CBCS SCHEME

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

18AU34

Third Semester B.E. Degree Examination, Feb./Mar. 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. Define :
i) Modulus of rigidity ii) Bulk modulus iii) Volumetric strain
iv) Poisson's ratio v) Hooke's law. **(10 Marks)**

b. Determine the stresses in various segment of the circular bar shown in Fig Q1(b). Compute the total elongation taking Young's modulus to be 195GPa.

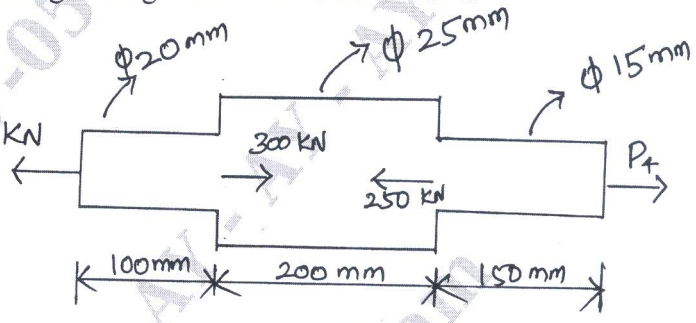

Fig Q1(b) **(10 Marks)**

OR

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

b. A steel rod 15m long at a temperature of 15°C. Find the free expansion of length when the temperature is raised to 65°C. Find the temperature stresses produced, when
i) The expansion of the rod is prevented
ii) The rod is permitted to expand by 6mm
Take $\alpha = 12 \times 10^{-6}$ per °C and $E = 2 \times 10^5$ N/mm^2. **(10 Marks)**

Module-2

3 a. Derive the construction of Mohr's circle for plane stress. **(10 Marks)**

b. Derive an expression for normal stress and shear stress on an oblique plane inclined at an angle 'θ' with vertical axis for two dimensional stress system. **(10 Marks)**

OR

4 a. Explain the concept of circumferential stress and longitudinal stress corresponding to thin cylinder. **(10 Marks)**

b. A pipe of 500mm external diameter and 75mm thick is filled with a fluid at a pressure of 6N/mm^2. Find the maximum and minimum hoop stress across the cross section of the cylinder. Also sketch the radial pressure and hoop stress distribution. **(10 Marks)**

Module-3

5 a. Derive the deflection equation $EI \frac{d^2y}{dx^2} = M$. **(10 Marks)**

b. A simply supported beam of span 6m is subjected to a concentrated load of 25kN acting at a distance of 2m from the left end. Also subjected to an uniformly distributed load of 10kN/m over the entire span. Draw the bending moment and shear force diagram indicating maximum and minimum values. **(10 Marks)**

OR

6 a. Write down the assumption in simple bending. **(08 Marks)**

b. Draw shear force and bending moment diagram as shown in Fig. Q6(b) indicating the principal values.

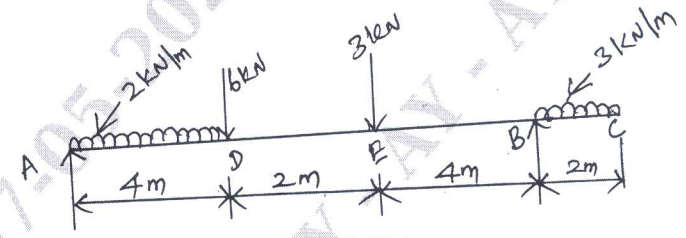

Fig. Q6(b) **(12 Marks)**

Module-4

7 a. Derive relationship between torque and shear stress in a solid circular shaft. **(10 Marks)**

b. A hallow shaft having internal diameter 40% of its external diameter, transmits 562.5kW power at 100rpm. Determine the internal and external diameter of the shaft if the shear stress is not exceed $60N/mm^2$ and the twist in a length of 2.5m should not exceed 1.3 degrees. The maximum torque being 25% greater the mean modulus of rigidity = 9×10^4 N/mm^2. **(10 Marks)**

OR

8 a. Derive an expression for Euler's crippling load for a column when one end is fixed and other end free. **(10 Marks)**

b. A solid round bar of 60mm diameter and 2.5m is used as strut. Find the safe compressive load for the strut if i) Both ends are hinged ii) Both ends are fixed.
Take $E = 2 \times 10^5$ N/mm^2 and Factor of safety = 3. **(10 Marks)**

Module-5

9 a. Determine the internal strain energy stored within an elastic bar subjected to an axial tensile Force F. **(10 Marks)**

b. A cantilever beam of uniform across section carries a print load at the free end. Determine :
i) Strain energy stored by the cantilever beam and deflection at the free end
ii) If the load F = 200kN, $E = 2 \times 10^8$ kN/m^2, $\ell = 3m$, $I = 10^{-3} m^4$. Determine the above. **(10 Marks)**

OR

10 a. Explain: i) Maximum principal stress theory ii) Maximum shear stress theory. **(10 Marks)**

b. A Bolt is under an axial pull of 9.6kN together with a shear force of 4.8kN. If the factor of safety is 3, yield strength of bolt. Material is $270N/mm^2$ and Poisson ratio is 0.3. Determine the diameter of bolt using maximum plane stress theory. **(10 Marks)**

* * * * *