006062

2007

CIVIL ENGINEERING (Paper I)

Time allowed : 3 Hours } **{ Maximum Marks : 200**

Note :
(i) Solve one question from each section.
(ii) If more than one questions are attempted in a section, the excess will be ignored.
(iii) Figures to the right indicate the number of marks for the question / sub-question.
(iv) Make suitable assumptions, if necessary and state the same.
(v) Use of log-tables, non-programmable calculators is permitted.
(vi) Use of any kind of I.S. Codes and Steel Table Codes is NOT permitted.
(vii) 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.

SECTION - A

1. (A) A uniform rod AB (length 1.6m and wt. 150N) rests in equilibrium. On the inner surface of a smooth semicircular channel, 1m in radius, when carrying two point loads, 100N and 400N as in Figure 1.A. **16**

Determine its configuration as defined by angle ϕ.

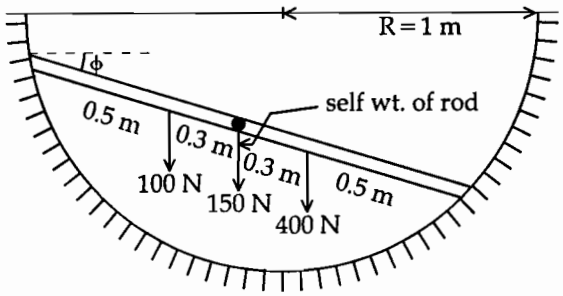

Figure 1. A

(B) A tensile load of 40KN is acting on a rod of diameter 40mm and of length 4m. A bore of diameter 20mm is made centrally on the rod. To what length the rod should be bored so that the total extension will increase by 30% under the same tensile load. **09**

Take $E = 2 \times 10^5$ N/mm^2.

(C) The steel truss shown in Figure 1.C is anchored at A and supported on rollers at B. If the truss is so designed that, under the given loading, all tension members are stressed to 100 N/mm^2 and all compression members, to 80 N/mm^2, find vertical deflection of point C. **09**
Take $E = 2 \times 10^5$ N/mm^2.
Also find the lateral displacement of end B.

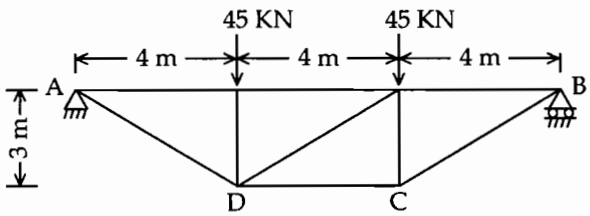

Figure 1. C

2. (A) A system of three identical, homogeneous cylinders (equal in wt.) as shown in Figure 2.A is in equilibrium. If coefficient of friction 'μ' is same for all surfaces where sliding is possible, what should be its minimum value ? **16**

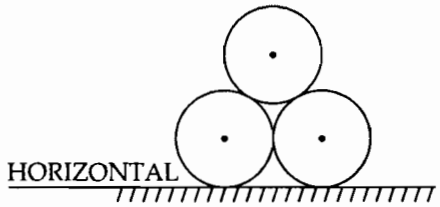

Figure 2. A

(B) The bar shown in Figure 2.B is subjected to a tensile force of 160KN. If the stress in the middle portion is limited to 150 N/mm^2, determine the diameter of the middle portion. Find also length of middle portion if the total elongation of bar is to be 0.2mm. **09**
Given : $E = 2.1 \times 10^5$ N/mm^2.

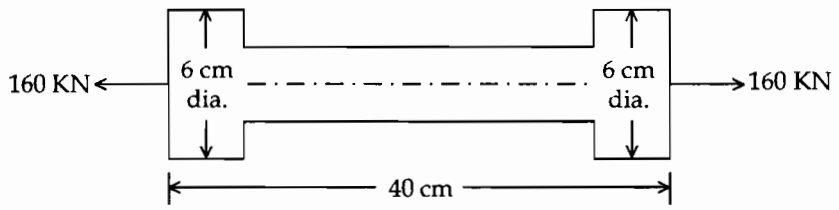

Figure 2. B

(C) At a point in a strained material, the principal stresses are 100 N/mm^2 tensile and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at that point ? **09**

