U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2023 Semester End Main Examinations

Programme: B E **Semester: IV**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 19AE4DCASM **Max Marks: 100**
Course: Aero-Solid Mechanics

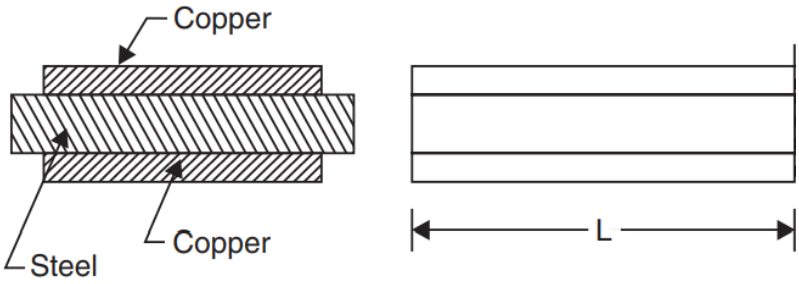
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Explain the following: **10**

(i) Poisson's Ratio,
(ii) Thermal Stress,
(iii) Margin of Safty
(iv) Hooks Law
(v) Bulk Modulus.

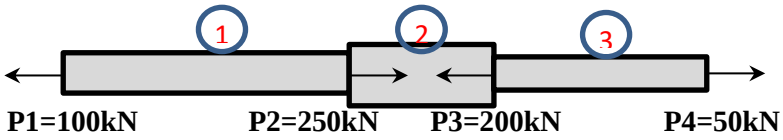
b) A compound bar is made of a steel plate 50 mm wide and 10 mm thick to which copper plates of size 40 mm wide and 5 mm thick are connected rigidly on each side as shown in the below Figure. The length of the bar at normal temperature L is 1 m. If the temperature is raised by 80°C, determine the stresses in each metal and the change in length. Given $\alpha_s = 12 \times 10^{-6}/°C$, $\alpha_c = 17 \times 10^{-6}/°C$, $E_s = 2 \times 10^5$ N/mm^2, $E_c = 1 \times 10^5$ N/mm^2. **10**



OR

2 a) Derive the relation between three elastic moduli. **10**

b) Construct the axial force, and displacement diagram for the following steel bar. **10**

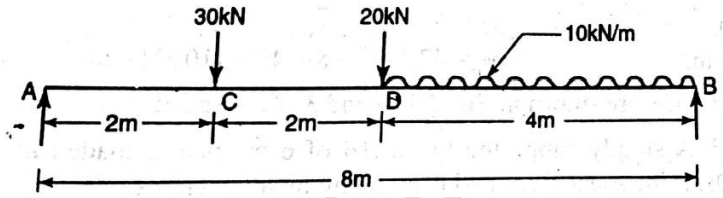


Take the lengths and areas as 2 meter, 1000 mm^2, 1meter, 2000 mm^2 and 1.5 meter, 1000 mm^2 for sections 1 to 3 respectively, and E=207GPa for all sections.

UNIT - II

3 a) Explain different types of loads and supports in a beam with neat sketches. **8**

b) Analyze and draw the SFD and BMD for the simple supported beam shown in fig. the beam carries a uniformly distributed load and two concentrated loads **12**



OR

4 a) Derive the expression bending stress equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$with usual notation. **8**

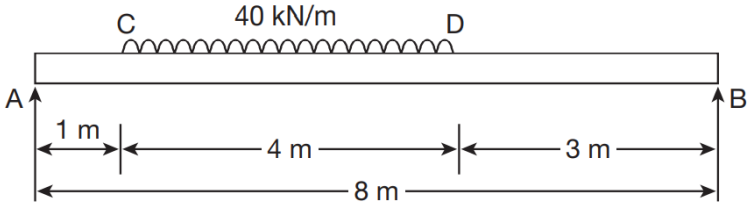
b) A T-section of simply supported beam has the following dimensions. Width of the flange = 150 mm, overall depth = 150 mm, and thickness of stem and flange = 25 mm. The beam is 10 m long and has a point load of 5kN at the middle length. Draw the shear stress and bending stress distribution across the section of the beam at a location 2.5 m from the support. **12**

UNIT - III

5 a) Derive the expression for slope, deflection, and radius of curvature relation $EI\frac{d^2y}{dx^2} = M$ for beams with usual notation. **8**

b) A beam AB of span 8 m is simply supported at the ends A and B which is loaded as shown in the below figure. If E = 200 GPa and I = 43×10^8 mm^4 determine **12**

i. Maximum deflection and
ii. Slope at the end A.

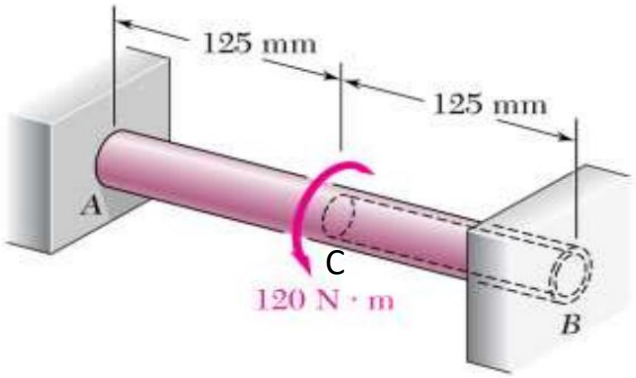


UNIT - IV

6 a) Derive the torsion equation $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$ for a circular shaft subjected to pure torsion with usual notations. **6**

b) Derive Euler's crippling load when both ends of the column are hinged. **7**

c) A circular shaft AB as shown in figure is held rigidly at A and B with 120 Nm torque at middle point C between A and B. The section between AC is solid with a diameter 40 mm and CB has a coaxial hole of diameter 20 mm. Determine the twist in each section if the modulus of rigidity is G = 80 GPa for the shaft material. **7**



UNIT – V

7 a) At a point in a strained material, the normal stresses are σ_x. and $\sigma_y$which are tensile in nature and shear stress τ_{xy}, derive the expression for normal stress and shear stress in an inclined plane making an angle θ with the vertical plane. **10**

b) The cross-section of a bolt is required to resist an axial tension of 15 kN and a transverse shear of 15 kN. Estimate the diameter of the bolt by, (i) Maximum principal stress theory and (ii) Maximum shear stress theory. The elastic limit of the material is 300 N/mm^2, Poisson's ratio = 0.25, and factor of safety = 3. **10**

******