SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

IV SEMESTER

CE3461 – STRENGTH OF MATERIALS

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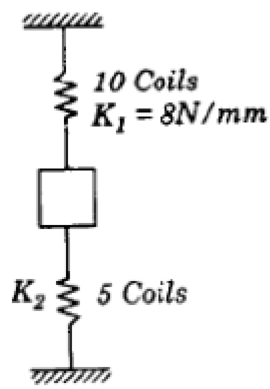
UNIT I - TORSION & SPRINGS

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – combined bending moment and torsion of shafts - Closed and Open Coiled helical springs.

PART A

Q.No	Questions	BT Level	Competence
1.	Compare and contrast between torsion, bending and torque.	BT-1	Remembering
2.	List the assumptions made in the theory of torsion.	BT-1	Remembering
3.	Write about Torsional equation and torsional rigidity.	BT-1	Remembering
4.	Write the expression for power transmitted by a shaft.	BT-1	Remembering
5.	Quote the expressions for polar modulus of solid and hollow circular shaft.	BT-1	Remembering
6.	What is called a torsional moment?	BT-1	Remembering
7.	Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled then the maximum shear stress developed corresponding to the same torque will be equal to?	BT-1	Remembering
8.	A solid circular shaft of 60 mm diameter transmits a torque of 1600 N.m. Determine the value of maximum shear stress developed.	BT-3	Applying
9.	Define pitch.	BT-1	Remembering
10.	A solid shaft of diameter 'D' carries a twisting moment that develops maximum shear stress τ. If the shaft is replaced by a hollow one of outside diameter 'D' and inside diameter D/2, then find out the maximum shear stress?	BT-2	Understanding
11.	The outside diameter of a hollow shaft is twice its inside diameter. Identify the ratio of its torque carrying capacity to that of a solid shaft of the same material and the same outside diameter?	BT-1	Remembering
12.	The outside diameter of a hollow shaft is twice its inside diameter. Find the ratio of its torque carrying capacity to that of a solid shaft of the same material and the same outside diameter.	BT-2	Understanding
13.	Compose the formula for the equivalent bending moment under combined action of bending moment M and torque T.	BT-2	Understanding
14.	What is the equivalent bending moment under combined action of bending moment M and torque T?	BT-1	Remembering
15.	A hollow circular shaft having outside diameter 'D' and inside diameter "d" subjected to a constant twisting moment 'T' along its length. If the maximum shear stress produced in the shaft is Ss then, calculate the twisting moment 'T'.	BT-2	Understanding
16.	The diameter of a shaft is increased from 30 mm to 60 mm, all other conditions remaining unchanged. How many times is its torque carrying capacity increased?	BT-3	Applying
17.	A solid circular shaft is subjected to a bending moment M and twisting moment T. What is the equivalent twisting moment Te which will produce the same maximum shear stress as the above combination?	BT-3	Applying

18.	Differentiate between closed coil helical spring and open coil helical spring.	BT-2	Understanding
19.	Discuss about spring index.	BT-3	Applying
20.	The diameter of shaft A is twice the diameter or shaft B and both are made of the same material. Assuming both the shafts to rotate at the same speed, find the maximum power transmitted by B.	BT-1	Remembering
21.	Formulate the mathematical expression for deflection of an open coiled helical spring.	BT-3	Applying
22.	Two hollow shafts of the same material have the same length and outside diameter. Shaft 1 has internal diameter equal to one-third of the outer diameter and shaft 2 has internal diameter equal to half of the outer diameter. If both the shafts are subjected to the same torque, what is the ratio of their twists?	BT-1	Remembering
23.	What is the equivalent stiffness (i.e. spring constant) of the system shown in the given figure? 	BT-1	Remembering
24.	Classify springs.	BT-2	Understanding
25.	A helical coil spring with wire diameter 'd' and coil diameter 'D' is subjected to external load. A constant ratio of d and D has to be maintained, such that the extension of spring is independent of d and D. What is this ratio?	BT-1	Remembering

PART B

1.	Derive the torsional equation.	BT-3	Applying
2.	Calculate the maximum torque that can be safely transmitted by a shaft of 400 mm diameter, if (a) the maximum allowable shear stress is 40 N/mm^2 (b) the maximum allowable angle of twist is 2o in a length of 10 m. Take G = 80 kN/mm^2 .	BT-3	Applying
3.	A steel bar of 25 mm diameter was tested on a gauge length of 250 cm in tension and in torsion. A tensile load of 50 kN produced an extension of 0.13 mm and a torque of 200 N-m produced in twist, determines: (a) the modulus of elasticity (b) the modulus of rigidity (c) the Poisson's ratio (d) the bulk modulus	BT-3	Applying
4.	Calculate the diameter of a solid shaft transmitting 150 kW at 25 rpm, if the maximum shear stress in the shaft is not to exceed 70 MPa. Compare this with the shaft delivering same power at 25000 rpm.	BT-3	Applying
5.	A steel shaft transmits 105 kW at 160 rpm. If the shaft is 100 mm diameter, find the torque on the shaft and the maximum shear stress induced. Find also the twist of the shaft in a length of 6 m. Take G = 80 kN/mm^2	BT-3	Applying

6.	Find the diameter of the shaft required to transmit 60 kW at 150 r.p.m., if the maximum torque is likely to exceed the mean torque by 25% for a maximum permissible shear stress of 60 N/mm^2 . Find also the angle of twist for a length of 2.5 metres. Take G = 80 kN/mm^2	BT-3	Applying
7.	A hollow shaft of internal diameter 400 mm and external diameter 450 mm is required to transmit power at 120 rpm. Determine the power it can transmit, if the shear stress is not to exceed 50 N/mm^2 and the maximum torque exceeds the mean by 30%.	BT-4	Analyzing
8.	A hollow shaft of inner diameter equal to 1/2 × the outer diameter and a solid shaft of diameter equal to the external diameter of the hollow shaft. Find ratio of the torsional strengths. Both the shafts are made with same material.	BT-3	Applying
9.	A hollow steel rod 200 mm long is to be used as torsional spring. The ratio of inside to outside diameter is 1 : 2. The required stiffness of this spring is 100 N.m /degree. Determine the outside diameter of the rod. Value of G is 8 x 10^4 N/mm^2.	BT-3	Applying
10.	In a torsion test, the specimen is a hollow shaft with 50 mm external and 30 mm internal diameter. An applied torque of 1.6 kN-m is found to produce an angular twist of 0.4° measured on a length of 0.2 m of the shaft. The Young's modulus of elasticity obtained from a tensile test has been found to be 200 GPa. Find the values of (i) Modulus of rigidity. (ii) Poisson's ratio.	BT-3	Applying
11.	A composite shaft length of 4.5m consists of a steel rod 75 mm diameter surrounded by a closely fitting tube of brass. A torque of 1200 N-m is applied to the composite shaft and it will be shared equally by the two materials. If modulus of rigidity of steel is 0.9 ×10^5 N/mm^2 and modulus of rigidity of brass is 0.5 ×10^5 N/mm^2, find **(i)** Outside diameter of the brass tube **(ii)** Maximum shear stress in each material **(iii)** Angle of twist	BT-4	Analyzing
12.	A copper tube of external diameter 60 mm and internal diameter 40 mm is closely fitted to a steel rod of 40 mm diameter to form a composite shaft. If a torque of 6 kN-m is to be resisted by the shaft, find the maximum stress in each material and the angle of twist in 2 m length. Take G = 80 kN/mm for steel, and G = 40 kN/mm^2 for copper.	BT-4	Analyzing
13.	Write about (a) Shafts in series and parallel (b) Springs in series and parallel	BT-4	Analyzing
14.	A close coil helical spring of round steel wire 10 mm in diameter has a mean radius of 120 mm. The spring has 10 complete turns and is subjected to an axial load of 200N. Determine **(i)** deflection of the spring **(ii)** maximum shear stress in the wire and **(iii)** Stiffness of the spring. Take G = 80 kN/mm^2.	BT-4	Analyzing
15.	(a) A member is subjected to the combined action of bending moment 400 Nm and torque 300 Nm. What is the equivalent bending moment? (b) A member is subjected to the combined action of bending moment 400 Nm and torque 300 Nm. What is the equivalent torque?	BT-4	Analyzing

