synchronous machines:** Principle of operation of alternators. Constructional features of cylindrical generators and salient pole alternator, EMF equation. Principle of operation of the synchronous motor, Synchronous motor on no load, Synchronous motor on load, Behaviour of the Synchronous motor with change of excitation curves. Starting methods of Synchronous Motor. Application of Synchronous motor. **Measuring Instruments:** Dynamometer type wattmeter. Induction type wattmeter. Single phase induction type energy meter. Errors and compensations.
3	**Basic Thermodynamics**	**System and Continuum:** Intensive and Extensive properties- Thermodynamic state, pressure, energy, work and heat- process and cycle – Macroscopic and Microscopic points of view – Kinetic theory of gases. **Laws of Thermodynamics:** Zeroth law – Concept of equilibrium- Principles of therm. Fixed points. First law of thermodynamics and its application to open and closed systems Concept of internal energy- Steady flow energy equation- Processes of closes systems. Second law of thermodynamics – Various statements – Carnot cycle – Irreversible and Irreversible processes – Thermodynamic efficiency and temperature scales – Concept of entropy – Entropy changes in various processes. **Properties of steam:** Latent heat – Saturation pressure and temperature- Dryness fraction – Degree of superheat – Total heat; Ranking cycles (use of steam tables, Mollier chart and other property diagrams). **Air Standard cycles:** Otto, Diesel and dual cycles. Principles of working of two and four stroke Sl and Cl engines-Representations of processes on T-s and p-v and p-v diagrams and comparisons of efficiencies. **Fuels and Combustions:** Classification of fuels ; HCV,LCV, Bomb Calorimeter, Boy's gas calorimeter; Combustion of fuels; Minimum air required (by weight and by volume) Conversion of volumetric analysis into weight analysis and vice versa; excess air and Orsat apparatus.
4.	**Theory of Machines**	**SIMPLE MECHANISM :** Link, Pair, chain, mechanism and inversions. Simple mechanism, Slider crank, four bar, straight line steering. Simple velocity and acceleration diagrams, **GOVERNOR :** Watt and Porter governors. Spring controlled centrifugal governor – Hartnell, Hartung, Wilson – Hartnell, Inertia governors. Stability, Effects of friction, Isochronism, Hunting, effort and power. **CAM:** Introduction, classification of cams and followers Displacement diagram, graphical layout of cam profiles. **FRICTION AND FRICTION DRIVES:** Types of friction, Uniform Pressure and Uniform Wear, Friction Clutches, Rolling Friction, Flat Belt, V Belt and Rope Drives, Velocity Ratio in Belt Drives, Law of Belting , Ratio of Friction Tensions in Belts, Power Transmitted by Belts and Ropes, Maximum Power Transmission by Belt, Types of Brakes, Block and Shoe Brake, Band Brake, Internal Expanding Shoe Brake, dynamometer. **TM DIAGRAM AND FLYWHEEL:** Fluctuations of energy, Co- efficient of

		fluctuation of energy and speed, function of flywheel. **GEAR AND GEAR TRAIN:** Nomenclature, types- simple, compound, epicyclic gear train including reverted gear train. Simple description of automobile gear train.
5	**Fluid Mechanics**	**Introductions :** Definition of Fluid, Dimension and Units, Concept of Continuum, No slip condition of viscous liquids, Classification of fluids, Properties of fluids, mass density, specific weight, specific gravity, viscosity, compressibility, compressibility, surface tension and vapor pressure. **Pressure and Fluid Statics:** Define Pressure, The Manometer pressure at a point, other pressure measuring devices, Hydrostatic forces on submerged plane and curved surfaces, Buoyancy, stability of floating and submerged bodies. **Kinematics of Fluids:** Lagrangian and Eulerian description fluid motion, Acceleration field of a fluid, Differential Equation of Mass Conservation, streamline, path line, streakline, stream tube, steady and unsteady flow, uniform and non- uniform flow, Rotational and Irrotational flows, Vorticity, Stream function, Velocity potential function, Flow net. **Elementary Flows in a two dimensional plane:** Uniform flow, Source and Sink, Vortex Flow, Free and Forced Vortex, Doublet, Continuity equation and its analysis based on integral form **Dynamics of Fluid Flow:** Euler's equation of motion, The Bernoulli's equation and its application, General Energy equation and momentum equation, Dynamic forces on plain and curved surfaces due to impingement of liquid jets. **Flow Measurement:** Concept of static and stagnation pressures, Pitot tube and its application, venturimeter, Orificemeter, Hydraulic co- efficient of an Orifice, Factors affecting the Orifice co- efficient. Dimensional Analysis and its applications Introduction, Dimensionless numbers and its significance, Fluid flow problems, drag in immersed bodies. **Flow through pipes:** Laminar and turbulent flow, Reynolds number, Pressure drop and head loss in pipe, Darcy Weisbach equation, Steady laminar flow through circular pipes, flow between parallel plates, Couette flow.
6	**Mechanics of Materials**	**Complex stresses and strains:** Introduction to Cartesian tensors, derivation of Cauchy relations and equilibrium equations in spherical and polar/ cylindrical coordinates, principal stresses and directions, stresses on octahedral planes, stress invariants, plane stress, stresses on oblique planes, Mohr's circle for plane and tri- axial stress system. Analysis of strain components, compatibility relations, strain tensor, **principal strains and directions, strain invariants, strain on oblique planes, plane strain, Strain Rosette.** **Combined stresses:** Stresses due to combined bending and torsion of circular shafts. Stresses in non- circular cross-sections / curved beams: crane hooks ,rings etc Stresses and deflection of helical springs
7	**Heat Transfer**	**Introduction:** Concept of Modes of Heat Transfer Conduction Heat Transfer: General 3-D differential equation for heat conduction, Boundary conditions and their types. One Dimensional Steady State Head Conduction System with or without heat generation: slab, cylinder, sphere, Concept of thermal resistance and electrical analogy, Variable thermal resistance and electrical analogy, Composite systems: slab, coaxial cylinder, concentric sphere, Critical radius of insulation, Fins. One Dimensional Unsteady State. Heat Conduction: Lumped system analysis, Response time of a temperature measuring instrument, Mixed: boundary condition.

