

APPENDIX I

(See paragraph 54)

PROCEDURE AND RULES REGARDING THE PROFESSIONAL EXAMINATION OF ASSISTANT ENGINEERS, DEPUTY ENGINEERS AND JUNIOR ENGINEERS

Section 1

PROCEDURE AND RULES REGARDING THE PROFESSIONAL EXAMINATION OF ASSISTANT ENGINEERS RECRUITED DIRECTLY TO THE MAHARASHTRA SERVICE OF ENGINEERS, CLASS I OR EQUIVALENT POSTS

(a) Instructions

1. The examination should be searching. A thorough knowledge of the Irrigation Act must be tested in the case of those officers who have been engaged on irrigation works. In setting a paper on accounts, great discrimination must be exercised, for it is easy to set one which no candidate would be able to answer unless he has crammed for the purpose of the examination. What is required is that he should have the knowledge necessary to control the expenditure in his division. He should understand and be able to apply rules and regulations concerning estimates, sanctions, allotments, muster rolls, measurement books, bills, registers of works, sub-divisional cash-books, and imprests, cheques, pass-books, cash payments and cash receipts, and other matters of a similar nature.

2. The examination should be for the most part oral, but not less than twelve and not more than fifteen questions should be answered in writing. It should be so designed as to give the examination committee the fullest opportunity of forming a correct opinion, of the general intelligence of the candidate and his knowledge of the subjects, and whether he has made good use of his time in acquiring that practical information which cannot be obtained from books. Question on theory and 'catch' questions shall not be put. As an Assistant Engineer may at any time be in-charge of a large subdivision or of an important work or may have to assume charge of a divisional office, he should be capable of giving to his subordinates detailed directions in regard to works, illustrated hand sketches, and of supplying dimensioned sketches in sufficient details to enable an ordinary draftsman to prepare designs from them. His ability in this direction should be tested in the examination and the Committee should see that the sketches are neat and easily intelligible to the class of subordinates for whom they would be intended.

APPENDIX I

169

(b) Rules

1. Assistant Engineers recruited directly to the Maharashtra Service of Engineers, Class I, shall pass the examination prescribed in the following rules within three years from the date from which their service as Assistant Engineers on probation commences.

2. Officers who are 45 years old or above on the date of appointment are totally exempted from passing the professional examination, while those who are between the ages of 40 and 45 are exempted from passing the professional examination except in the subject of "accounts".

The age of 40 or 45 for the purposes of exemption from passing the professional examination should be counted with reference to the date of the first appointment to the Class I cadre and the liability of an officer to pass the examination so far as it exists with reference to the date of the first appointment will not cease on attaining the age of 40 or 45 subsequently.

3. An officer who has failed to pass the examination within the prescribed period shall not be, unless Government by general or special order declares him to be, entitled to any increment in pay after that date unless he passes the examination, after which he shall be entitled to pay at the rate corresponding to his position in the time-scale.

4. In cases in which owing to the exigencies of the public service, illness or want of time or lack of opportunity to convene a committee, an officer is not able to pass the examination within the prescribed period, Government may grant him a reasonable extension of time up to a maximum of one year to enable him do so, and if he passes within this further period, no penalty, will be enforced. Should he, however, fail to pass within the extended period, his further increments shall be withheld until such time as he does pass.

5. The Chief Engineer, Koyna, the Superintending Engineers of Circles and other officers having the status of Heads of Departments are empowered to convene committees for the examination and to decide on the committee's report whether an officer has passed or failed.

6. The examination committee shall consist of one President of the rank of Superintending Engineer and two members of the rank of Executive Engineer, who shall be nominated by the President and also either the Superintending Engineer of Electric Circle, or the Superintending Engineer of the Public Health Circle having jurisdiction over the place where the examination is held, as a third member according as an officer of the electrical branch or the public health branch is to be examined.

7. The examination shall be held once a year on the first Monday in October (which is not a holiday) at—

(a) Poona—Under the presidency of the Superintending Engineer, Poona Circle, Superintending Engineer, Deccan Irrigation Circle (I), or the Superintending Engineer, Deccan Irrigation Circle (II), whoever may be the senior of the three.

(b) Nagpur—Under the presidency of the Superintending Engineer, Vidarbha Irrigation Circle (East), Nagpur or the S. E., Nagpur (P. W.) Circle, Nagpur, whoever may be the senior of the two.

(c) Aurangabad—Under the presidency of the Superintending Engineer, P. W. Circle, or Superintending Engineer, Marathwada Irrigation Project Circle, Aurangabad, whoever may be the senior of the two.

(d) Koyna—Under the presidency of the Chief Engineer, Koyna, or of the senior-most Superintending Engineer in the Koyna Organisation to be nominated by the Chief Engineer, Koyna.

8. An officer who is desirous of undergoing the examination shall apply to the local President.

9. Applications for permission to appear for the examination shall be submitted in time to reach the President, six weeks before the prescribed date, on which it is held in order to permit of a committee being convened and the papers being drawn up. Application received later than ten clear days before the date notified as the first day of examination shall not be considered by the President. If no application is received in time to make the necessary arrangements, no examination shall be held and the applicants will be required to wait for the next examination.

10. The subjects for the examination shall include—

(a) General (Civil/Mechanical/Electrical Engineering).—

For officers in the civil section, this paper shall contain following subjects :—

- (1) Materials.
- (2) Construction (General).
- (3) Management of work.

