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2005

CIVIL ENGINEERING

Paper 1

Time : 3 Hours] *[Maximum Marks : 300*

INSTRUCTIONS

Candidates should attempt ***all*** *the questions in Parts A, B & C. However, they have to choose only* ***three*** *questions in Part D. The number of marks carried by each question is indicated at the end of the question.*

Answers must be written in English.

This paper has four parts :

A	20 marks
B	100 marks
C	90 marks
D	90 marks

Marks allotted to each question are indicated in each part.

Additional data, if required for solving the problems, may be suitably assumed and clearly indicated.

PART A

4×5=20

Each question carries 5 marks.

1. (a) State Castigliano's theorems of strain energy and explain their applications in structural analysis. *5*

   (b) Discuss briefly Newton's law of viscosity. *5*

   (c) Write a brief note on influence of clay minerals on engineering behaviour. *5*

   (d) Discuss briefly philosopy of limit state method as applicable to design of R.C. members. *5*

PART B

10×10=100

Each question carries 10 marks.

1. The cantilever beam shown in Figure 1 is subjected to actions A_1 and A_2 at the free end. The corresponding displacements are denoted by D_1 and D_2 in Figure 1. Write the flexibility and stiffness matrices. EI is constant. *10*

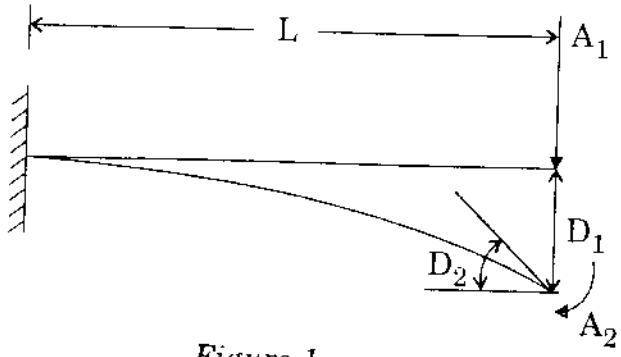

Figure 1

2. Analyse the continuous beam shown in Figure 2 by slope deflection method. The supports are at same level and the beam is of constant stiffness throughout. *10*

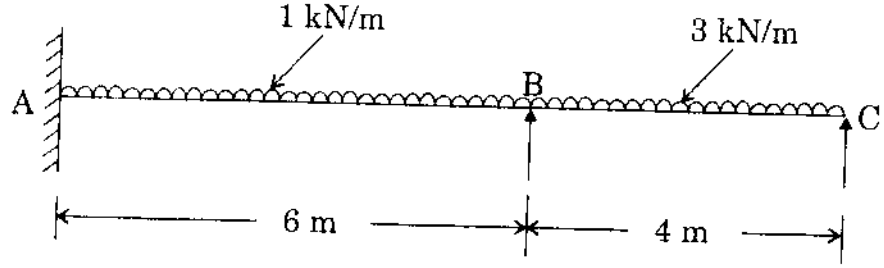

Figure 2

3. Design a R.C. column square in cross section to carry a factored load of 2000 kN. The unsupported length of column is 4 m. Adopt M20 concrete and Fe 415 steel. *10*

4. A singly reinforced rectangular beam 230 mm × 460 mm effective depth is reinforced with three numbers of 20 mm bars. Find out the depth of neutral axis, type of beam and ultimate moment of resistance of the section. Given f_{ck} = 25 N/mm^2 and f_y = 415 N/mm^2. *10*

5. A single angle strut ISA80 80 10 transmits a compressive load of 97 kN to the gusset plate of 8 mm thick as shown in Figure 3. Design suitable welded connection. The permissible stress in fillet weld is 108 MPa. *10*

