AOU

2007

100042

CIVIL ENGINEERING - I (OPTIONAL)

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) Candidates 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/she will be penalised.

1. Answer ***any four*** of the following sub-questions :

(a) The steel bar shown in Figure 1 is supported by two springs at the ends A and B. Each spring has a stiffness of 45 kN/m and is originally unstretched. If the bar is loaded with a force of 3 kN at point C, determine the total vertical displacement of the force. Neglect the weight of the bar and take E_{st} = 200 GPa, I = 4.6875 x 10^{-6} m^4. 10

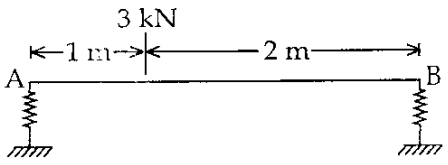

Figure 1

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(b) Carry out the checks for the stability of the cantilever retaining wall shown in Figure 2, against (i) overturning (ii) sliding and (iii) pressure distribution. Assume unit weight of soil as 18 kN/m^3, safe bearing capacity of soil = 65 kN/m^2, coefficient of friction between concrete and soil = 0.5 and coefficient of active earth pressure = 1/3. Comment on your results. **10**

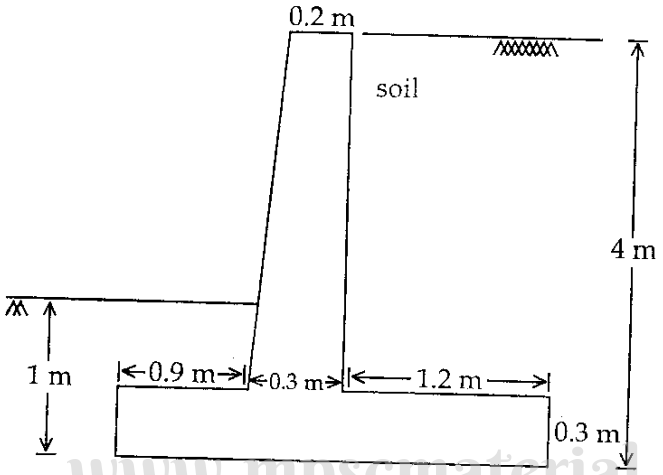

Figure 2

(c) (i) Explain the design criteria of shallow foundations with respect to foundation placement, safety against bearing capacity and tolerable foundation settlement. **6**

(ii) An elastic medium carries at its surface a uniform load of 10 t/m^2 (≈ 100 kPa) covering a rectangular area 4m x 3m. Find the vertical pressures at a depth of 5.0m below the centre and a corner of the loaded area. (Use Boussinesq theory). (For m = 0.3, n = 0.4, K_B = 0.0474 and for m = 0.6, n = 0.8, K_B = 0.1247) **4**

(d) List the properties that should be checked for fresh concrete. Also describe the procedure for checking these properties. **10**

(e) How are the bricks classified ? Describe properties of each class. **10**

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SECTION - A

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2. Answer the following sub-questions :

(a) Find the resultant force of the non-concurrent force system acting on a body as shown in Figure 3., restricting your numerical results to two decimal places only. Comment on the state of motion of the body. **10**

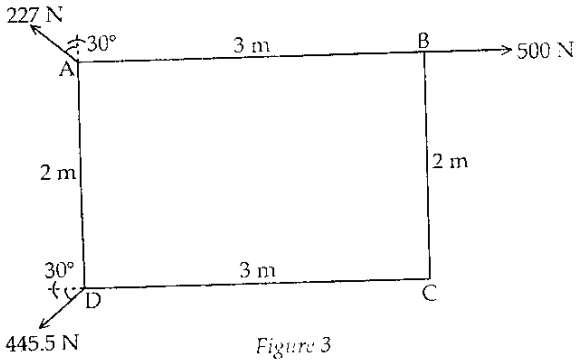

Figure 3

(b) State the Muller-Breslau Principle. Using this principle draw influence line diagrams for (i) shear force at C and (ii) bending moment at B, for the compound beam shown in Figure 4. **10**

