# DEPARTMENT OF CIVIL ENGINEERING

## STRENGTH OF MATERIALS -II

## QUESTION BANK

**YEAR: II B.TECH / II SEM**

**UNIT-I**

1. Write about Principal stress theory. Discuss briefly the maximum principal stress theory.
2. What are the different Theories of Failures and Explain about Mohr's circle?
3. Explain about Normal and tangential stresses on an inclined plane, Show that the greatest shear strain is equal to greatest difference of principal strains
4. Derive an expression for the major and minor principal stresses on an oblique plane, when the body is subjected to direct stresses in two mutually perpendicular directions accompanied by a shear stress
5. Direct stresses of 120 N/mm$^2$ (tensile) and 90 N/mm2 (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 the point due to these is 150 N/mm$^{2.}$

(i) What must be the magnitude of the shearing stresses on the two planes?
(ii) What will be the maximum shearing stress at the point?

6. a)Derive an expression for the normal stress and shear stress on an oblique section of a
rectangular body when it is subjected to direct stress in one plane only.
b) A rectangular element is a strained body is subjected to tensile stresses of 250 N/mm$^2$
and 180 N/mm2 on mutually perpendicular planes together with a shear stress of 80N/mm$^2$. Determine: i) Principal stresses ii) Principal planes
iii) Maximum shear stress and iv) Plane of maximum shear stress

7. A circular shaft 100 mm diameter is subjected to combined bending and twisting of moments
the B.M being 3 times the twisting moment. If the direct tensile yield point of the material is

350 N/mm$^2$, and the factor of safety is 4, calculate the allowable twisting moment according to the following theories of failures.
(i). maximum principle stress theory, (ii) shear strain energy theory, if the simple shear is not to exceed 60 N/mm$^2$.

8. An element is subjected to tensile stresses of 60 N/mm$^2$ and 20 N/mm$^2$ acting on two perpendicular planes and is also accompanied by shear stress of 20 N/mm$^2$ on these planes.
Draw the Mohr's circle of stresses and determine the magnitudes and directions of principal
stresses and also the greatest shear stress.

9. Write a note on Mohr's circle of stresses. What is the importance of this circle?
b) A rectangular block of 1200 mm$^2$ cross-sectional area is subjected to a longitudinal compressive load of 1200kN. Determine the normal stress across the cross section of the block. If the block is cut by an oblique plane making an angle of 40$^0$ with normal section of the block. Determine:
(i) Normal stress on the oblique plane
(ii)Tangential stress along the oblique plane, and
(iii) Resultant stress on the oblique plane.

**UNIT-II**

1. a) Write the assumptions made in the theory of torsion and a) (i)Derive the torsion equation from fundamentals T/J =q/r = N_/L with usual notation.(ii) Explain the Theory of pure torsion?
b) A solid steel shaft has to transmit 75 kW at 200 r.p.m., taking allowable shear stress as 70N/mm$^2$. Find the diameter for the shaft, if maximum torque transmitted at each revolution exceeds the mean by 30%.
2. Write about Polar section modulus with one example and Write the different Types of springs Write about close and open coiled helical springs
3. A solid shaft is required to transmit 120 kW power at 200 r.p.m. Find the suitable diameter of the shaft if maximum torque transmitted in each revelation exceeds the mean by 20%.Take allowable shear stress as 70 N/mm$^2$.
4. A 450 kW of power has to transmit at 100 r.p.m. Find the suitable diameter of hollow circular section, the inside diameter being 3/4 of the external diameter. Take allowable shear stress as 70 N/mm$^2$.
5. a) Derive the maximum shear stress induced, in the wire of a closed-coiled helical spring which carries an axial load W. Assume mean radius of spring coil is R and diameter of spring wire is d.
b) A leaf spring carries a central load of 3000 N. The leaf spring has to be made of 10 steel plates 5 cm wide and 6 mm thick, if the bending stress is limited to 150 N/mm$^2$. Determine: (i)length of the spring and (ii) deflection at the centre of the spring. Take E = 2x10$^5$ N/mm$^2$
6. A leaf spring carries a central load of 3000 N. The leaf spring has to be made of 10 steel plates 5cm wide and 6 mm thick. If the bending stress is limited to 150 N/mm2 determine: (i) length of the spring and (ii) deflection at the centre of the spring. Take E = 2x10$^5$ N/mm$^2$.
7. Define helical spring? Name the two important types of helical springs.
b) A hollow shaft of diameter ratio 3/5 is required to transmit 400KW at 140 r.p.m with

uniform twisting moment. The shear stress in the shaft must not exceed 60 MPa a 
the twist in a length 2.5 m must not exceed 10. Calculate the minimum external diameter of the shaft. Take C=8X$10^4$ MPa

8. Closely coiled helical spring is made out of 10mm dia. steel rod, the coil having 12 complete turns. The mean dia. of spring is 10mm. Calculate the shear stress induced in the section of the rod due to an axial load of 250N. Find also the deflection under the load, energy stored in the spring and the stiffness of spring. Take N = 8 x104 *N/mm*$^2$.
9. Find the maximum torque that can be safely applied to a shaft of 200 mm diameter, if the permissible shear stress is 45 N/mm$^2$.

