Code No: NR210302 **NR**

**II B.Tech I Semester Supplementary Examinations, November 2006**
**MECHANICS OF SOLIDS**
**( Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering and Aeronautical Engineering)**
**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. A bar of steel is 70 cm long. For the first 20 cm it is 2.5 cm in diameter, for the next 30 cm it is 2 cm in diameter and for the remaining 20 cm its diameter is 1.5 cm. Find the change in length of the bar if it is subjected to a tensile load of 90 kN. E = $2\times10^7 N/cm^2$. [16]

2. A steel rod 28 mm diameter is fixed concentrically in a brass tube of 42 mm outer diameter and 30 mm inner diameter. Both the rod and tube are 450 mm long. The compound rod is held between two stops which are exactly 450 mm apart and the temperature of the bar is raised by $70^0$C. [16]

   (a) Find the stresses in the rod and tube if the distance between the stops is increased by 0.30 mm.

   (b) Find the increase in the distance between the stops if the force exerted between them is 90 kN

   Take $E_S = 200kN/mm^2$ ; $\alpha_S = 11.2 \times 10^{-6} per^0$C
   $E_b = 90kN/mm^2$ ; $\alpha_b = 2.1 \times 10^{-5} per^0$C

3. (a) How do you classify loads? Give examples. [4]

   (b) A simply supported beam of length 5m carries a uniformly increasing load of 800 N/m run at one end to 1600 N/m run at the other end. Draw the S.F. and B.M. diagrams for the beam. [12]

4. (a) State the assumptions involved in the theory of simple bending. [6]

   (b) Derive the Bending equation from fist principle. [10]

5. (a) A beam of length L is supported at each end with a couple applied at an intermediate point. Deduce an expression for the deflection and hence calculate the deflection at the point of application of the moment. [8]

   (b) A beam of length L carries a uniformly distributed load w/unit length and rests on three supports, two at the ends and one in the middle. Find how much the middle support be lower than the end ones in order that the pressures on the three supports shall be equal. [8]

6. (a) Derive a relation for the hoop stress at the junction of a compound thick cylindrical shell. [8]

(b) A steel cylinder is 1.5 m inside diameter and is to be designed for an internal pressure if 8 MN/ $m^2$. Calculate the thickness if the GN/ $m^2$ and Poisson's ratio = 1/3.Neglect any constraint due to ends. [8]

7. Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the above derivation ?

[16]

8. A propeller shaft, 160mm external diameter, 80mm internal diameter, transmits 450kW at 4/3 Hz. There is, at the same time, a bending moment of 30kN-m and an end thrust of 250kN. Find [16]

   (a) the maximum principal stresses and their planes

   (b) the maximum shear stress and its plane

   (c) the stress, which acting alone, will produce the same maximum strain. Take poisson's ratio = 0.3.

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