महाराष्ट्र स्थापत्य अभियांत्रिकी सेवा (मुख्य) परीक्षा - २०२३, दि.२८ जानेवारी, २०२४.
(पेपर - I)

2023

O18

BOOKLET NO.

105626

Civil Engineering
Paper – I

Maximum Marks : 200

Time Allowed : Three Hours
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 Sections.

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.

P.T.O.

SEAL

SECTION – A

Q1. Answer **any five** of the following :

(8×5=40)

(a) A compound tube consist of steel tube 150 mm internal diameter and 10 mm thickness and outer brass tube 170 mm internal diameter and 10 mm thickness, the two tube are of same length. The compound tube carries axial load 1000 N. Find the stresses and load carried by each tube and also amount of shorten L = 150 mm, $E_s = 2 \times 10^5$ MPa, $E_b = 1 \times 10^5$ MPa.
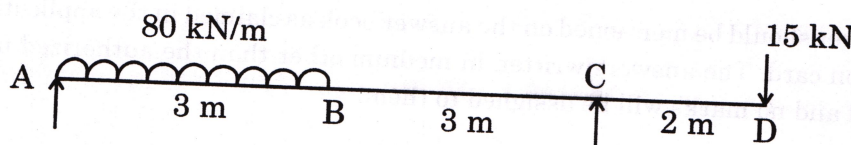
(b) Analyse a continuous beam as shown in Fig.
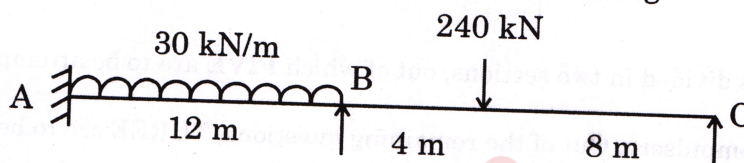
(c) Find a real root of the equation $x = e^{-x}$ using Newton Raphson method.

(d) A 3 hinged parabolic arch of 20 m span and 3 m rise is carrying a point load of 100 kN at 7.5 m from left support. Find the value of horizontal thrust and BM at 7.5 m from right support.

(e) Explain the term plastic hinge and plastic collapse.

(f) Explain factors to be considered for selection of equipment in construction industry.

(g) Derive the relation for beam deflection of simply supported beam carries uniformly distributed load w kN/m over entire span.
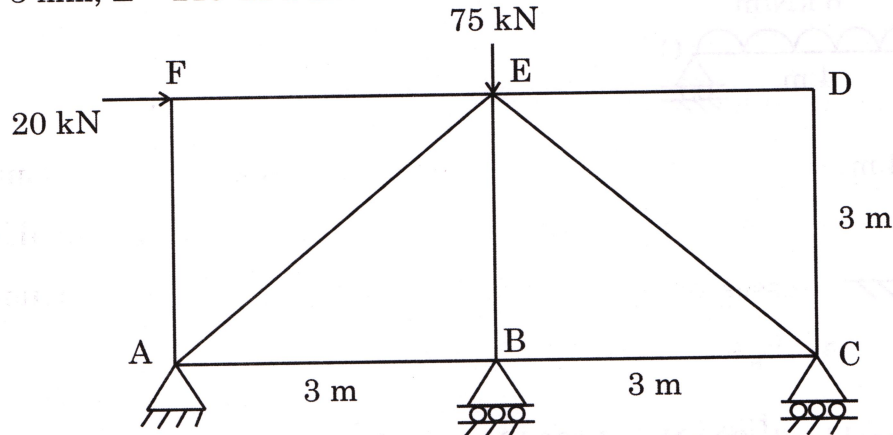
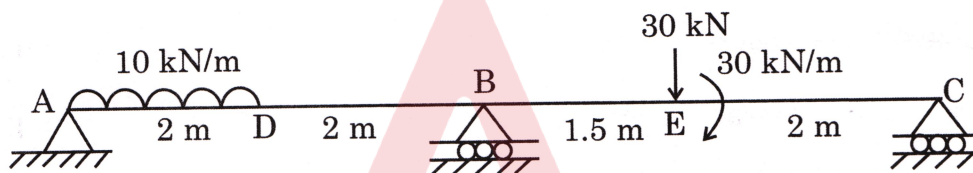**Q2.** (a) Draw shear force and bending moments for the beam as shown below. **15**

