X20291 Reg. No. :

Question Paper Code : X 20291

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Third/Fourth Semester
Mechanical Engineering
CE 6306 – STRENGTH OF MATERIALS
(Common to Mechanical Engineering (Sandwich)/Agriculture Engineering/ Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Materials Science and Engineering/ Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering)
(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. What is meant by temperature stress ?
2. What is the pole of a Mohr circle ?
3. Describe the beam with its type.
4. State the flitch beam.
5. Write short notes on shaft.
6. Distinguish the springs in parallel and series.
7. How the conjugate beam method is used to find the deflection ?
8. Discuss the Macaulay's method.
9. List out the assumptions used in the Shells.
10. Write short notes on spherical shell and its advantages.

PART – B **(5×13=65 Marks)**

11. a) i) A hollow steel tube of external diameter 100 mm, is used to carry a compressive load of 456 kN. Find the internal diameter if the permissible stress is 150 Nmm^2. **(6)**

ii) A 25 mm diameter rod is subjected to an axial load P, and the strain in the rod is 0.00075. Find the tensile force P, if $E = 2 \times 10^5$ N/mm^2. **(7)**

(OR)

b) A steel cylinder is enclosed in a copper tube as shown in Fig 11. b. The cylinder and tube are compressed between rigid parallel plates. Find the stresses in the steel and copper and also the compressive strain. P = 450 kN, d = 100 mm and D = 200 mm. For steel E = 210 kN/mm^2 and for copper E = 110 kN/mm^2.

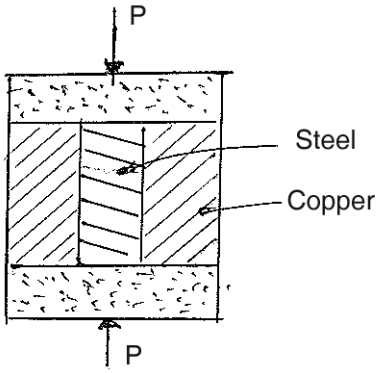
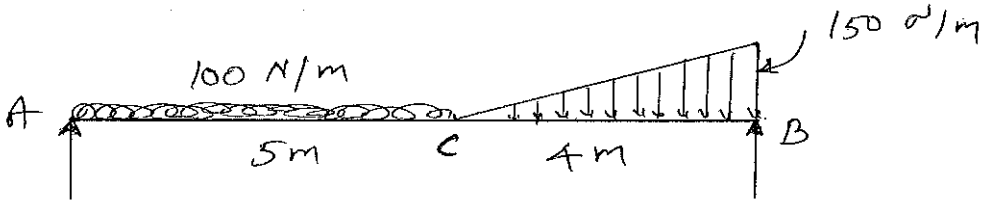


Fig. 11. (b)

12. a) i) Determine the reactions at the supports and draw S.F and B.M diagrams for the simply supported beam shown in Fig. 12. a. i. **(8)**



12. a (i)

ii) A timber joist of rectangular section 150 mm wide × 300 mm deep is freely supported over a span of 4 m and carries a uniformly distributed load 7.5 kN/m. Calculate the skin stresses at 0.5 m intervals from the left-hand support. **(5)**

(OR)

b) Draw shear and moment diagrams for the overhanging beam shown in Fig. 12. b.

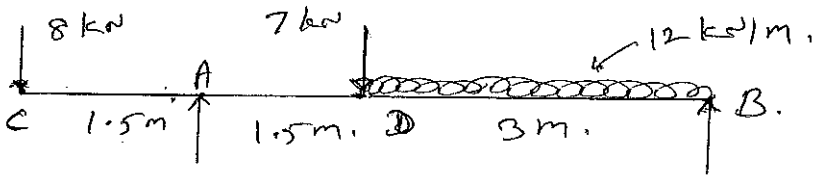


Fig. 12 (b)