9			Radiation Head Transfer Nature of thermal radiation, emissive power, Absorption, Reflection and Transmission, Concept of a black body, Intensity of radiation, Laws of black body radiation, Radiation to and from real surfaces. Radiative Heat Exchange Between Surfaces Radiation between two black bodies, Radiation shape factor (View factor) and its properties. Shape factors for different geometries, Radiation between two infinite parallel places, Radiation between two infinitely long concentric cylinders, Radiation between grey bodies, Electric network analogy for thermal radiation, Radiation shields, Radiation combined with convection. Diffusion Mass Transfer Concentrations, Velocities and Fluxes, Fick's law of diffusion, the diffusion co- efficient, Species conservation equation and the boundary equation, Steady state molecular diffusion.
8	Industrial Engineering and Management		**Introduction to Organization:** Definition of organization, organizational structure, types of organization, span of control, delegation of authority and responsibility **Plant Location and Layout:** Objectives, Locational factors, Economics of plant location: Meaning objectives and types of plant layout and their relevance to mass, batch and job- order production systems. **Network Analysis:** Objectives, Network development technique, Network computations – Critical Path and its significance, Earliest and Latest dates, calculation of float. Deterministic and probabilistic network models, Assumption and computations related to PERT model, Crashing of jobs for minimum cost-time schedule for CPM models **Work Study:** Meaning and scope, subdivisions of work study- Method / Motion study and Work Measurement; Method/ Motion study – its meaning and scope, steps in method / motion study, Tools and techniques of method / motion study, Principles of motion economy; Micro – motion study – Meaning and scope, therbligs, use of motion camera in micro-motion study; Work measurement- concept of observed time, rating factor, average worker and standard time for jobs. Use of stop watch and work sampling techniques in the determination of standard time. **Product Design and Development:** Meaning of product, Product life cycle (PLC) and Product mix; Decisions to be taken during product development and design, Procedure for product development and design, Value of a product- its meaning, Value Analysis. **Production Planning and Inventory Control:** Meaning and Objectives, Effects of types of production, steps in Production Planning and Control, Use of Gantt chart, Machine Scheduling Problems, Make / Buy decision and Break – even analysis and Inventory Control: EOQ Model, ABC, VED, FSN analysis. **Maintenance Management:** Meaning and Types of maintenance. And their suitability, Standards of maintenance, Total Productive Maintenance (TPM) **Quality and Quality Control Engineering:** Meaning of Quality, Inspection Quality Control, Process Control, Control Charts, Acceptance Sampling, Total Quality Management Philosophy.
9	Air Conditioning		**Psychrometry Psychrometric:** properties, representations of properties in charts, preparation of charts. Psychrometric processes Constant sensible heat and latent heat processes, adiabatic saturation and enthalpy deviation. Adiabatic mixing of air stream. Humidification, Dehumidification water spray processes, sensible heat factors, grand sensible ratio lines, apparatus dew points, Bypass factors, Air washer – humidifying efficiency. Comfort A/C Air temperature, human health, body temperature regulation, comfort indices, comfort charts and their limitations. Load analysis Inside and outside design conditions, load classification, summer

cooling loads, solar heat gain and transmission and radiation. Flywheel effect of building materials, equipment temperature differential loads due to human beings, load due to electric light, equipment and appliances. Infiltrator and ventilator loads, product loads, miscellaneous loads such as duct heat gain, duct air leakage, fans, pumps etc. Winter heat load – computation of loads.

Duct design and Air distribution Different methods of duct design such as velocity reduction, equal friction and static regain, aspect ratio duct losses, distribution of air in rooms, nature and supply grill; duct arrangement and air handling system.

A/C System Unitary control system, special features of residential, commercial and industrial A/C system, Year round a/c zoning.

Equipment: (1) Fans – types of fans, characteristics, curves, fan selection. (2) Air filter and cleaner. (3) Cooling towers, evaporators, condensers (4) Cooling coils and water capacity, (5) Chemical dehumidifiers, (6) Heaters, radiators, Convection coils

MODULE 8: Instruments and controls Temperature, humidity, air velocity measuring instruments, Thermostat, humidistat. By pass and damper control. Dew point control, noise control, Pneumatic control.

02/01/24

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Assam Public Service Commission
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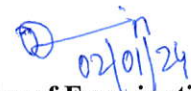(ADVT. NO 34/2023 dated 18th December, 2023)

PAPER-II
Subject: General Studies & General English

(Multiple Choice Question Type)

Full Marks: 100 Marks   **Time:** 2-00 hours

Sl. No.	Item/Topic
1	Current affairs (India/Assam)
2	Indian History & National Movement
3	Assam History
4	Geography (India/Assam)
5	Indian Polity & Constitution
6	Sports/Books/Author and important people of Assam
7	Economy of India & Assam
8	Environment of Assam
9	General Mental Ability
10	Literature, Culture & festivals of Assam & North East
11	English Grammar

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