SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code : Strength of Materials-II (16CE111) **Course & Branch**: B.Tech - CE

Year &Sem: II-B.Tech & II-Sem **Regulation:** R16

UNIT –I

PRINCIPAL STRESSES AND STRAINS

1. The principle tensile stresses at a point across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2.Find

i) The normal and shear stress and the resultant stress and its obliquity on a plane at 20^0 with the major principal plane.

ii) The intensity of stress which acting alone can produce the same maximum strain. Take Poisson's ratio=0.25 [12M]

2. A rectangular block of material is subjected to a tensile stress of110 N/mm^2 on one plane and a tensile stress of 47 N/mm^2 on the plane at right angles to the former. Each of the above stresses is accompanied by a shear stress of 63 N/mm^2 and that associated with the former tensile stress tends to rotate the block anticlockwise. Find:

i) The direction and magnitude of each of the principal stress and

ii) Magnitude of the greatest shear stress. [12M]

3. The normal stress in two mutually perpendicular directions are 600N/mm^2 and 300N/mm^2 both tensile. The complimentary shear stresses in these directions are of intensity 450 N/mm^2. Find the normal, tangential stresses on the two planes which are equally inclined to the planes carrying the normal stresses mentioned above. [12M]

4. Direct stresses of 120 N/mm^2 tensile and 90 N/mm^2 compressive exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at a point due to these is 150 N/mm^2.

i) What must be the magnitude of shearing stresses on the two planes?

ii) What will be the maximum shearing stress at the point? [12M]

5. At a point in a strained material, the stresses on two planes, at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are also accompanied by shear stress of a magnitude of 10 N/mm^2.Find the location of principal planes and evaluate the principal stresses? [12M]

6. The stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2(compressive). Use graphical method; determine the resultant stress in magnitude and direction on a plane inclined at 60^0 to the axis

of the major stress. Also determine the maximum intensity of shear stress in the material at the point. [12M]

7. The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2. Using Mohr's circle method determine the normal, tangential and resultant stresses on a plane inclines at 30^0 to the axis of the minor stress. [12M]

8. 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. [12M]

9. a) Explain maximum strain energy theory. [6M]

b) Explain maximum principal strain theory. [6M]

10. a) Explain maximum shear stress theory. [6M]

b) Explain maximum shear strain energy theory. [6M]

UNIT –II

THIN & THICK CYLINDERS

1. A cylindrical thin drum 80 cm in diameter and 3 m long 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= 2x 10^5 N/mm^2 Poisson's ratio 0.25. [12M]

2. A cylindrical vessel, whose ends are closed by means of rigid flange plates, is made of steel plate 3 mm thick. The length and the internal diameter of the vessel are 50 cm and 25 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 3 N/mm^2. Also calculate the increase in length, diameter and volume of the vessel. Take E as 2x 10^5 N/mm^2 and Poisson's ratio 0.3. [12M]

3. A copper cylinder, 90 cm long, 40 cm external diameter and wall thickness 6 mm has its both ends closed by rigid blank flanges. It is initially full of oil at atmospheric pressure. Calculate additional volume of oil which must be pumped into it in order to raise the oil pressure to 5 N/mm^2 above atmospheric pressure. For copper assume E= 1.0 x 10^5 N/mm^2 and Poisson's ratio 1/3. Take bulk modulus of oil as K= 2.6 x 10^3 N/mm^2. [12M]

4. A cast iron pipe 200 mm internal diameter and 12 mm thick is wound closely with a single layer of circular steel wire of 5 mm diameter, under a tension of 60 N/mm^2. Find the initial compressive stress in the pipe section. Also find the stresses set up in the pipe and steel wire, when water under a pressure of 3.5 N/mm^2 is admitted in to the pipe. Take E = 1 x 10^5 N/mm^2 for cast iron and for steel E = 2 x 10^5 N/mm^2.poisson's ratio is given as 0.3. [12M]

5. Derive an expression for wire winding of thin cylinder [12M]

6. Calculate the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to withstand an internal pressure of 8 N/mm^2, if maximum hoop stress in the section is not exceed to 35 N/mm^2. [12M]

7. Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of 8 N/mm$^{2.}$ Also sketch the radial pressure and hoop stress distribution across the section. [12M]

8. A compound cylinder is made by shrinking a cylinder of external diameter 300 mm and internal diameter of 250 mm over another cylinder of external diameter 250 mm and internal diameter 200 mm. The radial pressure at the junction after shrinking is 8 N/mm^2. Find the final stresses set up across the section, when the compound cylinder is subjected to an internal fluid pressure of 84.5 N/mm^2. [12M]

9. A steel cylinder of 300 mm external diameter is to be shrunk to another steel cylinder of 150 mm internal diameter. After shrinking, the diameter at the junction is 250 mm and radial pressure at the common junction is 28 N/mm^2. Find the original difference in radii at the junction. Take E = 2 x 10^5

N/mm^2. [12M]

10. A thick spherical shell of 200 mm internal diameter is subjected to an internal fluid pressure of 7 N/mm^2. If the permissible tensile stress in the shell material is 8 N/mm^2, find thickness of the shell.

