

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

Contents

Paper I.—General (Civil Engineering).
General (Mechanical Engineering).

Paper II.—Special subject.—

- (i) Irrigation and Irrigation Act.
- (ii) Land drainage.
- (iii) Design and construction of earthen dams.
- (iv) Construction and maintenance of lift irrigation schemes.
- (v) Water-supply and sanitary engineering.
- (vi) Roads, buildings and bridges.
- (vii) Construction of masonry and concrete dams.
- (viii) Boring.
- (ix) Use of machinery.
- (x) Harbour engineering.

Paper III.—Accounts (Sub-divisional and works account).

Paper IV.—(1) Practical test of Civil Junior Engineers, (2) Practical test for Mechanical Junior Engineers, (3) Practical test for Civil Junior Engineers in Ports Organisation.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

PAPER I

General (Civil Engineering)

Part—(I) Materials, (II) Construction and
(III) Management of works.

PART I

Materials

(a) *Stones.*—General characteristics of building stones. Chief varieties and uses. Quarrying, blasting, dressing, tools used—strength—cause of decay and methods of preservation. Tests artificial stone—manufacture and uses—costs.

(b) *Bricks and tiles.*—General characteristics, varieties and uses. Manufacture, selecting clay; moulding and burning in kilns (Bull's and Hoffman's kilns). Causes of decay and methods of preservation. Strength—essentials of good bricks, tests Mangalore and country tiles, salt glazed pipes and china clay ware—Terra cotta and refractory materials—costs.

(c) *Glass*.—General characteristics, varieties, composition, manufacture and uses—costs.

(d) *Limes and cements*.—Limes—Hydraulic and fat, occurrence collection, burning, stacking and storing, artificial hydraulic limes; gypsum plaster of paris—properties and uses, tests.

(e) *Cements*.—Composition and manufacture—storing, varieties and uses. Normal and rapid hardening cements. Aluminous cements, properties and B.S.S. tests—costs.

(f) *Mortars*.—lime mortars—composition—use of sand and surkhi—preparation, mixing and grinding, storing, uses, properties strength and tests—costs.

Cement mortars : Composition, preparation and use, Properties, strength and tests. Gauged mortars—proportioning of materials in mortars. Effect of water content in mortars.

(g) *Mud*—mortars.

(h) *Concrete*.—Lime concrete, composition, preparation and use Properties and strength—tests.

Cement concrete :

(i) *Constituents*.—Aggregate (coarse and fine). Cement and water proportioning and mixing, real nominal and field mixes. Bulking of sand. Grading of aggregates. Water-cement ratio. Placing and curing. Properties—strength of various mixes and uses. Tests. Water-proofing and surface treatment.

(j) (1) *Timber*.—Wood : Growth of trees; faults, felling; sap-wood and hard-wood—methods of sawing and seasoning. Defects in timber Deteriorating agents and decay of timber. Preservation of timber.

Varities and uses of important Indian timbers. Characteristics of good timber. Strength of timber. Tests of timber. Reconstructed wood : Plywood and pressed woods. Manufacture, properties and uses. Proprietary timber used for sound and thermal insulation.

(k) *Metals and alloys*.—Cast iron : Composition, manufacture, characteristics and uses.

Wrought iron : Composition, manufacture, characteristics and uses.

Steel : Characteristics and uses of mild steels, hard steels, alloy steels, such as manganese, nickel, chromium, tungsten and silicon steels, stainless steels and tool steels.

(l) *Preservatives*.—Composition, preparation, properties and tests and uses of paints, polishes, varnishes, distempers and oils and pigments.

(m) *Miscellaneous*—

(i) Carbonaceous and cementing materials—

Asphalt and bitumen, natural and artificial asphaltic products, properties and uses.

PART II

Construction (General)

- (1) *General principles of designing foundations.*—Types of soils and safe bearing pressures on the various types of soils. Various types of foundations suitable for various circumstances, e.g., open foundations, black soil foundation, raft foundation, pipe foundation, well foundations, grillage foundation etc. etc.
- (2) Masonry (of various types).
- (3) Roofs (of various types).
- (4) Scaffolding, centering and form work.
- (5) Points to be borne in mind while drafting specifications.
- (6) Analysis of rates and schedule of rates.
- (7) Minimum Wages Act, as it applies to the analysis of rates.

