(Compulsory Question)

9. (a) Draw stress strain diagram for mild steel and explain the various elements of this curve. **4**

(b) Differentiate between statically determinate and indeterminate beams using suitable examples. **4**

(c) Find the torque which a shaft of 200 mm diameter can safely transmit, if the shear stress is not to exceed 50 N/mm^2. **4**

(d) Calculate Euler critical stress for a column having slenderness ratio 100 assuming that both ends of column are fixed. Take $E = 2 \times 10^5$ N/mm^2. **3**

Roll No. ..... **Total Pages : 04**

Sep-21-00017

B. Tech. EXAMINATION, 2021

Semester III (CBCS)

MECHANICS OF SOLIDS–I

CE-301

Time : 2 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. **9** is compulsory.

Section A

1. Rails of such material are laid so that no stress will develop at 8° Celsius. Find :

(a) Stress at rails at 20° Celsius if no expansion is allowed.

(b) Stress at rails at 20° Celsius if expansion is allowed 3 mm per rail.

(c) Expansion allowance needed if stress in rail is to be zero at 20° Celsius.

(d) Maximum temperature to have no stress in rails if expansion allowance is 10 mm per rail.

The rails are 20 m long. Given : $\alpha = 12 \times 10^{-6}$ per° Celsius and $E = 2 \times 10^5$ N/mm^2. **15**

2. A mild steel rod of 25 mm diameter and 400 mm long is encased centrally inside a hollow copper tube of external diameter 35 mm and inside diameter 30 mm. The ends of rod and tube are rigidly attached and composite bar is subjected to an axial pull of 40 kN. Find stress developed in rod and tube. Find also extesion of the rod. (E_{steel} = 200 GN/mm^2 and E_{copper} = 100 GN/mm^2). **15**

Section B

3. A beam of length (L) carries a uniformly distributed load (w) per unit run on whole length. It has one support at its left end and other support is at a distance (a) from other end. Find value of (a) so that maximum bending moment for beam is as small as possible. Also find maximum bending moment for this position. Plot SFD and BMD for whole beam. **15**

4. Derive the bending equation and write the assumptions of simple theory of bending. **15**

Section C

5. Prove that the intensity of shear stress at a point in cross-section of a shaft subjected to pure torsion is proportional to its distance from centre. **15**

6. A cantilever of uniform section has a length AB = L. End B is free end and carries a point load W, while end A is fixed end. Find the slope and deflection at a point C, distant L/4 from the free end B. **15**

Section D

7. What do you understand by Euler's theory for buckling failure ? What are the assumptions of Euler's theory ? What are the limitations of Euler's theory ? **15**

8. A thin cylindrical shell has an internal diameter of 250 mm and is 6 mm thick. It is subjected to an internal pressure of 3 MN/m^2. Estimate the circumferential and longitudinal stresses :

(a) If the ends of cylinder are closed. **7.5**

(b) If the ends of cylinder are closed by pistons sliding in cylinder. **7.5**