CIVIL ENGINEERING - I (OPTIONAL) 000044

Standard : Degree **Total Marks : 200**

Nature : Conventional **Duration : 3 Hours**

Note :

*(i) Answers must be written in **English**.*

*(ii) Question **No. 1** is **Compulsory.** Of the remaining questions, attempt **any Four** selecting one question from **each section.***

*(iii) Figures to the **RIGHT** indicate marks of the respective question.*

(iv) Use of log table, non-programmable calculator is permitted, but any other table/code/reference book are not permitted.

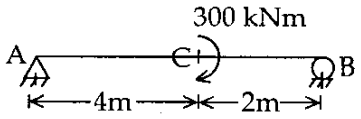
(v) Make suitable assumptions, wherever be necessary and state the same.

(vi) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.

(vii) Credit will be given for orderly, concise and effective writing.

(viii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he will be penalised.

1. (a) A horizontal beam AB is simply supported at A and B, 6 m apart. The beam is subjected to a clockwise couple of 300 kNm at a distance of 4 m from left end as shown in figure. For beam material $E = 2 \times 10^5$ N/mm^2 and $I = 2 \times 10^8$ mm^4. **10**



Determine :

(i) Deflection at the point 'C' where couple is acting.

(ii) Maximum deflection indicating section where is occurs use Mecaulay's method.

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Marks

(b) A column in a multistory R.C. building is subjected to an axial force of 2500 kN and a bending moment of 650 kNm under gravity and earthquake loads. Design the column section for ductility. Use M20 concrete and Fe 415 grade steel. Useful data from interaction diagram for design: For $\frac{Pu}{6ckbD} = 0.417, \frac{Mu}{6ckbD^2} = 0.18$ and $\frac{d'}{D} = 0.10$ for column reinforced on all the four faces, $\frac{p}{\sigma ck} = 0.162$. **10**

(c) What is bearing capacity ? State the difference between safe bearing capacity and net safe bearing capacity. Explain (i) stress isobar (ii) vertical pressure distribution on a horizontal plane, by means of Boussinesq's stress distribution theory. **10**

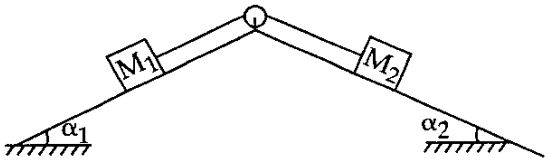
(d) Discuss the engineering characteristics and suitability of building stones found in Maharashtra. **10**

(e) Explain the effect of fly ash on fresh and hardened concrete. **10**

SECTION - A

2. (a) State (i) Work energy theorem (ii) D'Alembert's principle. **2**

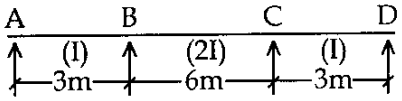
Two masses M_1 and M_2 are placed on smooth inclined planes of angles α_1 and α_2 respectively and are connected by an inextensible string of negligible mass which passes over a smooth pulley as shown in figure. Find the acceleration of masses. **8**



(b) State Castigliano's theorems. **2**

ABCD is a continuous beam as shown in figure. Support B sinks by 2 mm and support C sinks by 7 mm.

Use Moment distribution method for the analysis and draw shear force diagram and Bending moment diagram. **8**



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(c) Solve the following :

(i) A two hinged parabolic arch of 30 m span and 5 m central rise has a varying second moment of area, which is proportional to the secant of the slope of its neutral axis. It carries a point load of 15 kN at a distance of 10 m from the left end.

Determine : Horizontal thrust, Bending moment, Normal thrust, and radial shear under the load. **5**

(ii) A fixed beam AB of span 6 m carries uniformly distributed load of 5 kN/m on right hand 4.5 m from fixed support B.

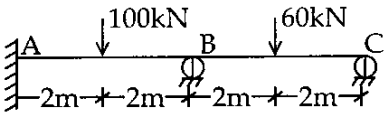
Using plastic theory for collapse load, calculate the section dimensions if rectangular section with depth, two times width is used.

Assume load factor = 1.75, shape factor = 1.15 and yield stress = 25 N/mm^2. **5**

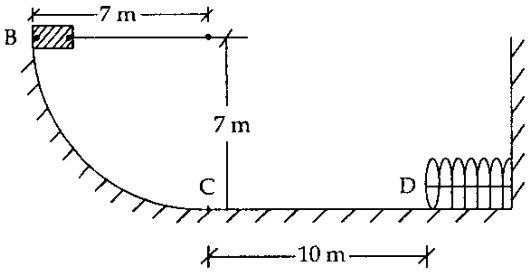
(d) A continuous beam ABC is shown in figure. Using Flexibility Matrix method analyse the beam to determine reactions and moments over the supports. **10**

Draw bending moment diagram.

Assume EI uniform over entire span.