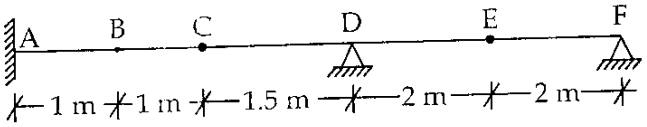

Figure 4

(c) (i) Discuss the consistency of deformation approach used to analyse a 2-hinged arch. **5**

(ii) Using upper bound approach of plastic analysis, determine the collapse load in terms of plastic moment capacity for the uniform propped cantilever shown in Figure 5. **5**

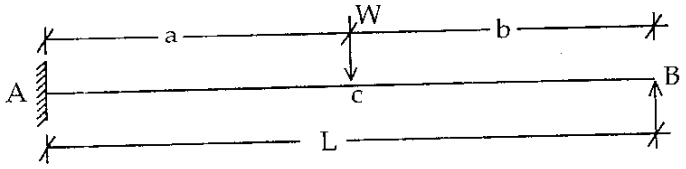

Figure 5

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(d) Generate the stiffness matrix for the bent cantilever shown in Figure 6, in terms of the coordinates 1, 2 and 3. 10

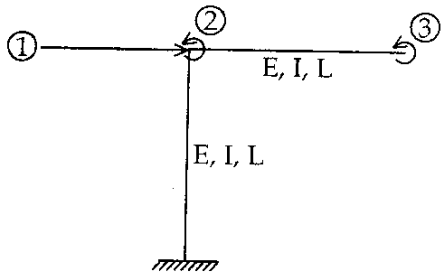

Figure 6

3. Answer the following sub-questions :

(a) A ball is thrown vertically up in the air from a height of 10m from the ground level with a velocity of 10m/s. Neglecting the air resistance determine (i) the maximum height the ball reaches (ii) time taken by the ball to come back to the same level and (iii) time taken by the ball to reach the ground. If the air resistance is considered comment on the maximum height the ball reaches. 10

(b) Analyse the continuous beam shown in Figure 7 using slope-deflection method. Assume E as constant. 10

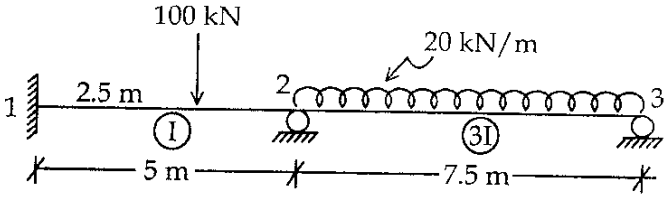

Figure 7

(c) (i) A three-hinged segmental arch has a span of 50m and a rise of 8m. A 100 kN load is acting at a point 15m measured horizontally from the right hand support. Determine the horizontal thrust developed at the supports. 5

(ii) Discuss the upper bound, lower bound and uniqueness theorems of plastic analysis. 5

Marks

(d) Using the stiffness matrix approach of analysis, analyse the frame shown in Figure 8 for displacements at the coordinates of the structure. **10**

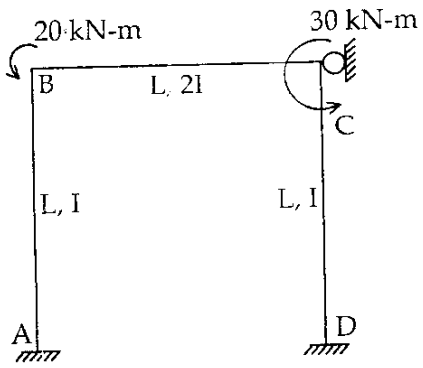

Figure 8

SECTION - B

4. Answer the following sub-questions :

(a) Design a gantry girder for a building to carry an electric overhead travelling crane having the following data. **15**

(i)	Crane Capacity	-	250 kN
(ii)	Weight of crane excluding crab	-	200 kN
(iii)	Weight of crab	-	60 kN
(iv)	Span of crane between rails	-	20m
(v)	Minimum hook approach	-	1.1m
(vi)	Wheel base	-	3.4m
(vii)	Span of gantry girder	-	7m
(viii)	Mass of rail section	-	30 kg/m
(ix)	Height of rail section	-	75mm

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Design for only flexural tensile stress may be done. Properties of following sections are available for use.