(b) Analyse the truss supported and loaded as shown in fig. if support B sink by 3 mm, E = 210 GPa and A = 400 mm^2. **15**

(c) Find the positive root of equation $xe^x = 1$ which lies between 0 and 1. **10**

Q3. (a) Analyse the continuous beam by flexibility method. **15**

(b) Design a plate girder for the span 24 m carries a load 100 kN/m simply supported at two ends. (connection – welded) **15**

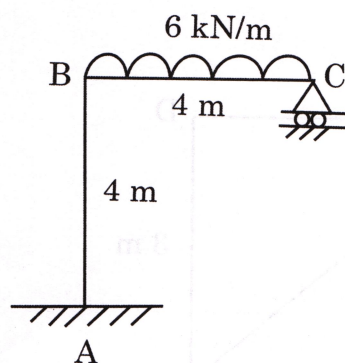(c) Explain ABC analysis concept and ABC classification of construction material. **10**

Q4. (a) Describe in details : **15**

   i) Resource planning process.

   ii) Importance of planning.

   iii) Function and role of chief planner in construction project management.

(b) Analyse the frame by moment distribution method.   **15**

(c) Two wheel loads 80 kN and 120 kN spaced at 3 m apart move along the beam of span 12 m simply supported. Find the maximum BM at 4 m from left support using influence line diagram concept.   **10**

SECTION – B

Q 5. Answer **any five** of the following : (8×5=40)

(a) A rectangular beam 230 mm wide and 415 mm effective depth is reinforced with 3 bars of 20 mm diameter in tensile zone and 2 bars of 16 mm diameter in compression zone. Determine moment of resistance using WSM. Use M20 and Fe415.

(b) Explain in detail distribution of loading on staircase and effective span on stairs.

(c) Explain the factors to be considered for site selection in bridges.

(d) Explain how aggregates can be classified based on weight, size, shape and texture.

(e) Write a short note on pretension system in prestressing.

(f) The dry unit weight of soil having 12% water content is 1812 kN/m^3. Find bulk unit weight, saturated unit weight and submerged unit weight (take G = 2.65).

(g) Write short notes on :
   i) Permeability of concrete.
   ii) Durability of concrete.

Q6. (a) Design a RC slab for a room of size 4 m × 6 m. The slab is simply supported on all the four edges and carries a live load 2 kN/m^2 FF = 1 kN/m^2 M20 and Fe415. **15**

(b) Design a watertank for following data

Open rectangular tank 4 m × 6 m × 3 m deep rest on ground. **15**

Use M20 concrete

Fe415 steel

Use (WSM) for analysis.

(c) Design a column to carry an axial load of 800 kN. Design the column as per IS code. Consider rectangular short column. **10**

Q7. (a) Write short notes on :   15

     i) Waterway calculation

     ii) Scour depth

     iii) Economical span for bridge construction.

(b) Explain the term grading of aggregate and also explain its effect on properties of concrete.   15

(c) Describe Terzaghi's bearing capacity theory of shallow foundation.   10

Q8. (a) A prestress concrete beam of rectangular section 300 mm × 600 mm has a span of 12 m. The effective prestressing force 980 kN at eccentricity of 120 mm. The DL = 4.5 kN/m and LL = 7.5 kN/m. Determine extreme stresses at   15

     a) end section

     b) mid span without LL

     c) mid span with LL.

(b) The void ratio of clay A decreased from 0.572 to 0.505 under a change in pressure from 120 to 180 kg/m^2. The void ratio of clay B decreased from 0.612 to 0.597. The thickness of sample A was 1.5 times that of B, if 50% consolidation was 3 times longer for sample B than sample A. What is the ratio of the coefficient of permeability of A to that of B ?   15

(c) Explain advantages and disadvantages of prestressing.   10