	(c) Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled, then what is the maximum shear stress developed corresponding to the same torque?		
16.	A close coiled helical spring is to carry a load of 5000N with a deflection of 50 mm and a maximum shearing stress of 400 N/mm^2. if the number of active turns or active coils is 8. Estimate the following: (i) wire diameter (ii) mean coil diameter (iii) weight of the spring.	BT-4	Analyzing
17.	(a) A length of 10 mm diameter steel wire is coiled to a close coiled helical spring having 8 coils of 75 mm mean diameter, and the spring has a stiffness K. If the same length of wire is coiled to 10 coils of 60 mm mean diameter, determine the spring stiffness. (b) A closely coiled helical spring of 20 cm mean diameter is having 25 coils of 2 cm diameter rod. The modulus of rigidity of the material if 107 N/cm^2. What is the stiffness for the spring in N/cm? (c) Two close-coiled springs are subjected to the same axial force. If the second spring has four times the coil diameter, double the wire diameter and double the number of coils of the first spring, then the ratio of deflection of the second spring to that of the first will be?	BT-4	Analyzing
18.	An open coiled helical spring consisting of 10 turns of 10 mm diameter wire wound to a coil of mean diameter 110 mm. The wire is making an angle of 60^0 to the axis of the coil which.is subjected to an axial load of 90 N. Find the extension of the coil. Take E = 210 GPa and v = 0.25.	BT-4	Analyzing

UNIT II- INDETERMINATE BEAMS

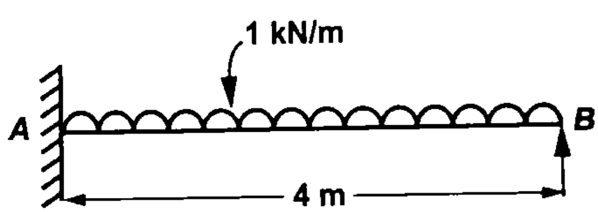
Propped cantilever and fixed beams - fixed end moments and reactions – sinking and rotation of supports - Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

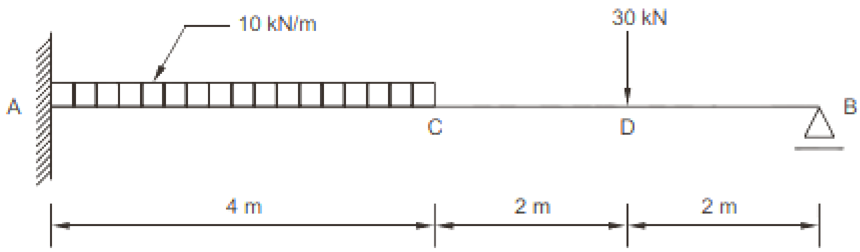
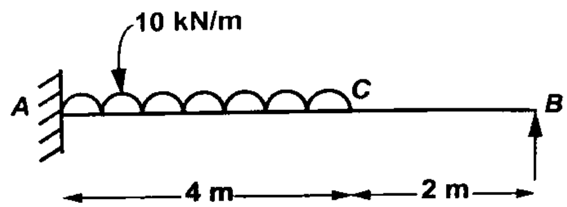
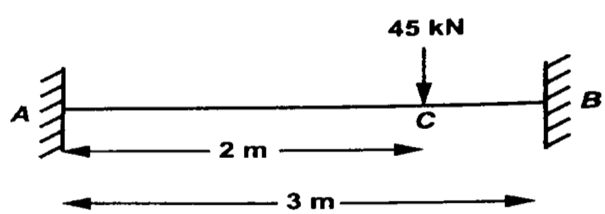
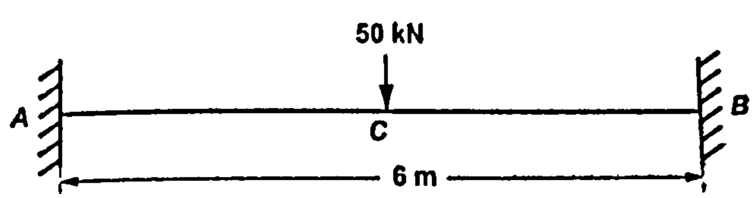
PART A

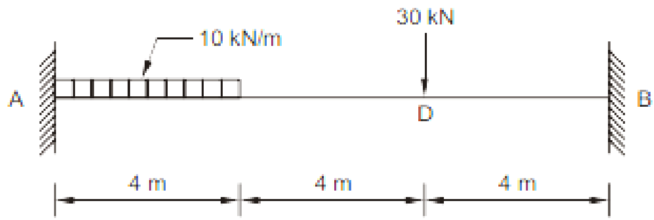
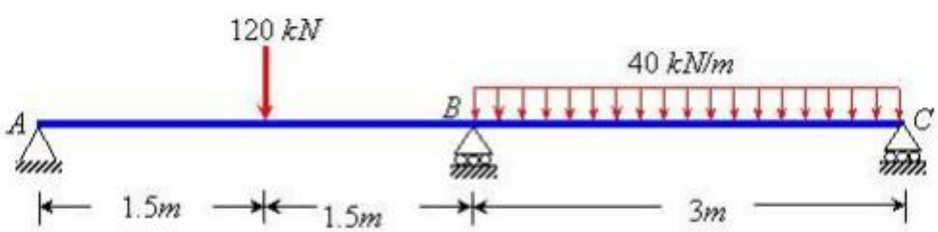
Q.No	Questions	BT Level	Competence
1.	Define fixed beam.	BT-1	Remembering
2.	State “Degree of static indeterminacy”.	BT-1	Remembering
3.	Is propped cantilever and fixed beams indeterminate structure. If yes what is the indeterminacy values of both.	BT-1	Remembering
4.	Define “compatibility condition”.	BT-1	Remembering
5.	A cantilever of length of 6m carries a uniformly distributed load of 4kN/m run over the length. The cantilever is propped rigidly at the free end. Determine the reaction at the rigid prop.	BT-1	Remembering
6.	List the methods of analysis of indeterminate beams.	BT-1	Remembering

