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B.E DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2011

Semester IV

**MECHANICAL ENGINEERING**

**CE 9213 – STRENGTH OF MATERIALS**

**(Regulation 2008)**

Time: 3 hours max: 100 marks

Answer ALL questions

**PART – A (10 x 2 = 20 marks)**

1. Write the relationship between the elastic modulii.
2. For a given plane stress system, the maximum shear stress values are ±100 MPa and the normal stress on these planes is 40 MPa. Find the principal stresses.
3. Draw the shear force and bending moment diagrams for a cantilever carrying a point load at the free end.
4. State the basic principles involved in the analysis of a composite beam.
5. If a shaft transmits 20 kW of power at 200 rpm, what is the torque generated?
6. What is the axial deflection of a close-coiled helical spring under axial load W?
7. Define conjugate beam
8. State the Maxwell's reciprocal theorems.
9. Write the stress components in a thin cylindrical shell subjected to internal pressure.
10. How many types of stresses are developed in thick cylinders? Name them.

**PART – B (5 x 16 = 80 marks)**

11. A shaft has to transmit a torque of 30 kNm. The maximum shear stress is not to exceed 100 MPa and the angle of twist is not to exceed 1° per metre length. Design the shaft according to the given specification if it is a (i) solid circular shaft and (ii) hollow circular shaft of internal diameter 90% of the external diameter. Take the shear modulus as 80 GPa.

12. (a) A steel rod of diameter 30 mm and length 500 mm is placed inside an aluminium tube of internal diameter 35 mm and external diameter 45 mm which is 1 mm longer than the steel rod. A load of 300 KN is placed on the assembly through the rigid collar. Find the stress induced in steel rod and aluminium tube. Take the modulus of elasticity of steel as 200 GPa and that of aluminium as 80 GPa

(Or)

(b) An element in a strained body is subjected to tensile stresses of 100 MPa and 70 MPa on two mutually perpendicular planes and an anticlockwise shear stress of 40MPa on the plane having the normal stress of 100 MPa. Find:

(i) the major and minor principal stresses and its corresponding principal planes.

(ii) the maximum shear stress and its corresponding planes.

(iii) Also the normal and tangential stresses on an inclined plane at 60° to the vertical plane.

13. (a) A horizontal beam AB of length 8m is simply supported at A and B. It carries a uniformly distributed load of 4 kN/m over the left half span and a clockwise moment of 10 kNm at 6m from A. Draw the shearing force and bending moment diagrams and determine the position and magnitude of maximum bending moment.

(Or)

(b) A symmetrical T section made with two rectangular planks of size 200mm x 20 mm is subjected to a vertical shear force of 100 kN. Calculate the shear stress at important points and draw shear stress distribution diagram.

14. (a) A horizontal beam of uniform section and 8m long is simply supported at its ends. The beam is subjected to a point load of 16KN at 3m from the left end and a clockwise concentrated moment of 10 kNm at 6m from the left end. Find slope and deflection at mid span using Macaulay's method.

(Or)

(b) A cantilever of span 4 m carries two point loads 8kNand 10 kN at mid span and free end respectively. Determine the slope and deflection of the cantilever at the free end by using strain energy method. Assume EI is uniform throughout.

15 (a) A thin cylindrical shell, 2m long has 200 mm diameter and 10 mm thickness. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 $mm^3$ fluid is pumped in, find the pressure developed and hoop stress developed. Find also the changes in diameter and length. Take modulus of elasticity of the wall material as 200GPa and Poisson's ratio as 0.3

(Or)

(b) A hydraulic cylinder with an internal diameter 300mm is subjected to an internal pressure of 12 $N/mm^2$. Determine the wall thickness based on

(i) maximum principal stress theory

(ii) maximum shear stress theory

(iii)maximum principal strain theory

(iv)maximum shear strain energy theory

Compare the results with wall thickness calculated based on thin cylinder assumption. Assume the yield stress of cylinder material to be 70 MPa.