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.

USN

Third Semester B.E. Degree Examination, December 2012

Mechanics of Materials

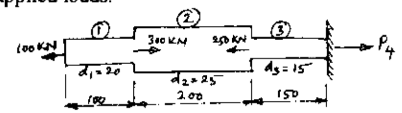
Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Missing data, if any, may be suitably assumed.*

PART – A

1 a. Define: i) Ductility, ii) True stress, iii) Principle of super position. **(06 Marks)**

b. Determine the stresses in various segments of the circular bar shown in Fig.Q1(b).
i) Compute its total elongation assuming Young's modulus of steel to be 195 GPa.
ii) Determine the length of the middle segment so that the bar length does not change under the applied loads.



All dimensions are in mm

Fig.Q1(b) **(08 Marks)**

c. Derive an expression for the extension of uniformly tapering rectangular bar subjected to axial load P. **(06 Marks)**

2 a. A C.I. flat, 300 mm long, 50 mm wide, and 30 mm thick, is acted upon by the following forces. 25 kN tensile in the direction of length; 350 kN compressive, in the direction of width; and 200 kN tensile, in the direction of thickness. Determine:
i) Change in volume of the flat ii) Modulus of rigidity iii) Bulk modulus
Take E = 140 GN/m^2 and 1/m = 0.25. **(10 Marks)**

b. A steel bar is placed between two copper bars, each having the same area and of length L as the steel bar at 15°C. At this stage, they are rigidly connected together at both the ends. The length of composite bar is also L. When the temperature is raised to 315°C, the length of the bar increase by 1.5 mm. Determine the original length end, find the stresses in the bars.
Take $E_S = 2.1 \times 10^5$ N/mm^2, $E_C = 1 \times 10^5$ N/mm^2,
$\alpha_S = 0.000012$ per °C, $\alpha_C = 0.0000175$ per °C. **(10 Marks)**

3 The state of stress in a two dimensionally stressed body is shown in Fig.Q3. Determine the principal planes, principal stresses, maximum shear stress and their planes. Also draw the Mohr's circle to verify the results obtained analytically. Indicate all the above planes by a sketch.

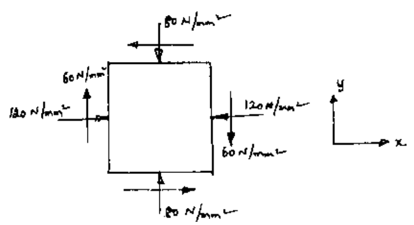


Fig.Q3 **(20 Marks)**

4 a. A simply supposed beam of span L carries a point load W at mid-span. Find the strain energy stored by the beam. **(05 Marks)**

b. Derive an expression for circumferential stress for thin cylinder. **(05 Marks)**

c. A cylindrical pressure vessel has inner and outer redii of 200 mm and 250 mm respectively. The material of the cylinder has an allowable normal stress of 75 MN/m^2. Determine the maximum internal pressure that can be applied and draw a sketch of radial pressure and circumferential stress distribution. **(10 Marks)**

PART – B

5 a. A cantilever of length 2.0 m carries a uniformly distributed load of 1 kN/m run over a length of 1.5 m from the free end. Draw the shear force and bending moment diagram for the cantilever. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig.Q5(b). Locate the point of contra flexure. **(14 Marks)**

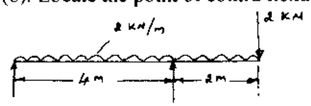
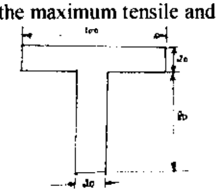


Fig.Q5(b)

6 a. A cast iron beam is of T-section as shown in Fig.Q6(a). The beam is simply supported on a span of 8m. The beam carries a uniformly distributed load of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses. **(10 Marks)**



All dimensions are in mm

Fig.Q6(a)

b. A beam of rectangular section of width 'b' and depth 'd' is subjected to shear force. Draw the figure showing the shear stress variation across the section. Also show that the maximum shear stress is 1.5 times the average shear stress. **(10 Marks)**

7 a. A cantilever of length 2.5 m carries a uniformly distributed load of 16.4 kN/m over the entire length. If the moment of inertia of the beam is 7.95×10^7 mm^4 and the value of $E = 2 \times 10^5$ N/mm^2, determine the deflection at the free end. Derive the equation used. **(10 Marks)**

b. A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Find: i) Deflection under each load, ii) Maximum deflection and iii) The point at which maximum deflection occurs. Take $E = 2 \times 10^5$ N/mm^2 and $I = 85 \times 10^6$ mm^4. **(10 Marks)**

8 a. Determine the diameter of a solid steel shaft which will transmit 90 KW at 160 rpm. 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 60 N/mm^2. Take the value of modulus of rigidity as 8×10^4 N/mm^2. **10 Marks)**

b. State the assumptions made in the derivation of Euler's expression. Derive the Euler's expression for a column subjected to an axial compressive load. Consider both ends of the column as Hinged. **(10 Marks)**

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