II B. Tech II Semester Regular Examinations, June/July - 2022
STRENGTH OF MATERIALS - II
(Civil Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT – I

1 a) The stresses at a point is given by normal stress of 120 N/mm^2 (compressive) along x – axis, 50 N/mm^2 (tensile) along y-axis and shear stress of -20 N/mm^2. Find the principal stresses and planes on which they act. Draw the Mohr's circle for the stress system. [7M]

b) Axial load acting on the bolt is 6 kN along with the transverse shear of 3 kN. Calculate the diameter of the bolt by using maximum principal stress theory and maximum shear stress theory. Factor of safety is 2, Poisson's ratio is 0.3 and yield stress is 280 MPa. [7M]

OR

2 a) An element in a structure is subjected to a tensile stress of 120 N/mm^2 accompanied by a shear stress of 50 N/mm^2 on the xy- plane. Draw the Mohr's circle and find the principal stresses and maximum shear stress. [7M]

b) A thin cylindrical shell of 1.2 m diameter is subjected to an internal pressure of 2 MPa. Find the thickness of the shell plate by using maximum shear stress and maximum strain energy theories. Take Factor of safety 2.5 and elastic limit is 200 MPa. [7M]

UNIT – II

3 a) A composite shaft made of aluminium rod of 40 mm diameter enclosed in steel tube of external diameter 60 mm and 10 mm thick. The shaft is required to transmit a torque of 1100 N-m. Determine the shear stresses developed in aluminium and steel, if both the shafts have equal lengths and welded to a plate at each end, so that their twists are equal. Take modulus of rigidity for steel is three times that of aluminium. [7M]

b) A close coiled spring is made of 18 mm diameter rod has 20 complete turns and a mean diameter of 130 mm. It is subjected to an axial tensile force of 600 N. Find the maximum stress and the deflection in the spring, if modulus of rigidity is 80 GPa. [7M]

OR

4 a) A composite shaft 6 m long consists of a steel rod 200 mm in diameter surrounded by a closely fitting 25 mm thick bronze tube. If the shear stress in the steel shaft shall not exceed 15 N/ mm^2, find the power transmitted by the shaft at 250 rpm. Take C_s = 8.5 x 10^4 N/ mm^2 and C_b = 4.2 x 10^4 N/ mm^2. [7M]

b) A open coiled helical spring is made of a wire of diameter 12 mm. the coil has a mean radius of 64 mm. The spring has 13 turns and angle of helix is 15°. Find the deflection and bending stress for an axial load of 300 N. Take G = 80 GPa and E = 200 GPa. [7M]
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UNIT - III

5 a) Calculate the safe compressive load on a hallow steel column of one end rigidly fixed and other end hinged with 12 cm external diameter and 8 cm internal diameter and 10 m length. Use Euler's formula with a factor of safety 3 and E = 200 GPa. [7M]

b) An angle section 150 mm x 150 mm x 10 mm is used as a strut 3 m long. Find the load carrying capacity of strut using Euler's and Rankine's formulae. E = 200 GPa and σ_y = 300 N/mm^2. [7M]

OR

6 a) A solid circular bar 5 m long and 5 cm diameter was found to extend 4 mm under a tensile load of 50 kN. The bar is used as a strut with both ends hinged. Determine the buckling load for the bar and also find the safe load by taking factor of safety 2. [7M]

b) Calculate the safe compressive load on a hallow cast iron column with one end fixed and other end hinged having 12 cm external diameter and 8 cm internal diameter and 6 m length. Use Euler's with factor of safety 4 and E = 100 GPa. [7M]

UNIT – IV

7 a) Write the difference between direct and Bending stress. [7M]

b) A trapezoidal masonry dam is of 13 m height. The dam is having water up to a depth of 10 m on its vertical side. The top and bottom width of the dam are 2.5 m and 5 m respectively. The density of the masonry is 21 kN/m^3, find the resultant force on the dam. [7M]

