**CBCS SCHEME**

USN | | | | | | | | | | 17MN34

## Third Semester B.E. Degree Examination, Aug./Sept.2020
# 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) Modulus of Elasticity
ii) Modulus of Rigidity
iii) Bulk Modulus
iv) Poisson's ratio
v) Principle of Superposition. **(10 Marks)**

b. A bar having cross sectional area of $1000mm^2$, is subjected to axial force shown in Fig.Q.1(b). Find the total elongation of the bar. Take $E = 100GN/m^2$. **(10 Marks)**

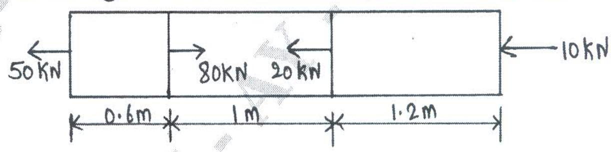



Fig.Q.1(b)

**OR**

2 a. A steel bar is placed between two copper bar, each having same area and length as the steel bar. These are rigidly connected together at a temperature of 25°C. When temperature is raised to 325°C. The length of the bar is increased by 1.5mm. Compute the original length and find stresses in each bar. Take $E_{steel} = 210GPa$, $E_{CU} = 100GPa$, $\alpha_{steel} = 12 \times 10^{-6}/°C$, $\alpha_{CU} = 17.5 \times 10^{-6}/°C$. **(10 Marks)**

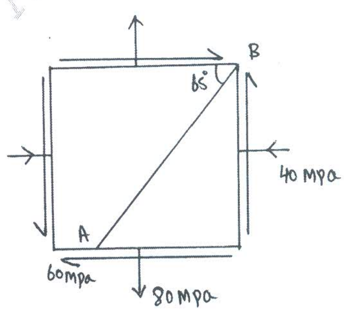
b. A steel rod 15m long at a temperature of 15°C. Find the free expansion of length when the temperature is raised to 65°C. Find the temperature stresses produced, when
i) The expansion of the rod is prevented
ii) The rod is termitted to expand by 6mm
Take $\alpha = 12 \times 10^{-6}/°C$ and $E = 2 \times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

**Module-2**

3 a. Derive an expression, the relationship between Young's modulus, Bulk modulus, Rigidity modulus. **(10 Marks)**

b. At a point in a strained material, the stresses are as shown in Fig.Q.3(b). Determine the
i) Principal stress
ii) Normal and tangential stress on the plane AB
iii) Maximum shear stress. **(10 Marks)**

Fig.Q.3(b)



**OR**

4 a. Derive expression for hoop stress and longitudinal stress for a thin cylindrical vessel subjected to an internal fluid pressure. **(10 Marks)**

b. A cylindrical thin drum 800mm in diameter and 3m long has a shell thickness of 10mm. If the drum is subjected to an internal pressure of 25bar. Calculate the change in diameter, change in length and change in volume. Take E = 200GPa, $\pi = 0.25$. **(10 Marks)**

## Module-3

5 a. Explain different types of beams and loads. **(08 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q.5(b). **(12 Marks)**

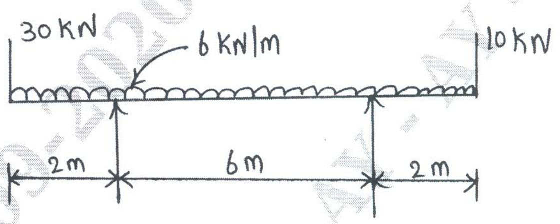



Fig.Q.5(b)

**OR**

6 a. Derive an expression for establishing relationship between shear force, bending moment and rate of loading. **(08 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q.6(b). **(12 Marks)**

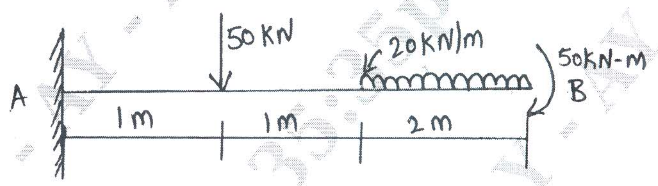



Fig.Q.6(b)

## Module-4

7 a. Prove the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. The T-section of a beam is shown in Fig.Q.7(b). Determine maximum moment of resistance that beam can support if yielding is to be avoided. The material of the beam has yield strength of 250MPa. **(10 Marks)**

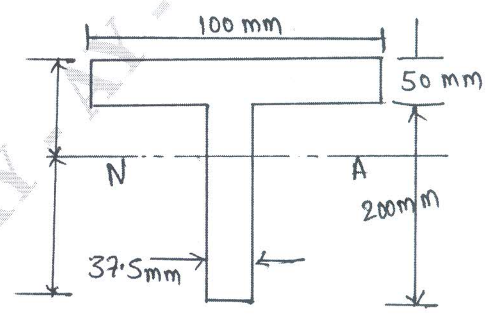



Fig.Q.7(b)

**OR**

**8** a. Derive an expression $EI\frac{d^2y}{dx^2} = M$ with usual notations. **(10 Marks)**

b. A simply supported beam of 200mm wide and 300mm deep supports an uniformly distributed load of intensity W kN/m over a span of 4m. Calculate the safe intensity of load that the beam can carry, if the permissible stresses in bending and shear are 56N/mm$^2$ and 4N/mm$^2$ respectively. **(10 Marks)**

## Module-5

**9** a. Derive the torsion formula in standard form $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$. **(10 Marks)**

b. Determine the diameter of a solid shaft which will transmit 300kW at 250rpm. The maximum shear stress should not exceed 30N/mm2 and twist should not be more than 1 in a shaft length of 2m. Take modulus of rigidity = $1 \times 10^5$N/mm$^2$. **(10 Marks)**

**OR**

**10** a. Find an expression for crippling load for a column with one and fixed and other end free. **(10 Marks)**

b. A 1.5m long column has a circular C/S of 50mm diameter, one end of the column is fixed and other end is free. Take FOS = 3, calculate the safe load using

i) Rankine's formula, take yield stress = 560N/mm$^2$ $a = \frac{1}{1600}$

ii) Euler's formula, Young's modulus = $1.2 \times 10^5$N/mm$^2$. **(10 Marks)**

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