CBCS SCHEME

USN | | | | | | | | | | | **15ME34**

Third Semester B.E. Degree Examination, July/August 2022
Mechanics 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 uniformly tapering rectangular bar. **(08 Marks)**

b. A compound bar consists of a 40mm diameter steel bar surrounded by a closely fitting cast iron tube of 4mm wall thickness. Length of the compound bar is 1.8m. Determine the load required to compress the compound bar so that the deformation induced in it is 1mm. Take the values of Young's modulli as $E_s = 200GPa$ and $E_{CI} = 100GPa$. **(08 Marks)**

OR

2 a. Derive a relationship between modulus of Dasticity (E) and Bulk modulus (K). **(08 Marks)**

b. A Steel bar is sandwiched between two copper bars each having the same area and length as the steel bar, at an initial temperature of 10°C. These are rigidly connected together at both the ends. When the temperature is raised to 260°C, the length of the bars increases by 1.0mm. Determine the original length and the final stresses in the bars. Take the following values :

$E_s = 2 \times 10^5$ N/mm^2 ; $E_c = 1 \times 10^5$N/mm^2

$\alpha_s = 12 \times 10^{-6}$ per °C ; $\alpha_c = 18 \times 10^{-6}$ per °C **(08 Marks)**

Module-2

3 a. What are principle stresses and principle planes? **(04 Marks)**

b. Show that sum of any two orthogonal components of stresses at a point in constant. **(04 Marks)**

c. The state of stress in a two dimensionally stressed body is as shown Fig Q3(c). Determine the principal planes, principle stresses, maximum shear stress and their planes.

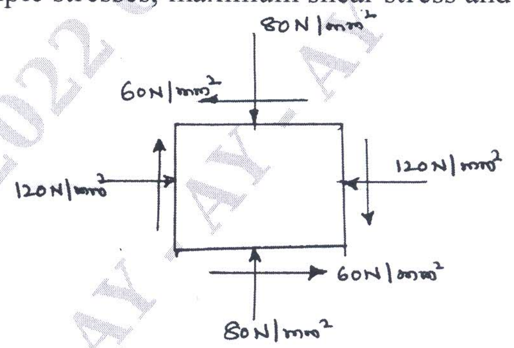

Fig Q3(c) **(08 Marks)**

OR

4 a. Show that

i) Circumferential stress $\sigma_c = \dfrac{pd}{2t}$ **(03 Marks)**

ii) Longitudinal stress $\sigma_L = \dfrac{pd}{4t}$ **(03 Marks)**

b. A thick cylinder of external and internal diameter of 300mm and 180mm is subjected to an internal pressure of $42 N/mm^2$ and external pressure $6 N/mm^2$. Determine the stresses in the material. Now if the external pressure is doubled, what internal pressure can be maintained without exceeding the previously determined maximum stress? **(10 Marks)**

Module-3

5 Draw the SF and BM diagrams for a simply supported beam subjected to the loads as shown below Fig Q5.

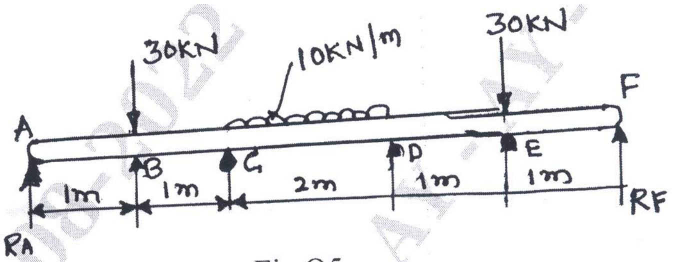

Fig Q5 **(16 Marks)**

OR

6 a. Show that $\frac{\sigma_b}{y} = \frac{E}{R}$ **(06 Marks)**

b. Show that maximum deflection $y_C = \frac{-5}{384}\frac{WL^4}{EI}$ and slope $\theta = \frac{WL^3}{24EI}$ when simply supported beam subjected to uniformly distributed load. **(10 Marks)**

Module-4

7 a. State the assumptions made in the theory of pure torsion. **(04 Marks)**

b. Prove that crippling load $P_{Cr} = \frac{\sigma_c A}{1 + a\left(\frac{L}{K}\right)^2}$. **(04 Marks)**

c. What percentage of strength of a solid circular steel shaft 100mm diameter is lost by boring 50mm axial how in it? Compare the strength and weight ratio of the two cases. **(08 Marks)**

OR

8 a. Derive an expression for crippling load when one and fixed and other end free. **(08 Marks)**

b. A hollow cast from iron whose outside diameter is 200mm and has a thickness of 20mm is 4.5m long and is fixed at formulate at both ends. Calculate the safe load by Rankine's formulae using a factor of safety of 2.5. find the ratio of Euler's to Rankine's loads. Take $E = 1 \times 10^5 N/mm^2$ and to Rankine constant = 1/1600 for both end pinned case and $\sigma_c = 550 N/mm^2$. **(08 Marks)**

Module-5

9 a. Determine the internal strain energy stored within an elastic bar subjected to a torque T. **(08 Marks)**

b. A simply supported beam is loaded as shown in Fig Q9(b). Determine the deflection using Castigliane theorem.

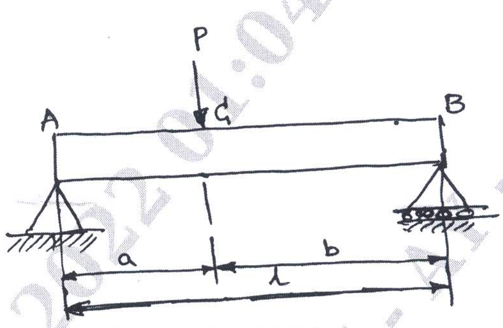

Fig Q9(b) **(08 Marks)**

OR

10 a. Explain :
i) Maximum principal stress theory
ii) Maximum shear stress theory **(08 Marks)**

b. A bolt is subjected to an axial pull of 12kN together with a transverse shear force of 6kN. Determine the diameter of bolt by using :
i) Maximum principal stress theory
ii) Maximum shear stress theory. **(08 Marks)**

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