OR

8 a) A small concrete dam 10 m high has a top width of 2.5 m and base width of 6 m, with the water face vertical. Determine the stress intensities at the base. [7M]

b) A masonry wall 7 m high, 3 m wide and 1 m thick is subjected to design wind pressure of 4 kN/m^2 of the projected area. Find the extreme stress intensities at the base. [7M]

UNIT – V

9 a) Determine the maximum stress and the position of neutral axis for an angle of dimensions 50 mm x 30 mm x 5mm. The given angle is used as cantilever of length 600 mm carrying a load of 1.5 kN at free end with 50 mm leg horizontal. [7M]

b) Find the position of shear centre of a channel having dimensions, flanges 120 mm x 20 mm and web 160 mm x 10 mm. [7M]

OR

10 a) Find the position of principal axes and the values of the principal moment of Inertia for an unequal angle 75 mm x 45 mm x 6 mm [7M]

b) Find the position of shear centre for a channel section of 400 mm x 200 mm outside and 5 mm thick. [7M]

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UNIT – I

1 a) An element in a structure is subjected to plane stress system with the stresses 120 MPa in x – direction, 150 MPa in y – direction and shear stress 50 MPa in xy plane. Draw the Mohr's circle and find the principal stresses, principal directions and maximum shear stress. [7M]

b) The internal pressure in a steel pipe is 12 MPa. The maximum circumference stress is 75 MPa and maximum longitudinal stress is 20 MPa. Find the equivalent tensile stress in a simple tensile test by using maximum shear stress theory. [7M]

OR

2 a) At a point in a strained material, the principal stresses are 90 MPa tensile and 30 MPa compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress. Also find the maximum shear stress in the material at the point. [7M]

b) A steel bolt is subjected to a load of 30 kN along with a transverse shear of 10 kN. Find the safe diameter of the bolt by using all the theories of failure. Assume factor of safety as 2.5, Poisson's ratio as 0.3 and yield stress as 250 MPa. [7M]

UNIT – II

3 a) A solid circular shaft of diameter 25 mm is enclosed within a brass hallow circular shaft of external diameter 35 mm and internal diameter of 25 mm. If the two shafts are rigidly connected and the angle of twist due to torque of 500 Nm is 2° in a length of 350 mm. Find the value of rigidity modulus for brass if G for steel is 80 GPa. Also find the maximum shearing stress in the two materials. [7M]

b) Two springs connected in series and carry a load of 3 kN. One spring has 12 turns of 6 mm wire wound in a diameter of 20 mm, and the other spring has 16 turns of wire diameter 8 mm wound in a diameter of 30 mm. Find the spring constant for the composite system and the maximum stress produced in the wire . Take G = 85 GPa [7M]

OR

4 a) Determine the maximum shear stress developed in a solid circular shaft of radius 100 mm, subjected to a twisting moment of 120 kN-m. Also determine the angle of twist per meter length of the shaft. If a hole of diameter 100 mm is bored at the centre of the shaft along the length, find the percentage increase of the maximum stress and angle of twist. Take G = 80 GPa. [7M]

b) A closely coiled helical spring of round steel wire 10 mm in diameter having 12 complete turns with mean diameter of 120 mm is subjected to an axial load of 200 N. Find the deflection of the spring and also find the maximum shear stress in the wire. Take G = 85 GPa [7M]

UNIT – III

5 a) Calculate the safe compressive load on a hallow cast iron column with one end hinged and other end fixed of 25 cm external diameter and 20 cm internal diameter and 6 m in length. Use Euler's formula with factor of safety 3 and E = 100 GPa [7M]

b) Derive an expression for the Euler's crippling load for a column with both ends hinged. [7M]

OR

6 a) A simply supported beam of length 3 m is subjected to u d l of 12 kN/m over the entire length and deflects 5 mm at the centre. Determine the crippling load when the beam is used as a column with one end fixed and other end hinged. [7M]

b) Explain how Rankine – Gordon formula for a column to calculate the intensity of stress in short columns. [7M]

