MPSC

Forest Service (Mains)

Previous Year Paper

(Civil Engineering)

10 May, 2025

महाराष्ट्र वन सेवा मुख्य परीक्षा - 2024 दिनांक - 10 मे, 2024

2024

W19

BOOKLET NO.
140026

Forest Services
Civil Engineering

Time Allowed : Three Hours **Maximum Marks : 200**

Medium : English **Type of Paper : Conventional**

Question Paper Specific Instructions

Please read each of the following instructions carefully before attempting questions :

1. There are **EIGHT** questions divided in two Sections, out of which **FIVE** are to be attempted.
2. Questions No. 1 and 5 are compulsory. Out of the remaining questions, **THREE** are to be attempted choosing at least **ONE** question from each Section.
3. The number of marks carried by a question/sub question is indicated against it.
4. Keep in mind the word limit indicated in the question if any.
5. Wherever option has been given, only the required number of responses in the serial order attempted shall be assessed. Unless struck off, attempt of a question shall be counted even if attempted partly. Excess responses shall not be assessed and shall be ignored.
6. Candidates are expected to answer all the sub-questions of a question together. If sub-question of a question is attempted elsewhere (after leaving a few page or after attempting another question) the later sub-question shall be overlooked.
7. Any page or portion of the page left blank in the Answer Booklet must be clearly struck off.
8. Unless otherwise mentioned, symbol and notation have their usual standard meanings. Assume suitable data, if necessary and indicate the same clearly.
9. Neat sketches may be drawn, wherever required.
10. The medium of answer should be mentioned on the answer book as claimed in the application and printed on admission card. The answers written in medium other than the authorized medium will not be assessed and no marks will be assigned to them.

Note –1. Candidates will be allowed to use Scientific (Non-programmable type) calculators.

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SECTION – A

Q1. Solve **any five** out of seven : **(8×5=40)**

(a) i) State D'Alembert's principle.

ii) A box of mass 70 Kg resting on a horizontal surface is subjected to a force of 350 N applied at 40° to the horizontal as shown in Fig. 1. Determine the velocity of the box after it has moved 5.5 m. Given coeff. of friction between the box and the surface as 0.25.

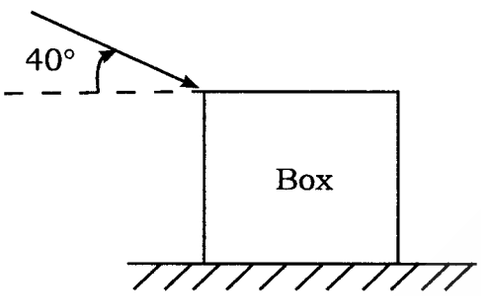

Fig. 1

(b) i) What are the merits and demerits of welded connection ?

ii) A tie of a roof truss consist of double angle ISA 100 × 75 × 10 mm with its short leg back to back and long legs connected to the same side of a gusset plate using 16 mm dia. rivets. Determine the strength of tie in axial tension. Given f_t = 150 MPa. Assume rivets have been provided at suitable pitch.

(c) i) Define Kinematic viscosity and compressibility.

ii) If the velocity distribution over a plate given by $u = \left(\frac{2}{3}\right)y - y^2$ in which 'u' is the velocity in m/sec at a distance 'y' meter above the plate. Determine the shear stress at y = 0 and y = 0.15 m. Take dynamic viscosity of fluid as 8.63 poise.

(d) i) Explain the three phase diagram for soil.

ii) A soil sample has a porosity of 40%. The specific gravity of solids is 2.70. Determine (a) void ratio, (b) dry density, (c) unit weight of saturated soil.

(e) i) Explain the effect of temperature on the horizontal thrust of a two hinged arch subjected to a system of vertical load.

ii) A simply supported beam has a span of 16 m and is subjected to a UDL (dead load) 5 kN/m and a UDL (live load) of 8 kN/m (longer than span) travelling from left to right. Draw ILD for shear force and bending moment at a section 4 m from left end. Use the ILD to determine maximum shear force and bending moment at this section.

(f) i) Give a stepwise design procedure to design a circular tank of 500 kiloliters capacity. The tank has a flexible base.

ii) List various systems of prestressing and explain about freyssinet system.

(g) i) What are the characteristics of laminar flow ?

ii) A crude oil of kinematic viscosity of 0.4 stoke is flowing through a pipe of diameter 300 mm at the rate of 300 liters/sec. Find the head loss due to friction for a length of 50 m of the pipe. Use Darcy-Weisbach equation. Assume coefficient of friction suitably.

Q2. (a) i) Distinguish between thin cylinder and thick cylinder and state their applications. **15**

ii) Passing through a point in material, there are two plane XY and YZ. Plane YZ is inclined at 45° clockwise to XY. The direct and shear stresses on plane XY are 80 MN/m^2 tensile and 40 MN/m^2 respectively. On plane YZ, there is a tensile stress of magnitude 150 MN/m^2 and a shearing stress. Determine (a) the magnitude of shear stress on plane YZ, (b) magnitude of principal stresses, (c) maximum shearing stress, and (d) direction of principal planes with respect to the plane XY.

P.T.O.

(b) i) A T-beam slab of an office comprise of a slab 150 mm thick spanning between ribs spaced at 3m centre to centre. The effective span of the beam is 8 m. Take live load on the floor as 5 kN/m^2. Design one of the intermediate beam using M20 grade concrete and Fe415 HYSD bars. **15**

ii) Explain about the check for deflection control in the design of slabs.

(c) i) Find the critical depth and critical velocity of the water flowing through a rectangular channel of width 8 m when the discharge is 20 cumecs. **10**

ii) Define specific energy. Draw a neat sketch of specific energy curve for a rectangular section showing all the details.

