STRENGTH OF MATERIALS CE2259 ANNA UNIVERSITY QUESTION BANK

CE1259 STRENGTH OF MATERIALS

UNIT I

STRESS STRAIN DEFORMATION OF SOLIDS

PART- A (2 Marks)

1. What is Hooke's Law?
2. What are the Elastic Constants?
3. Define Poisson's Ratio.
4. Define: Resilience, proof resilience and modulus of resilience.
5. Distinguish between rigid and deformable bodies.
6. Define stress and strain.
7. Define Shear stress and Shear strain.
8. Define elastic limit.
9. Define volumetric strain.
10. Define tensile stress and compressive stress.
11. Define young's Modulus.
12. Define modulus of rigidity.
13. Define thermal stress.

PART- B (16 Marks)

1. A rod of 150 cm long and diameter 2.0cm is subjected to an axial pull of 20 KN. If the modulus of elasticity of the material of the rod is 2x 105 N/mm2
Determine 1. Stress 2. Strain 3. the elongation of the rod (16)
2. The extension in a rectangular steel bar of length 400mm and thickness 10mm is found to 0.21mm .The bar tapers uniformly in width from 100mm to 50mm. If E for the bar is 2x 105 N/mm2 ,Determine the axial load on the bar (16)
3. A rod of 250 cm long and diameter 3.0cm is subjected to an axial pull of 30 KN. If the modulus of elasticity of the material of the rod is 2x 105 N/mm2 Determine 1. Stress 2. Strain 3. the elongation of the rod (16)
4. Find the young's modulus of a rod of diameter 30mm and of length 300mm which is subjected to a tensile load of 60 KN and the extension of the rod is equal to 0.4 mm (16)
5. The extension in a rectangular steel bar of length 400mm and thickness 3mm is found be 0.21mm .The bar tapers uniformly in width from 20mm to 60mm E for the bar is 2x 105 N/mm2 Determine the axial load on the bar. (16)
6. The ultimate stress for a hollow steel column which carries an axial load of 2Mn is 500 N/mm2 .If the external diameter of the column is 250mm, determine the internal diameter Take the factor of safety as 4.0 (16)

UNIT II

BEAMS – LOADS AND STRESSES

PART- A (2 Marks)

1. State the different types of supports.
2. What is cantilever beam?
3. Write the equation for the simple bending theory.

4. What do you mean by the point of contraflexure?
5. Define beam.
6. Define shear force and bending moment.
7. What is Shear stress diagram?
8. What is Bending moment diagram?
9. What are the types of load?
10. Write the assumption in the theory of simple bending.
11. What are the types of beams?
12. When will bending moment is maximum.

PART- B (16 Marks)

1. Three planks of each 50 x200 mm timber are built up to a symmetrical I section for a beam. The maximum shear force over the beam is 4KN. Propose an alternate rectangular section of the same material so that the maximum shear stress developed is same in both sections. Assume then width of the section to be 2/3 of the depth. (16)
2. A beam of uniform section 10 m long carries a udl of KN/m for the entire length and a concentrated load of 10 KN at right end. The beam is freely supported at the left end. Find the position of the second support so that the maximum bending moment in the beam is as minimum as possible. Also compute the maximum bending moment (16)
3. A beam of size 150 mm wide, 250 mm deep carries a uniformly distributed load of w kN/m over entire span of 4 m. A concentrated load 1 kN is acting at a distance of 1.2 m from the left support. If the bending stress at a section 1.8 m from the left support is not to exceed 3.25 N/mm2 find the load w. (16)
4. A cantilever of 2m length carries a point load of 20 KN at 0.8 m from the fixed end and another point of 5 KN at the free end. In addition, a u.d.l. of 15 KN/m is spread over the entire length of the cantilever. Draw the S.F.D, and B.M.D. (16)
5. A Simply supported beam of effective span 6 m carries three point loads of 30 KN, 25 KN and 40 KN at 1m, 3m and 4.5m respectively from the left support. Draw the SFD and BMD. Indicating values at salient points. (16)
6. A Simply supported beam of length 6 metres carries a udl of 20KN/m throughout its length and a point of 30 KN at 2 metres from the right support. Draw the shear force and bending moment diagram. Also find the position and magnitude of maximum Bending moment. (16)
7. A Simply supported beam 6 metre span carries udl of 20 KN/m for left half of span and two point loads of 25 KN end 35 KN at 4 m and 5 m from left support. Find maximum SF and BM and their location drawing SF and BM diagrams. (16)

