# CSM : 17

## 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) State and explain clearly the principle of virtual work. Also explain how it can be used in solving problems in statics. **(10)**

(b) Draw the Shear force diagram and bending moment diagrams of a cantilever beam of length 4m with a uniformly loaded of 10kN/m throughout the whole span. **(10)**

**2.** (a) Derive the expression with usual notations. **(10)**

$$\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

(b) A simply supported beam of length 8m carries point loads of 4kN and 6kN at distance of 2m and 4m from the left end. Draw Shear force diagram and bending moment diagram. Also find the maximum BM. **(10)**

**3.** (a) A bar of cross section 10mm×10mm is subjected to an axial pull of 10kN. The lateral dimension of the bar is found to be changed to 11.0112mm×11.0112mm. If the modulus of rigidity of the material is $0.85\times10^5 N/mm^2$, determine the Poisson's ratio and modulus of elasticity. **(10)**

(b) Find the reinforcement required for a doubly reinforced beam section to the following particulars. **(10)**

(i) Width of the beam = 250mm

(ii) Depth of the beam to the center of the tensile reinforcement = 500mm

(iii) Effective cover to the center of tensile reinforcement = 50mm

(iv) Maximum bending moment under working load condition = 160kNm

(v) Grade M 20 concrete and Fe 415 steel

**4.** (a) State Lami's theorem and explain it with figures. **(10)**

(b) A motorist travelling at a speed of 86.4km/h suddenly sees a man 100m ahead. He instantly slows the engine and applies the brake, so as to stop the car 10m ahead of the man. Calculate the time required by the motorist to stop the car. **(10)**

## PART - B

**5.** (a) Draw a neat sketch of storage hydropower plant indicating different component parts of it. Briefly explain the functions of each part. **(10)**

(b) Differentiate between normally consolidated and the over consolidated soils. How would you determine the over consolidation pressure? **(10)**

**6.** (a) Explain the law of conservation of energy in fluid motion and subsequently derive the Bernoulli's theorem on steady and incompressible fluid flow. **(10)**

(b) In the natural state, a moist soil has a volume of 0.0085 $m^3$ and weighs 166.56 N. The oven dry weight of the soil is 144.5 N. If $G_s$ =2.69, calculate the moisture content, moist unit weight, dry unit weight, void ratio, porosity and degree of saturation. **(10)**

**7.** (a) State Newton's Law of viscosity and define Newtonian and Non-Newtonian fluids. Explain the importance of viscosity in fluid motion. What is the effect of temperature on viscosity? **(10)**

(b) Two points A and B are located in a long 20 cm diameter pipe. When a downstream valve is completely closed difference in pressure between B and A, $P_B$-$P_A$ =100kPa. When the valve is open and a discharge of 70 liter/sec of water is flowing, $P_A$-$P_B$= 50kPa. Calculate the head loss between A and B. **(10)**

**8.** (a) Define the specific speed of a turbine. Obtain an expression for specific speed. Write down the significance of specific speed. **(10)**

(b) The laboratory test data for a standard Proctor test are given in the table. Find the maximum dry unit and the optimum moisture content. **(10)**

| **Volume of Proctor Mold ($cm^3$)** | **Mass of the weight soil in the mold (kg)** | **Moisture content (%)** |
|---|---|---|
| 943.3 | 1.78 | 5.0 |
| 943.3 | 1.87 | 7.5 |
| 943.3 | 1.95 | 10.0 |
| 943.3 | 1.98 | 12.5 |
| 943.3 | 2.02 | 15.0 |
| 943.3 | 1.97 | 17.5 |
| 943.3 | 1.91 | 20.0 |

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