Q3. (a) i) Explain the importance of multistage centrifugal pump. **15**

ii) A four stage centrifugal pump has four identical impellers keyed to the same shaft. The shaft is running at 400 rpm and the total manometric head developed by the multistage pump is 40m. The discharge through the pump is 0.2 m^3/sec. with the vanes of each impeller at outlet is 5 cm and 6cm respectively. Calculate the manometric efficiency.

(b) i) State merits of triaxial test over direct shear test. **15**

ii) A permeameter of 80 mm diameter contain a two layered soil sample of 300 mm thickness. The top 200 mm thick soil has (permeability) $K = 4 \times 10^{-6}$ mm/sec and the remaining bottom 100 mm thick soil has (permeability) $k = 4 \times 10^{-7}$ mm/sec. If the falling head permeability test is conducted on this soil with a stand pipe of diameter 15 mm, what would be the time taken for the head to fall from 500 mm to 100 mm.

(c) i) Explain the friction circle method for the slope stability analysis. **10**

ii) A footing 2m square is laid at a depth of 1.3 m below the ground surface. Determine the net ultimate bearing capacity using BIS formula. Given Y = 20 kN/m^2, $\phi = 30°$, C = 0. For $\phi = 30°$, take $N_c = 30.1$, $N_q = 18.4$ and $N_Y = 22.4$.

Q4. (a) A horizontal member DBC is rigidly joined at B to a vertical member AB (A being below B) having the support A and C fixed and D as free. The member AB and BC are 4m in length each and has moment of Inertia I and 1.5I respectively. The overhanging portion BD is 1.2 m long with moment of inertia I. The member DBC carries a UDL of 60 kN/m. Use slope deflection method and draw bending moment diagram for the frame. **15**

Calculate the vertical deflection of the free end 'D' in terms of EI. (Ref. Fig. 2)

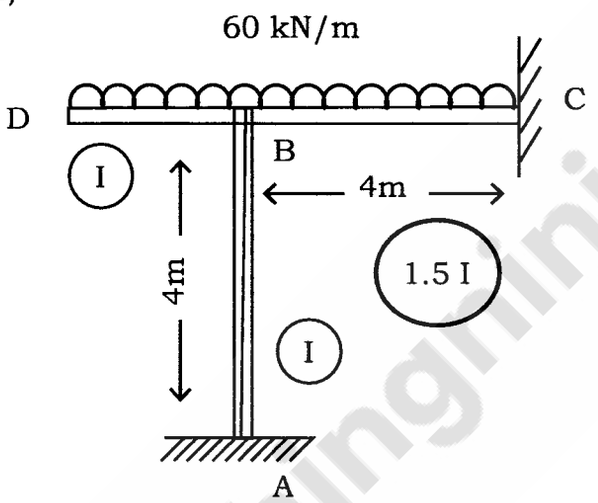

Fig. 2

(b) Design a T-shaped cantilever retaining wall for the following data : **15**

i) Height of the wall above ground = 3.5 m

ii) Depth of foundation = 1.3 m

iii) Safe bearing capacity of the soil = 140 kN/m^2

iv) Angle of internal friction of soil = 25°

v) Coeff. of friction between slab and contact = 0.44.

vi) Unit weight of earth fill = 18 kN/m^3. Adopt M25 grade concrete and Fe415 grade steel. Sketch reinforcement details.

(c) A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.74 N/cm^2 and 11.77 N/cm^2 respectively. Find the loss of head due to contraction if C_c = 0.62. Also determine rate of flow of water. **10**

SECTION – B

Q5. Write short notes on **any five** from seven. **(8×5=40)**

(a) How does high strength concrete contribute to sustainability in construction ?

(b) What are the different methods of tacheometry ? Explain any one in brief.

(c) List and briefly describe main components of hydrological cycle.

(d) Enlist various methods used for prediction of future population of a city. Explain in brief any one method.

(e) What are the major earthwork equipments ? What are their importance in construction industry ?

(f) Explain in brief the essential requirements of a good highway drainage system.

(g) Describe different types of canal lining and their importance in brief.

Q6. (a) Discuss elements of Engineering Economics. Explain how will you use following methods for economic appraisal.

i) Benefit-cost ratio method.

ii) Payback method. **15**

(b) Explain in details about traffic signs, signals and street lighting used for efficient traffic management system. **15**

(c) What is PERT ? How is it different from CPM ? **10**

Q7. (a) Explain different irrigation methods with suitable examples and their efficiencies. **15**

(b) What are the various methods used for the analysis of pressure in distribution system ? Explain any two methods in detail. **15**

(c) What is meant by water logging ? What are its ill effects ? Describe major anti-water logging measures. **10**

Q8. (a) The staff intercept between the outer stadia wires were 0.496 m for a horizontal distance of 50 m and 0.796 m for a distance of 80 m in an instrument with telescope horizontal. The instrument is then set over station 'A' having R.L. 410.75m, with height of instrument above station point being 1.378 m. The stadia readings on a vertical staff at station 'B' with vertical angle 15° are 0.410, 1.340 and 2.250 m.

Calculate tacheometric constants, the horizontal distance between 'A' and 'B' and reduced level of station 'B'. **15**

(b) A stream of 130 litres per second was diverted from canal and 100 litres per second was delivered to the field. An area of 1.6 hectares was irrigated in 8 Hrs. The effective depth of root zone was 1.7 m. The run off loss in the field was 420 cum. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at tail end. Available moisture holding of the soil is 20 cm per meter depth of soil. Determine the water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency. Irrigation was started at a moisture extraction level of 50% of the available moisture. **15**

(c) Explain in short the following :

i) Sources of Air pollution.

ii) Sustainable development. **10**

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