7.	Explain about sinking of supports.	BT-2	Understanding
8.	Classify structure based on degree of static indeterminacy.	BT-2	Understanding
9.	What is meant by a prop?	BT-1	Remembering
10.	Explain the advantages and disadvantages of the fixed beam.	BT-2	Understanding
11.	What is continuous beam and classify its types?	BT-1	Remembering
12.	Show the BM diagram (qualitative) of a propped cantilever of *l* m long carries an UDL of w/unit run over the entire span and propped at the free end.	BT-3	Applying
13.	Enlist the advantages of continuous beam. Also draw its deflected shape.	BT-1	Remembering
14.	State the theorem of three moments	BT-1	Remembering
15.	Examine fixed end moment when the support sinks by amount of deflection.	BT-3	Applying
16.	Compare statically determinate and statically indeterminate structure.	BT-2	Understanding
17.	A fixed beam of length 3 m is having moment of inertia I=3 x 10^6 mm^4, the support sinks down by 3 mm. If E = 2 X 10^5 N/mm^2, find the fixed end moments.	BT-3	Applying
18.	What are the advantages and limitation of the theorem of three moments?	BT-1	Remembering
19.	Write the compatibility equation for propped cantilever beam and fixed beam.	BT-3	Applying
20.	Write the principle by which a continuous beam can be analyzed.	BT-1	Remembering
21.	Write the expression fixed end moments and deflection for a fixed beam carrying eccentric point load.	BT-1	Remembering
22.	What are the methods of analysis of continuous beams?	BT-1	Remembering
23.	Find the reaction at the prop in a propped cantilever of span 3m carrying a UDL of 5kN/m over the entire span.	BT-3	Applying
24.	A propped cantilever of length 6m carries a point load of 48kN at its centre. It is propped at free end. Determine the prop reaction of rigid prop.	BT-3	Applying
25.	A fixed beam AB, 6m long is carrying a point load of 40 kN at its center. The M.O.I of the beam is 78 x 10^6 mm4 and value of E for beam material is 2.1x10^5 N/mm^2. Determine the fixed end moments at A and B.	BT-3	Applying

PART B

1.	A propped cantilever of span of 6 m having the prop at the end is subjected to two concentrated loads of 24 kN and 48 kN at one third points respectively from left fixed end support. Describe shear force and bending moment diagram with salient points.	BT-4	Analyzing
2.	Draw SFD and BMD for a propped cantilever carrying a) a point load at the centre and propped at the free end. b) Uniformly distributed load throughout the span	BT-4	Analyzing
3.	Determine the prop, deflection @ centre, magnitude and position of maximum deflection for the beam shown below.  	BT-4	Analyzing
4.	A propped cantilever shown in Figure carries the loads as shown. Find the	BT-4	Analyzing

	support reactions and draw the BM and SF diagrams. 		
5.	Write the prop reaction and draw the SFD and BMD for the beam shown below 	BT-4	Analyzing
6.	A cantilever beam of span AB 6m is fixed at the end 'A' and propped at the end B. It carries apoint load of 50 kN at the mid span. Level of the prop is the same as that of the fixed end. Determine the reaction at the Prop and draw S.F& B.M Diagrams	BT-4	Analyzing
7.	State an expression for the end moments of a fixed beam of length L carrying central point load. Also draw the SFD and BMD for the beam.	BT-3	Applying
8.	State an expression for the end moments of a fixed beam of length L carrying UDL throughout its length. Also draw the SFD and BMD for the beam.	BT-3	Applying
9.	Draw the SFD and BMD of a fixed beam carrying eccentric point load placed on the beam at a distance of 'a' from left end.	BT-2	Understanding
10.	For the fixed beam shown below, sketch SFD and BMD. Also find the deflection of the beam. 	BT-3	Applying
11.	A fixed beam of AB, length 6 m carries point loads of 160 kN and 120 kN at distance of 2 m and 4 m from the left end. Predict the following. (i) FEM (ii) Support Reactions (iii) Draw SFD and BMD	BT-4	Analyzing
12.	For the fixed beam shown below, sketch SFD and BMD. Also find the deflection of the beam. 	BT-4	Analyzing

<table>
<tr><td>13</td><td>Find the fixed end moments and draw the BM and SF diagrams for the fixed beam shown in Figure. EI is constant for the beam

</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>14.</td><td>Construct a continuous beam ABC by three moment equation, fixed at its ends A and C and simply supported at support B. Span AB of length 10 m carries a point load of 115 kN at the left of support B. Span BC of length 10 m carries UDL of 20 kN/m of its full length. Draw its SFD and BMD.</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>15.</td><td>A continuous beam ABCD is simply supported at A, B, C and D, AB = BC = CD = 5 m. Span AB carries a load of 30 kN at 2.5 m from A. Span BC carries an UDL of 20 kN/m. Span CD carries a load of 40 kN at 2 m from C. Examine SFD and BMD.</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>16.</td><td>A continuous beam ABCD of length 15 m rests on four supports covering 3 equal spans and carries a UDL of 2kN/m length. Draw SFD and BMD for the beam.</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>17.</td><td>Analyze the continuous beam shown in Figure by the three moment equation. Draw the shear force and bending moment diagram as well.

</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>18.</td><td>Find the support reactions and draw the BM and SF diagrams of the continuous beam shown in Figure. EI = constant.