## UNIT-III

1. What the different types of columns? What is the difference between short and long column?
2. Starting from secant formula, derive Perry's formula for long columns.
3. a)Derive the Rankine's formula for crippling load.

   b) A column of circular section has 160mm diameter and 4m length. Both ends of the column are fixed. The column carries a load of 150kN at an eccentricity of 15mm from the geometrical axis of the column. Find the maximum compressive stress on the column section.
4. Write and explain about the limitations of Euler's Formula Calculate Euler's critical stress for the column having slenderness ratio 100,150 with both ends hinged. Take E = 2x$10^5$ N/mm$^2$.
5. A hollow rectangular column of external depth 1 m and external width 1 m is 10 cm thick. Calculate the maximum and minimum stress in the section of the column, if vertical load of 200 kN is acting with an eccentricity of 20 cm.
6. Deduce a formula for the critical load of a column having both ends hinged.

   b) A solid circular bar 6m long and 5 cm in diameter was found to extend 4.5 mm under a tensile load of 50KN. The bar is used as a strut with both ends hinged. Determine the buckling load for the bar and the safe load, consider factor of safety as 3.0.
7. a)Define slenderness ratio of a column. What is its importance?

   b) A column of circular section has 160mm diameter and 4m length. Both ends of the column are fixed. The column carries a load of 150kN at an eccentricity of 15mm from the geometrical axis of the column. Find the maximum compressive stress on the column section.
8. In an experimental determination of the buckling load for a rod 12 mm mild steel pin ended struts of various lengths, two of the values obtained were: (a) When the length is 50 cm load is 10 kN and

   (b) When the length is 20 cm load is 30 kN. Make necessary calculations and state whether either of the values of the loads, confirm with Euler's formula for the critical load. Take E= 2x105 N/mm$^2$.
9. An I-section joist ISWB400 and 8 m long is used as a strut with both ends fixed, determine Euler's crippling load. Give for the section Ixx = 23426.7 cm$^4$, Iyy= 1388.0 cm$^4$ and E =2x$10^5$ N/mm$^2$.

10. a) Derive Euler's buckling load formula of a long column pinned at both ends.
b) A solid round bar 3 m long and 5 cm in diameter is used as a strut with one end is fixed and
other is hinged. Determine the crippling load. Take E = $2x10^5$ N/mm$^2$.

11. A 1.5 m long column has a circular cross section of 5 cm diameter, one of the ends of the column is fixed in direction and position, and the other end is free. Taking factory of safety as 3, calculate the safe load using: (i) Rankin's formula, take yield stress is 560 N/mm$^2$ and a= 1/1600 for pinned ends, (ii) Euler's formula, Young's Modulus for the material is $1.2x10^5$ N/mm$^2$.

## UNIT-IV

1. Find core diameter of a solid section, if diameter is 'd'. Find core diameter of a hollow section, if external and internal diameter are 'D' and 'd'.
2. A beam carries a UDL of 50 kN/m over a span of 2 m long, with an axial compressive load of 50 kN. The beam section is rectangular, having depth equal to 240 mm and width equal to 120mm. Compute (i) maximum fibre stress, (ii) fibre stress at a point 0.5 m from the left end of thebeam and 80 mm below the N.A.
3. A hollow rectangular column of external depth 1 m and external width 1 m is 10 cm thick. Calculate the maximum and minimum stress in the section of the column if vertical load of 200 kN is acting with an eccentricity of 20 cm.
4. Explain about the term kernel and determine the size of kernel for a rectangular 200 mm x300. Find maximum eccentricity of the rectangular section (width b and depth d) for no tension in
the section.
5. A short column of external diameter 40 cm and internal diameter 20 cm carries an eccentric load of 80kN. Find the greatest eccentricity which the load can have without producing tension
on the cross –section.
6. A square chimney, 30 m high, has a flue opening of size 1.5 m x 1.5 m. Find the minimum width required at the base for no tension if the masonry weights 20 kN/m3 and the wind pressure is 1.5 kN/m2. The permissible stress in the masonry is 1kN/m2.
7. Determine of stresses in the case of dams and explain the conditions for stability? Write the stresses in retaining walls?
8. Determine of stresses in the case of chimneys, retaining walls
9. Distinguish between direct stress and bending stress by means of a diagram.



