[Time: 3 Hours] **[Marks:80]**

Please check whether you have got the right question paper.

N.B:
1. Question no.1 is compulsory.
2. Attempt any three questions out of the remaining 5.
3. Figures to the right indicate full marks.
4. Assume suitable data wherever necessary.

(5 ×4 = 20 Marks)

Q. 1 a) A vertical tie rod of uniform strength is 25 mm long. if the area of bar at lower end is 400 mm^2 and tie rod is carry a load of 600KN,Find the area of the upper end. The material of tie weighs 80 KN/m^3.

(b) At point in strained material, the normal tensile stresses are 60 N/mm^2 and 30 N/mm^2.Determine by Mohr circle, the resultant intensity of stress on a plane inclined at 40° to the axis of the minor stress.

(c) Derive the relation between shear force and bending moment.

(d) Derive the equation for the section modulus of rectangular I and T sections.

(e) What do you mean by double integration method ?

Q.2 a) A hollow shaft, having an internal diameter 40 % of its external diameter, transmits 562.5 kW power at 100 r.p.m. Determine the external diameter of shaft if shear stress is not to exceed 60 N/mm^2 and the twist in length of 2.5 m should not exceed 1.3° .Assume maximum torque is 1.25 mean torque and modulus of rigidity $= 9 \times 10^4$ N/mm^2. **(10 Marks)**

Q.2 b) A steel rod of 20 mm dia. passes centrally through a copper tube of 50 mm external dia. and 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The Nut are tightened lightly home on the projected parts of the rod. If temperature of the assembly raised by 50 ° C ,calculate the stresses develop in copper and steel .Take E for Steel and copper as 200 GN/m^2 and 100 GN/m^2 and α for steel and copper as 12×10^{-6} per °C and 18×10^{-6} per °C. **(10 Marks)**

Q.3 a) A hollow shaft of external diameter D and internal diameter d is subjected to torsion ,prove that the strain energy stored is given by,

$$U = \frac{\tau^2}{4\,G\,D^2}\,(D^2 + d^2) \times V$$

Where V = volume of hollow shaft
G = modulus of rigidity. **(10 Marks)**

Q.3 b) A square chimney 24 m high, a has an opening of 1.25 m × 1.25 m inside .The external dimension are 2.5 m × 2.5m .The horizontal intensity of wind pressure is 1.3 kN/m^2 and specific weight of masonry is 22 kN/m^3.Calculate the maximum and minimum stress intensities at the base of the chimney. **(10 Marks)**

Q.4 a) A C.I beam section is of I-section with a top flange 18 cm × 2 cm , bottom flange 16 cm × 4 cm and web 20 cm deep and 2cm thick. The beam is freely supported on span of 5m.If tensile stress is not exceed 20MN/m^2, find the safe udl which the beam can carry. Find also maximum compressive stress. **(10 Marks)**

Q.4 b) A cantilever of length L carrying uniformly distributed load w kN per unit run over whole length. Derive the formula to find the slope and deflection at the free end by double integration method. Calculate deflection if w = 20 kNm, L = 2.30 m and EI = 12,000 kN/m^2 **(10 Marks)**

Q.5 a) A boiler drum consists of a cylindrical portion 4 m long, 1.5 m in diameter and 2.25 cm thick. It is closed by hemispherical ends. In hydraulic test pressure 6 MN/m^2, how much additional water will be pumped in after initial filling at atmospheric pressure? The circumferential strain at the junction of the cylinder and hemisphere may be assumed as same for both. Take E = 200 GN/m^2, K= 2.14 GN/m^2 for water and Poisson ratio = 0.3 **(10 Marks)**

Q.5 b) Draw the shear force and bending moment diagram for beam shown in Fig (1) **(10 Marks)**

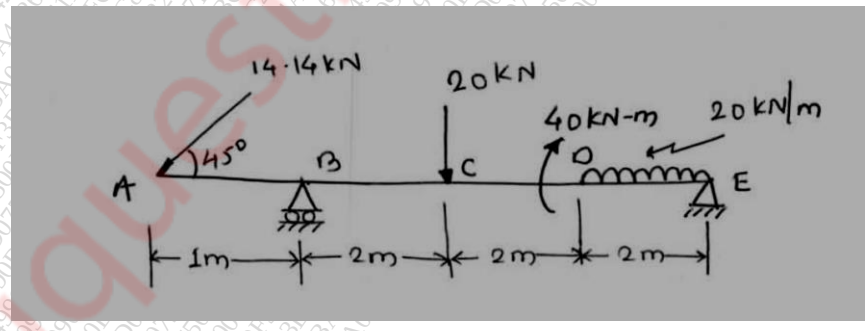

Fig.1

Q.6 a) Fig (2) is shear force diagram for beam which rest on two support, one being at the left hand end. Deduce from S.F.D. the loading on the beam. Draw the bending moment diagram with principal values. **(10 Marks)**

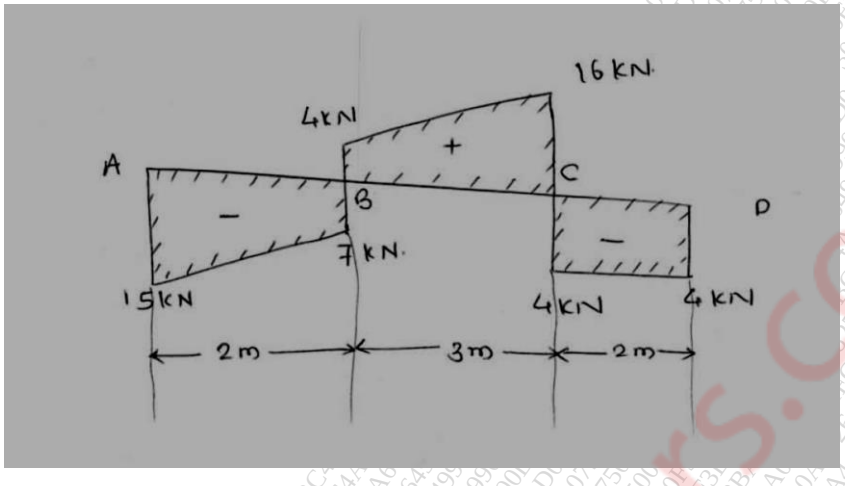

Fig.2

Q.6 b) A materials is subjected to two mutually perpendicular linear strains together with a shear strains. One of the linear strains is 0.00025 tensile. Determine the magnitude of the other linear strain and the shear strain if the principal strains are 0.0001 compressive and 0.0003 tensile. **(10 Marks)**