</td><td>BT-4</td><td>Analyzing</td></tr>
</table>

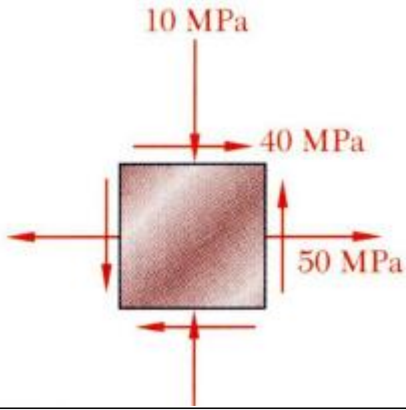
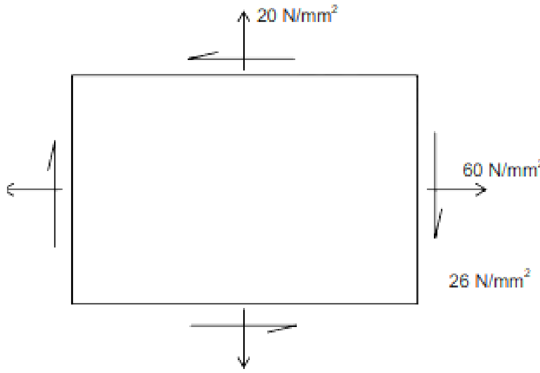
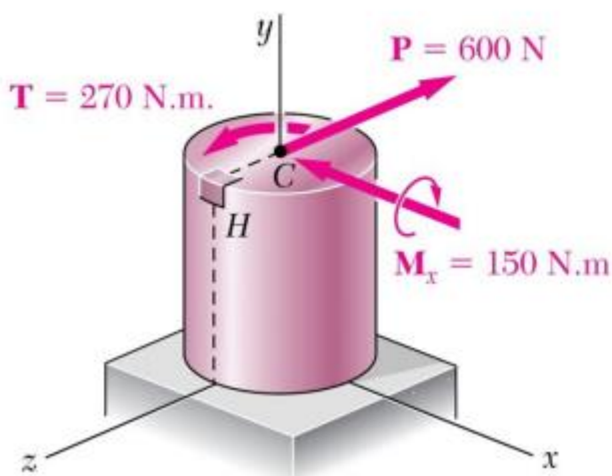
UNIT III - STATE OF STRESS

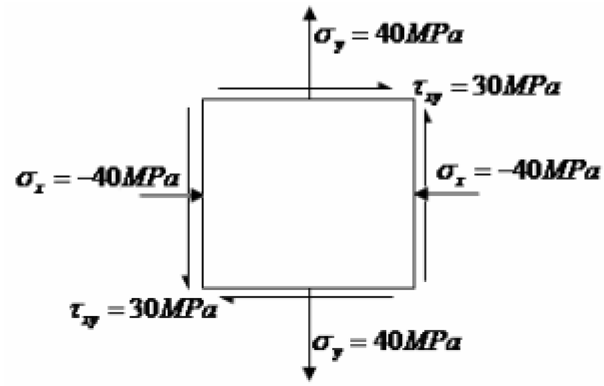
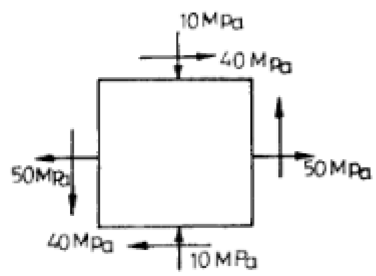
State of Stress in two dimensions – Stresses on inclined planes – Principal Stresses and Principal Planes - Theories of failures - Mohr's circle method - Stress tensor – Stress invariants - Volumetric strain.– Application problems.

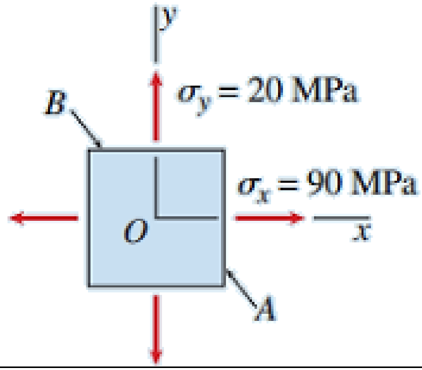
PART A

Q.No	Questions	BT Level	Competence
1.	What do you mean by principal plane and principal stress?	BT-1	Remembering

2.	Summarize the formula for direction cosines.	BT-2	Understanding
3.	State “Rankine‟s theorem of failures”	BT-1	Remembering
4.	Define octahedral stress.	BT-1	Remembering
5.	State Guests Tresca’s theories of failure.	BT-1	Remembering
6.	State maximum strain energy theory or Haigh‟s theory.	BT-1	Remembering
7.	Explain Shear strain energy theory or Von-mises theory.	BT-2	Understanding
8.	Maximum principal strain theory (or) St. Venant‟s theory- Report it.	BT-2	Understanding
9.	Define Spherical tensor.	BT-1	Remembering
10.	Draw the Mohr’s circle for a state of pure shear and indicate the principal stresses	BT-2	Understanding
11.	What are the theories used for ductile failure?	BT-1	Remembering
12.	Define Major and minor principal stress theory.	BT-1	Remembering
13.	What is meant by stress tensor?	BT-1	Remembering
14.	What are the theories used for britlle failure?	BT-1	Remembering
15.	Define Dilatation.	BT-1	Remembering
16.	Define residual stresses.	BT-1	Remembering
17.	Generalize the term stress invariants.	BT-1	Remembering
18.	State distortion energy theory for failure.	BT-1	Remembering
19.	Explain hydrostatic types of stress.	BT-2	Understanding
20.	Summarize deviator tensor.	BT-2	Understanding
21.	What is state of stress at a point?	BT-1	Remembering
22.	Define stress invariants.	BT-1	Remembering
23.	What do you mean by volumentric strain?	BT-1	Remembering
24.	Sketch the stress strain curve for ductile and brittle material.	BT-2	Understanding
25.	What are the 5 theories of failure?	BT-1	Remembering
PART B			
1.	For state of plane stress shown, find (a) principal planes (b) principal stresses (c) maximum shearing stress and corresponding normal stress.	BT-4	Analyzing

			
2.	Evaluate the principal stresses and principal planes for the state of stress shown in Figure 	BT-4	Analyzing
3.	a) A prismatic bar of circular section with 80 mm diameter is subjected to bending moment of 5 kN-m and a torque of 7 kN-m. Analyse the state of stress at the critical section. b) A prismatic bar of hollow circular cross-section has the outer and inner diameters as 100 mm and 60 mm respectively. Find the maximum stresses induced due to the action of a bending moment of 5 kN-m along with a torque of 7 kN-m.	BT-4	Analyzing
4.	Find equivalent force-couple system at center of transverse section passing through H shown in figure.  a) Find normal and shearing stresses at H. b) Find principal stresses and planes.	BT-4	Analyzing