There shall be a similar paper for "General" (Mechanical/Electrical Engineering) for the officers in the Mechanical/Electrical Sections.

(b) One of the following special subjects :—

- (1) Irrigation and Irrigation Act.
- (2) Land drainage.
- (3) Design and construction of earthen dams.
- (4) Construction of masonry and concrete dams.

(5) Construction and maintenance of lift irrigation schemes.

(6) Water-supply and sanitary engineering.

(7) Roads and buildings including bridges with special reference to modern types of road construction.

(8) Boring (for Mechanical Engineers only).

(9) Use of machinery (for Mechanical Engineers only).

(10) Electrical engineering and Indian Electricity Act (for Electrical Engineers only).

Note.—The special subject to be selected by an officer should be the one with which is actually concerned in his official duties.

(c) Accounts and rules of the Public Works and Irrigation Department syllabus therefor being as under :—

I. Introduction to the Indian Government Accounts and Audit—

Part I—Chapter 1.

Part II—Chapters 9 and 11.

Part III—Chapters 12, 13, 15, 17 and 21.

Part IV—Chapters 29, 30, 31 and 35.

Part V—Chapter 37.

II. Maharashtra Public Works Account Code and the Maharashtra Public Works Manual—Whole.

III. Labour Laws :—

(a) The Industrial Disputes Act, 1947 and rules made thereunder.

(b) The Minimum Wages Act, 1948 and rules made thereunder.

(c) The Workmen's Compensation Act, 1923 and rules made thereunder.

Note.—The officers appearing at the examination should be allowed to have books for subject under I of the syllabus during the examination.

The syllabus for the examination shall be as shown in the accompanying (Schedule X).

11. The marks to be assigned to each question shall be determined by the committee and shall be in proportion to the importance of the questions. To qualify, the candidate shall obtain not less than 60 per cent of the maximum marks in each subject, and not less than 66 per cent of the maximum aggregate marks. For a pass with credit, the candidate must obtain 80 per cent or more marks out of the maximum aggregate number of marks. The average percentage should be the percentage of the total marks gained to the total marks obtainable.

12. A candidate who fails only in one subject but obtains a percentage of not less than 70 in the total of the other two, may appear again only in the subject in which he has failed. In such a case, he must obtain not less than 60 per cent marks in that subject in order to pass. A candidate who has obtained the necessary marks to qualify under this rule shall be given a certificate by the President to the effect that he has so qualified and such certificate shall be sufficient authority to permit the candidate to appear at the subsequent examination in the remaining subject only.

13. If a candidate fails to qualify, he shall be informed by the President accordingly. If he is declared to have passed, the fact shall be reported to Government for publication in the Maharashtra Government Gazette. While submitting such reports to Government, names of the successful candidates should be arranged in the alphabetical order. In submitting such reports, the President shall invariably furnish the following information :—

1. Total marks obtainable
2. Marks actually obtained
3. Percentage actually obtained

If the candidate has passed with credit, it should be stated in the report.

14. The President and each member of the examination committee shall be present during the whole of the oral examination.

15. Copies of the written as well as oral questions should be submitted to Government soon after the 31st December every year in order that they may be printed for circulation.

16. Marks for the papers and oral examination should be allotted as shown in the accompanying sample form.

PROFESSIONAL EXAMINATION (Sample Form for the allotment of marks)

Assistant Engineers

| (A) | | | (B) | | (C) | | | Minimum marks required for passing. | Total marks obtainable. |
|---|------|------------------|--|------|--|------|------------------|-------------------------------------|-------------------------|
| Written | Oral | Minimum required | Written | Oral | Written | Oral | Minimum required | | |
| General/Civil/Mechanical/Electrical Engineering. For officers in the civil section, this paper shall contain following subjects:— (1) Materials. (2) Construction (general). (3) Management of work. | | | (1) Irrigation and Irrigation Act, (2) Land drainage. (3) Design and construction of earthen dams. (4) Construction of masonry and concrete dams. (5) Construction and maintenance of lift irrigation schemes. (6) Water-supply and sanitary engineering. (7) Roads and buildings including bridges with special reference to modern types of road construction. (8) Boring. (9) Use of machinery. (10) Harbour engineering. (11) Electrical Engineering and Indian Electricity Act. | | Accounts and rules of the P. W. and I. Dept. | | | 450 | 297 |
| 75 | 75 | 90 | 75 | 75 | 75 | 75 | 90 | | |

Note.—A total of 30 marks (15 for written test and 15 for oral test) shall be earmarked for questions on various Acts and rules made thereunder included in the syllabus for accounts and rules of the P. W. and I. Departments.

No. _____ Dated 19 _____

Memorandum.

With reference to his application, dated 19 _____, Shri., Junior Engineer is informed that his name has been registered amongst the candidates for the Junior Engineers Professional Examination to be held at on 19 _____, and assigned No.

Executive Engineer and President,
Junior Engineers Professional Examination Committee.

Through : The Executive Engineer,
Division.

SCHEDULE X

SYLLABUS FOR THE PROFESSIONAL EXAMINATION FOR ASSISTANT ENGINEERS AND DEPUTY ENGINEERS.

Contents.

(1) *Paper I.*—General (civil engineering).
General (mechanical engineering).

(2) *Paper II.*—Special Subject—

(i) Irrigation and Irrigation Act.

(ii) Land drainage.

(iii) Design and construction of earthen dams.