3. (a) A body of mass 5 kg is released from rest on a frictionless circular face BC as shown in figure. It then moves on a horizontal rough surface CD, whose coefficient of friction with body is $\mu = 0.2$. A spring having constant of 15 N/mm is positioned as shown. How much will the spring be compressed when the body comes to rest ? **10**



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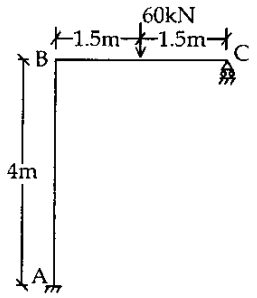
(b) Write a note on 'Modified slope deflection equations'. **2**

Using slope deflection equation method, analyse the link ABC shown in figure. Find reactions at A and C and draw Bending moment diagram. **8**



(c) (i) Explain 'rib shortening of arches'. **2**

A two hinged parabolic arch has span of 30 m and rise of 7.5 m. The moment of inertia of arch section is proportional to secθ where θ is slope of arch axis at any point with horizontal.

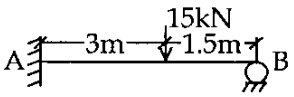
Calculate the horizontal thrust developed in the arch due to rise in temperature by 25°C.

Given : $E = 2 \times 10^5$ N/mm^2, coeff. of thermal expansion $\alpha = 6 \times 10^{-6}$/°C, and M.I. at crown $= 125 \times 10^8$ mm^4. **3**

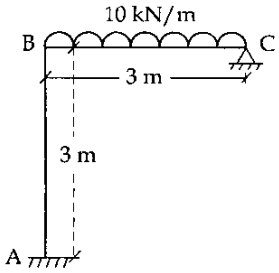
(ii) Define : Plastic hinge, Plastic moment. **2**

Find collapse load and the plastic moment for the propped cantilever beam shown in figure.

Take : working stress = 15 N/mm^2, shape factor = 1.15, and yield stress = 22.5 N/mm^2. **3**



(d) Using 'stiffness matrix method' analyse the link ABC shown in figure and draw Bending moment diagram. **10**



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SECTION - B

4. (a) (i) Design a double angle discontinuous strut of length 3 m connected by welds to a 10 mm gusset at both ends for design compressive force of 200 kN. **5**

(ii) Sketch : Gussetted base of column. **4**
Bearing stiffener for plate girder.
A column section SC250@839 N/m carries an axial load of 600 kN. Design a slab base for the column. Allowable bearing pressure on concrete = 4 N/mm^2, Allowable bending stress in slab base = 185 MPa. **6**

(b) The foundation of a structure is to consist of 16 piles to carry a total load of 10400 kN. The piles are 300 mm and are 9 m long. Piles are spaced at 1.5 m centre to centre. Design one of the piles. Use M20 concrete and Fe415 steel. **10**

(c) (i) Sketch 'connection of the wall with base' for circular water tank resting on ground. **1**
Design a circular water tank resting on ground for 3 m depth of water and tank diameter = 3.5 m. **4**

(ii) Write short note on 'Losses in prestress'. **2**
A rectangular concrete beam 150 mm × 300 mm is prestressed by a straight cable carrying an effective prestressing force of 225 kN at an eccentricity of 50 mm. The beam supports a uniformly distributed load of 7.2 kN/m inclusive of self weight. Span of beam is 5 m.
Calculate load factor against cracking.
Given : Modulus of rupture of concrete = 5 N/mm^2. **3**

(iii) A retaining wall is 6 m high with earth level at top. It is 2 m wide at base and 1 m wide at top. Check the stability of wall. Back of wall is vertical. Unit weight of earth = 16 kN/m^3, unit weight of masonry = 24 kN/m^3, angle of repose of earth = 30°. **5**

5. (a) (i) Determine the capacity in tension of a single angle member 55 × 55 × 6 mm connected by fillet weld to the gusset.
Find Weld length for full strength of member.
Properties of 55 × 55 × 6 angle : Gross area of c/s = 626 mm^2, radius of gyration = 10.6 mm. **5**

(ii) ABCD is a continuous beam such that, AB = CD = 4.9 m and middle span BC = 6 m. The beam carries a uniformly distributed load of 32.5 kN/m. The beam is supported on column MB225 and is laterally restrained. Stiff bearing width at the column is 100 mm.
Design the beam using steel Fe250 grade. **10**

P.T.O.

