CBCS SCHEME

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18MR34

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define : (i) Plasticity (ii) Ductility (iii) Brittleness (iv) Poisson's ratio **(06 Marks)**

b. Define Hooke's law and explain stress-strain diagram for mild steel with characteristic points. **(06 Marks)**

c. The tensile test was conducted on a mild steel bar. The following data was obtained from the test.
Diameter of steel bar = 16 mm ; Gauge length of the bar = 80 mm
Load of proportionality limit = 72 kN ; Extension of a load of 60 kN = 0.115 mm
Load of failure = 80 kN ; Final gauge length of bar = 104 mm
Diameter of the rod of failure = 12 mm.
Determine (i) Young's modulus (ii) Proportionality limit (iii) True breaking stress (iv) Percentage elongation. **(08 Marks)**

OR

2 a. Derive an expression for relation between modulus of elasticity and modulus of rigidity. **(10 Marks)**

b. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 25 mm and length 1.6 mm, if the longitudinal strain in the bar during tensile test is four times the lateral strain. Also find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. E = 1×10^5 N/mm^2. **(10 Marks)**

Module-2

3 a. Show that the sum of the normal stresses on any two planes at right angles in a general two dimensional stress system is constant. **(10 Marks)**

b. At a certain point in a strained material, the values of normal stresses across two planes at right angles to each other are 80 MPa and 32 MPa, both tensile and there is a shear stress of 32 MPa, CW on the plane carrying 80 MPa stresses across the planes as shown in Fig. Q3 (b). Determine
(i) Maximum and minimum normal stresses and locate their planes.
(ii) Maximum shear stress and specify its plane.
(iii) Normal stress on maximum shear stress plane.
(iv) Verify the answer by Mohr's circle method. **(10 Marks)**

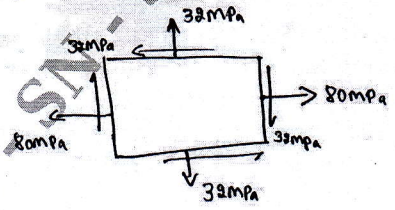

Fig. Q3 (b)

OR

4 a. Derive an expression for circumferential stress and longitudinal stress for thin cylinder. **(10 Marks)**

b. A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/mm^2. Find the maximum and minimum hoop stress across the cross-section of the cylinder. Also sketch the radial pressure and hoop stress distribution across the section. **(10 Marks)**

Module-3

5 a. Derive an expression for load, shear force and bending moment. **(10 Marks)**

b. Draw the shear force and bending moment diagram for the Cantilever beam shown in Fig. Q5 (b). **(10 Marks)**

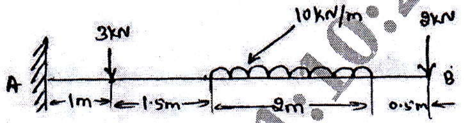

Fig. Q5 (b)

OR

6 a. Sketch different types of beams and different types of loads and explain. **(10 Marks)**

b. A simply supported beam of span 6 m is subjected to a concentrated load of 25 kN acting at a distance of 2 m from the left end. Also subjected to an uniformly distributed load of 10 kN over the entire span. Draw the bending moment and shear force diagrams indicating the maximum and minimum values. **(10 Marks)**

Module-4

7 a. Write the assumptions made in theory of simple bending and derive an expression for relationship between bending stress and radius of curvature. **(10 Marks)**

b. The cross section of a beam is as shown in Fig. Q7 (b). If permissible stress is 150 N/mm^2 find its moment of resistance. Compare it with equivalent section of the same area for a square section. **(10 Marks)**

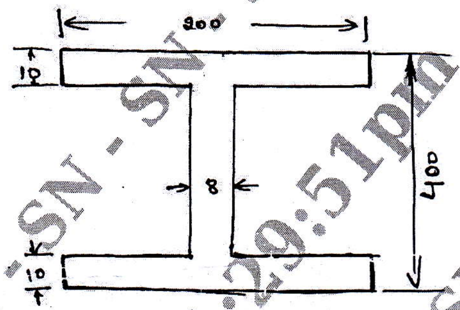

Fig. Q7 (b)

OR

8 a. Derive Euler's Bernoulli's equation for deflection. **(10 Marks)**

b. A Cantilever beam 2 m long is carrying a load of 20 kN at its free end and 30 kN at a distane of 1 m from the free end. Find the slope and deflection at the free end. Take $I = 15 \times 10^7$ mm^4, $E = 2 \times 10^5$ N/mm^2. **(10 Marks)**

Module-5

9 a. State the assumptions made in theory of torsion and derive an expression for relation between torque and shear stress in a solid circular shaft. **(10 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 times 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? **(10 Marks)**

OR

10 a. Derive an expression for Euler's cripping load for a column when one end of the column is fixed and other end is free. **(10 Marks)**

b. Design the section of a circular cast iron column that can safely carry a load of 1000 kN. The length of the column is 6 meters. Rankine's constant is $\frac{1}{1600}$, factor of safety is 3. One end of the column is fixed and other end is free. Critical stress is 560 MPa. **(10 Marks)**