Code No: 113AC

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, December-2014

MECHANICS OF SOLIDS

(Common to ME, MCT, MMT, AE, AME, MSNT)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

Part- A **(25 Marks)**

1.a) Write the relation between the Young's modulus, Rigidity modulus and Bulk modulus. [2M]

b) Derive the formula for the elongation of a tapered bar under the action of axial load. [3M]

c) Derive the relation between the Bending Moment and Shear Force in a beam subjected to transverse loading. [2M]

d) A cantilever 8m long carries throughout its length a uniformly distributed load of 'w' Kg/m run. If the Max.B.M is 3200Kg-m. Find the rate of loading 'w'. [3M]

e) Sketch the shear stress distribution diagram for a rectangular section and square section with one diagonal vertical. [2M]

f) What is bending stress? What is the difference between bending stress and direct stress? [3M]

g) At a point in a strained material the principal stresses are p_1 , p_2 and zero. What combination of principal stresses will give the same factor of safety by yielding according to the Max.shear stress theory and the Distortion energy theory of failure? [2M]

h) What is the importance of Mohr's stress circle? The major and minor principal stresses at a point are $120N/mm^2$ and $40N/mm^2$ respectively. If a Mohr's stress circle is drawn for the stresses, determine the radius of the Mohr's stress circle. [3M]

i) Show the possible crack propagation for the failure of the cylinder due to hoop stress considering an element on the periphery of a thin walled cylinder. [2M]

j) The diameter of a solid shaft is D. The inside and outside diameters of a hollow shaft of the same material and length is $\frac{D}{\sqrt{3}}$ and $\frac{2D}{\sqrt{3}}$ respectively. Determine the ratio of the weight of the hollow shaft to the weight of the solid shaft. [3M]

Part- B **(50 Marks)**

2. The bar AB is considered to be absolutely rigid and is horizontal before a load of 220KN is applied, as shown in Fig.1. The connections at A is a pin, and AB is supported by steel rod EB and the copper rod CD. The length of CD is 1.0m and of EB is 1.50m. The cross-sectional area of CD is $500mm^2$ and that of EB $300mm^2$.Determine the stress in each of the vertical rods and the elongation of the steel. Neglect the weight of AB. Take $E = 1.2\times10^5$MPa for copper and for steel $E = 2\times10^5$MPa.

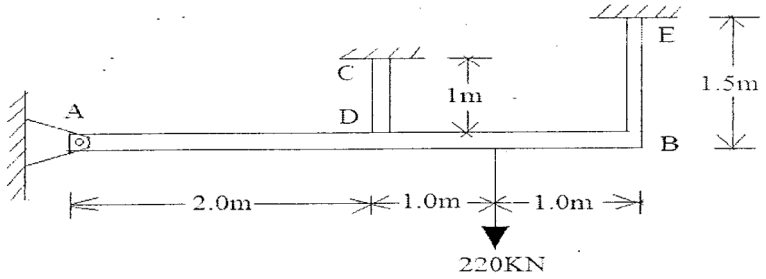

Fig.1

OR

3.a) A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7 KN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Find Poisson's ratio and elastic constants E, G and K.

b) Explain the stress-strain relationship for mild steel in direct tension.

4. The beam 8m length is hinged at one end and supported on rollers at a distance of 5.0m from the hinge. It carries an UDL of 100N/m run over its entire length and a concentrated load of 300N at free end .Draw SFD and BMD.

OR

5. Draw the SFD and BMD for the beam as shown in Fig.2

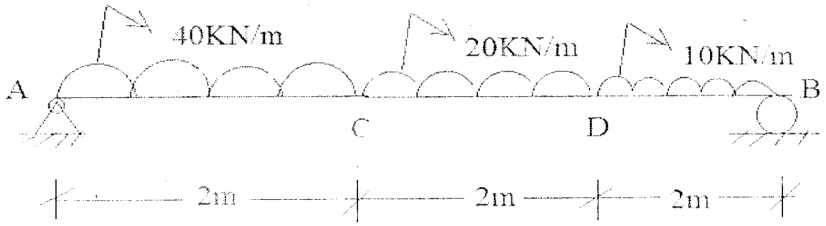

Fig.2

6. A simply supported steel beam of inverted T-section is 4.50m long. It has 1.0m overhang at one end and carries an UDL of intensity 20KN/m on its entire span. The T-section has flange dimensions 5t × t and web dimensions 4t × t, where't' is the thickness of the section. Determine the dimension't' of a section, if the max.stress is limited to 165N/mm^2.

OR

7. A beam of square section is placed so that the plane of bending is parallel to a diagonal, the side of square is 'a' and shear force is 'V'. Obtain an equation of shear stress 'τ' at distance 'y' from N.A and find the mean and maximum intensity of shear stress and where it occurs.

8. A circle of 15cm diameter is inscribed on an aluminum plate before it is stressed. The plate is then loaded so as to produce stresses as shown in Fig.3 and the circle is deformed to an ellipse. Determine the major and minor axes of the ellipse and their directions. Given E = 70×10^3N/mm^2, poisson's ratio (1/m) = 0.33

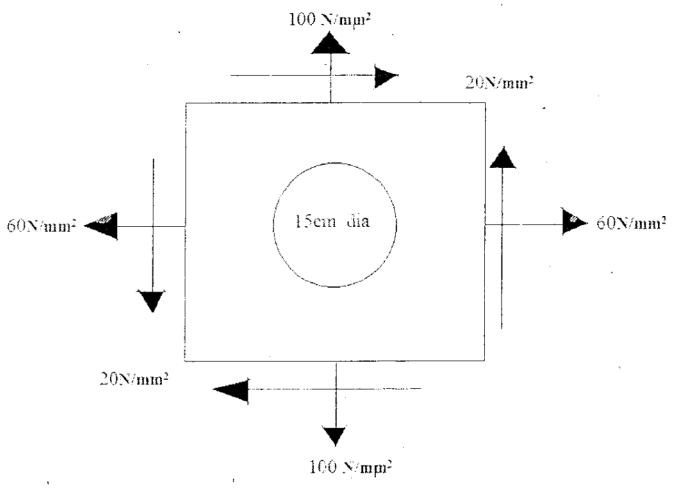

Fig.3

OR

9. A shaft is simultaneously subjected to a bending moment of 20Kg-m and a twisting moment of 15Kg-m. Design the diameter of the shaft according to the Max.Principal strain theory.
Given: Yield strength of the material = 2100Kg/cm^2.
1/m (poisson's ratio) = 0.3, Factor of safety = 2.

10. A solid circular shaft has a radius r_1 at one end and r_2 at the other end. Derive an expression for the angle of twist 'θ' in a length 'L'. Calculate the angle if r_1 = 4cm, r_2 = 4.5cm and L = 100cm. Also calculate the % error committed if 'θ' is calculated on the basis of a mean radius of 4.5cm.

OR

11. A shell 3.25m long and 1.0m diameter is subjected to an internal pressure of 1.2N/mm^2. If the thickness to the shell is 10.0mm, find the circumferential and longitudinal stresses. Find also the maximum shear stress and changes in dimensions of the shell. Take E = 200KN/mm^2, and poisson's ratio = 0.3.

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