

# CBCS Scheme

15CV/CT32

## Third Semester B.E. Degree Examination, Dec.2016/Jan.2017 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. Name and define the four elastic constants. (06 Marks)  
 b. Determine the value of "P" and the total deformation of the stepped bar. (10 Marks)  
 Take  $E = 2.1 \times 10^5 \text{ N/mm}^2$ . Refer fig.Q1(b).

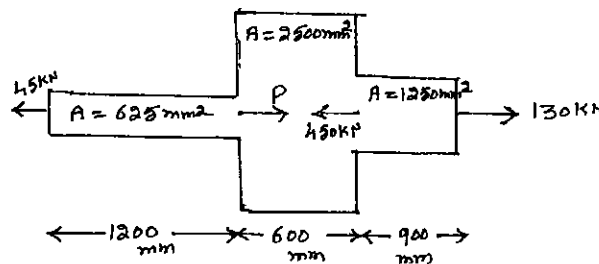


Fig.Q1(b)

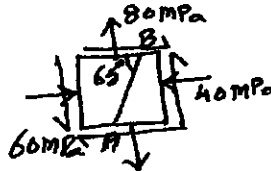
OR

- 2 a. Derive the relationship between Young's modulus and bulk modulus. (06 Marks)  
 b. A steel bar is placed between two copper bars, each having same area and length as the steel bar. These are rigidly connected together at a temperature of  $25^\circ\text{C}$ . When the temperature is raised to  $325^\circ\text{C}$ , the length of the bar is increased by 1.5 mm. Compute the original length and final stresses in each bar. Take  $E_{\text{steel}} = 210 \text{ GPa}$  and  $E_{\text{copper}} = 100 \text{ GPa}$  ;  
 $\alpha_{\text{steel}} = 12 \times 10^{-6}/^\circ\text{C}$  and  $\alpha_{\text{copper}} = 17.5 \times 10^{-6}/^\circ\text{C}$ . (10 Marks)

### Module-2

- 3 a. Explain the procedure to construct Mohr's circle and to find principal stresses and their planes. (04 Marks)  
 b. The stresses acting at a point in a two dimensional stress system is as shown in fig.Q3(b). Determine : i) Principal stresses ii) Normal and tangential stress on the plane AB iii) Maximum shear stress. (12 Marks)

Fig.Q3(b)



OR

- 4 a. Derive an expression for hoop stress in thin cylinder. (04 Marks)  
 b. Find the thickness of the metal necessary for a steel cylindrical shell of internal dia 150 mm to withstand an internal pressure of  $50 \text{ N/mm}^2$ . The maximum hoop stress in the section not to exceed  $150 \text{ N/mm}^2$ . If the thickness is found using the cylinder analysis, what is the percentage error? (12 Marks)

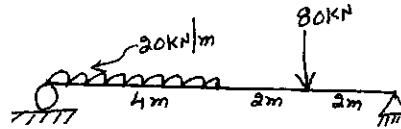
### Module-3

- 5 a. Derive the relationship between intensity of load, shear force and bending moment.

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.

- b. Draw shear force and bending moment diagrams for the beam shown in fig.Q5(b). (10 Marks)

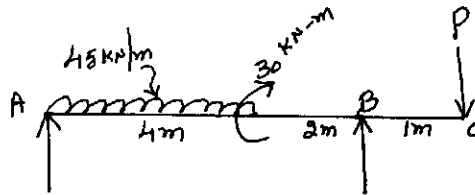
Fig.Q5(b)



OR

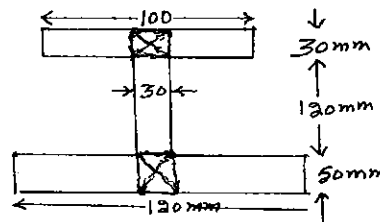
- 6 a. Define i) Shear force ii) Bending moment and iii) Point of contra flexure. (03 Marks)  
 b. For the beam AC shown in fig.Q6(b), determine the magnitude of the load 'P' acting at C, such that the reaction at supports A and B are equal. Also draw SF and BM diagrams, locate the point of contra flexure if any. (13 Marks)

Fig.Q6(b)

**Module-4**

- 7 a. What are the assumptions in bending theory? (04 Marks)  
 b. A beam simply supported at ends and having cross section as shown in fig.Q7(b) is loaded with a  $ud\ell$  over a span of 8m. The allowable bending stress in tension is  $30\text{N/mm}^2$  and that in compression is  $45\text{N/mm}^2$ . Determine the maximum value of  $ud\ell$ , the beam can carry. (12 Marks)

Fig.Q7(b)



OR

- 8 a. Differentiate between short and long columns. (04 Marks)  
 b. What are the limitations of Euler's theory? (04 Marks)  
 c. A column 6m long has both of its ends fixed and has a timber section of  $150\text{mm} \times 200\text{mm}$ . Determine the crippling load on the column. Take  $E = 17.5 \times 10^3 \text{N/mm}^2$ . (08 Marks)

**Module-5**

- 9 a. Derive the torsion equation with usual notations. (08 Marks)  
 b. A hollow shaft of external dia 120mm transmits 300KW power at 200rpm. Determine the maximum internal dia, if the maximum shear stress in the shaft is not to exceed  $60\text{N/mm}^2$ . (08 Marks)

OR

- 10 a. Explain Maximum Principal Stress theory. (04 Marks)  
 b. A solid circular shaft is subjected to a bending moment of 9000N-m and a twisting moment of 12000 N-m. In a simple uniaxial tensile test of the same material, it gave the following particulars : Stress at yield point =  $300\text{N/mm}^2$  ;  $E = 200\text{GN/mm}^2$ . Estimate the least dia required using i) Maximum principal stress theory ii) Maximum shear stress theory. Take FOS = 3 and  $\mu = 0.25$ . (12 Marks)

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