Syllabus for Manager(Electrical/ Civil/ Mechanical), Grade-A

Total Marks-100 (Written Exam- 85, Interview-15)
Duration of Examination-3 Hours

Selection Phase - I

I) GENERAL STUDIES (COMPULSORY FOR ALL GRADE/POSTS/BRANCHES) – 35 MARKS

Sl. No.	Topic	Marks
(i)	Vocabulary (Synonyms & antonyms, idioms & Phrases)	05
(ii)	General Knowledge (Knowledge of Tripura only)	15
(iii)	Current Affairs (Knowledge of Electricity Market, Renewable Market and Electricity situation in India, NE Region and Tripura)	15

II) ELECTRICAL ENGINEERING BRANCH (DEGREE) – 50 MARKS

- **Electrical Materials:** -Conductor, Semi-conductor and Insulators. Super Conductivity. Insulators for electrical and electronics applications. Magnetic Materials. Ferro and Ferri Magnetism. Ceramics, properties and applications. Hall effects and its applications, Special Semi-Conductors.
- **Electrical Circuit:**-Circuit elements. Kirchhoff's Law. Mesh and nodal analysis. Network Theorems and Applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of Networks in terms of poles and zeros. Transfer function. Resonant Circuits. Three phase Circuits. Two-Port Networks. Elements of two-element network Synthesis.
- **Measurements and Instruments:**-Units and Standards. Measurement of current, voltage, power, Power-factor and energy. Indicating Instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge Measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducer and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate condensers, evaporates and expansion devices, Psychometric , Charts and application to air conditioning, Sensible heating and Cooling, Effective temperature, comfort indices, Load Calculations, Solar refrigeration, Control, Duct design.
- **Smart Meters/Communicable Electronics Meters**
- **Solar Engineering**
- **EV Charging System**
- **Control System:**-Block Diagrams and signal flow graphs and their reduction. Errors for different types of inputs and stability criteria for feedback system. Stability analysis using Routh-Hurwitz array, Nyquist plot and Bode plot, Root locus and Nicols chart and the estimation of gain and phase margin. Basic concepts of compensator design. State variable matrix and its use in system modelling and design. Sampled data system and performance of such a system with the samples in the error channel. Stability of Sample data system. Elements of non-linear control analysis. Control system components, electromechanical, hydraulic, pneumatic, Components.

- **Electrical Machines and Power Transformers: -**Magnetic circuits. Construction and testing, Equivalent circuits, Losses and efficiency, Regulation, Auto-Transformer, 3-phase transformer, parallel operation.

  Basic concepts in rotating machines.EMF, Torque, basic machine type. Construction and operation, leakage losses and efficiency.

  Synchronous machines, Construction, Circuit Models, Operation Characteristics. Synchronous reactance.Efficiency.Voltage regulation.Salient-pole machine, Parallel Operation, Hunting, Short Circuit transients.

  Induction machines.Construction.Principle of Operation.Rotating fields, Characteristics and performance analysis.Determination of circuit model. Circle Diagram. Starting and speed control. Fractional KW motors. Single-phase Synchronous and induction motors.

- **Power Systems: -**Types of power Stations, Hydro, Thermal and Nuclear stations. Pumped storage plants. Economics and operating factors. Power transmissions lines. Modelling and performance characteristics. Voltage control. Load flow studies. Optimal power system operations. Load frequency control. Symmetrical components. Per Unit representations. Fault analysis. Transient and study-state stability of power systems. Equal area criterion. Power system Transients. Power system protection Circuit breakers. Relays. HVDC transmissions.
- **Analog and Digital Electronics and Circuits :-** Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behaviour of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multistage amplifiers and feed-back amplifiers, D.C. amplifiers, oscillator. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators and flip-flops and their applications. Digital logic gate families, universal gates-combination circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and -ROMs.