[12M]

UNIT –III

DIRECT &BENDING STRESS AND SPRINGS

1. A line of thrust, in a compression testing specimen 15 mm diameter, is parallel to the axis of the specimen but is displaced from it. Calculate the distance of the line of thrust from the axis when the maximum stress is 20 %greater than the mean stress on a normal section. [12M]

2. A masonry dam of rectangular section, 20 m high and 10 m wide, has water upto a height of 16 m on its one side find:

i) Pressure force due to water on one meter length of the dam

ii) Position of centre of pressure

iii) The position at which the resultant cuts the base and

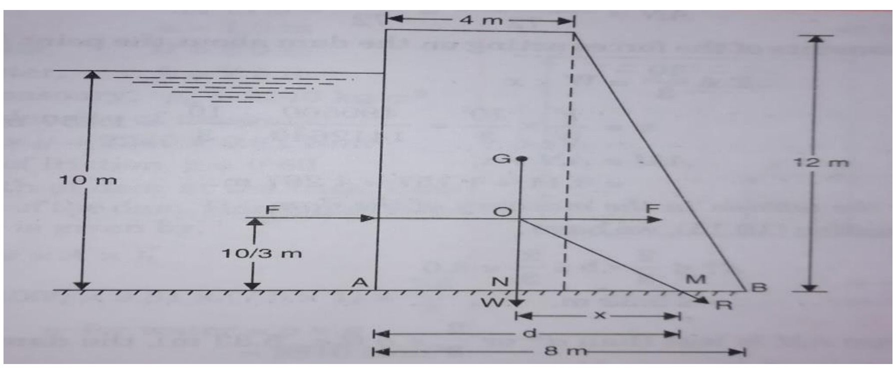
iv) Maximum and minimum intensities at the base of the dam. Take weight density of masonry is 19.62 kN/m^3 and of water 9.81 kN/m^3 [12M]

3. Derive kernel of section for Rectangular, Circular and Hallow Circular sections [12M]

4. a) Derive the equation for resultant stresses when a column of rectangular section is subjected to a load which is eccentric to both axes [7M]

b) A short column of rectangular cross-section 80 mm by 60 mm carries a load of 40 KN at a point 20 mm from the longer side and 35 mm from the shorter side. Determine the maximum compressive and tensile stresses in the section. [5M]

5. A trapezoidal masonry dam having 4 m top width, 8 m bottom width and 12 m high, is retaining water upto a height of 10 m as shown in fig. The density of masonry is 2000 kg/m^3 and coefficient of friction between dam and soil is 0.55. The allowable compressive stress is 343350 N/m^2. Check the stability of dam. [12M]



6. (a) Derive the expression for closely-coiled helical spring subjected to an axial load. [6M]

b) A closely coiled helical spring of round steel wire 10 mm in diameter having 10 complete coils of 12 cm diameter is subjected to an axial load of 200 N. Find the deflection of the spring and the maximum shearing stress in the material. Take C=8*10^4 N/mm^2. [6M]

7. A closely coiled helical spring of 100 mm mean diameter is made of 10 mm diameter and has 20 turns. The spring carries an axial load of 200 N. Determine the shearing stress, take value of the modulus of rigidity =8.4*10^4 N/mm^2. Determine the deflection when carrying this load. Also calculate the stiffness of the spring and frequency of free vibrations for a mass hanging from it. [12M]

8. A closely coiled helical spring of mean diameter 20 cm is made of 3 cm diameter rod 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 = 8 x 10^4 N/mm^2. [12M]

9. The stiffness of a close-coiled helical spring is 1.5 N/mm of compression under a maximum load of 60N. The maximum shearing stress produced in the wire of the spring is 125 N/mm^2. The solid length of the spring (When the coils are touching) is given as 5cm. Find i) Diameter of the wire ii) Mean diameter of the coils iii) Number of coils required Take C= 4.5*10^4 N/mm^2. [12M]