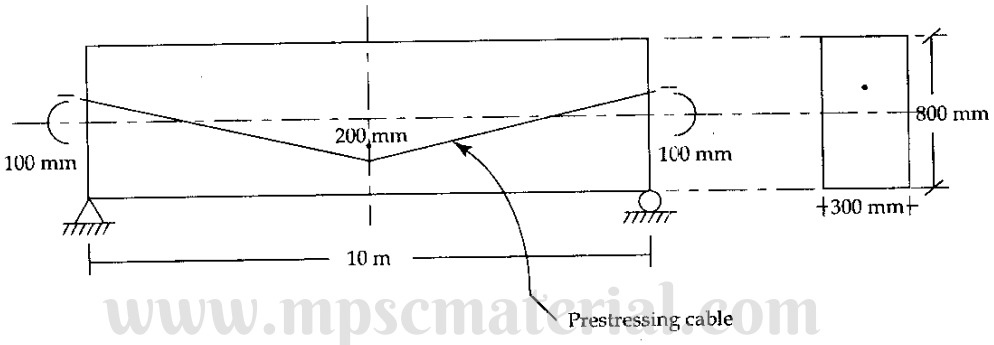
Marks

(b) A T beam has flange width 700 mm, overall depth 800 mm, flange thickness 120 mm, and web width 350 mm. The beam is subjected to factored bending moment of 125 kNm, factored shear force of 150 kN, and factored Torsional moment of 105 kNm. **10**
Design the beam using M30 concrete and Fe415 steel.

(c) (i) Explain design procedure in short for an elevated water tank columns and bracings for wind forces. **3**

(ii) Sketch reinforcement details for a rectangular water tank resting on ground with corner reinforcement drawn separately. **2**

(d) Write percentage loss in prestress due to various reasons. **1**
A simply supported beam 300 mm × 800 mm and span 10 m is carrying a live load of 10 kN/m over entire span. The beam is prestressed with a cable as shown in figure. The eccentricity is −100 mm at ends and +200 mm at mid span. The effective prestressing force is 600 kN.
Plot the stress distribution at ends and mid span. **4**



(e) Write short notes : **5**

(i) Is code provisions for seismic forces with respect to masonry structures.

(ii) Effect of mortar proportion on strength of brick masonry.

SECTION - C

6. (a) (i) What are the systems of soil classification ? Explain in brief Textural classification of soil. **5**

(ii) State the factors affecting permeability. Due to a rise of temperature, the viscosity and unit weight of percolating fluid are reduced to 75% and 97% respectively. Other things being constant, calculate the percentage change in coefficient of permeability. **5**

(b) Define consolidation.
Explain in brief Terzaghi's theory of one dimensional consolidation. **10**

Marks

(c) (i) Differentiate between active and passive earth pressures.
A retaining wall with a smooth vertical back retains sand backfill for a depth of 6 m. The backfill has a horizontal surface and has following properties. 5

$C' = 0, \phi' = 28°, \gamma = 16\ kN/m^3, \gamma_{sat} = 20\ kN/m^3$

Calculate the magnitude of total thrust against the wall if backfill fully drained but the top of the wall is restrained against yielding.

(ii) What are the types of samplers ? 5
Explain Auger boring in brief.

(d) What is pile ? State the methods to determine load carrying capacity of a pile. Explain in brief pile load test and penetration test to determine load carrying capacity of a pile. 10

7. (a) (i) Define plastic limit and plasticity index. The mass specific gravity of a fully saturated specimen of clay having a water content of 36% is 1.86. On oven drying, the mass specific gravity drops to 1.72. Calculate the specific gravity of clay and its shrinkage limit. 5

(ii) What is permeability ? Explain in brief determination of coefficient of permeability by falling head permeability test. 5

(b) Define compaction. State the factors affecting compaction. Explain in brief field compaction control. 10

(c) (i) Explain Coulomb's theory of active earth pressure against retaining walls giving the assumptions made if any. 5

(ii) State penetrometer tests and explain in brief standard penetration test. 5

(d) Define raft foundation. State types of pile foundation. Explain in brief ground improvement techniques. 10

SECTION - D

8. (a) Suggest suitable organisation structure for construction projects. Give justification for your suggestion. 10

(b) (i) Make comparison between English bond and Flemish bond of brick masonry. 5

(ii) With reference to Indian Conditions, list the factors to be considered in deciding orientation of building. 5

(c) What do you understand by standard equipment and special equipment. Discuss the criteria that govern the selection of standard and special type of equipment for construction projects. 10

P.T.O.

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(d) (i) What is updating of network ? State the objectives of network updating. 5

(ii) A uniform annual investment is to be made into a sinking fund with a view to provide capital required at the end of 10 years for the replacement of a concrete mixer. If required capital is Rs. 1,50,000/- calculate the annual investment needed to provide this required capital. Assume an interest rate of 9%. 5

9. Answer the following subquestions :

(a) Information regarding small construction project is given below :

Activity i - j	Duration (in days)
1 - 2	8
2 - 3	9
2 - 4	8
2 - 5	6
3 - 6	10
4 - 7	11
5 - 7	7
6 - 8	10
7 - 8	9
8 - 9	9

Draw the network, mark critical path and determine project duration. Also calculate total float for each activity. 10

(b) (i) List common defects of plastering. Suggest precautions to avoid such defects. 5

(ii) Write a note on energy efficient buildings. 5

(c) What do you understand by economic life of construction equipment ? How do you estimate it ? 10

(d) (i) Differentiate between Resource allocation and Resource levelling. 5

(ii) List the methods of making economic appraisal of projects. Give the suitability of any one method. 5

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