(iv) Construction of masonry and concrete dams.

(v) Construction and maintenance of lift irrigation schemes.

(vi) Water-supply and sanitary engineering.

(vii) Buildings and roads—including bridges, with special reference to modern types of road construction.

(viii) Boring.

(ix) Use of machinery.

(x) Harbour engineering.

(3) *Paper III.*—Accounts.

(4) *Paper IV.*—(1) Practical test for Civil Deputy Engineers. (2) Practical test for Mechanical Deputy Engineers. (3) Practical test for Engineering Officer in the Ports organisation.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT ENGINEERS AND DEPUTY ENGINEERS

PAPER I

General (Civil Engineering)

Part—(I) Material (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 use—strength—causes of decay and methods of preservation. Tests—artificial stone—manufacture and use—costs.

(b) *Bricks and tiles*.—General characteristics, varieties and uses, manufacture selecting clay, moulding and burning in kiln (Bull's and Hoffman's kilns), causes of decay and method 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) *Plastics*.—Composition, chief varieties, properties and uses. Costs.

(e) *Celluloid, bakelite, ebonite, vitrolite, marbarite, etc.*

(f) *Limes and cements*—

Limes.—Hydraulic and fat. Occurrence, collection, burning, stacking and storing. Artificial hydraulic limes. Gypsum, plaster of Paris, Properties and uses. Test—costs.

Cements.—Composition and manufacture—storing, varieties and uses. Normal and rapid hardening cements. Aluminous cements. Properties and B. S. S. tests—costs.

(g) *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—costs.

Mud mortars.

(h) *Concrete*—

Lime Concrete.—Composition, preparation and use. Properties and strength. Tests—costs.

Cement concrete.

Constituents.—Aggregate (course 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. Costs. Different grades and their proportion.

(i) *Timber*.—*Wood* : Growth of trees—faults—felling : sapwood and hardwood—methods of sawing and seasoning. Defects in timber. Deteriorating agents and decay of timber. Preservation of timber.

Varieties and uses of important Indian timbers. Characteristics of good timber. Strength of timber. Tests of timber. Costs. Reconstructed wood—plywood and pressed woods. Manufacture, properties and uses. Proprietary timber used for sound and thermal insulation.

(j) 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.

Non-ferrous metals : Properties and structural uses of copper, zinc, lead, tin, aluminium and silver.

Alloys : Composition, properties uses of brasses, bronzes, white metals, anti-friction bearing metals and other principal alloys.

Metallic Products : Pipes, tubes. Plane and corrugated iron sheets, rolled steel sections, cast-iron and steel castings. Costs.

(k) *Preservatives*.—Composition, preparation, properties and tests and uses of paints, polishes, varnishes, distempers and oils and pigment. Costs

(1) Miscellaneous :—

(i) *Fuels for power* : Coal, coke, diesel, petroleum, gas, etc. Costs.

(ii) *Carbonaceous and cementing materials* :—

Asphalt and bitumen, natural and artificial, asphaltic products. Properties and uses and costs.

(iii) Asbestos and asbestos products. Properties and uses.

(iv) Rubber, leather, felt, coir and their products. Properties and uses.

(v) Soils and soil stabilisation and equipment for testing soils.

PART II

Construction (General)

(i) General principles of designing foundations. Types of soils and safe bearing pressures on the various types of soils. Various types of foundation suitable for various circumstances e. g., open foundations, black-soil foundations, raft foundations, pile foundations, well foundations, grillage foundations, etc.

(ii) Masonry (various types).

(iii) Roofs (various types).

(iv) Scaffolding, centering, and form works different types, steel and wooden moving forms—design for centering for arches and domes tunnel lining and reservoirs, etc. Removal of forms—periods and methods.

(v) Drafting specifications for various items in construction. Points to be borne in mind while drafting specifications.

(vi) Analysis of rates and schedule or rates.

(vii) Minimum Wages Act, as it applies to the analysis of rates.

PART III

Management of works

(i) System of execution of works—departmental agency, piece-work system, contract system. Various types of contract agreements. General conditions of contract agreements, relation with contractors, enforcing contract conditions.

(ii) Measures for the welfare of labour on work-site.

(iii) Compensation under the Workmen's Compensation Act and rules thereunder.

(iv) 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.

(v) Management and organisation of scarcity works.

(vi) Organisational set up for execution of large work through—

(a) departmental labour system,

(b) piece-work system and

(c) contract system.

(vii) Precautions about storing and use of explosives, precautions against accidents on large works.

- (viii) Planning watching progress of work.
- (ix) Stores and workshops.
- (x) Communications as pertaining to large projects.
- (xi) Co-ordination of different branches established for the execution of big projects.
- (xii) Statistics about labour employment.
- (xiii) 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.
- (xiv) Residential accommodation for different kinds of establishments as well as labour camps.
- (xv) Transport.—Requirement, organisation, various types, legal aspects.
- (xvi) Organisational set up for highly mechanised jobs.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF MECHANICAL
ASSISTANT ENGINEERS AND DEPUTY ENGINEERS

PART I

General (mechanical engineering)

1. Standard weights and measures of engineering materials required in mechanical field with their fundamental properties. Special attention to metric system.
2. Various types of precision instruments and gauges with their uses.
3. Lifting equipments and their uses.
4. Various types of power transmission systems and their direct application with advantages and disadvantages.
5. Welding, soldering and brazing, heat treatment.
6. Tools in tool room and their application.
7. Various methods of speed governing in case of oil engines.
8. Various methods of water cooling adopted for oil engines.
9. Lubrication and servicing of automobile units.
10. Schedule of servicing.
11. Valuation of machinery.
12. Layout of machinery and erection of the same.
13. Various types of motive powers (compressed, air combustion engines, electricity, gas, steam). Their various advantages and disadvantages.
14. Commercial correspondence.
15. Battery repair, charging and servicing.