5.	The state of stress at a point in a loaded member is shown in the figure.  determine the stresses for $\theta = 45^0$ & -15^0	BT-4	Analyzing
6.	a) For the state of plane stress shown below. Find the maximum and minimum principal stresses.  b) The magnitude of normal stress on two mutually perpendicular planes, at a point in an elastic body are 60 MPa (compressive) and 80 MPa (tensile) respectively. Find the magnitudes of shearing stresses on these planes if the magnitude of one of the principal stresses is 100 MPa (tensile). Find also the magnitude of the other principal stress at this point.	BT-4	Analyzing
7.	The tensile stresses at a point across two mutually perpendicular planes are $120N/mm^2$ and $60N/mm^2$. Determine the normal, tangential and resultant stresses on a plane inclined at 30^o to the axis of minor stress by Mohr's circle method	BT-4	Analyzing
8.	The stresses at a point in a bar are $200N/mm^2$ (tensile) and $100N/mm^2$ (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60^o to the axis of major stress. Also determine the maximum intensity of shear stress in the material at the point.	BT-4	Analyzing
9.	A rectangular block of material is subjected to a tensile stress of $65N/mm^2$ on one plane and a tensile stress of $35N/mm^2$ on the plane right angles on the former. Each of the above stresses is accompanied by a shear stress of $25N/mm^2$. Determine the Normal and Tangential stress a plane inclined at 45o to the axis of major stress.	BT-4	Analyzing
10.	Construction of mohr's circle a) Stresses on an oblique section of a body subjected to a direct stress in one plane b) Stresses on an oblique section of a body subjected to direct stresses in two mutually perpendicular directions	BT-4	Analyzing

11.	Using Mohr's circle, determine the stresses acting on an element inclined at an angle θ=30°.  	BT-4	Analyzing
12.	Brief about the following. (i) Rankine's theories of failure (ii) Guest's or Tresca's theory (iii) Haigh's theory (iv) Von Mises-Henky theory (v) St. Venant theory	BT-4	Analyzing
13.	The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory; 3. Maximum principal strain theory; 4. Maximum strain energy theory; and 5. Maximum distortion energy theory. Take permissible tensile stress at elastic limit = 100 MPa and poisson's ratio = 0.3.	BT-4	Analyzing
14.	The major principal stress on an element of a steel member is 2000 kg/cm^2 and the minor principal stress is compressive. If tensile yield point of steel is 3000 kg/cm^2, find the minor principal stress at which failure will occur, according to following theories of failure: (a) Maximum strain theory (b) Maximum shearing stress theory (c) Maximum strain energy theory (d) Maximum distortion energy theory	BT-4	Analyzing
15.	A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. the maximum principal stress; 2. The maximum shear stress; and 3. the maximum distortion strain energy theory of yielding.	BT-4	Analyzing
16.	a) When the stress tensor at a point with reference to axes (x, y, z) is given by the array. (MPa) $\begin{pmatrix} 4 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 2 \end{pmatrix}$ Calculate the deviatoric and spherical stress tensor.	BT-4	Analyzing

	b) Calculate the deviatoric stress tensor and its invariants for the following stress tensor (MPa) $$\begin{pmatrix} 2 & -3 & 4 \\ -3 & -5 & 1 \\ 4 & 1 & 6 \end{pmatrix}$$		
17.	When the stress tensor at a point with reference to axes (x, y, z) is given by the array $$\begin{bmatrix} 4 & 1 & 2 \\ 1 & 6 & 0 \\ 2 & 0 & 8 \end{bmatrix} MPa$$ Show that the stress invariants remain unchanged by transformation of the axes by 45^0 about the z-axis.	BT-4	Analyzing
18.	The state-of-stress at a point is given by the following array of terms $$\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix} MPa$$ Determine the principal stresses.	BT-4	Analyzing

UNIT IV -COLUMNS AND CYLINDERS

Euler's column theory – critical load for prismatic columns with different end conditions - Rankine-Gordon formula - Eccentrically loaded columns – core of a section – Thin and thick cylinders.

PART A

Q.No	Questions	BT Level	Competence
1.	What are the types of column failure?	BT-1	Remembering
2.	What are the assumptions made in the Euler's Equations?	BT-1	Remembering
3.	Write the limitations of Euler's Formula.	BT-1	Remembering
4.	Define buckling load and safe load	BT-1	Remembering
5.	Give the parameters influencing buckling load of a long column.	BT-1	Remembering
6.	What are the assumptions made in Lame's Theory	BT-1	Remembering
7.	Tabulate effective length of columns with different support conditions.	BT-2	Understanding
8.	Define slenderness ratio.	BT-1	Remembering
9.	Differentiate between eccentrically loaded column and axially loaded column.	BT-2	Understanding
10.	Explain middle third rule.	BT-2	Understanding

11.	What are the classification of columns based on end conditions?	BT-1	Remembering
12.	What is known as crippling load?	BT-1	Remembering
13.	Define column and strut	BT-1	Remembering
14.	What is effective length?	BT-1	Remembering
15.	Differentiate Rankine method and Euler's method.	BT-2	Understanding
16.	Differentiate short and long column.	BT-2	Understanding
17.	Write Rankine"s-Gordon formula.	BT-1	Remembering
18.	How columns are classified depending upon slenderness ratio?	BT-1	Remembering
19.	What is the kernel of rectangular, Square and circular sections.	BT-1	Remembering
20.	Distinguish between thick and thin cylinder.	BT-1	Remembering
21.	How many types of stresses are developed in thick cylinders?	BT-1	Remembering
22.	Define-hoop stress & longitudinal stress.	BT-1	Remembering
23.	State the assumption made in lame's theorem for thick cylinder analysis.	BT-1	Remembering
24.	Find the thickness of the pipe due to an internal pressure of $10 N/mm^2$ if the permissible stress is $120 N/mm^2$ and the diameter of the pipe is 750 mm	BT-2	Understanding
25.	Write Lame's equation to find out stresses in a thick cylinder.	BT-2	Understanding
	PART B		
1.	Derive the relation for Euler's crippling load for a column with both ends hinged.	BT-3	Applying
2.	Derive the relation for Euler's crippling load for a column with both ends fixed.	BT-3	Applying
3.	Derive the relation for the Euler's crippling load for a column with one end fixed and other end hinged along with the assumptions.	BT-3	Applying
4.	State the Euler's assumption in column theory. And derive a relation for the Euler's crippling load for a column with both ends fixed.	BT-3	Applying
	a) A solid round bar 3 m long and 5 cm in diameter is used as a strut. Determine the crippling load for all the end conditions. Take $E = 2 X 10^5 N/mm^2$. b) A hollow mild steel tube 6 m long 4 cm internal diameter and 6 mm thick is used as a strut with both ends hinged. Find the crippling load and safe load taking factor of safety as 3. Take $E = 2 x 10^5 N / mm^2$.	BT-4	Analyzing
5.	a) A solid round bar 75mm diameter and 3 m long is used as a column. Find the safe compressive load for the column with support condition as one end fixed and other end is hinged. Take E = 200 GPa and FOS as 3. b) Calculate the safe compressive load on a hollow cast iron column, whose one end is rigidly fixed and the other end is hinged with	BT-4	Analyzing

