16/05/19 AN

Reg. No. :

Question Paper Code : 80077

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third/Fourth Semester

Mechanical Engineering

CE 8395 — STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS

(Common to Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Marine Engineering/Material Science and Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation Engineering)

(Regulation 2017)

Time : Three hours　　　　Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you meant by thermal stress?
2. Define principal plane and principal stresses.
3. What is meant by point of contra-flexure?
4. What is ratio of maximum shear stress to the average shear stress in the case of solid circular section?
5. Write down the expression for power transmitted by a shaft.
6. Define helical springs.
7. A beam 3 m long, simply supported at its ends, is carrying a point load W at the centre. If the slope at the beam should not exceed 1°, find the deflection at the centre of the beam.
8. State Maxwell's reciprocal theorems.
9. Differentiate between a thin cylinder and a thick cylinder.
10. State Lame's theorem.

PART B — (5 × 13 = 65 marks)

11. (a) A steel rod of 3 cm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stress and pull exerted when the temperature falls to 30°C, if (i) the ends do not yield, and (ii) the ends yield by 0.12 cm. Take $E = 2 \times 10^5$ MN/m^2 and $\alpha = 12 \times 10^{-6}$ /° C.

Or

(b) An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress.

12. (a) Draw the shear force and bending moment diagrams for the overhanging be a carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig. 1.

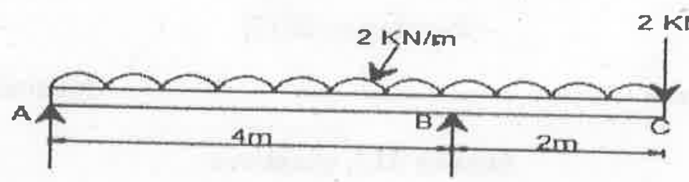

Fig. 1

Or

(b) A timber beam 100 mm wide and 200 mm deep is to be reinforced by bolting on two steel flitches each 150 mm by 12.5 mm in section. Calculate the moment of resistance when flitches are attached symmetrically at the top and bottom. Allowable stress in timber is 6 N/mm^2. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_t = 1 \times 10^4$ N/mm^2.

13. (a) Two shafts of the same material and of same lengths are subjected to the same torque, if the shaft is of a solid circular section and the second shaft is of hollow circular section, whose internal diameter is 2/3 of the outside diameter and the maximum shear stress developed in each shaft is the same, compare the weights of the shafts.

Or

(b) A closely coiled helical spring of mean diameter 20 cm is made up of 3 cm diameter rod and has 16 turns. A weight of 3 kN is dropped on this spring. Find the height by which the weight should be dropped before striking the spring so that the spring may be compressed by 18 cm. Take 8×10^4 N/mm^2.

14. (a) A beam of length 5 m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9 kN/m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is 7 N/mm^2 and central deflection is not exceed 1 cm.

Take E for beam material = 1×10^4 N/mm^2.

Or

(b) A simply supported beam of length 5 m carries a point load of 5 kN at a distance of 3 m from the left end. If $E = 2 \times 10^5$ N/mm^2 and $I = 10^8$ mm^4, determine the slope at the left support and deflection under the point load using conjugate beam.

15. (a) A cylindrical thin drum 80 cm in diameter and 3 m tong has a shell thickness of 1 cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine

(i) change in diameter

(ii) change in length and

(iii) change in volume.

Take $E = 2 \times 10^5$ N/mm^2, Poisson's ratio = 0.25.

Or

(b) A spherical shell of internal diameter 0.9 m and of thickness 10 mm is subjected to an internal pressure of 1.4 N/mm^2. Determine the increase in diameter and increase in volume. Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 1/3$.

PART C — (1 × 15 = 15 marks)

16. (a) An I – section beam 350 mm × 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. If the shear force acting on the section is 40 kN, find the maximum shear stress developed in the I – section. Also sketch the shear stress distribution across the section.

Or

(b) Derive an expression for the slope and deflection of a simply supported beam subjected to uniformly distributed load.

15. a) A cylindrical shell 100 cm long 18 cm internal diameter having thickness of metal as 8 mm is filled with fluid at atmospheric pressure. If an additional 20 cm^3 of fluid is pumped into cylinder find (i) the pressure exerted by the fluid on the cylinder and (ii) the hoop stress induced. Take Young's modulus $E = 2 \times 10^5$ N/mm^2 and poisson ratio = 0.3.

(OR)

b) Derive an expression for the radial pressure and hoop stress for a thick cylindrical shell.

PART – C (1×15=15 Marks)

16. a) A point in a strained material is subjected to stresses as shown in Fig. 16(a). Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Also verify the normal and tangential stresses analytically.