PART III

Management of works

- (1) System of execution of works.—Departmental agency, piece-work system, contract system.
- (2) Measures for the welfare of labour on work site.
- (3) Compensation under the Workmen's Compensation Act and rules thereunder.
- (4) Sanitary and water-supply arrangement including public health arrangements on large and small works of various categories, e.g., buildings, roads and irrigation projects, etc.
- (5) Management and organisation of scarcity works.
- (6) Organisation set up for execution of large work through.—
 - (a) Departmental labour.
 - (b) Piece-work system, and
 - (c) Contract system.
- (7) Precautions about storing and use of explosives.
- (8) Precautions against accidents on large works.
- (9) Acquisition and requisition of lands and houses, and rehabilitation of displaced persons, e.g., for villages going under water due to construction of reservoirs, etc.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF
MECHANICAL JUNIOR ENGINEERS

PAPER I

General (Mechanical Engineering)

1. Standard weights and measurements of engineering materials required in mechanical field with their fundamental properties—special attention should be given to metric system.
2. Types of various drives and their application.
3. Lifting equipment like tackles, cranes, pulley blocks, etc.
4. Welding, brazing and soldering.
5. Tool room and application of tools.
6. Use of precision instruments like micrometers, alignment indicators etc.
7. Batteries—maintenance, servicing and charging.
8. General repairs and overhaul of automobiles.
9. Foundation of structures—special engine foundation and foundation of electric poles and pylons.
10. Fundamentals of surveying and levelling.
11. Fuel oil and lubricants—general knowledge of various types of fuel oils, fundamentals of efficient lubrication. Different types of lubricating oils and their uses—method of reclaiming used lubricating oils.
12. Estimation of works.
13. Commercial correspondence.
14. General knowledge of the working of workshop. Movement of a job from shop to shop and its accounting etc.
15. Transport rules and regulations.
16. General knowledge of heavy machinery, like tractors, bulldozers, road rollers, tipper and other types of trucks, loaders, dumpers, etc., specially of each.
17. Use of air for machinery. Air compressors and machines run on compressed air.
18. Road-making machinery such as steam boiler, cranes, road rollers, concrete mixers, etc., general knowledge.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

PAPER III

Special subject—Construction and maintenance of lift irrigation schemes.

1. Preliminary investigation for site gauging discharges, collection of hydraulic data, fixing H.F.L. analysis of water for suitability, various salts and their permissibility for seasonal or perennial irrigation, location for infiltration galleries.
2. Lifting devices, e.g., pumps, oil or electric, their relative use and economy, calculations for B.H.P., approximate costing materials required for running and running cost.
3. Crop-planning—distribution of water, construction of channels, and water courses including design.
4. Auxiliary structures like engine-house, sump well, delivery chamber, etc., their design and construction.
5. Measurement of supply—various devices—their description and use.
6. Determination of water-rates, and considerations for economic use of water.
7. Maintenance of the schemes.
8. Procedure to be followed in admitting such schemes and declaring the feasibility thereof.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

PAPER IV

Special subject—Water supply and Sanitary engineering

Water supply—

A. *Sources of water-supply.*—(a) *Ground water.*—Springs development of springs, wells, capacities of wells, construction of wells, infiltration wells and galleries.

(b) *Surface water.*—*Rainfall.*—measurement of run-off, relation of rainfall and run-off gauging of rivers and stream-gauge works in perennial rivers.

Dams and impounding reservoirs—Types of and materials used for foundations, spillways, design of dams intakes in wells—protection of catchment area.

B. *Treatment of water.*—Sanitary survey of the water-supply source—sampling of water for analysis—chemical and bacteriological care of.

(a) *Aeration of water.*—Types of aerators.

(b) *Sedimentation of water.*—Detention period, inlets and out-lets velocity of flow, sludge removal, different types of settling tanks.

(c) *Coagulation of water.*—Necessity, coagulants used for normal doses, method of application, care for storage, costs of coagulants. Flocculation, detention period.

(d) *Filtration of water.*—Type of filters and comparison, capacity and rate of filtration. Arrangement of filter bed and underdrainage system. Loss of heads in filters operation of filters cleaning, washing, etc.

(e) *Hardness of water and method of softening.*

(f) *Disinfections.*—Methods of disinfection, chemicals used, normal doses and cost of chemicals disinfection of new and old mains.

C. *Distribution of water.*—Types of supply—continuous and intermittent—materials for pipes and classification, design formulae for flow in pipes—accessories on distribution system—weights of pipes and quantity of materials for jointing and materials of jointing. Testing of pipes lines. Maintenance of pipe lines.

Balancing and service reservoirs, location.

D. *Pumps and pumping stations.*—Types of pumps efficiencies, choice of prime movers. Maintenance of pumping machinery.

Managements of water works.