SECTION - B

3. (A) Analyse the frame shown in Figure 3.A using moment distribution method. Draw bending moment diagram. **16**

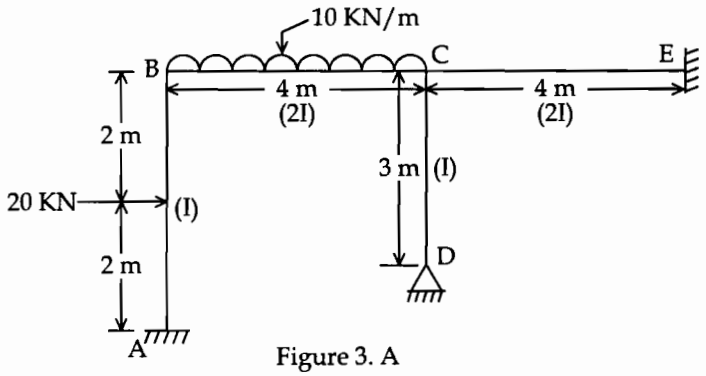

Figure 3. A

(B) For the pratt truss shown in Figure 3.B construct the influence line diagrams for forces in members L_0U_1, L_0L_1, L_1U_1, U_1L_2 and U_1U_2. **10**

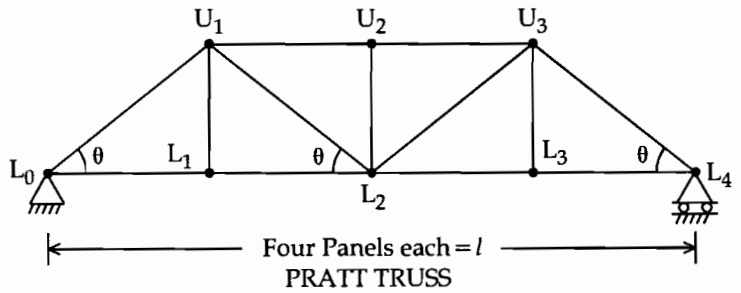

Figure 3. B

(C) Determine the horizontal thrust and the bending moment at the crown in parabolic two hinged arch shown in Figure 3.C assuming that $I = I_C \sec\theta$. The outward horizontal displacements at A and B due to yielding of supports are $40/EI_C$ and $60/EI_C$ respectively. **08**

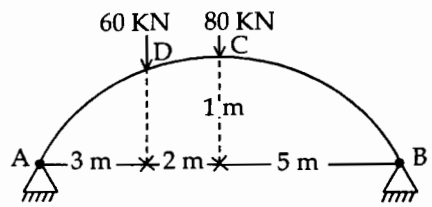

Figure 3. C

4. (A) Analyse the continuous beam with a spring at the joint C as shown in Figure 4.A by slope deflection method. **16**

Draw bending moment diagram.

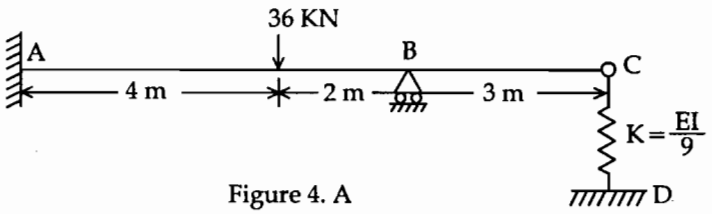

Figure 4. A

(B) Using flexibility method, find out reactions at the supports for a continuous beam ABCD with spans AB = BC = CD subjected to uniformly distributed load of intensity ω KN/m over entire span. **10**

Assume EI uniform.

(C) A cable is suspended between two points A and B located at 60m apart horizontally. B is lower than A by 15m. At the point G located at a horizontal distance of 15m from A, the cable is 12.875m below the point A. The cable carries a uniform load of 24 KN/m of span. **08**

Determine the position and sag of the lowest point and the horizontal tension 'H' in the cable.

Also determine the curved length of the cable.