UNIT – IV

7 a) A short hallow column has an outside diameter 150 mm and an inside diameter 120 mm. If the compressive stress is limited to 150 N/mm^2, find the maximum load that can be applied at the middle of the section. [7M]

b) A masonry dam of rectangular cross section 6 m high and 3 m wide has water upto the top on its one side. If the density of the masonry is 19.5 kN/m^3. Find the resultant force and the point at which it cuts the base of the dam. [7M]

OR

8 a) A column 200 mm external diameter and 110 mm internal diameter supports an axial load of 1500 kN and eccentric load of P (in N) at an eccentricity of 230 mm. If the compressive and tensile stresses are not to exceed 120 N/mm^2 and 50 N/mm^2 respectively. Find the value of P. respectively. Find the value of P. [7M]

b) A masonry dam of rectangular section 10 m high and 3.5 m wide has water upto the top on its one side. If the density of the masonry is 2100 kg/m^3, find the resultant force and the point at which it cuts the base of the dam. [7M]

UNIT – V

9 a) For an unequal angle of dimensions 100 mm x 50 mm x 8 mm thick, determine the position of principal axes and magnitude of principal moments of Inertia. [7M]

b) Determine the position of shear centre for a channel section of 140 mm x 140 mm outside and 10 mm thick. [7M]

OR

10 a) A cantilever of length 1.2 m carries a point load of 2 kN at the free end and cross section is an unequal angle of dimensions 100 mm x 60 mm x 10 mm thick. Long leg is vertical and load passes through the centroid of cross section. Determine the position of neutral axis. [7M]

b) Find the position of shear centre of a channel having dimensions, flanges 140 mm x 25 mm and web 150 mm x 10 mm. [7M]

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UNIT – I

1 a) An Element subjected to a plane stress system having the stresses, - 30 MPa in x– direction, + 60 MPa in y – direction and shear stress of 15 MPa in xy plane. Draw the Mohr's circle and fine the stresses on a plane whose normal is inclined at -30° to the x – axis and also find the principal stresses. [7M]

b) A hallow shaft of 25 mm internal diameter and 50 mm external diameter is subjected to a twisting moment of 600 Nm and axial compressive force of 30 kN. Find the factor of safety according to the strain energy theory, if yield stress is 260 MPa and Poisson's ratio is 0.3. [7M]

OR

2 a) A circular shaft 120 mm diameter is subjected to a twisting moment of 7000 Nm along with a bending moment of 5000 Nm. By using maximum principal stress and strain theory, check the safety of the shaft and also find the factor of safety. Assume Poisson's ratio as 0.3 and elastic limit is 250 MPa. [7M]

b) A tension member of cross sectional area 1200 mm^2 is subjected to an axial load of 80 kN. Find the normal, tangential and resultant stresses on plane makes an angle of 30° with the axis of the bar. Also find on which planes, these stresses are maximum. [7M]

UNIT – II

3 a) A hallow steel shaft 4 m long is to transmit 150 kW power at 150 rpm. The total angle of twist in this length is not to exceed 2.5° and the allowable shear stress 60 N/mm^2. Determine the inside and outside diameters, if N = 0.082 x 10^6 N/mm^2. Take inside diameter is 0.5 times the outside diameter. [7M]

b) Two springs are connected in parallel. One has 16 coils of 6 mm diameter wire with an outside diameter of 36 mm and second has 18 coils of 4 mm diameter wire with an outside diameter of 40 mm. Find the maximum load that the system can carry without exceeding the shear stress of 350 MPa. Take G = 85 GPa. [7M]

OR

4 a) A solid circular shaft transmits 75 kW power at 250 rpm. Calculate the shaft diameter (based on twist and shear stress), if the twist in the shaft is not to exceed 1° in 2.5 m length of shaft, and shear stress is limited to 50 N/mm^2. Take C = 1 x 10^5 N/mm^2. [7M]

b) An open coiled helical spring has 12 turns. Assume the mean diameter of coil is eight times the diameter of the wire. An axial load is subjected, then the maximum bending and shear stresses are 120 MPa and 130 MPa respectively. Find the diameter of the wire. Take E = 200 GPa and N = 85 GPa. [7M]

