CBCS SCHEME

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

15CT/CV32

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Strength of Materials

Time: 3 hrs. Max. Marks: 80

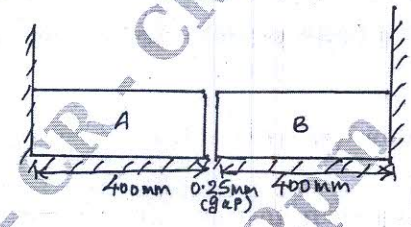
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive an expression for deformation of a tapering rectangular bar subjected to axial load 'P' with usual notations (bar dimensions are a × t on one end and b × t on other end). **(08 Marks)**

b. At room temperature the gap between the bar A and bar B shown in Fig.Q.1(b) is 0.25mm. What are the stresses in the bars, if the temperature rise is 35°C?
Given:
$A_a = 1000mm^2$, $E_a = 2 \times 10^6 MPa$
$\alpha_a = 12 \times 10^{-6}/°C$, $l_a = 400mm$
$A_b = 800mm^2$, $E_b = 1 \times 10^5 MPa$
$\alpha_b = 23 \times 10^{-6}/°C$, $l_b = 300mm$

Fig.Q.1(b)



(08 Marks)

OR

2 a. Derive the relationship between Bulk Modulous (K), Youngs Modulous (E) and Rigidity Modulous (G). **(08 Marks)**

b. A weight of 300kN is supported by a short concrete column of 250mm square section. The column is reinforced with 4 steel bars at corner of cross-sectional area $5500mm^2$. Find the stress in steel and concrete if $E_S = 15E_c$. If the stress in the concrete must not exceed 4.5MPa, what area of steel is required in order that column may support a load of 500kN? **(08 Marks)**

Module-2

3 a. Derive Lame's equation with usual notations in thick cylinder. **(08 Marks)**

b. For the two-dimensional stressed element with 50MPa compressive stress along with Y axis and 90MPa tensile stress along X axis, determine the value of i) Minimum principal stress ii) Shear stress iii) Normal stress on plane of maximum shear iv) The maximum shear stress of major principal stress is 100MPa. **(08 Marks)**

OR

4 a. A thin cylindrical shell 1m in diameter and 3m long has a metal wall of thickness 10mm. It is subjected to an internal fluid pressure of 3MPa. Find the circumferential and longitudinal stresses in the wall. Determine the change in length, diameter and volume of cylinder. Also find maximum shear stress in the cylinder. Assume E = 210GPa and μ = 0.3. **(08 Marks)**

b. Explain construction of Mohr's circle for graphical method of compound stress analysis for a rectangular element subjected to σ_x and σ_y (normal stresses) and τ_{xy} (shear stresses). **(08 Marks)**

Module-3

5 a. Explain the following with neat sketch: i) Types of beams ii) Types of loads iii) Types of supports. **(08 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q.5(b). Determine the maximum BM and its location. Locate point of contra flexure. **(08 Marks)**

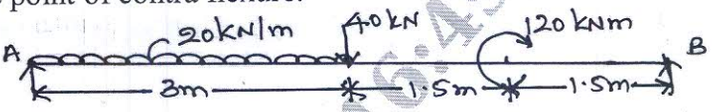


Fig.Q.5(b)

OR

6 a. Derive the relationship between udl, SF and BM. **(06 Marks)**

b. Draw BMD and SFD for cantilever beam shown in Fig.Q.6(b). **(10 Marks)**

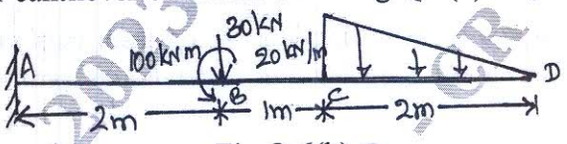


Fig.Q.6(b)

Module-4

7 a. Distinguish between long and short columns. What are limitations of Eulers theory? **(08 Marks)**

b. A simply supported beam of span 1.3m having a cross-section 150mm wide by 250mm deep carries a point load W at the centre. The permissible stress is 7MPa in bending and 1 MPa in shear. Determine W. **(08 Marks)**

OR

8 a. Derive an equation with usual notations to obtain shear stress across any section at any point from neutral axis $\tau = \frac{Vx(a\bar{y})}{Ib}$. **(08 Marks)**

b. Find the Euler's crippling load for a hollow cylindrical steel column of 40mm diameter and 4mm thick. Take the length of column as 2.3m and the column is hinged at both ends. Also determine the crippling load by Rankine's formula using constants as 335MPa and 1/75,000. Take E = 205MPa. **(08 Marks)**

Module-5

9 a. Define the following theories of failures in brief:
i) Rankines theory
ii) Tresca's theory
iii) Beltrami and Haigh theory
iv) St Venant's theory. **(08 Marks)**

b. A solid shaft has to transmit 120kW of power at 160rpm. If the shear stress is not to exceed 60MPa and the twist in a length of 3m is not to exceed 1°, find the suitable diameter of the shaft G = 80GPa. **(08 Marks)**

OR

10 a. Explain "Torsional Rigidity". **(02 Marks)**

b. A solid shaft transmits 250kW at 100rpm. If the shear stress is not to exceed 75MPa, what should be the diameter of the shaft? If this shaft is to be replaced by a hollow one, whose diameter ratio is 0.6 determine the size and percentage of saving in weight. The maximum shear stress being the same. **(14 Marks)**

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