BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
Department of Aerospace Engineering and Applied Mechanics
B.E. Part II 3rd Semester (A.E. & M.E.) Final Examination, 2012
Subject : **Fundamentals of Solid Mechanics** Code : **AM 308**
Time : 3 hrs. Full Marks : 70.

(Answers to be given in two separate sheets)

FIRST HALF
Answer any three questions

1. A simply supported beam AB of 8 m span is subjected to a central concentrated load of 20 kN and an uniformly distributed load of 10 kN/m over the one half of its length. Find by any suitable method the central deflection of the beam. Assume EI of the beam is uniform and having its value equals to 34285.7 kN-m^2.

2.(a) State and explain Castigliano's theorem.
(b) A beam with both ends fixed is subjected to a uniformly distributed load over its entire length. Using Castigliano's theorem find the support moments and support reactions of the beam. Then draw the shear force and bending moment diagram of the beam.

3.(a) A vertical short column having rectangular cross-section 120 cm x 100 cm is subjected to an eccentric load of 20 kN passing through a point (30 cm, 20 cm) on the section but acting normal to the section.
(i) Determine the maximum and minimum stress in the column section.
(ii) Write down the equation of the neutral axis of the section.
(b) A hollow cast iron column rigidly fixed at one end and pin-pointed at the other end, has 150 mm outer diameter and 120 mm inner diameter. Its length is 6 m and E = 90 GN/m^2. Calculate the critical load of this column by Euler's formula.

4.(a) Explain the following theories of failure and indicate which are more suitable for design of machine components made of ductile materials :
(i) Maximum principal stress theory
(ii) Maximum shear stress theory
(iii) Total strain-energy theory
(iv) Total distorsional (shear) strain energy theory.
(b) A thin cylindrical shell 2.5 m in diameter is composed of plate 12.5 mm thick. The yield stress of the material is 300 MPa. Calculate the internal pressure which cause yielding according to failure theories as per question No. Q.4.(a). Assume same value of yield point in tension and compression and Poisson's ratio as 0.3.

5.(a) Using Lame's equations, determine the maximum and minimum circumferential stress in a thick cylinder of inside radius r_1 and outside cylinder r_2, when the cylinder is subjected to an outside pressure p_0.
(b) A beam having the thin-walled semicircular cross-section shown in Fig. Q.5.(b) is loaded in a principal plane xy so as to produce simple bending in this plane. Find the distance 'e' defining the location of the shear centre O.

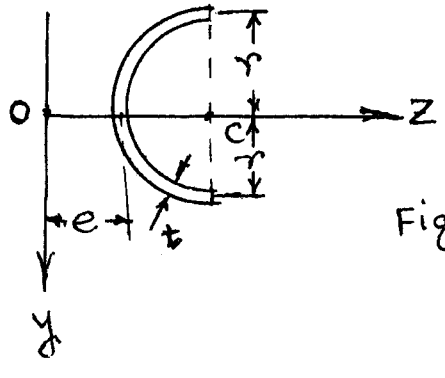

Fig Q5(b)

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Second Half

Answer any three questions

6. Determine the diameter of a solid shaft which will transmit 300 kW@ 250 r.p.m. The maximum shear stress should exceed 30 MPa and twist should not be more than one degree in a shaft length of 2 m. Consider modulus of rigidity 100 GPa.

7. The normal stresses in two mutually perpendicular directions are 600 MPa and 300 MPa, both tensile. The complimentary shear stresses in these directions are of intensity 450 MPa. Find the normal and tangential stresses on the two planes which are equally inclined to the planes carrying the normal stresses mentioned above.

8. A beam of cross-section of an isosceles triangle of base width 150 mm and height 450 mm, is subjected to a shear force of 30 kN. Determine (i) horizontal shear stress at the neutral axis and (ii) the value of maximum shear stress.

9. A hollow circular shaft of 20 cm external diameter and 10 cm internal diameter is subjected to a direct compressive load of 750 kN, a bending moment of 4500 kNcm and a twisting moment of 6200 kNcm. Calculate the maximum principal stress and maximum shearing stress.

10. A piece of material is subjected to three mutually perpendicular tensile stresses of 500, 650 and 800 kg/cm^2. Calculate the strain energy per unit volume. Calculate the maximum shear strain energy per unit volume. Consider Poisson's ratio 0.3 and modulus of elasticity 200 MPa.