(i) ISWB 600 @ 133.7 kg/m : Z_{xx} = 3540 x 10^3 mm^3 , I_{xx} = 106198.5 x 10^4 mm^4, I_{yy} = 4702.5 x 10^4 mm^4, a = 17038 mm^2, h = 600 mm, b = 250 mm, t_f = 21.3 mm and t_w = 11.2 mm.

(ii) ISMC 300 @ 35.8 kg/m : I_{yy} = 310.8 x 10^4 mm^4, I_{xx} = 6362.6 x 10^4 mm^4, a = 4564 mm^2, C_{yy} = 23.6 mm and t_w = 7.6 mm

Take f_y = 250 N/mm^2 and E = 2 x 10^5 N/mm^2

(b) Find the moment of resistance of a singly reinforced section 200mm wide and 400mm deep, reinforced with 4 bars of 16mm diameter of Fe 415 steel. Grade of concrete is M20. Use limit state method. 10

(c) (i) Discuss the structural behaviour of circular water tank with flexible base and rigid base. 5

(ii) Write a note on losses of prestress. 5

(iii) What is the necessity of reinforcement in masonry construction to resist earthquakes ? What are the important locations of providing reinforcement in masonry ? 5

5. Answer the following sub-questions :

(a) Design a double angle discontinuous strut of a truss to carry an axial load of 160 kN. The length of strut between centre to centre of intersection is 2.6 m and is connected to both sides of a gusset plate 16mm thick. Take f_y = 250 N/mm^2. Following data is available.

(i) Properties of ISA 70×45×10mm @ 8.3 kg/m : a = 10.52cm^2, r_{xx} = 2.16 cm, I_{yy} = 15.6 cm^4, C_{yy} = 1.24 cm.

(ii)

Slenderness Ratio	80	90	100	110	120
σ_{ac} (N/mm^2)	101	90	80	72	64

Marks

(b) A rectangular section 300mm x 400mm is reinforced with 8 bars of 20mm diameter symmetrically placed near the periphery with an effective cover of 50mm. Taking σ_{cc}= 4 N/mm^2, σ_{cbc}= 5 N/mm^2 and m = 19, determine (i) maximum eccentricity along the longer side at which load can be applied without developing tension in the section (ii) magnitude of the load. 10

(c) (i) Discuss the different design forces to be considered in the design of wall of a rectangular water tank. 5

(ii) Explain the fundamental concepts applied to explain the basic behaviour of pre-stressed concrete. 5

(iii) Discuss the provisions regarding openings provided in load bearing masonry construction for achieving earthquake resistance. 5

SECTION - C

6. Answer the following sub-questions :

(a) (i) (1) Define : Sensitivity and activity of clays 2

(2) Due to rise of temperature the viscosity and unit weight of a fluid are reduced to 72% and 98% respectively. Other things being constant calculate the percentage change in the value of coefficient of permeability. 3

(ii) What are the requirements of soil classification system ? 2

A core cutter 10 cm diameter and 15 cm long weighs 1200 gms when empty. In an inplace density test the core-cutter full of soil weighed 3438 gms and water content of the soil was found to be 10%

If the embankment gets saturated, what is the increase in water content ? (The volume of soil does not get altered and take G = 2.70) 3

(b) (i) State and explain - critical void ratio and Liquefaction of sand. 4

(ii) A strata of normally consolidated clay of thickness 3m is drained on both sides. It has a coefficient of permeability = 5 x 10^{-8} cm/sec and coefficient of volume compressibility = 125 x 10^{-4} cm^2/kg. Determine the ultimate value of compression of the strata by assuming a uniformly distributed load of 25 t/m^2. Also determine the time required for 20% consolidation. 6

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(c) (i) A retaining wall with a smooth vertical backface has to retain a backfill of c - ϕ soil upto 5m above the ground level. The surface of the backfill is horizontal and the back has the following properties. 6

$\gamma = 1.8$ t/m^3 (18 kN/m^3), C = 1.5 t/m^2 (15 kN/m^2) and $\phi = 12°$.

(1) Determine the depth of the zone of tension cracks.

(2) Plot the distribution of active earth pressure on the wall

(3) Determine the intensity of ficitious uniform surcharge, which if placed over the backfill, can prevent the tension cracks.

