Written Examination Syllabus

for the Post of Executive Engineer (Civil), Class-I

Cochin Port Authority

Section-I: General Aptitude, Port Awareness and IT

Module 1: Quantitative Aptitude and Engineering Mathematics — Arithmetic, percentages, ratio, data interpretation; matrices and linear equations, calculus basics, probability and statistics (mean, standard deviation, normal distribution), numerical integration by trapezoidal and Simpson's rule.

Module 2: Reasoning — Verbal, logical and non-verbal reasoning.

Module 3: Port and Maritime Awareness — Major Port Authorities Act 2021; Indian Ports Act 1908; Sagarmala Programme; Maritime India Vision 2030; PM Gati Shakti; major and non-major ports of India, port-led development, PPP models in ports; Tariff fixation Guidelines by GoI; General knowledge and current affairs.

Module 4: Computers and IT Office automation (Word, Excel incl. formulas and analytics, PowerPoint); web technologies, networks, IoT in office management; e-office, e-procurement and GeM portals; GIS and GPS basics; AutoCAD and civil engineering software (STAAD Pro, ETABS, MS Project/Primavera); awareness of generative AI.

Section-II: Technical

Module 1: Structural Engineering and Design

- **Mechanics and solid mechanics:** System of forces, free-body diagrams, equilibrium; bending moment and shear force; simple bending, flexural and shear stresses, shear centre; torsi+on; transformation of stress; buckling of columns; combined and direct bending stresses.
- **Structural analysis:** Determinate and indeterminate structures by force and energy methods; trusses, arches, beams, cables and frames; slope deflection and moment distribution; influence lines; stiffness and flexibility methods; free vibration of undamped SDOF systems.
- **Concrete structures:** Working stress and limit state design; beams, slabs, columns, footings, retaining walls, water tanks; bond and development length; prestressed concrete beams and losses; durability of concrete in marine exposure.
- **Steel structures:** Tension and compression members, beams and beam-columns, column bases; bolted and welded connections; plate girders and trusses; plastic analysis of beams and frames.

- Pre-Stressed Concrete: Basic concepts, material for pre-stressing, losses in Pre-stress, classification of pre-stressing system; Analysis of PSC Sections.
- **Masonry and loads:** Design of masonry structures; dead, live, wind and seismic loads, earthquake-resistant design principles.

Module 2: Port, Harbour and Coastal Engineering

- **Harbour planning:** Classification of ports and harbours; site selection; harbour layout; channel and turning circle design; navigational aids; port capacity and berth occupancy.
- **Marine structures:** Breakwaters (rubble mound and vertical)- (Hudson/Van der Meer), composite/ caisson breakwaters; seawalls & revetments – armor sizing, filters, geotextiles; groynes & nearshore structures; wharves, quays, jetties, piers, dolphins and berthing structures; fenders, bollards and mooring systems; dry docks and slipways; berthing and mooring forces, Design and construction of reinforced soil retaining walls, coping levels, apron components; IWT structures – RCC jetties, pontoon systems, gangways.
- **Dredging and reclamation:** Capital and maintenance dredging, dredger types, disposal of dredged material, land reclamation.
- **Shore protection and maintenance:** Seawalls, groynes, revetments; corrosion protection of marine structures (cathodic protection, coatings); condition assessment and rehabilitation of port structures, coastal processes – erosion, accretion, beach nourishment.
- **Port infrastructure:** Container yards, storage sheds, port roads and rail sidings, hinterland connectivity, port environmental management.

Module 3: Geotechnical and Foundation Engineering

- **Soil mechanics:** Soil formation, Soil types, composition, specific gravity, water content, shape and size, grain size distribution curves, relative density, consistency of soils, unified soil classification system, IS soil classification system, field identification tests, principle of effective stress, direct shear test, unconfined compression test, Triaxial shear test : consolidated drained, consolidated undrained, unconsolidated undrained, vane shear test, shear strength of clays and sands, general principles of compaction, compaction tests, factors affecting compaction, field compaction, compaction techniques, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement, secondary consolidation, 3-D consolidation, vertical sand drains, earth pressure theories, earth pressure due to surcharge, retaining walls, stability analysis of retaining walls, proportioning and design of retaining walls.
- **Foundations:** Sub-surface investigation (boreholes, SPT, CPT, plate load test); earth pressure theories (Rankine, Coulomb); slope stability; Boussinesq stress distribution; bearing capacity (Terzaghi, Meyerhof); correlations between penetration resistance and soil design parameters. Types of foundations & selection criteria, mechanism of load

transfer in shallow and deep foundations, computation of bearing capacity in soils, settlement analysis of footings and rafts, design and testing of shallow & deep foundations; Slope stability analysis, Earthen embankments, Principles of ground modifications, sheeting and bracing of foundation excavation, Pile Foundations : Types and methods of construction, estimation of pile capacity, capacity and settlement of group of piles, proportioning of piles.

- **Marine and ground improvement:** Foundations on soft marine clays; sheet piles and diaphragm walls; ground improvement (preloading, vertical drains, stone columns); engineering geology basics.

