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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 $1.25 \times 10^5 \text{ N/mm}^2$ 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/mm². Take Young's modulus = 1×10^5 N/mm².

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/mm² in bending and 1 N/mm² in shearing. Calculate the safe load W.



13. a) A solid circular shaft is to transmit 375 kW at 150 r.p.m.
- Find the diameter of the shaft if the shear stress is not to exceed 65 N/mm^2 . (4)
 - What percent saving in weight would be obtained if this shaft is replaced by a hollow shaft whose internal diameter equal to $2/3^{\text{rd}}$ 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. Young's 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 = $6.50 \times 10^8 \text{ mm}^4$.

(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.



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 $E = 2 \times 10^5 \text{ N/mm}^2$ 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.

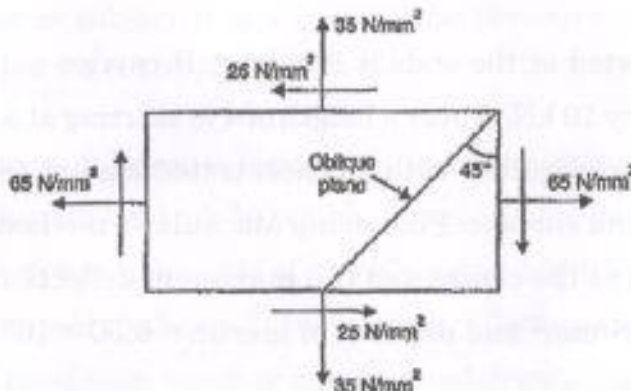


Fig. 16(a)

(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 Young's modulus of steel = 20 times Young's modulus of wood.