16. Electric system in mobile units.
17. Electric motors mainly induction type, their methods of starting, characteristics and application air pumps.
18. Use of air for machinery—air compressors and various types of pneumatic tools and their application.
19. Boring machines types and use.
20. The general construction of internal combustion, engines, carburetors electrical injection systems, fuel pump and injection system, governors and fuel controls, super charges.
21. General knowledge of Factory Act, Workmen's Compensation Act and store and labour organisation.
22. General knowledge about electric transmission and distribution and electrical instruments and measurements.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—Irrigation and Irrigation Act

1. Design and construction of canals.—Preliminary surveys—location and selection and layout of head works—type of weirs profiles—afflux—under sluices, divide wall, head-regulators—silt control at head work—moveable weir-crest and shutters—gates—lifting arrangements. Weirs on permeable foundations—design requirements—design of channels—contour surveys—surveys and alignments of canals—land plans—location of alignment of branches and distributaries and minors—commanded area culturable command—irrigable command—crop pattern—existing and proposed—water requirements of crops—A. I./D. C.—loss in transit—rotational running—capacity factor—canal capacities—typical sections of canals—non-siltting non-scouring channels—design criteria—lining—advantages and disadvantages—precaution when spring level is high—construction and design of masonry works—bridges—falls—flumes. Regulators culverts aqueducts—escape diversion—head regulators—modules—costs.
2. Administration and maintenance of irrigation works.—Irrigation programme—A. I./D. C. water account—rotation—water requirements of crops—perennial blocks—two seasonal blocks—volumetric supply—water rates—duties of canal officers—measurers—patkaries—discharge observations—dundies and delta—periodical inspection and repairs of canal structures—weed control—siltting—scour—remedies—performance of canals—maintenance of head works.
3. Irrigation Act and canal rules.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—land drainage

1. Definitions and limitation.
2. Classifications of soils, sub-soils, sub-strata and their roles.
3. Properties of soils, sub-soils.
4. Role of moisture in soils and sub-soils, etc.
5. Crop growth in relation to soils various types.
6. Occurrence of damage—
 - (a) Alkalization.
 - (b) Salinity.
 - (c) Water-logging.
7. Sub-soil water.—
 - (a) Percolation from a canal, distributary and irrigated areas leading to sub-soil water.
 - (b) Factor helping control to sub-soil water.
 - (c) General knowledge of drainage scheme and its early drainage.
8. Preliminary survey for land drainage.—
 - (a) Survey of damage and other miscellaneous details in topography and sub-survey.
 - (b) Survey of H.I.B., M.I.B., 45 cm., 1.2 m. and 2.4 m.
 - (c) Observation of recuperation and its co-efficient.
 - (d) Pit work, soil survey and nala survey, etc.
9. Preparation of plans and estimates and submission of projects of drainage schemes—
 - (a) Design of drains and branch drains.
 - (b) Alignment of drains and sub-drains.
 - (c) Open trenches and pipe lines.
 - (d) Masonry structures such as slab drains, ramps, causeways, S. W. F. inlets head walls, etc.
10. Preliminaries such as.—
 - (a) Land acquisition proposals and their proceedings for acquiring land.
 - (b) Land valuations.

APPENDIX I

11. Construction of drainage scheme. Various methods and equipment required therefor.

12. General knowledge of drainage schemes constructed and their present behaviour.

13. Cost data of drainage schemes at various stages.

14. Maintenance of constructed drainage schemes.

15. Observation of sub-soil water levels and reduction in damage after construction of drainage scheme results.

16. Possibilities of utilization of drainage waters for irrigation.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—Design and construction of earthen dams

1. Preliminary investigation comprising of surface and sub-surface exploration. Testing of soils for utilisation in embankment as hearing and casing. Preparation of pervious and impervious foundations by cut off trenches, pressure grouting, etc. Selection of borrow areas.
2. *Storage capacity*.—Precipitation—its extent and distribution, types of catchments, rainfall and run off relationship. Losses—quantity of water available, gauging flow of streams and rainfall—descriptions of various types of rain gauges and their use.
3. *Planning of crops*.—Soil survey for various crops—duty and delta, fixing irrigable command.
4. *Design of waste weir*.—Selection of site, computation of maximum flood discharges, various formulas types of waste weirs and design—design of the tail channel—flood absorptive capacity emergency spillway.
5. *Embankments*.—Laboratory tests for co-efficients of friction and cohesion—permeability, saturation gradients—proctors density plasticity index optimum moisture, specific gravity, moisture contents, selection of soils for core and casing. Types of fill—their relative uses, design of the cross section—free board, wave height, pitching, slope protection filters—filtering materials, their selection and use.
6. *Structural design*.—Shearing stresses in foundation as seepage phenomenon—Different types of cut off arrangements, conditions of stability, stability analysis by slip circle, wedge and other methods—core walls of masonry and their use. Specifications, consolidation including use of various types of rollers.