UNIT – III

5 a) A column of length 5 m with internal diameter 180 mm and thickness 10 mm carries a load at an eccentricity of 20 mm. Find the value of the load carried by the column by using Secant formula, if permissible stress is not to exceed 150 MPa. Both the ends of the column are hinged. E = 200 GPa. [7M]

	b)	A hollow mild steel tube 5 m long 6 cm internal diameter and 8 mm thick is used as a strut with both ends fixed. Find the crippling load and safe load by taking factor of safety as 2.5 and E = 200 GPa.	[7M]

OR

6	a)	The external and internal diameters of a hollow cast iron column are 5 cm and 4 cm respectively. If the length of this column is 2 m and both of its ends are fixed. Determine the crippling load using Rankine's formula. Take the values of crushing stress as 550 N/mm^2 and α=1/1600 in Rankine's formula.	[7M]
	b)	Determine the safe load that can be carried by a column, 30 cm diameter and 3 m long, if both the ends are hinged. Use factor of safety as 2. If the proportional limit is 35 MPa, determine the minimum length upto which Euler's formula can apply. Take E = 15 GPa.	[7M]

UNIT – IV

7	a)	A column of rectangular section 120 mm x 90 mm carries a load of 60 kN at a point 30 mm from the longer side and 35 mm from the shorter side. Determine the maximum compressive and tensile stresses in the section.	[7M]
	b)	A masonry retaining wall of trapezoidal section is 10 m high and retains earth which is level upto the top. The width of the top is 3 m and at the bottom is 8 m and the exposed face is vertical. Density of earth and masonry is 1500 kg/m^3 and 2200 kg/m^3 respectively and angle of repose is 30°. Find the maximum and minimum normal stresses at the base.	[7M]

OR

8	a)	A column of rectangular section 200 mm x 300 mm carries a compressive load of 600 kN. The load is applied at a point (-50, 100) considering the centroid of the section as the origin. Find the stresses at the four corners of the section.	[7M]
	b)	A steel column of length 5 m with both ends hinged, external diameter 180 mm and thickness 15 mm carries a load of an eccentricity 20 mm. Find the maximum value of load if the permissible stress is limited to 150 N/mm^2. Take E = 2 x 10^5 N/mm^2.	[7M]

UNIT – V

9	a)	For an unequal angle of dimensions 120 mm x 60 mm x 10 mm thick, determine the magnitude of principal moments of Inertia.	[7M]
	b)	Determine the position of shear centre for a channel section of 150 mm x 150 mm outside and 8 mm thick.	[7M]

OR

10	a)	Find the position of principal axes and the values of the principal moment of Inertia for an unequal angle 100 mm x 60 mm x 8 mm	[7M]
	b)	Find the position of shear centre for a channel section of 300 mm x 150 mm outside and 6 mm thick.	[7M]

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UNIT – I

1 a) Determine the diameter of the bolt which is subjected to an axial pull of 8 kN and a transverse shear force of 4 kN using maximum principal stress theory. Take elastic limit of material in tension = 230 N/mm^2, factor of safety = 2 and Poisson's ratio = 0.3 [7M]

b) The stresses at a point is given by normal stress of 125 N/mm^2 (compressive) along x – axis, 50 N/mm^2 (tensile) along y-axis and shear stress of -35 N/mm^2. Find the principal stresses and planes on which they act. Draw the Mohr's circle for the stress system. [7M]

OR

2 a) At a point in a beam the normal stress along its length is 100 N/mm^2. The shear stress at that point is 45 N/mm^2. Find the stresses on a plane whose normal is inclined at 30° to the longitudinal axis. Also find the principal stresses and planes on which they act [7M]

b) The principal stresses at a point in an elastic material are 200 N/mm^2 (tensile), 100 N/mm^2 (tensile) and 50 N/mm^2 (compressive). If the stress at the elastic limit in tension is 250 N/mm^2, determine whether the failure of material will occur or not according to maximum strain energy theory. [7M]