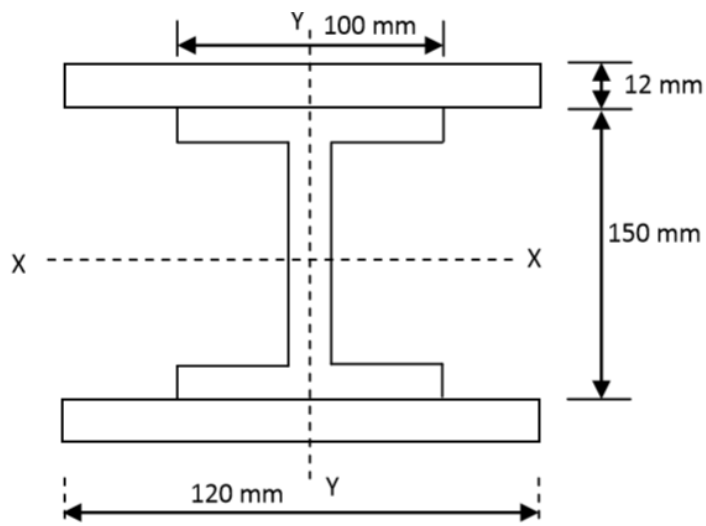
10. a) Derive expression for maximum bending stress and central deflection for laminated spring. [6M]

b) A leaf spring carries a central load of 3000 N. The leaf spring is to be made of 10 steel plates 5 cm width and 6 mm thick. If the bending stress is limited to 150 N/mm^2 determine length of the spring and deflection at centre of the spring. Take E= 2*10^5 N/mm^2. [6M]

UNIT – IV

COLUMNS AND STRUTS

1. (a) Determine the crippling load on a column when both ends of columns are hinged. [7M]
(b) An angular section 240 x 120 x 20 mm is used as 6 m long column with both ends are fixed. What is the crippling load for the column? Take E = 210 GPa. [5M]
2. Design a hollow circular mild steel column, 6 m long, one end fixed and other end is hinged, to carry an axial load of 500 kN. Take the factor of safety as 3. The internal diameter is 0.65 times of the external diameter. The Rankine's constants are 320 MPa and 1/7500. [12M]
3. Drive the equation for the Euler's crippling load for a both ends are fixed. [12M]
4. a) Define Crippling load and Effective length of a column [2M]
Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Determine the crippling load by Rankine's formula. Take E = 205 GPa, Yield stress = 335 N/mm^2 and Rankine's constant (α) = 1/7500. [10M]
5. a) What are the assumptions made in Euler's column theory [4M]
b) A round steel bar of 16 mm diameter and 2 m length is subjected to a gradually increasing axial compressive load. Determine the buckling load, safe load when FOS = 4 and also the maximum deflection when both the ends are fixed. Take E = 2 x 10^5 MPa. [8M]
6. Derive Rankine formula for crippling load. [12M]
7. Derive an Euler's load expression for the column with one end fixed and the other end hinged. [12M]
8. A Built-Up column consisting of 150 mm × 100 mm R.S.J with 20 mm × 12 mm riveted in each plane as shown in figure given below. Calculate the safe load of the column carry of 4 m long having one end fixed and the other hinged with a factor of safety 3.5. Take the properties of the joist: area = 2167 mm^2, I_{XX} = 8.39 × 106 mm4, I_{YY} = 0.945 × 106 mm4. Assume the yield stress as 315 MPa and Rankine's constant (α) = 1/7500. [12M]



9 (a) What are the limitations of Euler's theory? [3M]

(b) Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Determine the crippling load by Rankine's formula. Take E = 205 GPa, Yield stress = 335 N/mm^2 and Rankine's constant (α) = 1/7500 [9M]

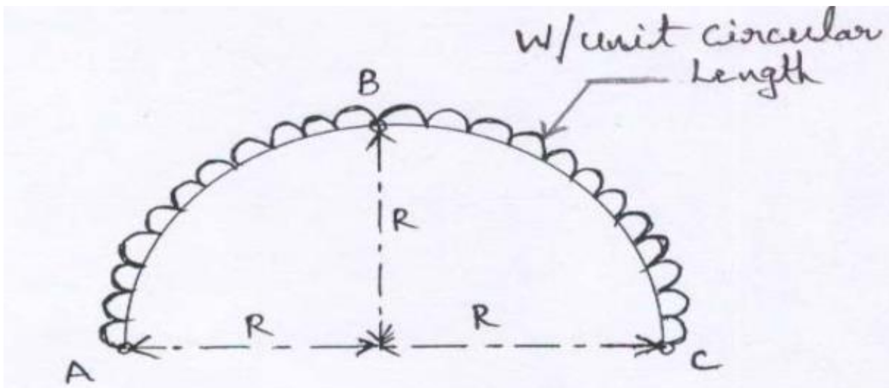
10. An I section has an overall depth of 400 mm, width of flanges are 150 mm, thickness of web and flanges are 30 mm. It is used as a beam with simply supported ends and it deflects by 10 mm when subjected to a load of 40 kN/m length. Find the safe load if this I-section is used as a column with both ends hinged. Use Euler's formula. Assume a factor of safety 1.75 and take $E = 2 \times 10^5$ N/mm^2. [12M]