13. a) i) 2250 kW has to be transmitted at 1 Hz. If the permissible shear stress is 80 N/mm^2. Determine the necessary diameter for a solid of circular section. If a hollow circular section is used with its internal diameter = 0.75 times external diameter. **(8)**

ii) A helical spring is made of 10 mm diameter and the coil diameter is 150 mm with 12 active numbers. Find the spring stiffness and the external force to have 50 mm of elongation, if C = 80 GN/m^2. **(5)**

(OR)

b) i) A hollow shaft of internal diameter 150 mm and external diameter of 250 mm is subjected to a torque of 150 kNm. Determine the shear stress at a point on the internal periphery of the shaft if G = 83 GPa. **(5)**

ii) A composite shaft, consisting of a solid brass rod 32 mm diameter encased in a steel tube 50 mm external and 40 mm internal diameter is subjected to a pure torque of 1000 Nm. Assuming that the angle of twist for a given length of shafting is the same, evaluate the maximum shear stresses in steel and brass. Consider, $G_{steel} = 2\ G_{brass}$. **(8)**

14. a) A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Find deflection under the 48 kN load by Macaulay's method. Let E = 2×10^5 N/mm^2 and I = 85×10^6 mm^4. **(13)**

(OR)

b) i) A cantilever of length 3 m carries a uniformly distributed load of 80 kN/m length over the entire length. If, E = 2×10^8 kN/m^2 and I = 10^8mm^4, find the slope and deflection at the free end using conjugate beam method. **(8)**

ii) Find the deflection of a simply supported beam of length 4.85 m and carrying a uniformly distributed load of 18 kN/m, by moment area method. Let EI = 9750 kN.m^2. **(5)**

15. a) i) A cylindrical shell of 80 mm internal diameter and 1.2 mm thick is closed at the ends and subjected to internal fluid pressure so that the maximum direct stress in the tube is 120 N/mm2. Determine the percentage increase in the capacity of the tube. Consider E = 2×10^5 N/mm^2 and 1/m = 0.3. **(8)**

ii) Calculate the thickness of metal required for a C.I. water main 800 mm diameter, for water under a static head of 100 m, if the permissible tensile stress is 20 N/mm^2. Consider unit weight of water w = 10 kN/m^3. **(5)**

(OR)

b) A thick cylinder whose external diameter is k times its internal diameter is subjected to an internal pressure. If the ratio of the maximum to minimum hoop stress is η, find the relation between η and k. If the maximum hoop stress 45 N/mm^2 and the value of η is 2.5, find the internal radial pressure exerted and the necessary thickness of metal if the diameter of the bore is 150 mm.

PART – C **(1×15=15 Marks)**

16. a) i) At a point in a strained material, there are two planes at right angles to each other on which the normal stresses are 75 MN/m^2, tensile on one plane and 45 MN/m^2 compressive on the other plane accompanied by a shear stress. If the major principal stress is 105 MN/m^2 tensile, evaluate the shear on the two planes. Calculate the minor principal stress and also the maximum shear stress at a point. **(7)**

ii) A hard rubber block completely confined in the x-direction but free to expand both in the y and z-directions, is subjected to a compressive stress σ_2= 2N/mm^2 in the y-direction as shown in Fig 16.a. ii. Calculate the stress σ_1 in the x-direction. What is the change in volume of the block if E = 2 MN/m^2 and 1/m = 0.5 ? **(8)**

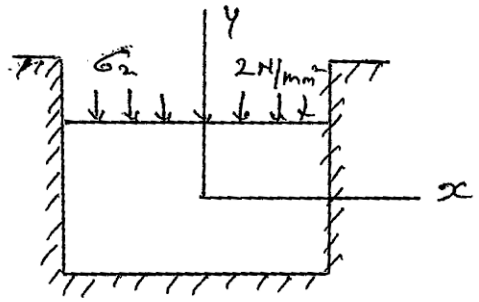


Fig 16 a (ii)

(OR)

b) A compound strut consist of a brass portion AB of diameter 75 mm and a steel portion BC of 40 mm diameter. The supports at A and C are rigid. If the temperature is raised through 140°C, find (a) the force exerted on the supports and (b) the relative movement of the junction B. **(15)**

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