UNIT III

TORSION

PART-A (2 Marks)

1. Define torsional rigidity of the solid circular shaft.
2. Distinguish between closed coil helical spring and open coil helical spring
3. What is meant by composite shaft?
4. What is called Twisting moment?
5. What is Polar Modulus ?
6. Define: Torsional rigidity of a shaft.
7. What do mean by strength of a shaft?
8. Write down the equation for Wahl factor.
9. Define: Torsional stiffness.
10. What are springs? Name the two important types.

PART- B (16 Marks)

1. Determine the diameter of a solid shaft which will transmit 300 KN at 250 rpm. The maximum shear stress should not exceed 30 N/mm2 and twist should not be more than 10 in a shaft length 2m. Take modulus of rigidity = 1x 105N/mm2. (16)
2. The stiffness of the closed coil helical spring at mean diameter 20 cm is made 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 C= 8x104 N/mm2. (16)
3. It is required to design a closed coiled helical spring which shall deflect 1mm under an axial load of 100 N at a shear stress of 90 Mpa. The spring is to be made of round wire having shear modulus of 0.8 x 105 Mpa. The mean diameter of the coil is 10 times that of the coil wire. Find the diameter and length of the wire. (16)
4. A steel shaft ABCD having a total length of 2400 mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80 mm and 50 mm respectively, BC is solid and 80 mm diameter. CD is also solid and 70 mm diameter. If the angle of twist is same for each section, determine the length of each portion and the total angle of twist. Maximum permissible shear stress is 50 Mpa and shear modulus 0.82 x 105 MPa (16)
5. The stiffness of close coiled helical spring is 1.5 N/mm of compression under a maximum load of 60 N. The maximum shear stress in the wire of the spring is 125 N/mm2. The solid length of the spring (when the coils are touching) is 50 mm. Find the diameter of coil, diameter of wire and number of coils. C = 4.5 (16)

UNIT IV

BEAM DEFLECTION

PART-A (2 Marks)

1. What are the advantages of Macaulay method over the double integration method, for finding the slope and deflections of beams?
2. State the limitations of Euler’s formula.
3. Define crippling load.
4. State Mohr’s theorem.
5. State any three assumption made in Euler’s column theory.
6. What are the different modes of failures of a column?
7. Write down the Rankine formula for columns.
8. What is effective or equivalent length of column?
9. Define Slenderness Ratio.
10. Define the terms column and strut.

PART- B (16 Marks)

1. A simply supported beam of 10 m span carries a uniformly distributed load of 1 kN/m over the entire span. Using Castigliano’s theorem, find the slope at the ends. EI = 30,000 kN/m2. (16)
2. A 2m long cantilever made of steel tube of section 150 mm external diameter and10mm thick is loaded. If E=200 GN/m2 calculate (1) The value of W so that the maximum bending stress is 150 MN/m (2) The maximum deflection for the loading (16)

3. A beam of length of 10 m is simply supported at its ends and carries two point loads of 100 KN and 60 KN at a distance of 2 m and 5 m respectively from the left support.
Calculate the deflections under each load. Find also the maximum deflection.
Take I = 18 X 108 mm4 and E = 2 X 105. (16)
4. i) A column of solid circular section, 12 cm diameter, 3.6 m long is hinged at both ends. Rankine's constant is 1 / 1600 and c = 54 KN/cm2. Find the buckling load.
ii) If another column of the same length, end conditions and rankine constant but of
12 cm X 12 cm square cross-section, and different material, has the same buckling load, find the value of c of its material. (16)
5. A beam of length of 6 m is simply supported at its ends. It carries a uniformly distributed load of 10 KN/m as shown in figure. Determine the deflection of the beam at its mid-point and also the position and the maximum deflection. Take EI=4.5 X 108 N/mm2. (16)
6. An overhanging beam ABC is loaded as shown is figure. Determine the deflection of the beam at point C. Take I = 5 X 108 mm4 and E = 2 X 105 N/mm2. (16)