	150 mm external diameter, 100 mm internal diameter and 10 mm long. Use Euler's formula with a FOS of 5 and E = 95 GN/m^2.		
6.	A bar of length 4m when used as a SSB and subjected to UDL of 30kN/m over the whole span, deflects 15mm at the centre. Find the EI value for the above beam and hence determine the crippling loads when it is used as a column with the following end conditions i. Both ends pin-jointed ii. One end fixed and the other end hinged iii. Both ends fixed	BT-4	Analyzing
7.	a) A column of timber section 15 cm X 20 cm is 6 m long both ends being fixed. If E for timber = 17.5 KN/mm^2, determine crippling load and safe load for the column if factor of safety = 3. b) An I-section 400 mm × 200 mm × 10 mm and 6 m long is used as a strut with both ends fixed. Find Euler's crippling load. Take Young's modulus for the material of the section as 200 kN/mm^2.	BT-4	Analyzing
8.	Find the Euler's crippling load for a hollow cylindrical sheet column of 40 mm external diameter and 3 mm thick. Take, length of the column as 3 m and hinged at both ends. Take E = 200 GPa. Also, determine crippling load by Rankine formula using constants as 320 MPa and 1/7500.	BT-4	Analyzing
9.	A 2 m long pin ended column of square cross section is to be made of wood. Assuming E = 13 GPa, σ_{all} = 12 MPa and using a factor of safety of 2.5 in computing Euler's critical load for buckling. Determine the size of cross section if the column is to safely support (a) 100 kN load and (b) 200 kN load.	BT-4	Analyzing
10.	Determine the critical stresses for a series of columns having slenderness ratio of 50, 100, 150 and 200 under the following conditions by Euler's formula. Take E = 2.1 x 10^5 N/mm^2 *a)* Both ends hinged *b)* Both ends fixed	BT-4	Analyzing
11.	A load of 75kN is carried by a column made of cast-iron. The external and internal diameters are 20cm and 18cm respectively. If the eccentricity of the load is 3.5cm Find (i) The maximum and minimum stress intensities (ii) Upto what eccentricity, there is no tensile stress in column?	BT-4	Analyzing
12.	*a)* A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pressure of 2 N/mm^2. If the thickness of the vessel is 20mm, find the hoop stress, longitudinal stress and the maximum shear stress. *b)* Find the thickness for a tube of Internal diameter 100mm subjected to an internal pressure which is 5/8 of the value of the maximum permissible circumferential stress, Also find the increase in internal diameter of such a tube when the internal pressure is 90 N/mm^2. Take E = 205kN/mm^2 and μ=0.29. Neglect longitudinal strain.	BT-4	Analyzing

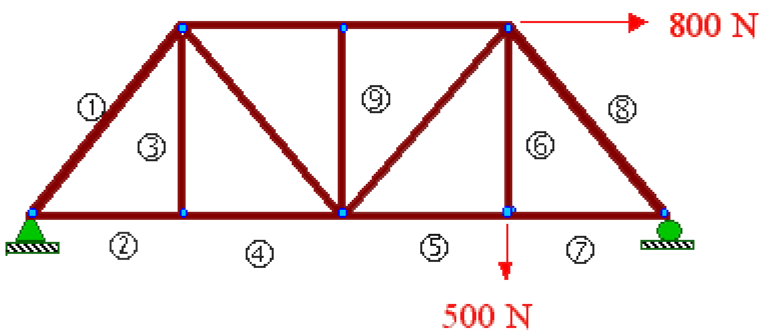
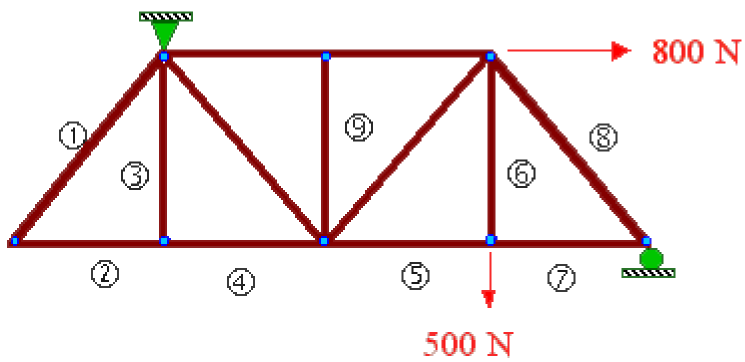
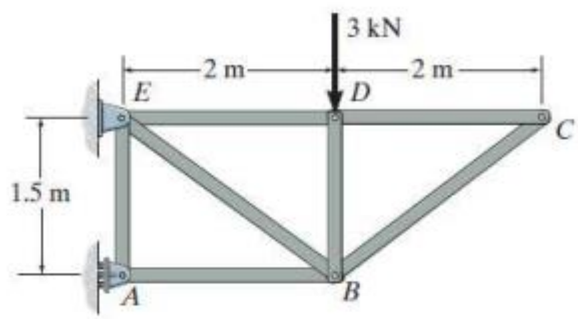
13.	Recall and arrive at the kern of a column for the following C/S *a)* Rectangular section *b)* Square section *c)* Circular section *d)* Hollow circular section	BT-3	Applying
14.	A thick cylinder with external diameter 320mm and internal diameter 160mm is subjected to an internal pressure of 8N/mm^2. Draw the variation of radial and hoop stresses in the cylinder wall. Also determine the maximum shell stress in the cylinder wall.	BT-4	Analyzing
15.	a) A storage tank of internal diameter 280 mm is subjected to an internal pressure of 2.56 MPa. Find the thickness of the tank. If the hoop & longitudinal stress is 75 MPa and 45 MPa respectively b) A thin cylindrical closed at both ends is subjected to an internal pressure of 2 MPa. Internal diameter is 1m and the wall thickness is 10mm. What is the maximum shear stress in the cylinder material?	BT-4	Analyzing
16.	A cylindrical thin drum 80cm in diameter and 3m long has a shell thickness of 1cm. 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 E=2×10^{5}N/mm^2 and poisons ratio=0.25	BT-4	Analyzing
17.	*a)* A cylinder pipe of diameter 1.5 m and thickness 1.5 cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Determine (i) Longitudinal stress developed in the pipe (ii) Circumferential stress developed in the pipe *b)* A cylinder of internal diameter 2.5 m and thickness 5 cm contains a gas. If the tensile stress in the material is not to exceed 80 N/mm^2, determine the internal pressure of the gas.	BT-4	Analyzing
18.	A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid pressure of 8 N/mm^2. Find the minimum and maximum hoop stress across the section. Also, sketch the radial pressure distribution and hoop stress distribution across the section.	BT-4	Analyzing