Public health engineering, importance of protected piped water-supply. Metering and maintenance of meters.

Preparation of water-supply projects, survey projects, survey investigations.

Sewerage—

Combined, partial and separate system of sewers. Surface drainage. Layout of sewers.

Materials for sewer pipes. Self cleansing velocities, sewer appurtenances, manholes, catch basins, flushing, devices, etc.

Sewer construction, testing of sewers cleaning and maintenance of sewers. Weights of pipes and materials required for jointing.

Treatment of sewage—

Primary treatment.

Screens and racks, disposal of rackings, grit chambers, quantity and disposal of grit, settlement of sewage. Settling tanks and clariflocculators; collection and disposal of sludge.

Secondary treatment.

Activated sludge process.

Filters, tricking filter.

Disposal of sewage effluent—

Dilution in sea and rivers,

Disposal on land, sewage effluent irrigation,

Selection of site, etc.

Maintenance of sewers and sewage disposal works.

Individual house sewage disposals—

Septic tanks, design of aqua privies,

Sanitary latrines,

Collection and disposal of sewage in unsewered areas,

Sanitation of slaughter-houses and schools.

Plumbing.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

PAPER II

Special subject—Roads, Buildings and Bridges

PART I

Buildings

(a) Masonry.—Stone-masonry— materials, dressing, laying and jointing. Tools used. Classes of masonry—coursed and uncoursed rubble, random rubble, ashlar and block-in-course, bonding of stones. Dry stones masonry, safe loads on masonry.

*Brick-masonry.—*Materials, brick laying and bonding, brick-nogging. Brick-laying in footings, isolated columns, piers, fire-places and arches. Hollow walls. Reinforced brick work. Partition walls. Wall tiles. Damp proof courses. Terms used in brickwork—Scaffolding, strength of brick-masonry safe loads on brick-work.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF
MECHANICAL JUNIOR ENGINEERS.

PAPER II

Special subject—Use of machinery(A) *Workshop.*—

- (1) Selection of site.
- (2) Layout of various shops like foundry, machine tools, smithy, general repairs and overhaul, automobile.
- (3) Selection of machinery and its application.
- (4) Foundry practice.
- (5) Methods of cost finding.
- (6) Estimation of the works.
- (7) Different rate systems.
- (8) Factory rules.
- (9) Payment and Wages Act.
- (10) Stores accounts and ledger system.
- (11) Stock-taking of stores and spares.
- (12) Labour Problem.
- (13) Commercial correspondence.

(B) *Earth moving machinery.*—

- (1) Selection of machinery for earthen dam, clearing site, foundation excavation.
- (2) Machinery required for construction of canals.
- (3) Repairs and maintenance of earth moving machinery.
- (4) Use of excavators, draglines, shovels.
- (5) Types of tractors and their applications.
- (6) Applications of scrapers, loader.
- (7) Overhaul and repairs.
- (8) Tools required for overhauls.
- (9) Defects (general).
- (10) Field servicing.
- (11) Cost accounting of the work done.

(C) *Mechanically propelled vehicles.*—

- (1) General administration of mechanically propelled vehicles :—
 - (a) Selection of for particular use.
 - (b) Equipment for field servicing.

(2) Principles of two and four stroke cycles, ignition system.—

(a) Permissible fits and tolerances.

(b) Lubrication and lubricants.

(c) Schedules of servicing.

(d) Instructions for running new and overhauled vehicles.

(e) Transport rules and regulations.

(3) Instructions for care and maintenance of 1,000 type steam boilers.—

(a) Points to be observed during the inspection.

(b) Estimation of repairs.

(c) Valuations and life.

(d) Special machinery for repairs and its applications.

(D) *Stationery plants.*—

(1) Layout of pumping plants.

(2) Selection of pumping units.

(3) General maintenance.

(4) Erection.

(5) Points to be observed during inspection.

(6) Different types of pumps and their applications.

(7) Application of pneumatic machines and tools.

(8) Their maintenance and repairs.

(9) Air lift pumping.

(E) *General.*—

(1) Fundamental principles of engineering.

(2) Type of various drives and their application.

(3) Lifting equipment like tackle and cranes, etc.

(4) Welding, brazing.

(5) Tool room and application of tools.

(6) Design of simple instruments and machinery like D. T. crane, asphalt, boilers, boiler test pumps, sluice valves, gates, etc.

(7) Use of precision instruments.

(8) Batteries repairs and charges.

(9) Screw cutting, gear cutting.

(10) Standard weights and measurements of the engineering materials with the mechanical properties.

(11) Heat treatment.