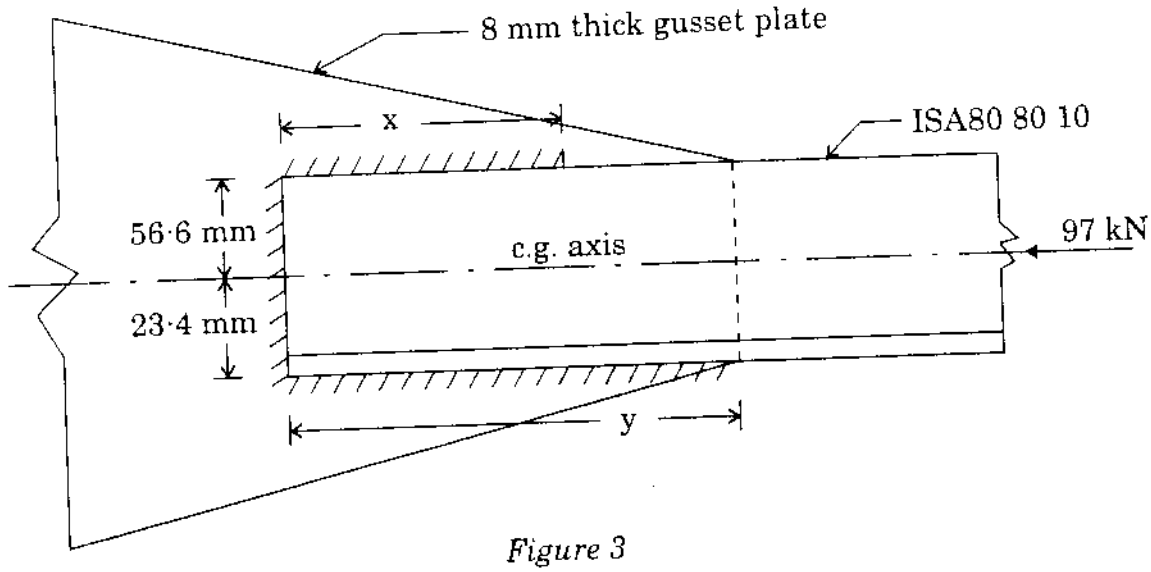

Figure 3

6. A 150 mm dia horizontal pipe is reduced to 75 mm dia through a gradual contraction. At this contraction the difference between the piezometric heads at main and contracted section is 40 mm of mercury. By neglecting losses, calculate the discharge of water in the pipe. Assume relative density of mercury as 13·6. *10*

7. What is the hydraulic condition necessary for the occurrence of a hydraulic jump ? What are the practical utilities of a hydraulic jump ? *10*

8. In a falling head (variable head) permeability test, head drops from 0·4 m to 0·3 m in 10 minutes. Calculate time required for head to drop from 0·4 m to 0·2 m. *10*

9. A group of 9 piles with 3 piles in a row were driven into soft clay extending from ground level to great depth. The diameter and length of piles were 0·3 m and 10 m respectively. The unconfined compressive strength of clay was 70 kN/m^2. If the piles were spaced at 0·9 m centre to centre apart, compute the allowable load on the pile group on the basis of shear failure criteria for a factor of safety of 2·5. Assume adhesion factor = 1·0. *10*

10. (a) Briefly explain the DO statement used in FORTRAN with an example. *5*

(b) Indentify the errors in the following FORTRAN coding segments : *5*

(i) If (X + Y . GT . 4·3) × . EQ . 2

(ii) COMMON A, B
EQUIVALENCE (A, B)

PART C

6×15=90

Each question carries 15 marks.

1. A vertical jet is issuing upwards from a nozzle with a velocity of 8 m/s. The jet impinges the bottom of a fixed ceiling slab at a height of 2·5 m from the nozzle. The fluid is oil with a density of 800 kg/m^3 and the nozzle exit diameter is 75 mm. Determine the force exerted by the jet on the ceiling slab. Neglect all losses. *15*

2. In a laminar flow through a tube, the discharge Q is a function of diameter D, the fluid viscosity μ, and the pressure gradient $\frac{dp}{dx}$. Using Buckingham's pi-theorem, obtain an expression for Q in a dimensionless form. *15*

3. (a) Briefly discuss the criteria for the design of machine foundations. *5*

   (b) A vertical smooth retaining wall 6 m high supports sand whose angle of internal friction $\phi = 30°$. Water table is at a depth of 2 m from the top surface. Unit weights of sand above and below water table are 16 kN/m^3 and 8·5 kN/m^3 respectively. Determine magnitude and location of active earth force, i.e. resultant earth pressure on the retaining wall. *10*

4. (a) What are the disadvantages of direct shear test ? *5*

   (b) Following are the observations of triaxial compression test on soil samples.