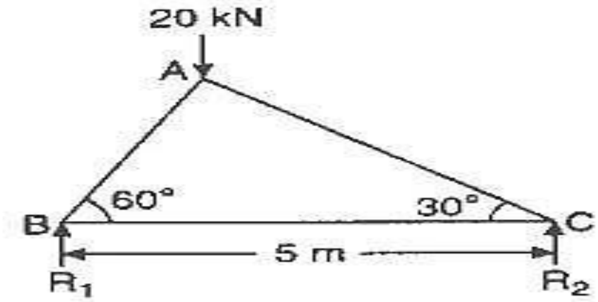
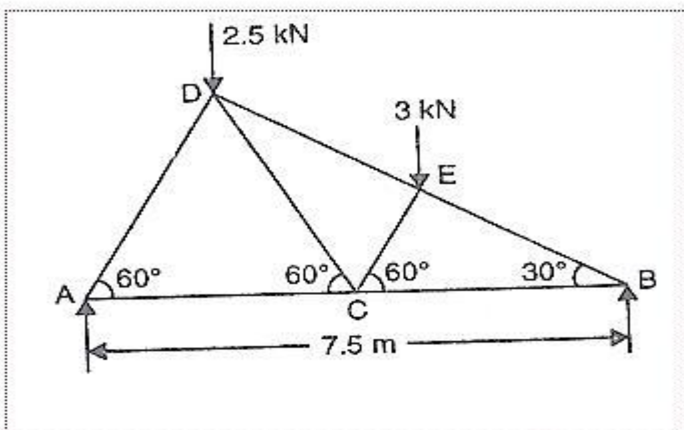
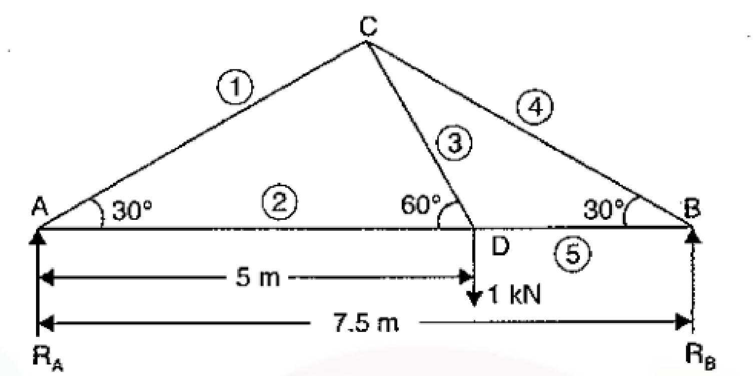
UNIT V - TRUSSES AND UNSYMMETRICAL BENDING

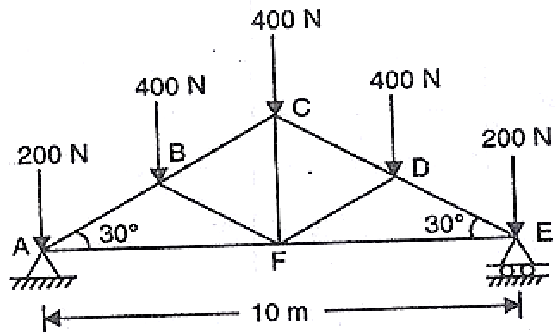
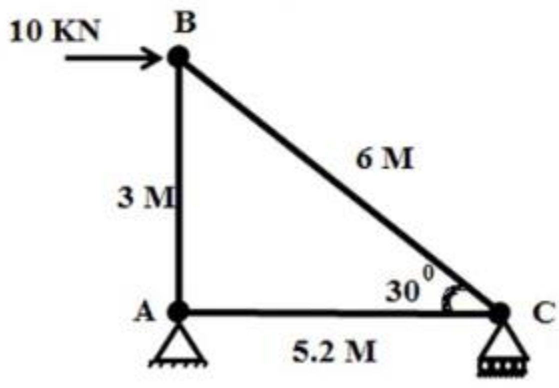
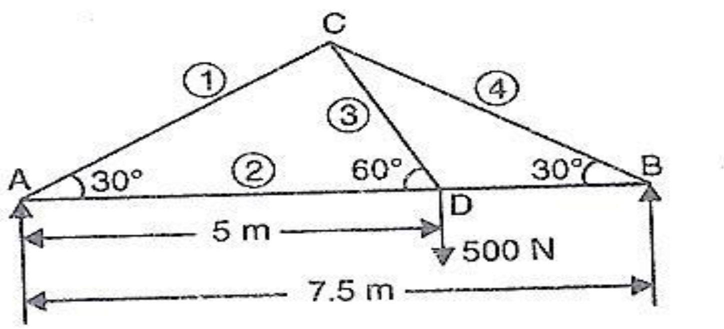
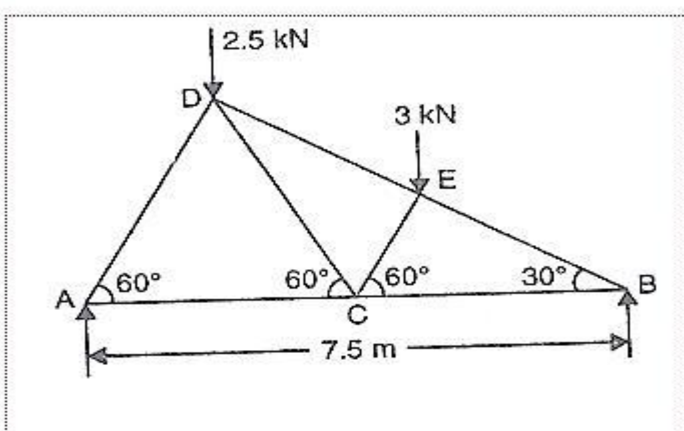
Analysis of pin jointed plane determinate trusses by method of joints and method of sections. Unsymmetrical bending of beams - Shear Centre.

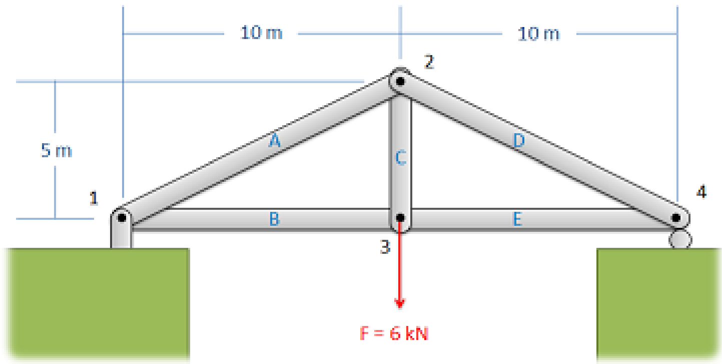
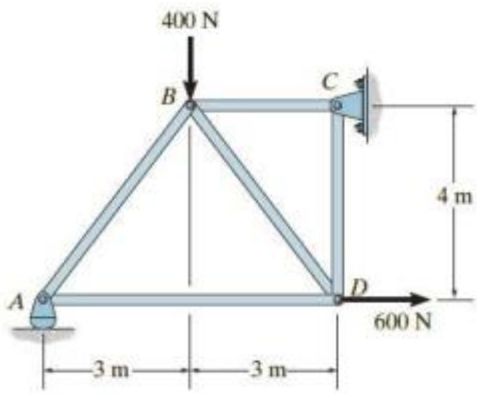
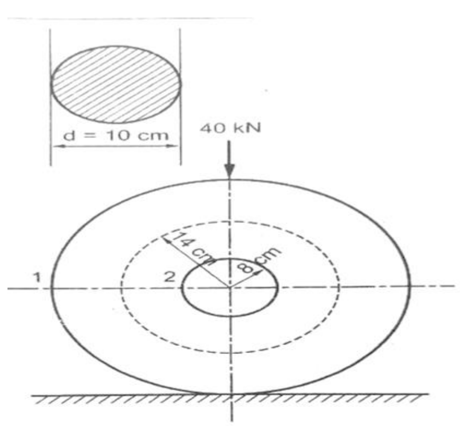
PART A