UNIT – V

UNSYMETRICAL BENDING & BEAMS CURVED IN PLAN

1. (a) What is unsymmetrical bending? [2M]
(b) Determine the principal moments of inertia for an unequal angle section 200 x 150 x 10 mm. [10M]

2. A curved beam as shown in figure below is semicircular in plan and supported on three equally spaced supports. The beam carries a uniformly distributed load per unit of the circular length. Analyze the beam and sketch the bending moment and twisting moment diagrams. [12M]



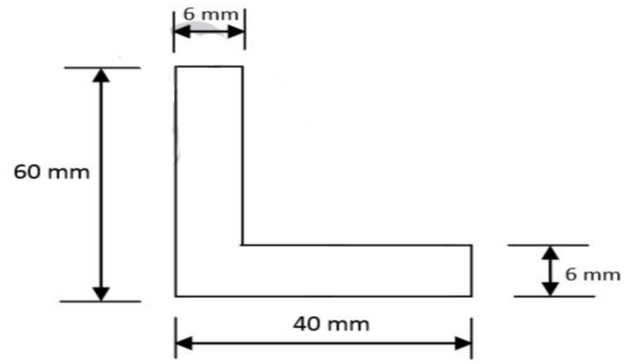
3. A 40 mm x 40 mm x 5 mm angle is used as a simply supported beam over a span of 2.4 m. It carries a load of 200 N along the vertical axis passing through the centroid of the section. Determine the resulting bending stresses on the outer corners of the section. [12M]

4. A steel bar 38 mm in diameter is bent into a curve of mean radius 31.7 mm. If a bending moment of 4.6 N-m tending to increase the curvature acts on the bar, find the intensity of maximum tensile stress. [12M]

5. A beam of rectangular section, 80 mm wide and 120 mm deep is subjected to a bending moment of 20kN-m. The trace of the plane of loading is inclined at 45° to the YY-axis. Locate the neutral axis of the section and calculate bending stress induced at each corner of beam. [12M]

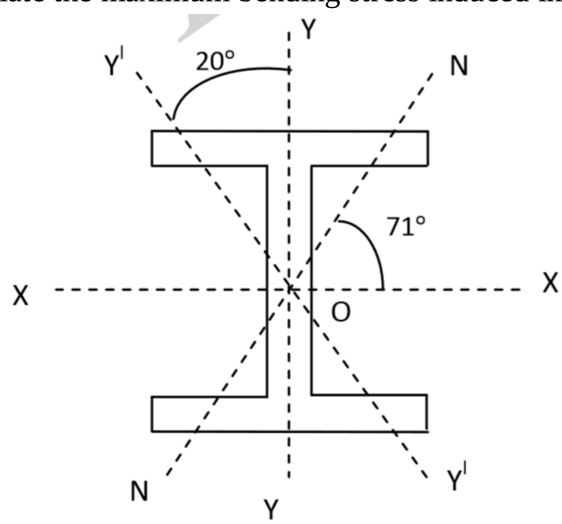
6. Calculate the stresses in curved beams and state the assumptions made in the analysis of curved beams. [12M]

7. Determine the principal moment of inertia for unequal angle section 60 × 40 × 6 mm shown in figure below. [12M]



8. A beam of circular section of diameter 20 mm has its centre line curved to a radius 50 mm. Find the intensity of maximum stresses in the beam, when subjected to a moment of 5 kN-mm. [12M]

9. An ISWB 200 mm x 140 mm rolled steel beam is freely supported over a span of 2 m as shown in figure below. It is subjected to a bending moment of 10 kNm at the central section, the trace OY1 of the plane loading being inclined at 200 to the principal axis OY. If Ixx = 2642.5 cm4 and Iyy = 328.8 cm4, locate then neutral axis and calculate the maximum bending stress induced in the section. [12M]



10. A curved beam is in the form of full continuous circle in plane with a radius of 4 m and is supported continuously on six supports. The beam carrying a uniformly distributed load of 2 kN/m length inclusive of its own weight. Determine the bending moment and twisting moment at salient locations. The coefficients C1, C2 and C3 are 0.089, 0.045 and 0.009 respectively. Plot the bending moment and twisting moment diagram. [12M]

PREPARED BY: S.Sudha & M.Manikantan