SECTION - C

5. (A) A 200mm × 150mm × 10mm angle, carrying a load of 200 KN is to be welded to a steel plate by fillet welds as shown in Figure 5.A. Find the length of the weld at the top and bottom if the allowable shear stress in the weld is 102.5 N/mm^2. **08**

Given : Distances between the neutral axis and the edges of the angle section from top and bottom are 144.7mm and 55.3mm respectively.

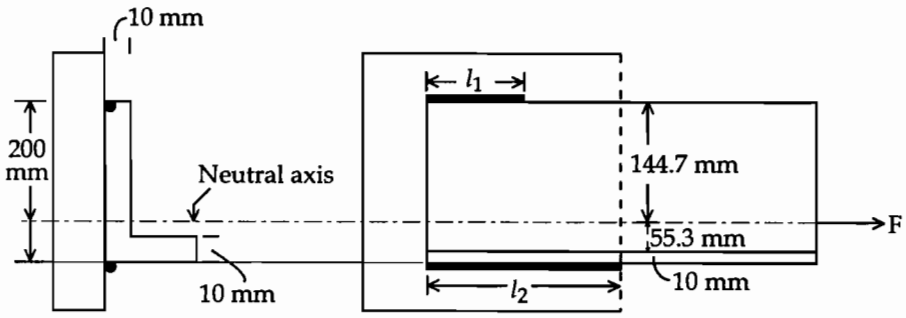

Figure 5. A

OVERALL DIMENSION OF ANGLE = 200 × 150 × 10 mm

(B) With the help of neat sketches explain : **10**

(i) Design of stiffners used in plate girder.

(ii) Design of splicing used in plate girder.

(C) An isolated T beam simply supported over a span of 6m has a flange width of 1500mm. The thickness of the flange is 80mm and the beam has an effective depth of 500mm upto the centre of tensile reinforcement. Which consists of 4 Nos. of 25mm diameter bars. **15**

Calculate the moment of resistance of the section neglecting compressive resistance of the area of web above the neutral axis. The width of web is 250mm. Use M20 grade concrete and HYSD steel of grade Fe415.

6. (A) Plates have been connected with flanges of 'I' section by applying 8mm fillet weld as shown in Figure 6.A. Compute the maximum load which may be placed at a distance of 100mm from the flanges. **15**

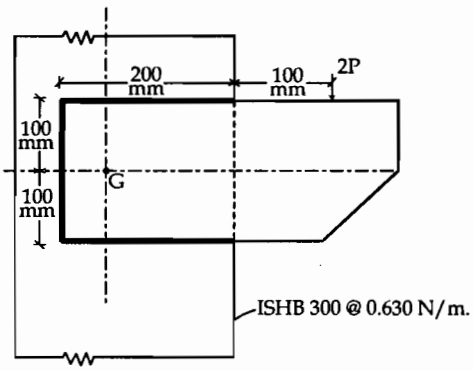

Figure 6. A

(B) Design a reinforced concrete column section to support an axial load of 500KN at the service state. One side of the column section is restricted to 250mm. The effective length of the column is 4.0m. The materials used are M15 grade concrete and HYSD steel of grade Fe415. **08**

Given : $\sigma cc = 4$ N/mm^2 and $\sigma sc = 190$ N/mm^2.

(C) Explain with the help of neat sketches : **10**

(i) Limit state of collapse : Flexure, for singly reinforced rectangular beam.

(ii) Wind load calculations for the design of steel roof truss.

P.T.O.

SECTION - D

7. (A) Design a circular water tank of 2,00,000 litres capacity. The joint between base slab and side wall is to be rigid. Good foundation for the tank is available at a depth of 0.6m below the ground level. σcbc for concrete = 7 N/mm^2, σst for steel = 115 N/mm^2, m = 13. **17**

(B) With the help of neat sketches explain : **08**

(i) Designing of cantilever retaining wall and counterfort retaining wall showing reinforcement details in each part.

(ii) Different forms of shear reinforcement and their share in resisting shear force.

(C) Write notes on : **08**

(i) Methods of concrete mix design.

(ii) Effects of materials, mix proportions, time and temperature on workability of concrete.

