B.E. DEGREE ARREAR EXAMINATION, NOV./DEC. 2013

IV SEMESTER

CIVIL ENGINEERING

CE 9251 STRENGTH OF MATERIALS –II {R 2008} /

CE 281 STRENGTH OF MATERIALS {R 2004}

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART – A (10 x 2 = 20 marks)

1. Write the expression for strain energy stored in a material due to shear stress.
2. State principle of virtual work.
3. Draw the shearing force and bending moment diagrams for a fixed beam when one of its supports rotates.
4. How do you analyze a fixed beam using theorem of three moment equations?
5. Define effective length of a column.
6. Show the core of the following column sections (i) rectangular (ii) circular.
7. What are the various stress invariants for a three dimensional state of stress?
8. State the criteria for failure of a material based on maximum shear stress theory.
9. What are the causes for unsymmetrical bending of beams?
10. State the assumptions made in Lame's theory for the analysis of thick cylinders.

PART – B (5 x 16 = 80 marks)

11. A cantilever AC with uniform cross section over the entire length 3 m is fixed at C and free at A. If it supports a uniformly distributed load of 20 kN/m for only half of its length from A, find the deflection and slope at A by energy method. Take EI =1 13 400 KN m^2.

12. (a) A fixed beam AB of span 4 m is carrying uniformly distributed load of 20 kN/m over the entire span. The support B sinks down by 12 mm. Determine the fixing moments at A and B, if the moment of inertia of the beam section is 9875 cm^4 and modulus of elasticity of the material of the beam is 200 GPa.

(Or)

(b) A continuous beam ABCD is simply supported at A and D and continuous over the supports B and C. The spans are AB = 6 m, BC = 4 m and CD = 5 m. The span AB carries a uniformly distributed load of 2 kN/m, the span BC carries a central concentrated load of 10 kN and the span CD carries a point load of 6 kN at a distance 2 m from D. Analyse the beam by theorem of three moments and draw the shearing force and bending moment diagrams. Assume EI is uniform throughout.

13 (a) (i) what are the assumptions made in Euler's column theory? (6)

(ii) Derive expression for Euler's crippling load of a column with both ends fixed from first principles. (10)

(Or)

(b) A 4 m long hollow circular cast iron column with fixed ends has 200 mm external diameter and 20 mm thickness. The column carries a load of 130 kN at an eccentricity of 30 mm from the axis of the column. Determine (i) the extreme stresses on the cross-section and (ii) the maximum eccentricity when there is no tension anywhere on the cross-section. The elastic modulus of the material of the column is 80 GPa.

14 (a) Determine the principal stresses for the state of stress at a point characterized by the components shown below as a stress tensor.

$$\begin{bmatrix} -16 & -20 & 0 \\ -20 & 35 & 0 \\ 0 & 0 & 10 \end{bmatrix} \text{ N/mm}^2$$

(Or)

(b) A metal sheet is to be used to fabricate a closed cylindrical vessel of 800 mm internal diameter which is to be subjected to an internal pressure of 2 MPa. The stipulated factor of safety, elastic limit stress under pure tension and the Poisson's ratio of the metal are: 3, 240 MPa and 0.3 respectively. Determine the necessary thickness of the sheet based on: (i) Maximum principal stress theory (ii) Maximum shear stress theory and (iii) Maximum strain energy theory.

15 (a) A rectangular beam section, 100 mm wide and 150 mm deep is subjected to a bending moment of 20 kN-m. The trace of the plane of loading is inclined at 40° to the YY axis of the section. Locate the neutral axis of the section and calculate the bending stress induced at each corner of the beam section.

(Or)

(b) A compound cylinder of 150 mm internal diameter and 250 mm external diameter is formed by shrinking one tube of 200 mm internal diameter and 250 mm external diameter on to another tube with an external diameter of 200 mm and internal diameter of 150 mm. Find the radial compressive stress between cylinders when the maximum tensile stress induced in the outer cylinder is 80 N/mm^2.