KLE Dr. M. S. SHESHGIRI COLLEGE OF ENGG. & TECH. LIBRARY BELGAUM

CBCS Scheme

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15ME/MA34

Third Semester B.E. Degree Examination, June/July 2017
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: ***Answer 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. Define the following: (i) Elasticity (ii) Ductility (iii) Toughness (iv) Hardness (v) Stiffness (vi) Resilience **(06 Marks)**

b. The tensile test was conducted on a mild steel bar. The following data was obtained from the test. Diameter of the steel bar = 16 mm; Gauge length of the bar = 80 mm; Load at proportionality limit = 72 kN; Extension at a load of 60 kN = 0.115 mm; Load at failure = 80 kN; Final Gauge length of bar = 104 mm; Diameter of the rod at failure = 12 mm. Determine : (i) Young's modulus (ii) Proportionality limit. (iii) True breaking stress (iv) Percentage elongation. **(10 Marks)**

OR

2 a. Derive a relation between modulus of elasticity and bulk modulus. **(06 Marks)**

b. At room temperature, the gap between bar A and bar B shown in Fig. Q2 (b) is 0.25 mm. What are the stresses induced in the bars, if the temperature rise is 35°C. Given, $A_A = 1000\,mm^2$; $A_B = 800\,mm^2$; $E_A = 2\times10^5$ N/mm^2; $E_B = 1\times10^5\,N/mm^2$; $\alpha_A = 12\times10^{-6}/°C$; $\alpha_B = 23\times10^{-6}/°C$; $L_A = 400\,mm$; $L_B = 300\,mm$ **(10 Marks)**

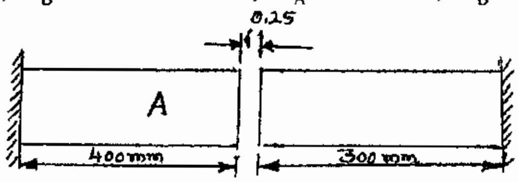

Fig. Q2 (b)

Module-2

3 a. A point in a strained material is subjected to a tensile stress of 500 N/mm^2 and 300 N/mm^2 in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliguity on a plane making an angle of 30° with the axis of second stress. Also find the maximum shear stress. **(10 Marks)**

b. A thick cylindrical shell of 160 mm internal diameter is subjected to an internal pressure of 8 N/mm^2. Find the thickness of shell if the permissible or hoop stress in the section is not to exceed 35 N/mm^2. **(06 Marks)**

OR

4 a. An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence determine the magnitudes and directions of principal stresses and also the greatest shear stress. **(08 Marks)**

b. A thin cylindrical shell with following dimensions is filled with a liquid at atmospheric pressure : Length = 1.2 m, External diameter = 200 mm, Thickness of metal = 8 mm. Find the value of the pressure exerted by the liquid on the walls of the cylinder and the hoop stress induced if an additional volume of 25000 mm^3 of liquid is pumped into the cylinder. Take $E = 2.1\times10^5$ N/mm^2 and $\mu = 0.33$. **(08 Marks)**

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Module-3

5 For the beam shown in Fig. Q5. Draw shear force and bending moment diagram. Locate the point of contraflexure if any. **(16 Marks)**

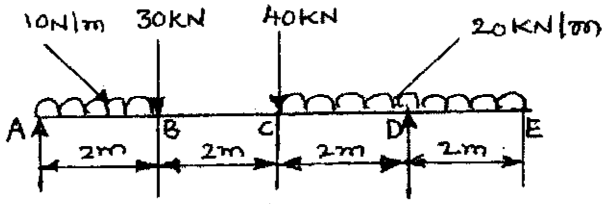

Fig. Q5

OR

6 a. Derive a relationship between bending stress and radius of curvature. **(08 Marks)**

b. Derive the deflection equation, $EI\frac{d^2y}{dx^2} = M$. **(08 Marks)**

Module-4

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

b. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm, Find the diameter of the shaft, if the shear stress of the material must not exceed 80 N/mm^2. The maximum torque 1.25 time of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(12 Marks)**

OR

8 a. Derive a Euler's crippling load for a column when both of its ends are hinged. **(08 Marks)**

b. A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using Euler's formula. Taking $E = 1.2 \times 10^5$ N/mm^2. **(08 Marks)**

Module-5

9 a. Derive an expression for strain energy due to shear stresses. **(08 Marks)**

b. Write a note on: (i) Maximum principal stress theory. (ii) Maximum shear stress theory. **(08 Marks)**

OR

10 a. A hollow circular shaft 2 m long is required to transmit 1000 kW power, when running at a speed of 300 rpm. If the outer diameter of the shaft is 150 mm and inner diameter is 120 mm. Find the maximum shear stress and strain energy stored in the shaft. **(08 Marks)**

b. A solid circular shaft is subjected to a bending moment of 40 kN-m and a torque of 10 kN-m. Design the diameter of the shaft according to, (i) Maximum principal stress theory. (ii) Maximum shear stress theory.

Take $\mu = 0.25$, stress at elastic limit = 200 N/mm^2 and factor of safety= 2. **(08 Marks)**

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