CBCS SCHEME

USN

18MT33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Derive an expression for deformation of uniformly tapering circular bar. **(10 Marks)**

b. A brass bar having cross-sectional area 300mm^2 is subjected to axial forces as shown in Fig.Q.1(b). Find the total elongation of the bar. Take E as 84GPa. **(10 Marks)**

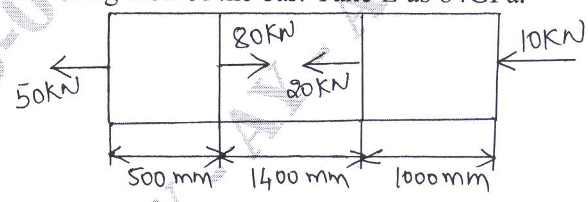

Fig.Q.1(b)

OR

2 a. Define the following:
i) Modulus of Rigidity
ii) Bulk modulus
iii) Poisons ration
iv) Volumetric strain. **(08 Marks)**

b. A steel rod of cross sectional area 1600mm^2 and 2 brass rods each of cross sectional area 1000mm^2 together support a load of 50kN as shown in Fig.Q.2(b). Find the stresses in the rods if E for steel $2 \times 10^5 \text{N/mm}^2$, E for brass $= 1 \times 10^5 \text{N/mm}^2$. **(12 Marks)**

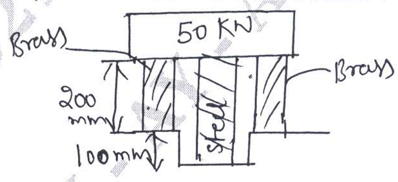

Fig.Q.2(b)

Module-2

3 a. Derive the expression for a rectangular bar is subjected to 2 direct stresses σ_x and σ_y two mutually perpendicular directions. Prove that the normal stress (σ_n) and shear stress (τ) on an oblique plane which is inclined at an θ with the axis of minor stress are given by $\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta$ and $\tau = \left(\frac{-\sigma_x + \sigma_y}{2}\right)\sin 2\theta$ **(10 Marks)**

b. Find principle stresses, principle planes, maximum shear stress and shear planes to the given 2D plane. **(10 Marks)**

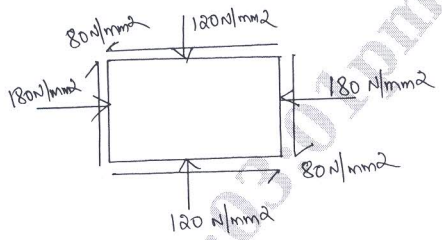

Fig.Q.3(b)

OR

4 a. Define principle stresses and principle planes. **(04 Marks)**

b. For the state of stress shown in Fig.Q.4(b), determine principle stress, principle plane, maximum shear stress and shear plane and verify your answers by constructing Mohr's circle. **(16 Marks)**

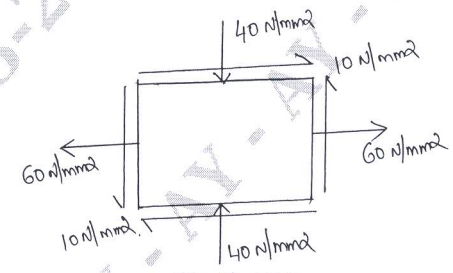

Fig.Q.4(b)

Module-3

5 a. Derive the relation between load, shear force and bending moment. **(08 Marks)**

b. Draw the shear force and bending moment diagram for a cantilever subjected to the forces as shown in Fig.Q.5(b) and locate the point of contra flexure. **(12 Marks)**

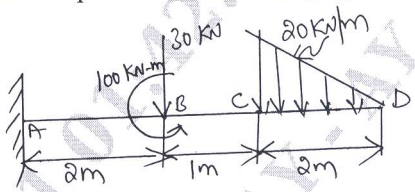

Fig.Q.5(b)

OR

6 a. Define the following:
- i) Beam
- ii) Bending moment
- iii) Point of contraflexture
- iv) Shear force **(04 Marks)**

b. Moment diagram for a simply supported beam subjected to the loads as shown in Fig.Q.6(b). **(16 Marks)**

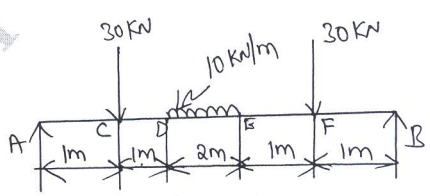

Fig.Q.6(b)

Module-4

7 a. With assumption derive the expression

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$ **(12 Marks)**

b. A cantilever with rectangular section, whose depth is twice the width is subjected to the forces as shown in Fig.Q.7(b). Determine the section of cantilever, taking yield stress for cantilever material as 210MN/m^2 and factor of safety as 3. **(08 Marks)**

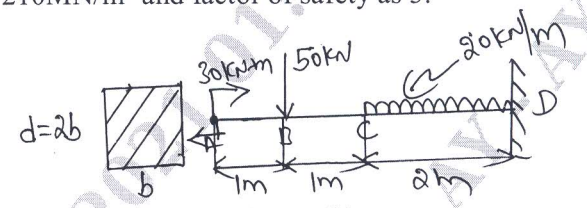

Fig.Q.7(b)

OR

8 a. Define deflection. Derive Euler Bernoulli equation for deflection. **(12 Marks)**

b. Derive an expression for maximum deflection in a cantilever beam subjected to a couple at free end. (Refer Fig.Q.8(b)). **(08 Marks)**

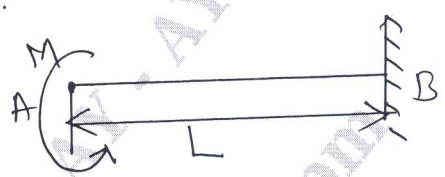

Fig.Q.8(b)

Module-5

9 a. State the assumptions in the theory of pure torsion and derive the torsional equation of shear stress produced in a circular shaft subjected to torsion. **(10 Marks)**

b. A hollow shaft is subjected to a torque 8kN-m. The angle on twist in the shaft is to be limited to 1.7° in length equal to twenty times the outer diameter. Taking the inner diameter to outer diameter ratio as 0.7 determine:

i) Inner diameter and outer induced

ii) Maximum shear stress induced

Take the modulus of rigidity for the shaft material as 80GPa. **(10 Marks)**

OR

10 a. Derive Euler's expression for buckling load for column with both ends hinged. **(10 Marks)**

b. A 2.5 meter long hollow circular column with inner diameter to outer diameter ratio of 0.8 is to carry a load of 136 kN. One end of the column is fixed and the other end is hinged. Determine the diameters of the column, taking σ_c = 320MPa and α = 1/7500 for the material of column. Take FOS = 2.5. **(10 Marks)**

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