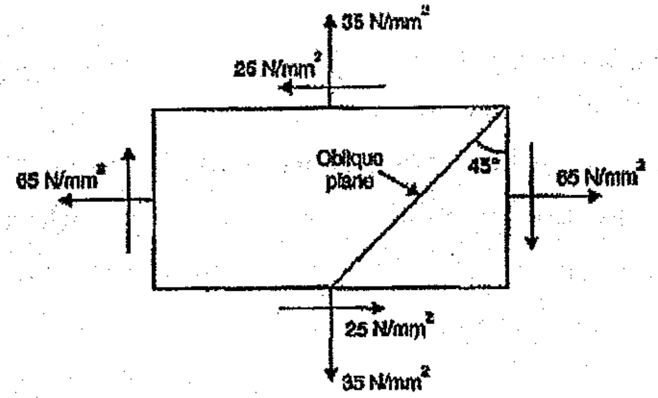

Fig. 16(a)

(OR)

b) A timber beam 150 mm wide and 200 mm deep is to be reinforced by bolting on two steel flitches each 150 mm by 12.5 mm in section. Find the moment of resistance when (i) flitches are attached symmetrically at top and bottom and (ii) the flitches are attached symmetrically at the sides. Allowable stress in timber is 6 N/mm^2. What is the maximum stress in steel in each case ? Take Youngs modulus of steel = 20 times Youngs modulus of wood.

Reg. No. :

Question Paper Code : 90117

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third/Fourth Semester

Aeronautical Engineering

CE 8395 – STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS

(Common to Aerospace Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Marine Engineering/Material Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation Engineering)

(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. A material has a Young's modulus of 1.25×10^5 N/mm^2 and a Poisson's ratio of 0.25. Calculate the modulus of rigidity.
2. What is meant by thermal stresses ?
3. What are the assumptions made in theory of simple bending ?
4. Draw the shear stress distribution of an I – section beam.
5. Why hollow circular shafts are preferred over solid circular shafts ?
6. Define torsional rigidity of a shaft.
7. What is the advantage of conjugate beam method over other methods ?
8. State Maxwell's reciprocal theorem.
9. Plot the radial pressure distribution and hoop stress distribution across the thickness of thick cylinder.
10. What do you understand by wire bound thin pipes ?

PART – B (5×13=65 Marks)

11. a) A steel bolt 25 mm diameter and 30 cm long passes through a copper tube having internal and external diameters of 30 mm and 40 mm respectively. The bolt has 4 threads per cm and the nut is initially just tight. Calculate (i) the angle through which nut is turned through to cause a tensile stress of 80 MPa in the bolt, (ii) stress in the tube, and (iii) the change in stress in the bolt and the tube due to an increase in temperature of 30°C. Young's modulus of steel = 200 GPa, Young's modulus of Copper = 100 GPa, co-efficient of linear expansion for steel = 10×10^{-6} per °C, co-efficient of linear expansion for copper = 15×10^{-6} per °C.

(OR)

b) Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter of 25 mm and of length 1.6 m, if the longitudinal strain in a bar during a tensile test is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. Take Young's modulus = 1×10^5 N/mm^2.

12. a) A horizontal beam is simply supported at the ends and carries a uniformly distributed load of 10 kN/m between the supports placed 10 m apart. Anticlockwise moments of 150 kNm and 100 kNm are applied to the left and right ends of the beam at the supports. Determine the position and magnitude of the maximum bending moment and draw shear force and bending moment diagrams.

(OR)

b) A simply supported wooden beam a span 1.3 m having a cross section 150 mm wide by 250 mm deep carries a point load W at the centre. The permissible stress are 7 N/mm^2 in bending and 1 N/mm^2 in shearing. Calculate the safe load W.

13. a) A solid circular shaft is to transmit 375 kW at 150 r.p.m.

i) Find the diameter of the shaft if the shear stress is not to exceed 65 N/mm^2. **(4)**

ii) What percent saving in weight would be obtained if this shaft is replaced by a hollow shaft whose internal diameter equal to 2/3rd of its external diameter, the length, the material and maximum shear stress being the same ? **(9)**

(OR)

b) A laminated steel spring, simply supported at the ends and centrally loaded, with a span of 75 cm is required to carry a proof load of 7500 N and the central deflection is not to exceed 5 cm. The bending stress must not be greater than 400 MPa. Plates are available in multiples of 1 mm for thickness and in multiples of 4 mm for width. Determine suitable values for the thickness, width and number of plates and the radius to which the plates should be formed. Assume the width to be twelve times the thickness. Youngs modulus = 200 GPa.

14. a) A beam AB simply supported at the ends is 8 m long. It carries a uniformly distributed load of intensity 10 kN/m over a length of 4 m starting at a distance of 4m from left end support together with a concentrated load of 48 kN at a distance of 2 m from left end support. Find using Macaulay's method (i) slope at each end (ii) Deflection at the centre and (iii) maximum deflection. Take Young's modulus = 200 kN/mm^2 and moment of inertia = 6.50×10^8 mm^4.

(OR)

b) A beam of length l is simply supported at the ends and carries a concentrated load W at a distance 'a' from each end. Find using conjugate beam method the slope at each end and under each load. Find also the deflection under each load and at the centre.