Module 4: Hydraulics, Hydrology and Water Resources

- **Fluid mechanics:** Fluid properties and statics; continuity, momentum and energy equations; laminar and turbulent flow; flow in pipes and pipe networks; boundary layer; lift and drag.
- **Hydraulics:** Flow measurement in pipes and channels; dimensional analysis and model studies; open channel flow, specific energy, critical flow, hydraulic jump, gradually varied flow; hydraulic machines (pumps and turbines) and hydropower.
- **Hydrology:** Hydrologic cycle, precipitation, infiltration, unit hydrograph, flood estimation and routing, groundwater and well hydraulics, Darcy's law.
- **Irrigation:** Canals, gravity dams, spillways, weirs on permeable foundations, cross-drainage works.

Module 5: Quantity Surveying, Estimation, Specifications and Rate Analysis

- Types of estimates (preliminary, detailed, revised, supplementary); methods of estimation for buildings, roads, water supply, drainage and marine works, estimation with latest project management tools and network analysis for different Types of works.
- Mode of measurement; recording measurements in the Measurement Book; check measurement. (M)
- Importance and requirements of Rate analysis of items, units of measurement, preparation of rate analysis, procedure of rate analysis for items; CPWD Specifications, Schedule of Rates and Analysis of Rates; lead and lift, cost index, escalation.
- Types of specifications, general specifications & technical specifications
- Bar bending schedules; valuation of buildings and depreciation; billing (running account and final bills), variations and deviations.

Module 6: Environmental and Public Health Engineering

- **Water supply:** Water quality standards, testing of water, demand estimation, treatment units, distribution system design, water distribution networks.
- **Wastewater:** Sewerage design, quantity of sewage, primary and secondary treatment, effluent standards, sludge disposal, reuse of treated sewage; storm water drainage.

- **Solid waste and air:** MSW generation, collection, treatment and disposal; air pollutants, control and AQI; noise pollution.
- **Environmental management:** EIA, CRZ notification and coastal environmental clearance, building plumbing and sanitation.

Module 7: Transportation Engineering

- **Highways:** Planning & construction methodology, Alignment and geometric design; Traffic Surveys and Controls; Principles and design of Flexible and Rigid pavements as per CBR and IRC design methods. Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements, hot mix plants, construction of rigid pavements; pavement maintenance.
- **Traffic:** Traffic studies, flow-speed-density relationships, signal design (Webster), intersections, highway capacity.
- **Railways:** Track components, gauges, speed and cant, points and crossings, port rail sidings.
- **Airports and tunnels:** Runway orientation, length and corrections, taxiway design; tunnelling methods, ventilation and drainage.

Module 8: Surveying, Geomatics and Hydrographic Survey

- Principles of surveying; classification of surveys, various methodologies, instruments & analysis of measurement of distances, elevation and directions; Map preparation errors and their adjustment; chain, compass and plane table surveying; levelling and trigonometric levelling; contouring, survey layout for culverts, canals, bridges, road/railway alignment and buildings, setting out of curves.
- Theodolite traversing, triangulation, tacheometry; total station; horizontal and vertical curves; setting out works.
- Photogrammetry; Satellite images and aerial photographs, remote sensing, 3-D modelling, GIS and GPS/DGPS.

Hydrographic surveying: Metocean parameters – waves, tides, currents, storm surge; wave spectra – Pierson-Moskowitz (PM)/ Joint North Sea Wave Project (JONSWAP); sediment transport & littoral drift; shoreline change modelling; hydrographic surveys – Single-Beam Echo Sounder (SBES) / Multi-Beam Echo Sounder (MBES); topographic surveys – DGPS/Total Station; geophysical surveys – SSS, sub- bottom profiler; survey instruments – ADCP, wave rider buoy, tide gauges.

Module 9: Construction Materials, Technology and Quality Control

- **Materials:** Stone, brick, lime, cement, aggregates, timber, steel, bitumen, paints, polymers, geosynthetics; properties and tests.
- **Concrete technology:** Mix design, admixtures, high-performance and special concretes, non-destructive testing (rebound hammer, UPV), concrete for marine environment.

- **Construction technology:** Formwork, scaffolding, construction equipment (earthmoving, piling, cranes, dredgers), pre-engineered and precast construction, building services.
- **Quality and maintenance:** Quality assurance plans, inspection and test plans, third-party inspection; maintenance and repair of buildings, roads, water supply and drainage work; distress diagnosis and retrofitting.

Module 10: Construction Management, Contracts and Procurement

- **Planning:** Project life cycle; PERT and CPM, crashing, resource levelling; bar charts and S-curves; project monitoring and earned value.
- **Contracts:** Types of contracts (item rate, percentage rate, lump sum, EPC, HAM, PPP); CPWD Works Manual; tendering and e-tendering process; Earnest money, security money, retention money, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction, Quality Control, Productivity, Operation Cost; Land acquisition; Labour safety and welfare; Different terms used in valuation, the role of a valuer, purpose and necessity of the same. Capitalised Value, Years purchase, sinking fund, depreciation, types of values, Indian Contract Act 1872; Arbitration and Conciliation Act 1996; dispute resolution.
- **Procurement and finance:** General Financial Rules 2017 (works and procurement chapters); GeM, earnest money and performance guarantee; cost estimation and project appraisal basics.
- **Safety and ethics:** Construction safety, engineering ethics, standards and quality practices.