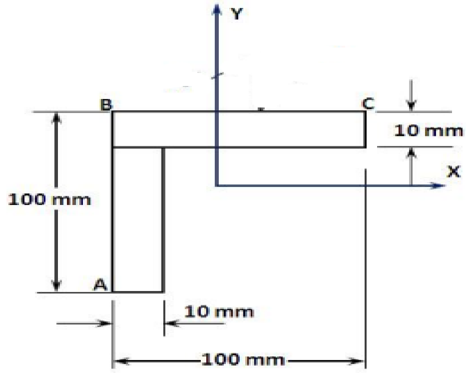
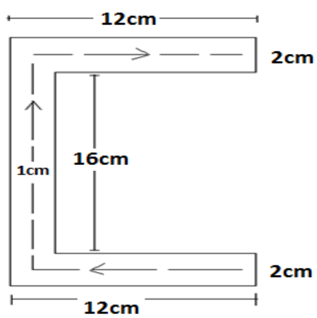
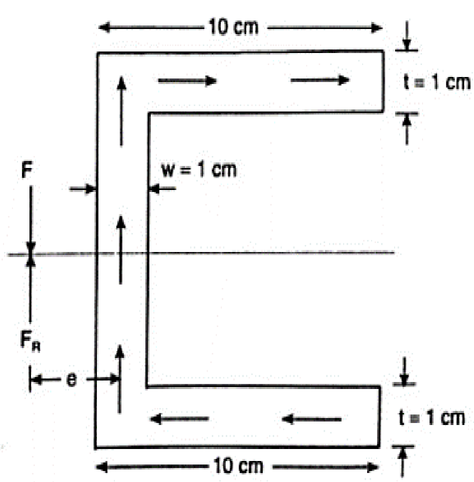
Q.No	Questions	BT Level	Competence
1.	How do you identify Zero force members in a truss?	BT-1	Remembering
2.	Distinguish between perfect and imperfect frame?	BT-1	Remembering
3.	Compare and contrast deficient and redundant frame.	BT-1	Remembering

4.	What are the different types of trusses?	BT-1	Remembering
5.	List the methods available for analyzing the frames.	BT-1	Remembering
6.	A perfect frame consists of 7 members. Decide the number of possible joints.	BT-1	Remembering
7.	Sketch any 4 trusses	BT-1	Remembering
8.	Differentiate statically determinate and indeterminate structures.	BT-1	Remembering
9.	Identify the zero force members for the truss shown 	BT-3	Applying
10.	Identify the zero force members for the truss shown 	BT-3	Applying
11.	Identify the zero-force members in the truss. 	BT-3	Applying
12.	Write the shear centre equation for channel section.	BT-1	Remembering
13.	Write the formula for stress using Winkler-Bach theory	BT-1	Remembering
14.	What do you mean by Residual stress?	BT-1	Remembering
15.	Tell the concept behind unsymmetrical bending.	BT-1	Remembering
16.	Name the reasons for unsymmetrical bending.	BT-1	Remembering
17.	Define Unsymmetrical Bending. State two reasons for unsymmetrical bending.	BT-1	Remembering
18.	How will you calculate the stress due to unsymmetrical bending?	BT-1	Remembering
19.	How will you calculate the distance of neutral axis from centroidal axis?	BT-1	Remembering

20.	Write the shear centre equation for channel section.	BT-1	Remembering
21.	Write the formula for stress using Winkler-Bach theory	BT-1	Remembering
22.	List the assumptions made in the analysis of curved bars.	BT-1	Remembering
23.	Define shear centre.	BT-1	Remembering
24.	Draw shear centre for various sections made by two narrow rectangles.	BT-1	Remembering
25.	Draw shear flow variation of channel section.	BT-1	Remembering
	PART B		
1.	A truss loaded shown in fig. Analyze and find the reaction and forces in the members by using any one analytical methods 	BT-4	Analyzing
2.	Analyze the truss by method of Joints 	BT-4	Analyzing
3.	A truss loaded shown in fig. Analyze and find the reaction and forces in the members 	BT-4	Analyzing
4.	Analyze and predict the forces in all members of the truss shown in figure by method of sections	BT-4	Analyzing

			
5.	Analyze and predict the forces in all members of the truss shown in figure below 	BT-4	Analyzing
6.	Investigate the truss shown below using method of joints 	BT-4	Analyzing
7.	Investigate the truss shown below using method of Sections 	BT-4	Analyzing
8.	Investigate the truss shown below using method of joints	BT-4	Analyzing

			
9.	Determine the force in each member of the truss shown in Figure. Indicate whether the members are in tension or compression. 	BT-4	Analyzing
10.	Determine (i) position of neutral axis, and (ii) maximum and minimum stresses when a curved beam of circular section of diameter 10mm is subjected to pure bending moment of +11.5kNm. The radius of curvature is 100mm.	BT-4	Analyzing
11.	A beam of rectangular section 20 mm X 40 mm has its Centre line curved to a radius of 50mm. the beam is subjected to a bending moment of 45×10^5 N.mm. Solve the intensity of maximum stresses in the beam. Also plot the bending stress across the section.	BT-4	Analyzing
12.	The figure shows a ring carrying a load of 30 kN. Calculate the stresses at 1 & 2. 	BT-4	Analyzing

13.	For the section shown determine position of principal axis and Principal moment of Inertia (I_{UU}& I_{VV}) 	BT-4	Analyzing
14.	Derive the equation of shear center for channel section	BT-3	Applying
15.	A channel section has flanges 12cm x 2cm and web 16cm x 1cm as shown. Determine the shear centre of the channel. 	BT-4	Analyzing
16.	Determine the shear centre for the section shown below 	BT-4	Analyzing
17.	A channel section has flanges 12 cm × 2 cm and web 16 cm × 1 cm. Determine the shear centre of the channel.	BT-4	Analyzing
18.	Predict the shear flow variation and sketch the same for a channel section of 100mm X 200mm X 5mm carrying a shear force of 2500N.	BT-4	Analyzing