## UNIT-V

1. What is moment of inertia? Explain briefly about unsymmetrical bending? State the assumptions made in analyzing a beam for unsymmetrical bending.
2. Explain briefly how stresses in beams due to un symmetric bending is considered b) Explain briefly the method of locating shear centre.
3. What are the conditions that should be satisfied for a beam to bend without twisting? Explain about centroid in rectangular section.
4. A beam of rectangular section 100mm wide and 180mm deep is subjected to a bending moment of 12kN.m The trace of the plane of loading is inclined at 45o to the y-y axis of the section. Locate the natural axis of the section and calculate the maximum bending stress induced is the section.
5. A beam of rectangular section 80mm wide and 120mm deep is subjected to a bending moment of 12kN.m The trace of the plane of loading is inclined at 45o to the y-y axis of the

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section. Locate the neutral axis of the section and calculate the maximum bending stress induced is the section.

6. Determine the principal moments of Inertia for an angle section 225x175x15 mm.

7. A rectangular section of dimensions 120 x 200 mm is used as a beam on a 3 m span, If the beam is loaded by a concentrated load (P) at the centre at 30° to the vertical (Y-Y axis). Find the maximum value of the load 'P' in kN, if the maximum bending stress is not to exceed 12MPa.

8. A T-Section of dimensions 150 wide x 200 mm deep, with 10 mm thickness of flange and web, is used as simply supported a beam on a span of 6 m. Find the maximum value of 'w' in kN/m, the permissible stress in the material is 120 MPa. The plane of loading is inclined at an angle of $40^{\circ}$ to the vertical plane.

## UNIT-VI

1. Explain the concept of determinate trusses and indeterminate trusses
2. Explain the procedure for tension coefficient method in statically determinate frame.
3. Explain the procedure for method of sections in statically determinate frame.
4. cantilever truss is loaded as shown in Figure 1. Analyze the truss by method of joints.
5. cantilever truss is loaded as shown in Figure 1. Analyze the truss by method of sections.

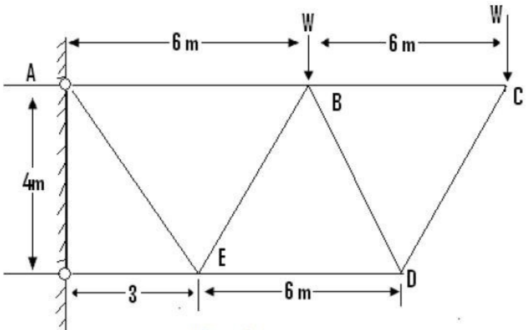



Figure 1

6. Write a note on method of joint? Determine the forces in the members of equilateral triangle truss of span 'L' loaded with apoint load 'W'.

7. Determine the member forces of the truss shown in Figure 1, using method of joints.

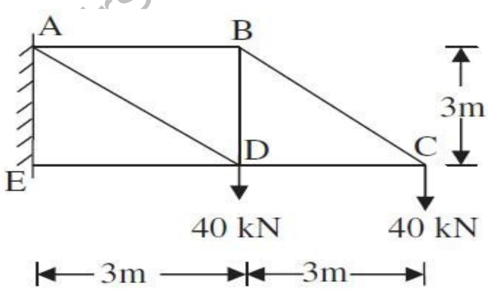
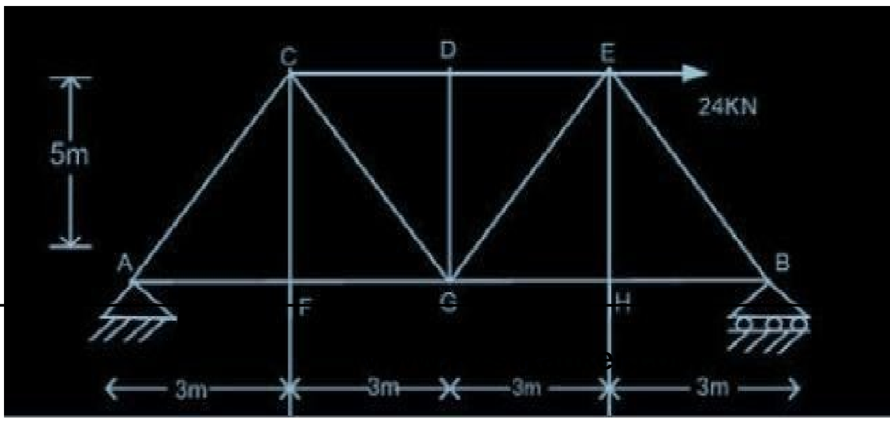



Figure 1

8. Determine the forces in all the members of the frame by method of joints.



9. Find the forces in the members of truss by method of joints as shown in Figure 1.

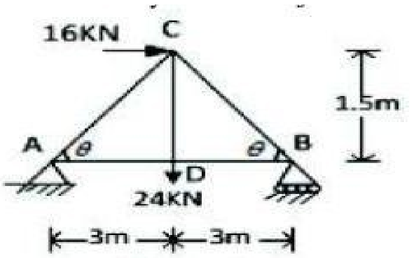


Figure 1