Sample No.	1	2	3
σ_3, kN/m^2	17	44	56
σ_1, kN/m^2	157	204	225
μ, kN/m^2	12	20	22

   Determine values of shear parameters C′ and ϕ' by considering effective stresses. *10*

5. (a) Under what circumstances combined footings are recommended ? Briefly discuss the steps involved in the design of combined footings. *5*

(b) A T-beam of effective flange width 1350 mm, thickness of slab 120 mm, width of rib 300 mm and effective depth of 560 mm is reinforced with 4 of 25 mm dia bars on the tensioned side. Calculate the ultimate moment of resistance of the section. Characteristic strength of concrete and steel are 20 N/mm^2 and 415 N/mm^2 respectively. *10*

6. Write a FORTRAN program to evaluate the area under a curve represented by $f(x) = e^{-x/2}$ using Trapezoidal rule. Lower limit of the curve A, upper limit B and the number of strips N are the input. *15*

PART D

*Answer any **three** of the following questions. Each question carries 30 marks.*

1. A two hinged parabolic arch has a span of 20 m and central rise of 4 m. The moment of inertia of arch rib varies as secant of slope i.e. $I = I_c \sec \theta$. The arch carries a uniformly distributed load of 20 kN/m over full span length. Determine the horizontal thrust at the supports. Prove that the bending moment is zero throughout the span of arch. *30*

2. A prestressed concrete beam of rectangular section 200 mm × 600 mm is prestressed by a cable located at an eccentricity of 100 mm at mid span and zero at the supports. The beam carries a uniformly distributed live load of 6 kN/m over a simply supported span of 10 m. The initial prestressing force in the cable is 875 kN. The loss factor is 0·85. Evaluate the extreme fibre stresses at mid span and support sections, at transfer and working load stages. Sketch the stress distribution diagrams. *30*

3. Water flows in a channel of the shape of an isosceles triangle of bed width B and sides making an angle 45° with the bed. The water surface is below the vertex and the bed is horizontal laterally. Determine the relationship between the depth of flow y and the bed width B for maximum velocity condition. Use Manning's equation for uniform flow. *30*

4. (a) Draw cross section of a well foundation and name the parts. *8*

(b) What will be the values of safe bearing capacity for the following cases ?

(i) 1·2 m wide strip footing

(ii) 1·4 m × 1·4 m square footing

(iii) Circular footing of 1·5 m diameter

Soil is sand having $\phi = 36°$, $\gamma = 18$ kN/m^3.

Depth of footing is 1·0 m from the ground level.

Water table is at great depth. Terzaghi's bearing capacity factors are $N_q = 47$ and $N_\gamma = 43$, factor of safety = 2·50. *22*

5. (a) A steel column carrying an axial load of 2450 kN consists of one ISHB 250 @ 64·96 kg/m and two cover plates 300 mm × 25 mm as shown in figure 4. The column is supported on a concrete pedestal. Design a suitable slab base for the column. Permissible bending stress in slab base is 185 N/mm^2 and permissible bearing pressure on concrete is 5 N/mm^2. *15*

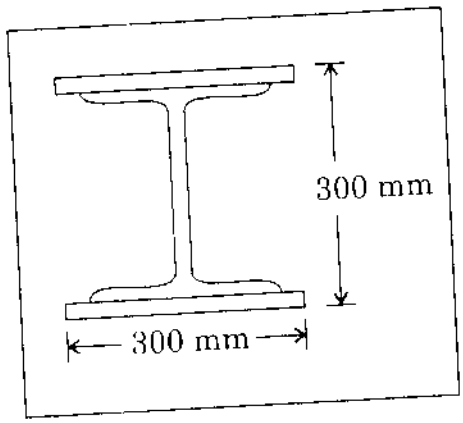

Figure 4

(b) A steel beam ISLB 350 @ 49·5 kg/m^3 of effective span 6·3 m supports a total load of 30 kN/m inclusive of its self weight over its entire length. Check the maximum bending and shear stresses in the beam. And also comment on the safety of the beam. The permissible bending stress and average shear stress in the beam are 165 N/mm^2 and 100 N/mm^2 respectively. The properties of ISLB 350 are, h = 350 mm, b_f = 165 mm, t_w = 7·4 mm, t_f = 11·4 mm and I_{xx} = 131·583 × 10^6 mm^4. *15*

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CIVIL ENGINEERING

Paper 2

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Answers must be written in English.

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A	20 marks
B	100 marks
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D	90 marks

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PART A

4×5=20

Each question carries 5 marks.

1. (a) What do you understand by polymerisation ? Explain the mechanism of polymerisation ? *5*

   (b) Define permanent way in railway engineering and discuss briefly the main requirements of an ideal permanent ways. *5*

   (c) What are the causes and remedial measures for loss of water in a canal ? What are the different ways of expressing the rate of water loss from a canal ? *5*

   (d) Write an explanatory note on the interface between water supply, excreta disposal and prevention of communicable diseases. Also explain the control measures that need to be undertaken. *5*

PART B *10×10=100*

Each question carries 10 marks.

