6. A simply supported beam of span 5 m carries a uniformly distributed load of 5 kN/m upto a distance of 3 m measured from the left end support. Draw the loading diagram, shear force diagram and bending moment diagram showing the S F and B M values at critical points. Calculate the values of maximum shear force and maximum bending moment as per step wise procedure. 10

7. A cantilever beam *AB* of length, 3 m is fixed at *A* and free at the other end, *B*. It is loaded with a point load of 4 kN at a distance of 2m from the fixed end. Find the maximum shear force, maximum bending moment and their respective locations. Draw the SFD and BMD for the beam showing the points, where the SF and BM are zero. 10

8. Write short notes on the following (any *two*) : 5 × 2

   (*i*) Bulk modulus

   (*ii*) Interrelationship between shear force and bending moment

   (*iii*) Butt Joint.

(Set-Q_1)

B. Arch-3rd
Structural Mechanics-I

Full Marks : 70

Time : 3 hours

Q.No.1 is compulsory and answer any **five** from the rest of the questions

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2 × 10

   (*a*) State Lamis Theorem.

   (*b*) Distinguish between coplanar forces and concurrent forces.

   (*c*) Show the interrelationship between elastic modulus and rigidity modulus.

   (*d*) Truss members carry what type of forces ? Draw a figure to show it.

(*e*) Define volumetric strain.

(*f*) Draw a figure and show the difference between shear stress and complimentary shear stress.

(*g*) Draw a simply supported beam and a cantilever beam separately of same span, L showing the end supports.

(*h*) Define shear force at any section of a beam.

(*i*) What do you mean by point of contraflexure ?

(*j*) Two plates of same dimension are to be connected with each other through a lap joint. Draw the c/s of the lap joint after connection.

2. Two forces $2P$ and P act on a body. If the first force be doubled and the second is increased by 12 kN, the direction of the resultant remains unaltered. Find the values of two forces. 10

3. A rectangular block of dimensions 250 mm × 150 mm × 100 mm is subjected to axial loads as follows ;
480 kN (tensile) on the 250 mm × 150 mm faces, 550 kN (tensile) on the 250 mm × 100 mm faces and 600 kN (compressive) on the 150 mm × 100 mm faces. Taking $E = 200$ GN/m^2 and Poisson's ratio as 0·25, find the changes in the dimensions of the block and the values of modulus of rigidity and bulk modulus. 10

4. (*a*) A uniform rope of length L units hangs vertically. Find the extension of length of the rope from the top due to the weight of the rope itself. 5

(*b*) Sketch the stress-strain curve for ductile steel. 5

5. A steel bar is placed between two copper bars, each having the same area and length as steel bar at 25°C. At this stage they are rigidly connected together at both the ends. As the temperature is raised to 250°C, the lengths of the bars increases by 2 mm. Determine the original length and final stresses in the bars. 10