USN | | | | | | | | | | |

18AU34

Third Semester B.E. Degree Examination, July/August 2022
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. List and explain any five mechanical properties of engineering materials. **(10 Marks)**

b. The composite bar shown in Fig Q1(b) is subjected to a tensile force of 30kN. The extension observed is 0.74mm. Find the Young's modulus of Brass, If Young's modulus of steel is 2×10^5 N/mm^2.

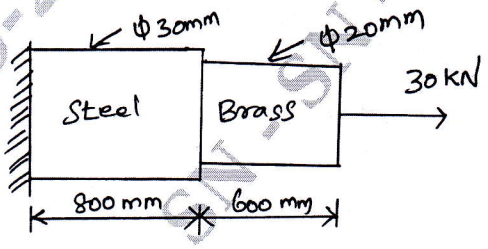

Fig Q1(b) **(10 Marks)**

OR

2 a. Derive the relationship between Young's modulus, modulus of Rigidity and Bulk modulus. **(10 Marks)**

b. A compound bar is made up of a central steel plate 50mm wide and 10mm thick to which copper plates 50mm wide and 5mm thick are connected rigidity on each side. The length of the compound at room temperature is 1000mm. If the temperature is raised by 100°C. Determine the stress in each material and change in length of the compound bar. Assume: $E_s = 200$GPa, $E_c = 100$GPa, $\alpha_s = 12 \times 10^{-6}$ per °C and $\alpha_c = 18 \times 10^{-6}$ per °C. **(10 Marks)**

Module-2

3 a. Derive expressions when a member subjected to two perpendicular normal stresses accompanied with state of sample shear. **(14 Marks)**

b. Write down the procedure to construct the Mohr's circle. **(06 Marks)**

OR

4 a. Derive Lane's equation for radial and hoop stress in case of thick cylinders. **(10 Marks)**

b. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an external fluid pressure of 3MPa. Determine :

i) Circumferential and longitudinal stress
ii) Circumferential and longitudinal strain
iii) Change in length and diameter.

Assume Poisson ratio as 0.3 and E = 210 GPa. **(10 Marks)**

Module-3

5 a. Explain the types of Beam, loads and supports. **(10 Marks)**

b. A simply supported beam of 6m long is subjected to loads 2kN, 5kN, and 4kN at distances 1.5m, 3m and 4.5m from the left support. Draw the shear force and Bending moment diagram. **(10 Marks)**

OR

6 a. What are the assumptions made in theory of simple bending? **(08 Marks)**

b. The cross-section of a beam is shown in Fig Q6(b). If permissible stress is 150N/mm^2. Find its moment of inertia. Compare it with equivalent section of the same area for a square section.

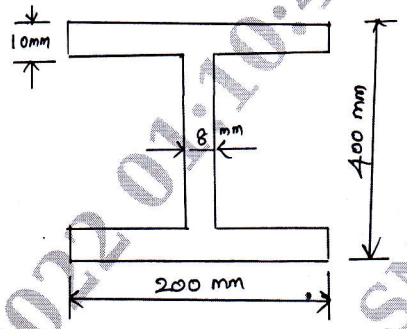

Fig Q6(b) **(12 Marks)**

Module-4

7 a. Derive the relation for a circular shaft when subjected to torsion as given by $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$. **(10 Marks)**

b. A solid shaft rotating at 1000rpm transmits 50kW. Maximum torque is 20% more than mean torque. Materials of the shaft has the allowable shear stress of 50MPa and modulus of rigidity 80GPa. Angle of twist in the shaft should not exceed 1° in one meter length. Determine the diameter of the shaft. **(10 Marks)**

OR

8 a. Derive an expression for the Euler's crippling load for a column when both of its ends are hinged. **(10 Marks)**

b. Determine the crippling load for a 'T' section of dimension 100mm × 100mm × 20mm length of column 12m with both ends fixed. Take E = 210GPa. **(10 Marks)**

Module-5

9 a. A Cantilever beam of length ℓ carries uniformly distributed load W per unit length over its entire length. Determine :

i) Strain energy stores Cantilever

ii) If W = 10kN/m, ℓ = 2m and EI = 2 × 10^{5}kN-m^2 determine the strain energy stored. **(10 Marks)**

b. Derive an expression for strain energy due to shear stress. **(10 Marks)**

OR

10 a. Explain :

i) Maximum Plane Stress Theory

ii) Maximum Shear Stress Theory **(10 Marks)**

b. A bolt is subjected to an axial pull of 10kN together with a transverse shear of 5kN. Determine the diameter of the bolt using

i) Maximum principal stress theory

ii) Maximum shear stress theory

Take permissible stress at elastic limit = 100MPa and Poisson ratio = 0.3. **(10 Marks)**

* * * * *