(ii) Explain standard penetration test conducted at site. What are the corrections applied to the field value of N, as per IS : 2131-1981 ? 4

(d) (i) What is negative skin friction ? How is the value of negetive skin friction estimated for single pile in cohesion and cohesionless soils ? What are the methods to reduce negetive skin friction ? 5

(ii) A group of 9 piles, 12 m long and 250mm in diameter, is to be arranged in a square grid in a clay deposit with an average compressive strength of 60 kN/m^2. Work out the centre-to-centre spacing of piles for a group efficiency factor 1. Neglect the bearing at the tip of the piles. 5

(consider average adhesion factor = 0.9)

7. (a) (i) A relative density test conducted on a sandy soil yielded the following results : 5

minimum void ratio = 0.48

maximum void ratio = 1.23

relative density = 42%

and G = 2.67.

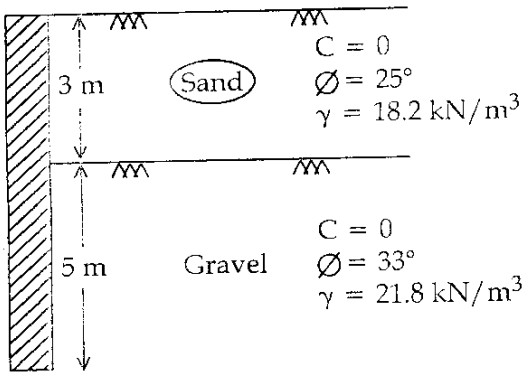
Find the dry density of the soil in the present state. If 3.0 m thickness of this stratum is densified to a relative density of 62% how much will the soil reduce in thickness ?

(ii) Define and explain seepage pressure and quicksand condition. Show that, during quicksand condition, critical hydraulic gradient = $\frac{G-1}{1+e}$. 5

Marks

(b) A homogeneous clay layer, 9.0 m thick is expected to have an ultimate settlement of 308 mm. After a time span of 2 years the average settlement was measured to be 108 mm. How much longer will it take for the average settlement to attain 220 mm ? 10

(c) (i) For the retaining wall shown in figure below make a sketch of the distribution of active pressure on the wall, giving the principle values, compute the thrust per meter length of the wall neglecting cohesive and frictional forces on the back of the wall. 5



(ii) Write a detailed note on location, spacing and depth of borings (boreholes). 5

(d) (i) What is the necessity of providing combined footings ? Explain the principles based on which a combined footing is designed. 4

(ii) Write the IS : 2911 (Part IV) - 1985 recommendations to estimate safe load using pile load test data. 3

(iii) What is grouting ? What are the applications of grouting ? 3

P.T.O.

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SECTION - D

8. Answer the following sub-questions :

(a) For the following data, draw an arrow network and calculate total and free floats for non-critical activities. **10**

Activity	A	B	C	D	E	F	G	H	J	K
Immediate Successors	C	D, E	F	F	G, J	H	H	K	K	-
Duration	3	4	5	9	2	3	1	12	10	8

(b) (i) Which factors should be considered for orientation of building in hot and humid regions ? **5**

(ii) Describe in brief method of repairs to damaged RCC column. **5**

(c) Describe: Compaction of concrete using mechanical vibration. **10**

(d) (i) List the issues to be considered for job layout. **5**

(ii) Write a note on project financing through private participation. **5**

9. Answer the following sub-questions :

(a) For following data, perform compression in steps to indicate how the project can be completed in two days prior to its normal completion time with minimum increase in direct costs. **10**

Activity	Normal Duration	Crash Duration	Direct Cost Slope
1 - 2	4	2	10
1 - 3	6	2	15
2 - 4	5	3	12
3 - 4	6	4	7
3 - 5	8	4	7
4 - 6	7	3	5
5 - 6	6	5	6

Marks

(b) (i) List methods of valuation and describe any one in brief. 5

(ii) Describe different types of mechanical systems of ventilation. 5

(c) Describe 'Sheet piling.' 10

(d) (i) Discuss concept of 'Resource levelling.' 5

(ii) Describe : Net Present Value and Internal rate of return. 5

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