CS-LH09
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CBCS Scheme

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Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. State Hooke's law. **(02 Marks)**

b. Determine an expression for shortening/ extension of bar. **(04 Marks)**

c. A bar of 30mm diameter is subjected to a pull of 60kN. The measured extension on gauge length of 200mm is 0.1mm and change in diameter is 0.004mm. Determine :
i) All three modulii ii) Poisson's ratio. **(10 Marks)**

OR

2 a. A rectangular bar made of steel is 2.8m long and 15mm thick. The rod is subjected to an axial tensile load of 40kN. The width of rod varies from 75mm at one end to 30mm at the other. Find the extension of rod if E = 200 GPa. **(02 Marks)**

b. Derive an expression for deformation of tapered bar (CIRCULAR Cross – section). **(06 Marks)**

c. A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube at a rise of 200°C
Take: $E_s = 210GPa$, $E_c = 100GPa$, $\alpha_s = 11\times10^{-6}$ per °C and $\alpha_c = 18\times10^{-6}$ per °C. **(08 Marks)**

Module-2

3 a. Define principal stresses and planes. **(04 Marks)**

b. An elemental cube is subjected to tensile stress of 30MPa and 10N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10MPa on these planes. Draw the Mohr's circle of stresses and hence or otherwise, determine the magnitudes and directions of principal stresses and also the greatest shear stress. Check the answer analytically. **(12 Marks)**

OR

4 a. Derive expression for circumferential stress and longitudinal stress and mention how they are related. State the assumptions made. **(06 Marks)**

b. Determine the maximum and minimum hoop stress across the section of pipe 400mm internal diameter and 100mm thick, when the pipe contains a fluid at a pressure of 8N/mm^2. Also sketch the radial pressure distribution and hoop stress distribution at inner fiber, mean fiber and outer fiber. **(10 Marks)**

Module-3

5 a. Write a note on classification of beams based on supports. **(04 Marks)**

b. Draw the shear force and bending moment diagram of a simply supported beam of length 10m and loaded as shown in Fig Q5(b).
Also calculate maximum Bending moment and location of it from left support. **(12 Marks)**

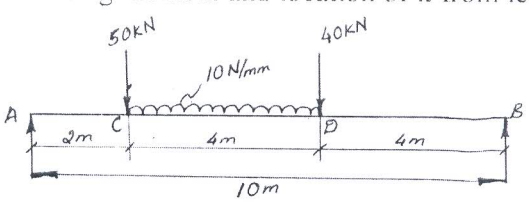

Fig Q5(b)

OR

6 a. Derive an expression for bending stress with assumption made. **(08 Marks)**

b. A timber beam of rectangular section of length 8m is simply supported. The beam carries a UDL of 12kN/m run over the entire length and a point load of 10kN at 3 meter from left support. If depth is two times the width and the stress in the timber is not it exceed 8MPa, Find the suitable dimension of the section. **(08 Marks)**

Module-4

7 a. Prove that torsional strength of hollow shaft is greater than that of solid shaft. Let Do of solid shaft is equal to Do of hollow shaft Di = 0.6 Do **(06 Marks)**

b. Determine the diameter of a solid shaft which will transmit 90kW at 160rpm. Also determine the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60N/mm^2. Take value of modules of rigidity as 80GPa. What will be diameter if we consider angle of twist? Suggest what should be shaft diameter. **(10 Marks)**

OR

8 a. Derive an expression for Euler's crippling load for a column when one of its ends are hinged or pinned. **(08 Marks)**

b. A hollow cylindrical cast iron column is 4m long with both ends fixed. Determine minimum diameter of the column if safe load of 250kN with a factor of safety 5 is applied. Take internal diameter is 0.8 times the external diameter. Take $\sigma_c = 550MPa$, $\alpha = \frac{1}{1600}$ and $E = 1.2\times10^5$ N/mm^2. Solve By Rankine's formula and Euler's formula and compare. **(08 Marks)**

Module-5

9 a. Explain maximum shear stress theory and state the need of theories of failures. **(06 Marks)**

b. Determine the diameter of a bolt which is subjected to an axial pull of 9kN together with a transverse shear force of 4.5kN using

i) Maximum principal stress theory

ii) Maximum shear stress theory. **(10 Marks)**

OR

10 a. Define strain energy, Resilience, proof resilience and modules of Resilience. **(08 Marks)**

b. A tension bar 5m long is made up of two parts 3 meter of its length has a cross section area of 10cm^2 while the remaining 2 meter has a cross section area of 20cm^2. An axial pull of 80kN is gradually applied. Find the total strain energy produced in the bar and compare this value with that obtained in a uniform bar of same length and have same volume under same loading condition. Take E = 200GPa. **(08 Marks)**

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