B.E. / B.Tech. Degree Examination, December 2020

Third Semester

CE16301-Strength of Materials - I

(Regulation 2016)

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. If the Young's modulus of elasticity of a material is twice its modulus of rigidity, then the Poisson's ratio of the material is

   (a) -1 (b) -0.5 (c) 0.5 (d) Zero

2. A 10 m long beam is supported over 6 m span with equal overhang on both the sides. It carries point loads of 40 kN each at its ends and a point load of 80 kN at the centre; if the points of contra flexure lie at a distance x from each end, the value of x is

   (a) 4.5 m (b) 4 m (c) 3 m (d) 2 m

3. If the deflection at the free end of a uniformly distributed loaded cantilever beam is 15 mm and the slope of the deflection curve at the free end is 0.02 radian, then the length of the beam is

   (a) 0.8 m (b) 1 m (c) 1.2 m (d) 1.5 m

4. On a plane, resultant stress is inclined at an angle of 30^0 with the plane. If the normal stress on the plane is 50 MPa, what is the shear stress on the plane?

   (a) 43.3 MPa (b) 86.6 MPa (c) 100 MPa (d) None of these

5. Determine the bulk modulus of a material having E=200 GPa and G=80 GPa.

6. Determine the Maximum shear force for a 2 m span simply supported beam subjected to a point load of 20 kN at the centre.

7. Draw the conjugate beam for a 2 m span simply supported beam subjected to a centre point load of 10 kN

8. Determine the power transmitted by a 75 mm diameter shaft at 140 rpm subjected to a maximum shear stress of 60 N/mm^2

PART B - (4 X16 = 64 marks)

9. (a) A steel tube of 50 mm external diameter and 5 mm thickness encloses centrally a copper bar of 30 mm diameter. The bar and the tube are rigidly connected together at the end at a temperature of 30^0C. The composite bar is subjected to a temperature raise of 150^0C. Determine the stresses in the steel tube and copper rod $\alpha_s=12x10^{-6}/^0C$, $\alpha_c=18x10^{-6}/^0C$, E_s=200 GPa and E_c=100 GPa. **(16)**

(OR)

   (b) A bar 30 mm diameter was subjected to a tensile load of 54 kN and measured extension on 300 mm gauge length was 0.12 mm and change in diameter was 0.00366 mm. calculate the Poisson's ratio and the values of three elastic moduli. **(16)**

10. (a) A simply supported beam of 8 m length carries three point loads of 8 kN, 4 kN and 10 kN at 2 m, 5 m and 6 m respectively from the left end. Draw the shear force and bending moment diagrams. **(16)**

(OR)

(b) An I- section with rectangular ends has the following dimensions: Flanges 100 mm x 10 mm and web 120 mm x 10 mm. If their section is subjected to a bending moment of 6 kNm and a shearing force of 5 kN, find the maximum bending stress and shear stress on it. **(16)**

11. (a) A simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m from the left support. Calculate (i) the slope at mid span and (ii) deflection at the load point. **(16)**

(OR)

(b) A cantilever of length L carries a point load W at its free end. The member is circular in section having diameter D for a distance L/2 from the fixed end and a diameter D/2 for the remaining length. Find the slopes and deflections at center point and at free end. **(16)**

12. (a) A shaft is required to transmit 245 kW power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 1^0 per meter length. Determine the diameter required if (a) the shaft is solid (b) the shaft is hollow with external diameter twice the internal diameter. Take modulus of rigidity = 80 kN/mm^2. **(16)**

(OR)

(b) A helical spring in which the mean diameter of the coil is eight times wire diameter is to be designed to absorb 0.2 kNm of energy with an extension of 100 mm. The maximum shear stress is not to exceed 125 N/mm^2. Determine the mean diameter of the spring, diameter of wire and the number of turns. Also find the load with which an extension of 40 mm could be produced in the spring. Assume modulus of rigidity C=84 kN/mm^2. **(16)**