7. *Selection of earth moving machinery.*—Planning of construction equipment, operating costs.

8. *Field control.*—Field tests and their significance in regard to specifications, e.g., consolidation, etc.

9. *Failure of dams.*—Their causes and precautionary measures, e.g., sliding, washing settlement.

10. *Maintenance and repairs.*—Including major repairs.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—Construction of masonry and concrete dams.

Hydrology—catchment—rainfall, run-off—gauging—annual yield—maximum flood—capacities of reservoirs—losses in reservoirs—silt data—topography selection of sites—foundation exploration—choice of type of dam.

Water requirements: Gross command—culturable command—soil surveys for various crops—proposed crop plan—duty and delta—fixing irrigable command—total requirements of water including transit losses—carry over.

Design of gravity dam.—Types of foundation—foundation treatment—cut off—materials of construction and their characteristics—tests—design criteria—forces acting on gravity dams—silt pressure, earthquake forces—uplift, wind pressure—wave pressure, temperature stresses—stability requirements—analysis of forces—design of profile for low and high dams—economic profiles—free board—wave height—drainage—construction details of masonry dams—construction details of concrete dams—temperature control—planning of construction—field control—field test and their significance in regard to specification—construction organisation set-up—construction equipment—cost and rates—failure of gravity dams.

Design of waste weirs.—Selection of sites, computation of maximum flood discharges—various formulae, types of waste weirs and their design—gates—design of tail channel—flood absorption capacity—emergency spillway reservoir flood routing.

Design of sluices.—Capacity—type—stresses in and around sluices—velocities—cavitation—entry and exit condition dissipation of energy—gates, types penstocks, cost.

Other types of dams.—Conditions suitable for adopting rock fill dams—R. C. C. dams—arch dams.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS

PAPER II

*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, pump 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 ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—Water-supply and sanitary engineering.

1. *Water-supply*—

A. *Sources of water supply.*—(a) *Ground water.*—Occurrence of ground water, water bearing formations, springs, development of springs, wells, different types of wells, specific capacity of wells, interference of wells. Quality of ground water. Problems related to construction of wells. Infiltration wells and galleries.

(b) *Surface water.*—Rainfall and run-off. Study of frequency and intensity of rainfall. Measurement of rainfall. Run-off co-efficients and classification of catchments. Rainfall run-off relations. Stream flow studies, flood flow estimates. Work connected with intakes from perennial rivers. Dams and impounding reservoirs. Purpose, materials and construction, capacity of storage required; foundations, spillways, various types of dams and design requirements. Construction problems of dams, intakes. Quality of surface water.

B. Treatment of water.—Sanitary survey of water source.

Analysis chemical and bacteriological of water. Interpretation of water analysis and requirement of treatment of water.

(a) *Aeration of water.* Necessity and types of aerations.

(b) *Sedimentation of water.*—Process, period of detention, design of tanks, velocity of flow, inlets and outlets, sludge removal, etc., different types of settling tanks.

(c) *Coagulation.*—Necessity. Different coagulants and the chemical reactions. Design of tanks, methods of application of coagulants, storage of coagulants, properties and care of coagulants. Costs of coagulants and normal dosages applied.

Necessity of flocculation. Different arrangements for flocculation. Design of flocculator tanks.

(d) *Filtration of water.*—Theory of necessity of filtration. Different types of filters. Design of filtration plants. Comparison of various types of filters. Details of various types of filtration plant. Rate of filtration, capacity of filter unit, size of filtering media, under drainage system, methods of cleaning filter media, wash other water gutter, inlet and outlet arrangement for filters; fixtures connected with filtration plants, loss of head through filters, maintenance of filters and treatment plants.

(e) *Other special methods of water treatment.*—Water softening purpose, hardness and types of method for water softening and process adopted and chemicals and materials used for.

Iron removal, manganese removal, tests and odour control, removal of fluorides, removal of colour, use of activated carbon.

C. *Distribution of water.*—Types of supply. Intermittent and continuous—Materials for pipes, etc. Pipes and other fixtures on distribution system and purpose of each, viz., sluice valves, air valves, non-return valves, pressure regulating valves, fire hydrants, etc. Types of distribution system design of pipes, flow in pipes, classification of pipes, laying of pipe lines, joining of pipes and materials required, testing of pipe lines, disinfection of new mains, Corrosion control of pipes. Balancing and service reservoirs—capacities of reservoirs required, design of reservoirs, location.

Waste surveys and prevention of waste in distribution of water, location of leaks, leakages in pipe line, service pipes and connections, pressure tests flushing of mains.

D. *Pumps and pumping stations.*—Necessity of pumping and pumping stations. Location and design of types of pumps and purpose of each. Work and efficiency of pumps. Choice of prime movers. Efficiencies of different prime movers. Stand-by for pumping machineries. Maintenance of pumping machineries. Operating schedule of pumping stations.

E. *Disinfection of water supply.*—Need and importance of disinfection. Different processes of disinfection and apparatus used for the process. Cost of chemicals used. Point of application—Disinfection of large distribution systems.

F. *Management of water works.*—Financial implications of water works. Public health engineering importance of protected water supplies. Economic of a water-supply. Watering and methods of revenue collections. Financial forecasts. Costs of various treatment work.

Plant laboratory control of quality of water. Measurement of quality of water at water works.

Preparation of water-supply project.