8. (A) Design the dog legged reinforced concrete stair case for a multistorey building in which the storey height (floor to floor distance) is 3.0m. The stair hall measures 2.8m × 4.3m (internal). The width of the stair is 1.25m. The staircase is not liable for overcrowding. The weight of finishes may be considered as 0.125 KN/m^2 of the finished surface of the step. **17**

Concrete MIS grade and HYSD steel of grade Fe415 is to be used.

(B) Design a concrete mix from following data : **10**

(i) Characteristic strength at 28 days = 25 N/mm^2.

(ii) Type of cement = rapid hardening, port-land cement.

(iii) Slump required = 30−60mm; exposure−moderate.

(iv) Aggregate available = Gravel 20mm to 40mm (max.)

(v) Fine aggregate = Natural sand is available.

(vi) Specific gravity of coarse aggregate = 2.7

(vii) Specific gravity of fine aggregate = 2.65

(viii) The fine aggregate corresponds to grading zone II giving fine aggregate percentage between 29% to 37%.

(ix) Water cement ratio corresponding to 28 days strength = 0.56

(x) Water cement ratio corresponding to durability consideration = 0.55

(xi) Approximate water contents corresponding to given type of aggregate and workability = 160 kg/m^3.

(xii) Wet density of concrete = 2480 kg/m^3.

(C) Write notes on : 06

(i) Factors affecting strength of concrete.

(ii) Admixtures used in concrete.

(iii) Tests on workability of concrete.

SECTION - E

9. (A) A rectangular beam 175mm × 350mm has an effective span of 10m. The prestressing cable has a triangular profile with zero eccentricity at ends and 60mm at the mid span. The effective prestress is 750 KN after all losses. 08

Determine the point load the beam can carry at mid span, if the pressure line passes through the upper kern of the section.

(B) The end block of a post tensioned beam is 100mm × 150mm. A prestressing cable consists of 7 wires of 6mm dia. strand and stressed to 800 MPa has to be anchored at the centre of the end block. 17

The anchorage plate is 75mm × 75mm having permissible bending stress = 165 MPa.

Using M45 grade concrete, design thickness of anchorage plate.

(C) Write notes on : 08

(i) Erection techniques adopted in modern days, with reference to precast construction.

(ii) Design considerations for transportation and erection of precast units.

10. (A) A prestressed concrete beam 150mm × 300mm in cross section supports a live load of 5 KN/m over a simply supported span of 8m. It has parabolic cable having an eccentricity of 75mm at the mid span and zero at the ends. 08

Determine the force of prestress if the net resultant stress at the bottom fibre at mid span is zero under the action of dead load, live load and prestress force.

(B) A section of a prestressed concrete beam 150mm × 300mm carries a factored shear force of 110 KN and a factored bending moment of 25KNm. The prestressing steel index is 0.4 and the effective prestress after all losses is 600 MPa. Compressive stress at centroidal axis due to prestress is 6.5 N/mm^2. 17

Design suitable shear reinforcement assuming $\sigma ck = 35\ N/mm^2$, $\sigma p = 1600 N/mm^2$, $Ap = 150mm^2$ and cover to reinforcement = 60mm.

(C) Write notes on : 08

(i) Precast and cast at site advantages and disadvantages for concrete structures.

(ii) Modern techniques used in precast construction.

SECTION - F

11. (A) Write algorithm and flow chart for finding roots of the equation by Newton Raphson Method. **18**

(B) Find smallest positive root of $x^3-5x+3=0$ using Newton Raphson Method. **08**

(C) For the system of equations : **07**

$$6x_1-x_2-x_3=11.33$$
$$-x_1+6x_2-x_3=32$$
$$-x_1-x_2+6x_3=42$$

Approximate values of $x_1=4.67$, $x_2=7.62$ and $x_3=9.05$, use Gaussian method to find values upto three decimal.

12. (A) Write algorithm and flow chart for finding roots of the equation by Bi-section method. **18**

(B) Find the roots correct to two decimals using Bi-section method for equation $x^3-x-4=0$. How many iterations are required if permissible error is 0.02. **09**

(C) Apply Newton Raphson Method to solve the equation $x^3+2x-5=0$ for finding out real root at the end of fifth iteration. **06**

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