CSM : 16

CIVIL ENGINEERING

PAPER - I

Time Allowed : 3 hours | Full Marks : 100

Figures in the margin indicate full marks for the questions.

Attempt any 5 (five) questions taking not more than 3 (three) questions from each Part.

PART - A

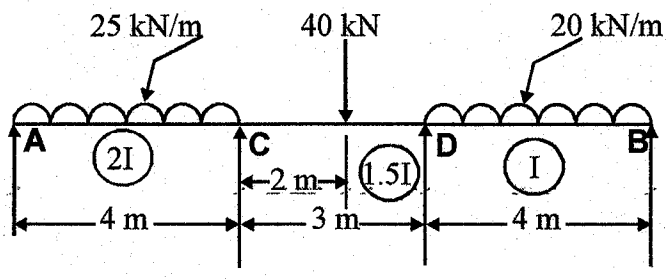
1. (a) One end of stout rope of 4m is fixed to a vertical telegraph post standing on the ground and a man pulls at the other end with given force F. Find the point of the post at which the rope is to be fixed in order that the man will have the best chance of overturning the post. **(10)**

(b) A straight rod of 7m long weighing 30kN is carried by two men. One man supports it at a distance of 1.5m from one end and the other at a distance of 2m from the other end. What load does each man bear? **(10)**

2. (a) Derive the equations of moment of inertia of hollow and rectangular sections about their CG. **(10)**

(b) The base of a triangular section is 14cm. If its perpendicular distance of the base from the vertex is 12cm, find its moment of inertia about the CG. **(10)**

3. (a) Draw bending moment diagram of the figure shown below. Use moment distribution method. **(10)**



(b) Using Castigliano's 1st theorem, find the deflection at the center of a beam of span 'l' carrying a uniformly distributed load of ω per unit run over the whole span. Assume uniform flexural rigidity. **(10)**

4. (a) A beam of uniform section, 10 meters long is simply supported at the ends. It carries point loads of 150kN and 65kN at a distance of 2.5m and 5.5m respectively from the left end. Calculate the deflection under each load.
Take $E=2\times10^5$ N/mm^2 and $I=1.18\times10^{10}$ mm^4. **(10)**

(b) A concrete beam has 350mm breadth and 650mm effective depth. Design the beam if it is subjected to a superimposed bending moment of 300kNm. Use HYSD bars of Fe 415 grade and M25 grade of concrete. **(10)**

PART - B

5. (a) A thin plate 2m×2m is placed edgewise in a flow of oil. Calculate the boundary layer thickness and the shear stress at the trailing edge when the free stream velocity is 2m/sec. Take relative density of oil as 0.85 and $\nu=10^{-5}$ m^2/sec. **(10)**

(b) A rectangular channel 7.5m wide carries a discharge of 12m^3/sec. If Manning's n is 0.015 and bed slope is 1 in 1440, find (i) normal depth (ii) Specific energy (iii) depth at minimum specific energy. **(10)**

6. (a) Derive an expression for Prandtl's universal velocity distribution for turbulent flow in pipes. Why is this velocity distribution called universal? **(10)**

(b) A 15cm diameter jet of water with a velocity of 15m/sec strikes a plane normally. If the plane is moving with a velocity of 6m/sec in the direction of the jet, calculate the work done per second on the plate and efficiency of the energy transfer. **(10)**

7. (a) A rectangular channel has a width of 1.80m and carries a discharge of 1.8 m^3/sec at a depth of 0.20m. Calculate (i) specific energy (ii) depth alternate to existing depth and (iii) Froude's numbers at the alternate depths. **(10)**

(b) A Kaplan turbine has a speed ratio of 2.0 and a specific speed of 450. Determine the diameter of the propeller in order that it will develop 10,100kW under a head of 20m. **(10)**

8. (a) What are the assumptions of Rankine's theory? Derive the expressions for active pressure and passive pressure. **(10)**

(b) What are the different methods for determination of the liquid limit of a soil? What are their relative merits and demerits? **(10)**

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