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MECHANICAL ENGINEERING BRANCH (DEGREE) – 50 MARKS

- **Strength of Materials:-** Stress and strains in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagram, bending stresses and deflection of beams, Shear stresses distribution, Torsion of shafts, helical springs, Combined stresses, thick and thin walled pressure vessels, Struts and columns.
- **Fluid Mechanics:-** Properties and classifications of fluids, Manometer, forces on immersed surfaces, Centre of pressure, Buoyancy, Elements of stability of floating bodies. Kinematics and Dynamics. Irrigational and incompressible, In viscid flow. Velocity potential, Pressure field and forces on immersed bodies. Bernoulli's equation, fully developed flow through pipes, pressure drops calculations, Measurement of flow rate and pressure drop. Integral approach, Laminar and turbulent flows, Separations. Flow over weirs and notches. Open channel flow, Hydraulic jump. Dimensionless numbers, Similitude and modelling.
- **Theory of Machines: -** Cams, Gears, and gear trains, Fly wheels, Governors. Balancing of rigid rotors and field balancing. Balancing of single and multi-cylinder engines. Critical speeds and whirling of shafts Automatic controls.

- **Machine Design :**
  Design of joints:-Cotters, keys, splines, welded joints, threaded fasteners, joints formed by interference fits, Design of friction drives, coupling and clutches, belt and chain drives, power screws.

  Design of power transmissions *systems:* - gears and gear driveshaft and axle, wire ropes.

  Design of Bearings: -hydrodynamics bearings and rolling elements bearings.

- **Fluid Machinery and Steam Generators:-** Performance, Operation and control of hydraulic pump, impulse and reaction Turbines, Specific speed, Classification, Energy transfer, Coupling, Power transmissions, steam generators, Fire-tube and water-tube boilers, Flow of steam through Nozzles and Diffusers, Wetness and Condensation. Various types of steam and gas turbines, partial admission, Reciprocating, Centrifugal and axial flow, Compressors, Multistage compression, role of Mach Number, Reheat, Regeneration, Efficiency, Governance.

- **THERMODYNAMICS: -**Cycles and IC Engines, Basic concepts, Open and closed systems. Heat and Work. Zeroth, First and second law, Application to non-flow and Flow processes, Entropy, Availability. Properties of ideal gases and vapours, Standard vapour, gass power and Refrigeration cycles, Two stage compressors, CI and SI Engines, pre-ignition, Detonation and Diesel knock, Fuel injection and carburetion, Supercharging. Turboprop and Rocket engines, Engine cooling, Emission & control. Measurement of Calorific values.
- **Heat transfer, Refrigeration and Air-conditioning:-** Modes of heat transfer, One dimensional steady conduction. Composite slab and Equivalent Resistance. Heat dissipation from extended surfaces. Heat exchangers, Overall het transfer coefficient, Empirical correlations for heat transfer laminar and turbulent flows and for free and forced Convection, Thermal boundary layer over a flat plate. Fundamentals of diffusive and connective mass transfer, Black body and basic concepts in Radiation, Enclosure theory, Shape factor. Heat pimp, and refrigeration cycles and systems, Refrigerants. Condenser, Evaporates and Expansion devices, Psychrometry, Charts and applications to air conditioning, sensible heating and cooling, Effective temperature, comfort indices, Load calculations, Solar refrigeration, controls, Duct design.
- **Engineering Materials: -** Basic concept of Structure of solids. Crystalline materials. Defects in crystalline materials. Alloys and binary phase diagrams. Structure and properties of common engineering materials.

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CIVIL ENGINEERING BRANCH (DEGREE) – 50 MARKS

- **Building materials:**
  Timber: - Different types and species of structural timber, density-moisture relationship, strength in different directions, defects, influence of defects on permissible stress, preservations, dry and wet rots, codal provisions for design, Plywood.
  Bricks: - Types, Indian Standard classification, absorption, saturation factors, strength in masonry, influence mortar strength on masonry strength.
  Cement: - Compounds of different types, setting times, strength.
  Cement Mortar: - Ingredients, proportions, water demand, mortars for plastering and masonry.

Concrete: - Importance of W/C Ratio, strength, ingredients, including admixture, workability, testing for strength, elasticity, non-destructive testing, mix design methods.

