04/06/2025 SE MECHANICAL SEM-III C-SCHEME SOM QP CODE: 10084137

3 Hours **Total Marks: 80**

- *Question-1 is compulsory.*
- *Answer any three from remaining five questions.*
- *Assume any suitable data, wherever required, but justify the same. Assumptions made should be clearly stated.*
- *Illustrate the answers with sketches, wherever required.*

I *Answer any four of the following:*

a. A brass bar with a cross section area of 1000 mm^2 (area of entire bar) is subjected to axial force as shown in Fig. 1. Determine total elongation of the bar. Take E =1.05×10^5 N/mm^2. **(05)**

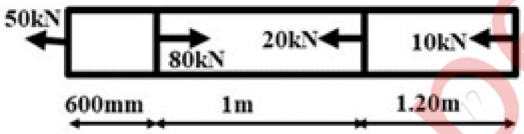

Fig.1

b. A rectangular beam of 200 mm wide and 250 mm deep, is subjected to maximum shear of 50 kN. Determine 1) Average shear stress 2) Maximum shear stress. **(05)**

c. Determine the maximum power transmitted by a shaft of 60 mm diameter rotating at 300 rpm, given that maximum permissible shear stress is 80 N/mm^2. **(05)**

d. What are the assumption made in theory of bending. **(05)**

e. Differentiate between column and struts. State different end conditions for columns with equation **(05)**

f. Differentiate between thick cylinder and thin cylinder. Define hoop stress and Longitudinal Stress. **(05)**

II a) T-shaped cross section of a beam is subjected to a vertical shear force of 30 kN as shown in Fig. 2. Determine the shear stress at the neutral axis and at the junction of web and flange. Draw shear distribution for figure no.2. Assume the moment of Inertia about horizontal neutral axis is 29.56×10^6 mm^4 **(10)**

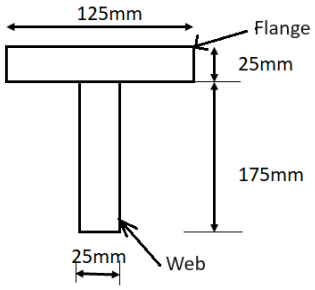

Fig. 2

II b) A 10 m long overhanging beam is loaded as shown in Fig. 3. Determine the shear force and bending moment with SFD and BMD diagram at various salient point. **(10)**

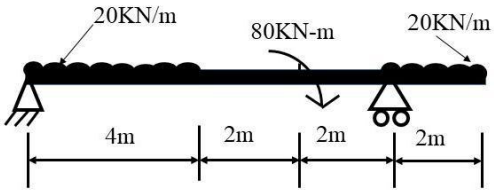

Fig.3

III a) A column of timber, with a section of 10 cm x 15 cm and length of 5 m has both ends fixed. If the Young's modulus for timber = 17.5 kN/mm^2. Determine, i) Crippling load ii) Safe load for column if factor of safety is 3. **(10)**

III b) A simply supported beam of span 10 m, carries loads as shown in Fig. 4, with a hinge support at A and roller support at B. Determine the slope at the ends and deflection at point D, consider EI is constant. **(10)**

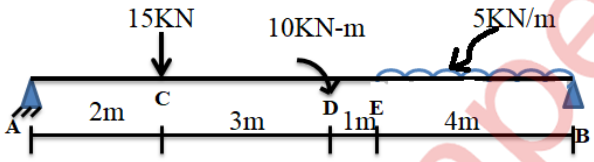

Fig. 4

IV a) At a certain point in a strained material, the stresses on the two planes at right angles to each other are 40 N/mm^2 and 20 N/mm^2 respectively (both tensile). They are accompanied by the shear stress of magnitude 20 N/mm^2. Determine the principal stresses and location of principal planes using Mohr circle and analytical method. **(10)**

IV b) A water main of 90 cm diameter contains water at a pressure head of 110 m. If the weight density of water is 9810 mm^3, determine the thickness of the metal required for the water main. Given the permissible stress as 22 N/mm^2. **(10)**

V a) A steel tube of 30 mm external diameter and 25 mm internal diameter encloses a gun metal rod of 20 mm diameter to which it is rigidly joined at each end. The temperature of the whole assembly is 140°C and the nuts on the rod are then screwed lightly on the ends of the tube. Calculate the intensity of stress in the rod when the common temperature has fallen to 30°C. The value of E for steel and gun metal is 2.1 x 10^5 N/mm^2 and 1 x 10^5 N/mm^2. The linear co-efficient of expansion for steel and gun metal is 12 x 10^{-6} per °C and 20 x 10^{-6} per °C. **(10)**

V b) A cast iron bracket, subjected to bending, has a cross-section of an 'I' shape with unequal flanges. If the compressive stress in top flange is not to exceed 17.5 N/mm^2, determine bending moment the section can withstand. Take dimensions of I section as: Top flange: 250 mm × 50 mm, web: 50 mm × 250 mm and bottom flange: 150 mm × 50 mm. **(10)**

VI a) A hollow circular shaft has inside diameter 60% as that of outside diameter. The solid shaft is replaced by a hollow shaft with same power and at the same speed. Determine percentage saving in material, if the same material to be used. **(10)**

VI b) Determine the instantaneous stress produced in a bar with a cross-sectional area of 10 cm^2 and a length of 4 m by the sudden application of the tensile load of unknown magnitude. Extension of the bar due to suddenly applied load is 1.35 mm. Also determine the magnitude of suddenly applied load. Take E= 2 x 10^5 N/mm^2. **(10)**
