CBCS SCHEME

USN

21AE/AS44

# Fourth Semester B.E. Degree Examination, June/July 2024
## Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. Define the following :
i) Hooke's law
ii) True stress
iii) Engineering stress
iv) Factors of safety. **(08 Marks)**

b. A steel rod ABCD 4.5m long and 25mm in diameter is subjected to the forces as shown in Fig.Q1(a). If the value of young's modulus for the steel is 200GPa determine its deformation.

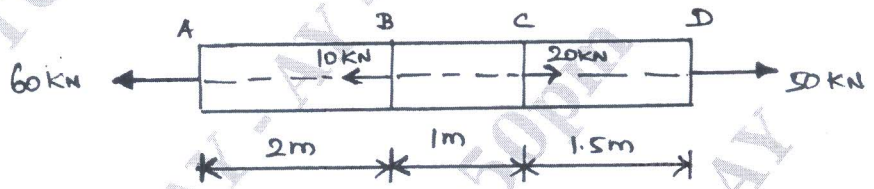


Fig.Q1(a) **(06 Marks)**

c. Derive the equation for the deformation of a body due to self weight. **(06 Marks)**

**OR**

2 a. A gun metal rod 20mm diameter, screwed at the ends, passes through ha steel tube 25mm and 30mm internal and external diameters respectively. The nuts on the rod are seaweed tightly home on the ends of the tube. Find the intensity of stress in each metal, when the common temperature rises by 200°F. (Refer Fig.2Q(a)). Take :

Coefficient of expansion for steel $= 6 \times 10^{-6}$/°F
Coefficient of expansion for gun metal $= 10 \times 10^{-6}$/°F
Modulus of elasticity for steel = 200 GPa
Modulus of elasticity for gun metal = 100 GPa

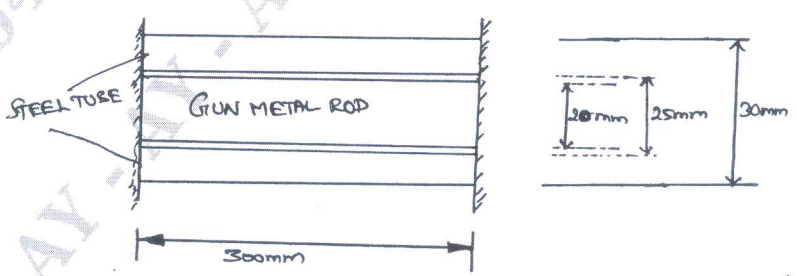


Fig.Q2(a) **(10 Marks)**

b. Derive the relationship between Young's modulus and bulk modulus. **(10 Marks)**

## Module-2

3 a. Analyse the beam as shown is Fig.Q3(a) and draw the SFD and BMD for the same.

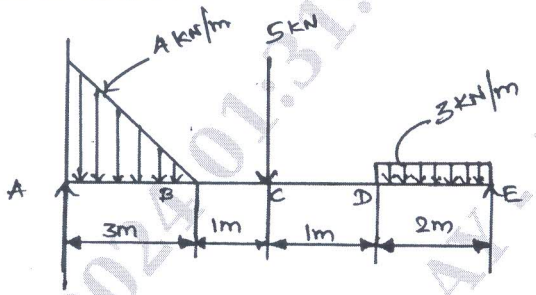


Fig.Q3(a) **(10 Marks)**

b. Derive the relationship between shear force and bending moment. **(06 Marks)**

c. What is a Beam? List the different types of beams. **(04 Marks)**

**OR**

4 a. State the assumptions of Euler-Bernoulli Beam theory. Explain the Implications in detail. **(10 Marks)**

b. An I section beam 350mm × 200mm has a web thickness of 12.5 mm and a flange thickness of 25 mm. It carries a shearing force of 20 tonnes at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

## Module-3

5 a. Derive the differential equation of deflected beams and establish the relation between slope, deflection and radius of curvature. **(08 Marks)**

b. A steel Cantilever beam of 6 m long carries two point loads. 15 kN at the free end and 25 kN at a distance of 2.5 m from the free end. Find the slope and deflection at the free end using Double Integration method and Maculay's method. Take $I = 1.3 \times 10^8 \text{ mm}^4$ and $E = 2 \times 10^5 \text{ N/mm}^2$. **(12 Marks)**

**OR**

6 a. State the assumptions made in the theory of pure torsion and derive the equation for torque transmitted by a hollow shaft. **(10 Marks)**

b. A hollow shaft is to transmit 200 kW at 80 rpm. If the shear stress is not to exceed 70 $\text{MN/m}^2$ and Internal diameter is 0.5 of the external diameter. Find the external and internal diameters assuming that maximum torque is 1.6 times the mean. **(10 Marks)**

## Module-4

7 a. Explain the principle of virtual work for a particle and a rigid body. **(10 Marks)**

b. Determine the bending moment at the point B is the simply supported beam ABC shown in Fig.Q7(b).

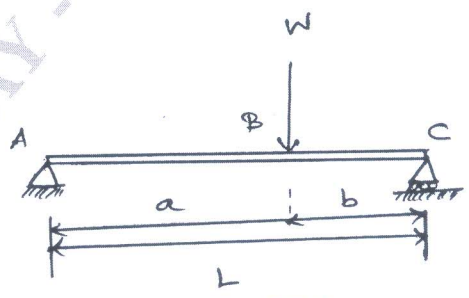


Fig. Q7(b) **(10 Marks)**

**OR**

8 a. State and derive the equations for finding strain energy and deflection using method of least work. **(10 Marks)**

b. Derive an equation for Total potential energy of a system. **(10 Marks)**

## Module-5

9 a. Explain the different modes of fracture in detail. **(10 Marks)**

b. Define creep. Explain the different stages of creep with neat sketch. **(10 Marks)**

**OR**

10 a. Define Fatigue. Draw the S-N curve and explain its significance. **(10 Marks)**

b. Explain the factors affecting fatigue life and fatigue testing method. **(10 Marks)**

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