II. Sewerage—

A. *Definitions.*—Different types of drainage systems, Separate combined and partial system, surface drain, design and adaptability of surface drains. Amount of storm water, the rational method. Design of layout of drains. Necessity of detailed surveys.

B. *Materials for sewer pipes, flow in sewers.* The hydraulic grade line, self-cleansing velocities, flow diagrams, sewer shapes.

Sewer appurtenances, manholes, inlets, catch-basin, flushing devices, various types of traps junctions of sewers, sewers, sewer crossings, syphons.

C. *Sewer Constructions.*—Lines and grades, pipe laying and jointing testing of sewers, maintenance of sewers, cleansing of sewers and equipment required for.

Ejectors, sewage pumping stations, design and location, pumping machinery and design of capacities.

D. *Treatment of Sewage.*—Primary treatment, Racks and screens, types and location. Maintenance of racks, amount of disposal of screenings, grit chambers, design requirements of grit chamber, quantity and disposal of grit.

Sedimentation of sewage.

Clarifloculators and settling tanks. Design consideration inlets and outlets, velocities, collection and disposal of sludge, maintenance of these, use of chemicals for settlement.

Secondary treatment of sewage.

Activated sludge process, different types, steps in the process, detention period, method of aeration, return sludge, control of the process, characteristics of the process, sludge disposal.

Trickling filters. Various types of filtration methods used in sewage treatment, adaptability and efficiency of each method, details of trickling filters, filtering material, rate of filtration, construction of filters underdrainage, inlet and outlet, method of dosing, operation and maintenance, bio-filtration and recirculation.

Chemical precipitation of sewage, chlorination, disinfection, sludge disposal, drying beds.

E. *Disposal of sewage and effluent.*—Dilution in sea and rivers, factor affecting, dissolved oxygen and regeneration of streams. Disposal on land irrigation, sewage effluent farms, selection of sites for location of disposal works and farms.

F. *Management.*—Financing of sewage scheme, public health engineering importance, maintenance of sewers and disposal works.

G. Individual house sewage disposal :—

Septic tanks, design and requirements. Sanitary latrines, aqua privies and other types of latrines with their design and requirements.

Collection and disposal of sewage in unsewered areas.

H. Treatment and disposal of trade wastes, necessity for general methods, for problems of steam pollution.

Preparation of projects for sewage scheme.

III. *General sanitary engineering.*—General weights of pipes for water-supply and drainage and quantities of jointing materials required. Transport of such materials and carrying capacities of normal vehicles.

Sanitary requirements of slaughter-houses and schools. Importance of town planning from public health point of view, sanitation of swimming pools, refuse collection and disposal plumbing, industrial hygiene.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—Buildings and roads including bridges, with special reference to modern types of road construction.

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 stone masonry, pitching. Lifting devices, scaffolding. Terms used in masonry, safe loads on masonry. Costs.

Brick masonry : Materials, brick laying and bounding, bricknogging, 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 brick work scaffolding, strength of brick masonry safe loads on brick work. Costs.

(b) *Reinforced concrete construction.*—(i) Concrete : Various mixes and their uses.

(ii) Reinforcement : Round bars, fabrics; laying.

(iii) Curing of concrete form work, removal of form work and after treatment, Waterproofing concrete. Pre-cast concrete work. Laying concrete in water. Use of plain and reinforced concrete in structures. Vibrated concrete. Strength of various types of concrete works.

(iv) Pre-stressed concrete : Method of procedure, form work. Reinforcement and equipment for preparing reinforcement various patent methods Freysser and others. Pre-stressed and post-tensioned method of fixing ends tests, creeps, slips, grounding of cables.

(c) *Masonry structures.*—Bearings walls, proportion of heights, lengths and thickness. Openings in walls; lintels and arches. Centering and false work. Retaining wall : buttresses and counterforts, dry masonry walls. Breast walls and revetments—framed structures. Methods of construction.

(d) *Doors and windows framed structures.*—Timber frames and shutters of various types joints in joining work. Fastening and fixtures, steel doors, windows and casements, ventilators and skylights.

Proportion of opening to wall surfaces and floor areas, size and location of doors and windows.

(e) *Floors.*—Single—Single, double and framed timber floors, flagstone floors, jack arches. Filled joint floors—hallow tile floors. Reinforced concrete and reinforced brick floors, vaulted floors.

Floor finishes : Murum, concrete and tiled floorings, terrazzo concrete floors, basements, floors, factory floors.

(f) *Roofs*.—Pitched roofs, slopes, types of roof frames of timber and steel for different spans. Purlins, hips, rafters, valleys, ridges and eaves. Boardings, ceiling, various types of roof coverings. Detached roofs. Rain-water gutters.

Flat roofs.—Drainage of roofs. Water proofing compounds and materials used—structural plumbing. Flashings. Use of milled and cast sheet leads.

(g) *Staircases*.—Size, location and layout of staircases, types of staircases, doglegged open newel, geometrical and spiral. Stone, brick, metal, timber, R.C. staircases. Fireproof staircases.

(h) *Structural steel*.—Rolled steel sections, used as joists, beams and columns. Built up sections, structural connections, cast iron columns.

(i) *Timber constructions*.—Timber fastenings, nails, screws, bolts, pins washers, etc. Design of timber joints, for compression, tension, bearing and shear, working stresses. Design of beams and columns. Timber spires and complicated roof trusses.