1. Describe the tests to which bricks may be put before using them for engineering purposes. *10*

2. Explain the fire resisting properties of stone, brick, timber, steel and concrete. *10*

3. A 300 mm diameter well completely penetrates a confined aquifer of permeability 45 m/day. The thickness of the aquifer is 20 m. Under the steady state of pumping the drawdown at the well was found to be 3 m and the radius of influence was 300 m. Calculate the discharge from the well. *10*

4. A water course has a cultivable command area of 2600 hectares, out of which the intensities of irrigation for sugarcane and rice crops are 20% and 40% respectively. The data for these crops at the head of water course are 750 hectares/cumec and 1800 hectares/cumec respectively. Find the discharge required at the head of the water course if the peak demand is 20% more of the average requirement. *10*

5. With a typical flow sheet explain the treatment units you would propose for utilising water from a stream into which treated domestic sewage is disposed upstream of the proposed intake. Explain the need for each unit proposed. *10*

6. Distinguish between garbage, rabbish and refuse. Write a note on the importance of a well designed refuse collection system. *10*

7. Indicate how traffic udume data are presented and results used in traffic engineering. *10*

8. Calculate the safe stopping distance for design speed of 50 kmph for (a) two way traffic in a two lane road (b) two way traffic in a single lane road. Assume coefficient of friction as 0·37 and reaction time of driver as 2·5 seconds. *10*

9. Why are marshalling yards necessary ? Describe the layout of a typical marshalling yard. *10*

10. What measures are to be taken to improve and strengthen an existing railway track for high speeds ? *10*

PART C

6×15=90

Answer each question in about 150 words. Each question carries 15 marks.

1. Using Lacey's theory, design a channel section for the following data.

Discharge = 30 cumecs

Silt factor = /

Side slope = $\frac{1}{2}$ H : 1 V

Find also the longitudinal slope. *15*

2. Describe briefly the phenomenon of water logging, its causes and effects. *15*

3. (a) Explain various natural methods of waste water disposal. *8*

(b) Name some of the common water borne diseases. Explain any two non-bacterial water borne diseases. *7*

4. (a) What are the different methods of sinking tubewells ? Explain any one method. *8*

(b) Water is pumped from an underground water tank of depth 2·5 m to an elevated water tank located at a distance 1200 m. The elevated tank is 48 m above the water level of the underground tank. The water is pumped at a constant rate of 810 m^3/hour. Suggest an economical diameter of rising main and the water horse power of the pump. Assume f = 0·04 and neglect minor losses. *7*

5. List the different types of estimates and explain any one type of estimate. *15*

6. Discuss briefly the applications of ferrocement and fibre reinforced concrete. *15*

PART D

3×30=90

Answer any ***three*** *of the following questions, each in about 300 words. Each question carries 30 marks.*

1. (a) Differentiate between CPM and PERT.

(b) In a residential building RC. slab is to be laid over three rooms. Prepare diagram showing overlapping activities with the following details. *10*

The laying of R.C. slab over single room includes three activities

(i) Erection of form work = F = 4 days

(ii) Placing of reinforcement = R = 3 days

(iii) Placing of concrete = C = 1 day

For a single room, the whole activity takes 8 days to complete the job. Find the effect on completion period due to overlapping activities. *20*

2. Enumerate the various methods of flexible pavement design. Discuss briefly the basis of design in each case. *30*

3. (a) Define superelevation and show how it is worked out. Also discuss the factors affecting superelevation. *15*

(b) A 6 degree curve branches off from a 3 degree curve in opposite direction in layout of a B.G. yard. If the speed on the branch line is restricted to 35 kmph, determine the speed restriction on the main line. Assume permissible deficiency in cant as 76 mm. *15*

4. A masonry dam 10 m high is trapezoidal in section with a top width of 1 m and bottom width of 8·25 m. The face exposed to water has a slope of 1 H : 10 V. Determine the factor of safety against overturning about the toe of the dam. Assume density of masonry as 2240 kg/m^3 and density of water as 1000 kg/m^3. Take into account the uplift force and assume no free board. *30*

5. (a) Explain the diffused air system in the activated sludge process with a neat sketch. What is need for a secondary sedimentation tank in activated sludge process ?

Find the capacity of aeration tank and amount of oxygen required to treat the waste water with the following data.

Quantity of waste water = 7000 m^3/day

BOD 5 day at 20° C = 250 mg/litre

Detention period = 6 hours

Oxygen required per kg of BOD = 2 kg *15*

(b) Explain the importance of Environmental Impact Assessment in a large project. What are the general guidelines for an Environmental Impact Assessment ? Briefly explain the matrix method of Environmental Impact Assessment. *15*