UNIT – II

3 a) A composite shaft consists of copper rod of 30 mm diameter enclosed in a steel tube of external diameter 50 mm and 10 mm thick. The shaft is required to transmit a torque of 1200 N-m. Determine the shear stresses developed in copper and steel, if both the shafts have equal lengths and welded to a plate at each end, so that their twists are equal. Take $C_{steel} = 2C_{copper}$. [7M]

b) An open coiled helical spring is made of a wire of diameter 10 mm. The coil has a mean radius of 50 mm. The spring has 11 turns and the angle of helix is 15°. Find the deflection, maximum bending and shear stresses under an axial load of 250 N. Take G = 80 GPa and E = 200 GPa. [7M]

OR

4 a) A hallow shaft is to transmit 325 kW at 120 rpm. If the shear stress is not to exceed 70 N/mm^2 and the internal diameter is 0.5 of the external diameter, find the internal and external diameters by assuming the maximum torque is 1.2 times the average torque. [7M]

b) A close coiled helical spring is made of a wire of diameter 20 mm. The mean radius of the coils is 80 mm. Find the number of turns required and the maximum axial load, if the shear stress is not to exceed100 MPa and maximum elongation is limited to 30 mm. Take G = 80 MPa. [7M]

UNIT – III

5 a) A steel pipe of outside diameter 20 mm and thickness 3 mm is deflected by 3 mm when used as a beam supported at its ends, 1 m apart, and subjected to a central load of 150 N. Find the buckling load when the pipe is used as a column with hinged ends. [7M]
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b) A hallow alloy tube 5 m long with external and internal diameters 40 mm and 20 mm respectively was found to extend 5.8 mm under a tensile load of 50 kN. Find the buckling load for the tube when used as column with both ends pinned. Also find the safe load the column carry by taking factor of safety as 3. [7M]

OR

6 a) Compare the ratio of the strength of a hollow steel column to that of solid of the same cross sectional areas. The internal diameter of the hollow column is ¾ of the external diameter. The columns have the same length and are pinned at the ends. [7M]

b) An equal angle of dimensions 100 mm x 100mm x 10 mm is used as a strut with a length of 3.5 m. The strut is hinged at both the ends. Calculate the critical load by using Euler's formula. Take $E = 2 \times 10^5$ N/mm^2. [7M]

UNIT – IV

7 a) A short column made of rectangular box section of outside dimensions 250 mm x 200 mm and inside dimensions 230 mm x 180 mm. Determine the permissible eccentricity along either of the principal axes of a load of 600 kN. The permissible stresses in tension and compression are 5 MPa and 60 MPa. [7M]

b) A compression member of hallow circular section of 250 mm outer diameter and 10 mm thick, is subjected to a compressive load at (80, 80) with reference to the centre of the circular section. Find the maximum stress in the section, if the load is 400 kN. [7M]

OR

8 a) A hallow circular section of outside diameter 280 mm and thickness 10 mm carries a load of 1200 kN. Determine at what eccentricity along a diameter the load can be placed if the permissible stresses in compression and tension are 160 MPa and 70 MPa respectively. [7M]

b) A square chimney, 20 m high has a flue opening of size 1.5 m x 1.5m. Find the minimum width required at the base for no tension if the masonry weighs 20 kN/m^3 and the wind pressure is 1.5 kN/m^2. The permissible stress in the masonry is 1MPa. [7M]

UNIT – V

9 a) A cantilever of length 1 m carries a point load of 2 kN at the free end and cross section is an unequal angle of dimensions 75 mm x 45 mm x 8 mm thick. Long leg is vertical and load passes through the centroid of cross section. Determine the position of neutral axis. [7M]

b) Find the position of shear centre of a channel having dimensions, flanges 150 mm x 20 mm and web 170 mm x 15 mm. [7M]

OR

10 a) For an unequal angle of dimensions 140 mm x 70 mm x 10 mm thick, determine the position of principal axes and magnitude of principal moments of Inertia. [7M]

b) Determine the position of shear centre for a channel section of 150 mm x 120 mm outside and 8 mm thick. [7M]