(12) Stress and strain.

~~(d) Designs and construction of dock walls—R. C. C. and masonry dock walls, R. C. C. and steel sheet pile walls, R. C. C. counterforts, cantilever walls, stability of dock walls.~~

~~(e) Docks and locks—Elementary principles of design and layout of wet and dry docks—slipway, floating docks, lock and lock gates, Dock bridges.~~

~~(f) Break water—Classification of breakwaters; Elementary principles of designs and construction of breakwaters, causes of failure of breakwaters.~~

~~(g) Port yards, warehouses and transit sheds—Layout of port yards including roads, stacking platforms, railway and crane rails, layout of godown and open sheds. Their types and construction details.~~

~~(h) Port and workshop machinery—General knowledge of port and workshop machinery.~~

~~(i) Inland water transport—Development of creeks and rivers.~~

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

PAPER III

Accounts—Sub-divisional and work accounts

1. Initial records of accounts—

- (i) Muster rolls.
- (ii) Recruitment of labour and its employment on daily rates.
- (iii) Employment of daily labour.
- (iv) Advances to labourers and their recoveries.
- (v) Arrears of wages.
- (vi) Measurement books, taking of measurements, use and maintenance of measurement books.
- (vii) Different kinds of bills, cheque and receipt books, cash books, imprest cash book, temporary advances, remittances into treasury, works abstracts, requisitions, vouchers, hand receipts.
- (viii) Schedule of rates.

2. Stores—

- (i) Initial records, receipts and issues including issues to contractors.
- (ii) Stores forms Nos. 22 to 26, 29 and 30, 33, 34 and 35.
- (iii) Road materials.
- (iv) Material at site account.
- (v) Omnibus—transfer of records.
- (vi) Tools and plant.

3. Contractors—

- (i) Rules regarding contracts as embodied in the different forms of agreements.
- (ii) Contractors' bills.
- (iii) Piece-work and contract work.
- (iv) Aid and advances to contractors.

4. Labour Laws—

- (i) The Industrial Disputes Act, 1947 and the rules framed thereunder.
- (ii) The Minimum Wages Act, 1948 and the rules framed thereunder.
- (iii) The Workman's Compensation Act, 1923 and the rules framed thereunder.

Note 1.—The relevant chapters or paragraphs of the Maharashtra Public Works Manual, Maharashtra Public Works Account Code should be studied.

Note 2.—20 marks shall be earmarked for questions on Acts and rules concerning Labour Laws mentioned above.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS

(CIVIL)

PAPER IV

Practical test—One paper

1. Practical and oral test in surveying and setting out—

(i) Care and adjustment of levels and theodolite and other survey instruments, such as, compass, ghat-tracer, abney level, etc., surveying by chain or chain compass.

(ii) Levelling and reduction of levels.

(iii) Setting out angles and curves.

(iv) Setting out a plan on the ground.

2. Practical drawing—

A pencil drawing to be made from data, e.g., section or foundation plan from plan and elevation; or a drawing of any simple structure from given dimensions or a drawing connected with either: (i) road and building, (ii) irrigation works including masonry, concrete and/or earthen dams, (iii) drainage problem, (iv) lift irrigation, (v) sanitary engineering and water-supply.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS
(MECHANICAL)

Practical test—One paper

1. Explaining the function of precision machine tools and using micrometers surface gauges, depth gauges, etc.
2. Marking the jobs.
3. Fixing a job in a 4 jaw chuck and turning to size on a lathe.
4. Explaining the various ways in which jobs are fixed on various machine tools and how the machines operate.
5. Naming various important parts of machines and stating use of each.
6. Checking up the crankshaft alignment of an oil engine.
7. Tracing various circuits on oil engines, e.g., fuel circuit, lubricating oil circuit, cooling water circuit, air circuit, battery system, etc.
8. Explaining in brief, function of following with small neat sketches drawn on the spot.

Fuel pump, automiser, governor, battery oil filters, etc.

9. Explaining how machines like tractors, road rollers, dumpers, air compressors, generators, will be tested for a trial running test and actually starting of one of them.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF JUNIOR ENGINEERS
(CIVIL) IN THE PORTS ORGANISATION

Practical test—One paper

1. Practical and oral test in surveying and setting out.—
 - (i) Levelling and reduction of levels.
 - (ii) Setting out angles and curves.
 - (iii) Setting out plan on the ground.

2. Practical drawing.—

A pencil drawing to be made from data, e.g., section or foundation plan from an elevation or a drawing of any simple structure from given dimensions or a drawing connected with marine works.