- **Solid Mechanic:-** Elastic constants, stress, plane stress, Mohr's circle of stress, strains, plane strain, Mohr's circle of strain, combined stress; Elastic theories of failure; simple bending, shear; Torsion of circular and rectangular sections and simple members.
- **Design and Steel Structures:-** Principles of working stress method. Design of connections, simple members, Built-up sections and frames, Design of Industrial roofs. Principles of ultimate load design.
- **Design and Concrete and Masonry Structures:** - Limit state design for bending shear, axial compression and combined forces. Codal provisions for slabs, beams, walls and footings. Working stress method of design of R.C. members.
  Principles of prestressed concrete design, materials, methods of prestressing, losses. Design of sample members and determinate structures.
- **Construction Practices, Planning and Management:-**
  Concreting Equipment:-Weight Batcher, Mixer vibrator, batching plant, concrete pimp. Cranes, hoists, lifting equipment.
  Earthwork Equipment:- Power shovel, hoe, dozer, dumper, trailers and tractor, rollers, sheep foot rollers, pumps.
  Construction, Planning, Management: - Bar chart, linked Bar chart, work-break down structures, Activity-on-arrow diagrams. Critical path, probabilistic activity durations; Event- based networks.

(1) Fluid Mechanics , Open channel flow, pipe Flow:- Fluid, properties, Pressure, Thrust, Buoyance; Flow Kinematics; Integration of flow equations; Flow Measurement; Relative motion; Moment of Momentum,; Viscosity, Boundary layer and Control, Drag Lift; Dimensional Analysis, Modelling; Cavitations; Flow oscillations, Momentum and Energy Principles in Open channel Flow, Flow controls, Hydraulic jump, Flow section and properties; Normal flow, Gradually varied flow; Surges; Flow development and losses in pipe flows, Measurements; Siphons; Surges and Water hammer.

- **Hydraulic Machines And Hydropower:-** Centrifugal pumps, types, performance, parameters, scaling, pumps in parallel; Reciprocating pumps, air vessels, performance parameters; Hydraulic ram;

Hydraulic turbines, types, performance parameters, controls choice; Power house, classification and layout, storage, pondage, control of supply.

(2) **Hydrology: -**Hydrological cycle, precipitation and related data analysis, PMP, unit and synthetic hydrographs; Evaporation and transpiration; Floods and their management, PMF; Steams and their gauging.

(3) Environmental Engineering:

- *Water Supply Engineering:-* Source of supply, yields, design of intakes and conductors; Estimations of demand; Water quality standards; Control of Water-borne diseases; Primary

and secondary treatment, detailing and maintenance of treatment units; Conveyance and distribution systems of treated water, leakages and control; Rural water supply; Institutional and industrial water supply.

- *Waste Water Engineering:-* Urban rain water disposal; Systems of sewage collection and disposal; Design of sewers and sewerage systems; pumping; Characteristics of sewage and its treatment, Disposal of products of sewage treatment, stream flow. Plumbing Systems, Rural and semi-urban sanitation.
- *Solid Waste Management:* - Sources, classification, collection and disposal; Design and Management of landfills.

(4) Soil Mechanics:- Properties of soils, classification and interrelationship; Compaction behaviour, methods of compaction and their choice; Permeability and seepage, flow nets, Inverted filters; Compressibility and consolidation; Shearing resistance, stresses and failure; Soil testing in laboratory and in-situ; Stress path and application; Earth pressure theories, stress distribution in soil; soil exploration, samplers, load test, Penetration tests.

- *Foundation Engineering:* -Types of foundation, Selection Criteria, bearing capacity, settlement, laboratory and field tests, Types of piles and their design and layout, Foundations on expansive soils, swelling and its prevention, foundation on swelling soils.

(5) Surveying:- Classification of surveys, scales, accuracy, Measurements of distances-direct and indirect methods, optical and electronic devices, Measurements of directions, prismatic compass, local attraction, Theodolites-types, measurements of elevations-sprit and trigonometric levelling, Relief representation, contours, Digital elevations, modelling concept, Establishment of control by triangulations and traversing-measurements and adjustment of observations, computation of coordinates, Field astronomy, Concepts of global positioning system.

- *Transportation Engineering:* -Planning of highway systems, alignment and geometric design, horizontal and vertical curves, grade separation, Materials and construction methods for different surfaces and maintenance, Principles of pavement design, Drainage.

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Phase– II

Interview – 15 Marks.

10.11.25

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