Total No. of Questions—**8**] [Total No. of Printed Pages—**4**

Seat No.	

[4857]-1019

S.E. (Mechanical S/W/Automobile) EXAMINATION, 2015
STRENGTH OF MATERIALS
(2012 PATTERN)

Time : Two Hours **Maximum Marks : 50**

N.B. **:—** (*i*) Answer maximum *four* questions out of 8.

(*ii*) Solve Q. No. **1** *or* Q. No. **2,** Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.

(*iii*) All the *four* questions should be solved in one answer-book and attach extra supplements if required.

(*iv*) Draw diagrams wherever necessary.

(*v*) Use of scientific calculator is allowed.

(*vi*) Assume suitable data, if necessary.

1. (*a*) A hollow steel tube with an inside diameter of 100 mm must carry a tensile load of 400 kN. Determine the outside diameter of the tube if the stress is limited to 120 MN/m^2. [6]

(*b*) Draw SFD and BMD for the beam loaded as shown in Fig.1 below. [6]

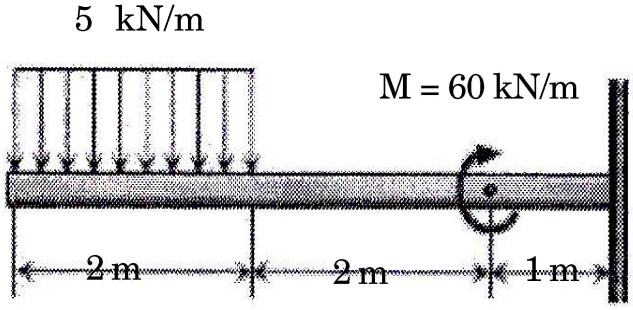

Fig. 1

P.T.O.

Or

2. (*a*) The following data were recorded during the tensile test of a 14 mm diameter mild steel rod. The gauge length was 50 mm.

Load, N	Elongation, mm	Load, N	Elongation, mm	Load, N	Elongation, mm
0	0	38090	0.061	68190	7.501
6500	0.011	40290	0.164	59190	12.501
12790	0.021	41790	0.434	67990	15.501
18990	0.031	46390	1.251	65190	20.001
25290	0.041	52590	2.501	61690	20.001
31490	0.051	58690	4.501		

Plot the stress-strain diagram on GRAPH paper and determine the following mechanical properties :

(*i*) Proportional limit

(*ii*) Modulus of elasticity

(*iii*) Yield point and

(*iv*) Ultimate strength. [6]

(*b*) Draw moment and load diagrams corresponding to the shear diagram as shown in Fig. 2 below. Specify values at all change of load positions and at all points of zero shear. [6]

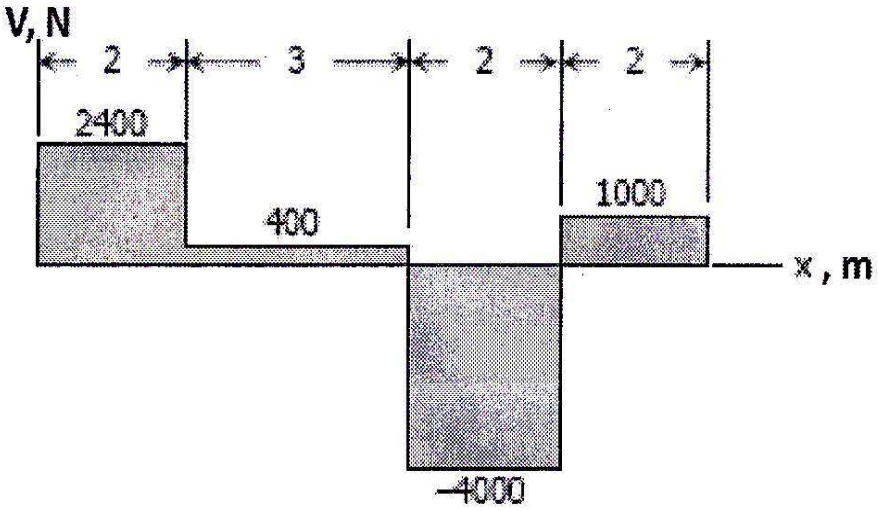

Fig. 2

3. (*a*) A cantilever beam, 60 mm wide by 100 mm high and 2 m long, carries UDL of 3000 N/m over entire span. Compute the magnitude and location of the maximum flexural stress. [6]

(*b*) For the problem described in question 3(*a*), find the maximum deflection and slope (in radians) of the beam.
Take E = 210 GPa. [6]

Or

4. (*a*) For the problem described in question 3(*a*) determine the type and magnitude of the stress in a fiber 20 mm from the top of the beam at fixed end. [6]

(*b*) A simply supported beam length 3 m is loaded centrally by a point load of 5 kN, find the location and values of maximum deflection and slope (in radians) of the beam. Take flexural rigidity of the beam section as 400 kN-m^2. [6]

5. (*a*) A hollow steel shaft 1.5 m long is required to transmit a torque of 12 kN-m. The total angle of twist in this length is not to exceed 2° and the allowable shearing stress is 100 MPa. Determine the inside and outside diameter of the shaft if G = 83 GPa. [6]

(*b*) A steel bar of rectangular cross-section 80 mm × 120 mm and pinned at each end is subject to axial compression. If the proportional limit of the material is 235 MPa and E = 207 GPa, determine the minimum length for which Euler's equation may be used to determine the buckling load. [7]

Or

6. (*a*) A solid circular shaft is required to transmit 90 kW while turning at 50 rev/s. The allowable shearing stress is 120 MPa. Find the required shaft diameter. [6]

(*b*) A rectangular steel bar 65 mm × 85 mm in cross-section, pinned at each end and subjected to axial compression. The bar is 3 m long and E = 235 GPa. Determine the buckling load using Euler's formula and corresponding stress. [7]

7. Stressed element in a machine component is subjected to 185 MPa tensile stress in *x*-direction, 55 MPa compressive stress in *y*-direction and 75 MPa shear stress clockwise on *x*-face. Compute the values and orientation of the principal stresses and maximum shear stress using graphical method proposed by Mohr. Mohr's circle must be drawn on GRAPH paper using appropriate scale.

(Note : Analytical solution and solution without GRAPH paper will not be evaluated.) [13]

Or

8. A solid circular shaft made from plain carbon steel with a yield point of 250 MPa is subjected to peak bending moment of 530 N-m due to transverse loading and twisting moment of 600 N-m. For a factor of safety of 3 determine required diameter of the shaft using :

(*a*) Maximum Normal Stress Theory

(*b*) Maximum Shear Stress Theory and

(*c*) Maximum Strain Energy Theory. [13]