(j) *Fireproof construction*.—Heat and sound insulating properties of masonry and concrete walls. Plasters and insulating boards.

(k) *Acoustics of buildings*.

(l) *Plastering and pointing*.—Treatment of internal and external brick, stone and concrete, wall surfaces. Plain plaster. Cement rendering, rough cost plaster. Fibrous plaster, lath in plaster, waterproofing plaster, gunmiting, pointing, painting, varnishing and polishing, glazing, papering, colour washes and distemper. Waterproof cement washers.

(m) *Foundations*.—(i) Soils, structural properties of soil. Examination of soils, probing and sounding and boring (wash-boring, percussion boring). Boring tools trial pits, testing soil for bearing pressure. Direct and indirect tests. Test piles.

(ii) *Bearing capacity of soils*.—Rock, clay and sandy soils, alluvium, quicksand. Black cotton soil. Reclaimed soil. Improving bearing capacity of soils by various methods. Transmission of load to foundations, dead load, live load and wind loads. Impact factor. Ratio of live load to dead load.

(iii) *Shallow foundations*.—Area of foundation, spreadings, timber and steel grillage foundations, R. C. C. raft, inverted arches. Foundations under eccentric loads, boundary footings. Depth of foundations.

(iv) preparation of bed demolition, under pinning, excavation, shoring and timbering of trenches, bailing out water.

(v) Different type—designs of buildings approved by Government.

PART II

Special subject—Roads and the Bombay Highways Act.

(1) Bombay Highways Act and rules made thereunder.

(2) Early roads. Road development in India.

(3) Road classification.—National highways, State Highways, M. D. R O. D. Rs., and V. Rs. (town roads and municipal streets).

(4) Road width and traffic lanes. Standards adopted for the various classification of roads.

(5) *Alignment of roads*.—Relative importance of length of road height of banks, depth of cutting, road grades, C. D. works, value of lands, nearness of quarries and sources of water supply in alignment.

Traffic arteries and bye-roads.

Special types of roads. Road tunnels, sub-grade and road foundations. Under drainage, camber, gradients, minor masonry cross-drainage works. Waterway calculations, masonry arches, culverts and piped drains. Construction details.

(6) *Curves*.—Simple, compound, parabolic, spiral lemniscate widening of road and super-elevation on roads, vertical curves, sight distance, road inter-sections and crossings.

(7) *Road surfaces*.—Earth roads and their stabilisation.

Sand clay, gravel, kanker, laterite and broken stone roads, water bound macadam and telford roads. Testing road metal. Effects of grading metal. Consolidation with power driven and bollock rollers, bindage and blinrage.

Modernisation of roads : Surface painting. Semi-grouting, grouting with tar and bituminous compounds. Premix tar and bituminous carpets, seal coats.

Cold treatment with bituminous emulsions, asphalt. Tar and asphalt mixtures. Testing of tar and tar products. Cement concrete roads. All concrete slabs. Section and reinforcements cement macadam, colloidal concrete, bonded concrete roads, joints and dowels.

(8) Arboriculture.

(9) Masonry registers.

(10) Road charts A and B.

(11) Paving with stone sets, bricks and wood blocks : Special roads, cycle tracks, road repairs waves corrugation, creeps.

(12) Use of road plant, graders, drags, scarifiers, scrapers, rollers, tar and asphalt boilers, sprinklers, mixer, vibrators, road drills.

(13) *Traffic problems*.—Traffic census, cross traffic, inadequate road space, waiting vehicles, slow moving vehicles, vehicles of large size, pedestrians peak load period, segregation of traffic.

- (14) *Traffic control*.—Width, layout, camber, gradient, surface, curves, corners and slight lines, kerbs, refuges and islands, lighting, parking, means of ingress and egress of road-side premises, restriction of ribbon development, junctions and intersections, roundabouts.
- (15) *Footpaths*.—Guard rails, foot-crossings, sub-ways and bridges for pedestrians.
- (16) *Traffic signs, standards, warning signs, prohibitory signs, mandatory signs, informative signs, white lines.*
- (17) *Road planning of a district and a whole State/inter-State communications.*

PART III

Bridges

- (a) *Deep foundations*.—Fraction and bearing piles. Timber, steel and cast iron piles, screw piles, pre-cast and cast in-situ (Vibro, Frank) concrete piles. Board piles. Pile driving, safe load on piles. Hiley's formulae.
- (b) *Methods of foundations in deep water*.—Diversion of streams. Cofferdams. Simple coffer-dams; sand bag, puddle, sheet pile coffer-dams. Design of coffer-dams. Pumping and sealing.

Well sinking.—Well curbs, cutting edge, masonry and R. C. C. well stenings, dredging, pumping and sinking. Fractional resistance. Plugging and filling. Well caps. Single and multiple wells.

Sinking cylinders, and concrete monoliths for bridge foundations. Details of construction and design.

Use of compressed air in sinking foundations. Diving, freezing and chemical methods.

(c) *Deep excavations*.—Excavation for deep trenches in waterlogged soils for pipes and sewers. Shoring and strutting.

(d) *Mechanical and power appliances*.—Earth-moving and excavating machines; boring machines and tools; concrete mixers; hoists and vibrators.

Pile hammers—

Manilla and wire ropes. Pulley blocks and lifting tackles, shears, gins, gin poles and derricks, crabs and winches and pumps.

Sub-structure and superstructure

(a) *General principles of design*.—Alignment. Number of spans. Economic spans. Waterway calculations. Depth of foundations. Scour depths, afflux. Clearance.