7. A cantilever of length 2 m carries a uniformly distributed load of 2.5 KN/m run for a length of 1.25 m from the fixed end and a point load of 1 KN at the free end. Find the deflection at the free end if the section is rectangular 12 cm wide and 24 cm deep and E=1 X 104 N/mm2 (16)
8. A cantilever of length 2m carries a uniformly distributed load 2 KN/m over a length of 1m from the free end, and a point load of 1 KN at the free end. Find the slope and deflection at the free end if E = 2.1 X 105 N/mm2 and I = 6.667 X 107 mm4 . (16)
9. Determine the section of a hollow C.I. cylindrical column 5 m long with ends firmly built in. The column has to carry an axial compressive load of 588.6 KN. The internal diameter of the column is 0.75 times the external diameter. Use Rankine's constants.
a = 1 / 1600, c = 57.58 KN/cm2 and F.O.S = 6. (16)

UNIT V

ANALYSIS OF STRESSES IN TWO DIMENSIONS

PART-A (2 Marks)

1. Distinguish between thick and thin cylinders.
2. Define Principal planes and principal stress.
3. Define: Thin cylinders. Name the stresses set up in a thin cylinder subjected to internal fluid pressure.
4. What is Mohr's circle & name any the situations where it is used?
5. Define principal planes and principal stresses.
6. Draw Mohr's Circle for given shear stress q.
7. What is the necessary condition for maximum shear stress?
8. Define Obliquity.
9. Define Strain energy and resilience.
10. Define proof resilience and modulus of resilience.

PART- B (16 Marks)

1. A Thin cylindrical shell 3 m long has 1m internal diameter and 15 mm metal thickness. Calculate the circumferential and longitudinal stresses induced and also the change in the dimensions of the shell, if it is subjected to an internal pressure of1.5 N/mm2 Take E = 2x105 N/mm2 and poison's ratio =0.3. Also calculate change in volume. (16)
2. A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under pressure of 3 N/mm2 The diameter of the cylinder is 25cm and length is 75 cm. Calculate the longitudinal and

hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take E =2.1x105 N/mm2 and 1/m = 0.286. (16)

3. A rectangular block of material is subjected to a tensile stress of 110 N/mm2 on one plane and a tensile stress of 47 N/mm2 on the plane at right angle to the former plane and a tensile stress of 47 N/mm2 on the plane at right angle to the former. Each of the above stress is accompanied by a shear stress of 63 N/mm2 Find (i) The direction and magnitude of each of the principal stress (ii) Magnitude of greatest shear stress (16)

4. At a point in a strained material, the principal stresses are100 N/mm2 (T) and 40 N/mm2 (C). Determine the resultant stress in magnitude and direction in a plane inclined at 600 to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point? (16)

5. A rectangular block of material is subjected to a tensile stress of 210 N/mm2 on one plane and a tensile stress of 28 N/mm2 on the plane at right angle to the former plane and a tensile stress of 28 N/mm2 on the plane at right angle to the former. Each of the above stress is accompanied by a shear stress of 53 N/mm2 Find (i) The direction and magnitude of each of the principal stress (ii) Magnitude of greatest shear stress (16)

6 A closed cylindrical vessel made of steel plates 5 mm thick with plane ends, carries fluid under pressure of 6 N/mm2 The diameter of the cylinder is 35cm and length is 85 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take E =2.1x105 N/mm2 and 1/m = 0.286.(16)

7. At a point in a strained material, the principal stresses are 200 N/mm2 (T) and 60 N/mm2 (C) Determine the direction and magnitude in a plane inclined at 600 to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point (16)

8. At a point in a strained material, the principal stresses are 100 N/mm2 (T) and 40 N/mm2 (C) Determine the direction and magnitude in a plane inclined at 600 to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point (16)