(b) *Loading dead load, live load, impact factors, B. S. S. recommendations and Indian Roads Congress recommendations for Loading on road bridges. Loading on railway bridges.*

- (c) *Sub-structures*.—Abutments, wing walls and piers, conditions of stability, types, design and constructions, foundations.
- (d) *Superstructures*.—Different types of road and railway bridges. Choice of material and type. Bridges, floors. Wearing surfaces on bridges. Methods of erection. Maintenance and preservations.
- (e) *Culverts*.—Box-pipe and Irish culverts: Causeways and submersible bridges. General principles of constructions.
- (f) *Approaches*.—Influence of conditions of approaches on selection of the type of bridges. Construction of approaches.
- (g) *Modern methods of designing superstructures.*
- (h) *Bearing.*

PART IV

Tunnelling

Tunnelling in rock and soft soil. Shield tunnelling. Use of compressed air in tunnelling. Shifts and headings. Lining of tunnels. Drainage and ventilation of tunnels.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF MECHANICAL ASSISTANT ENGINEERS AND DEPUTY ENGINEERS

PAPER II

Special subject—Boring

- (1) Fundamental principles of boring.
- (2) Types of boring machines and their application.
- (3) Types of bores.
- (4) Geological strata.
- (5) How to obtain and record the underground strata.
- (6) What are the methods to test the yield of bores.
- (7) How to test the verticality of the bore.
- (8) How to prepare the estimate.
- (9) Selection of boring plant.
- (10) Developing a bore.
- (11) Sand pumps.
- (12) Bore-hole pumps.
- (13) Air-lift pumping.
- (14) Reciprocating pumps.
- (15) Methods used for clearing the bores, etc.

SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF MECHANICAL
ASSISTANT ENGINEERS AND DEPUTY 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 loco 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 and 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 application.
- (7) Application of pneumatic machines and tools.
- (8) Their maintenance and repairs.
- (9) Air-lift pumping.

(E) *General—*

- (1) Fundamental principles of engineering.
- (2) Types 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.

**SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ENGINEERING
OFFICERS IN THE PORTS ORGANISATION**

PAPER II

Special subject—Harbour Engineering

PART I

- (a) Port administration.—General knowledge of the existing Port Organisation in Maharashtra State.
- (b) Wind, waves and tides.—
 - (i) Wind.—Effects of wind on marine construction works.
 - (ii) Waves.—Formation, height, period and amplitude of waves. Effect of waves on marine construction works.
 - (iii) Tides.—Formation of tides : flood and ebb tides, range of tides, (maximum and minimum). Spring and neap tides, tidal bore velocity of tides, tidal variations, tidal and littoral currents, tidal observations and tidal graphs.
- (c) Erosion and siltation.—Causes and remedial protection works.
- (d) Hydrographic survey.
- (e) Dredger, dredging.

PART II

Harbour structures

- (a) Harbour layout.—General principles of design and layout of harbour
- (b) Foundations of harbour structures—
 - (i) Soil.—Structural properties of soil—bearing capacity of soils.
 - (ii) Loading.—Dead and live load ; impact factors.
 - (iii) Shallow foundations.—Area of foundation, spreads, R. C. C. raft, foundations under eccentric loads ; depth of foundation.
 - (iv) Pile foundations.—Friction and bearing piles, timber, steel and cast iron piles, screw piles ; precast and cast *in-situ* concrete piles, bored piles ; pile driving, safe load on piles ; Hilley's formulae ; load test on piles, designs of pile structures.
 - (v) Well foundations.—Well-inking, well curbs, cutting edge, masonry and R. C. C. well steinings, dredging, pumping and sinking, frictional resistance ; plunging and filling well caps, single and multiple wells. Sinking cylinders and concrete monoliths, caissons for foundations.
 - (vi) Designs of wells, cylinders and monoliths.

(c) Jetties.—General principles of layout and designs—design of R. C. C. superstructure ; Types of fenders and their functions—dolphins.

(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 calculations.

(e) Docks and locks.—Elementary principles of designs and layout of wet and dry docks ; slipway ; floating docks, lock and lock-gates, dock bridges.

(f) Break water.—Classifications of break waters ; alignment ; design and construction of break waters ; failure of break water.

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

(h) Port and workshop machinery.—General knowledge of port machinery, mechanical handling plants and workshops machinery.

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

**SYLLABUS FOR THE PROFESSIONAL EXAMINATION OF ASSISTANT
ENGINEERS AND DEPUTY ENGINEERS**

PAPER III

Accounts

Accounts and rules of the Public Works and I Departments syllabus therefor being as under :—

I. Introduction to the Indian Government Accounts and Audit.

Part I—Chapter 1.

Part II—Chapters 9 and 11.

Part III—Chapters 12, 13, 15 17 and 21.

Part IV—Chapters 29, 30, 31 and 35.

Part V—Chapter 37.

II. Maharashtra Public Works Account Code and the Maharashtra Public Works Manual—Whole.

III. Labour Laws :—

(a) The Industrial Disputes Act, 1947 and the rules framed thereunder.

(b) The Minimum Wages Act, 1948 and the rules framed thereunder.

(c) The Workmen's Compensation Act, 1923 and the rules made thereunder.

Note.—The officers appearing at the examinations should be allowed to have books for subjects under I of the syllabus during the Examinations.