SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

IV SEMESTER

1903401–STRENGTH OF MATERIALS

Regulation – 2019

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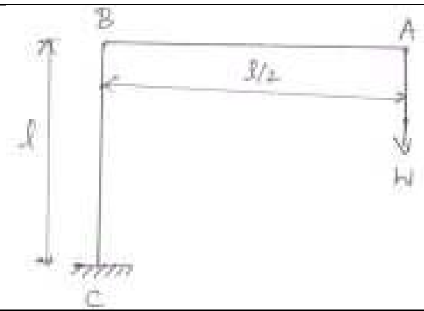
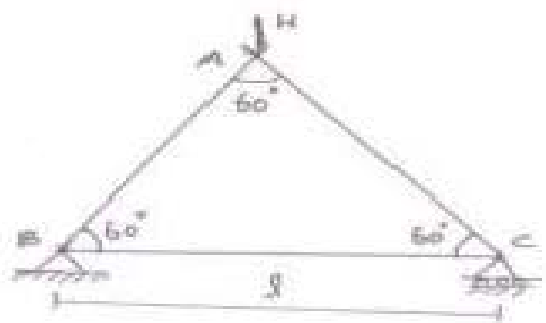
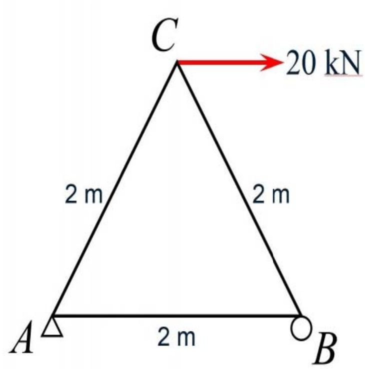
UNIT I -ENERGY PRINCIPLES

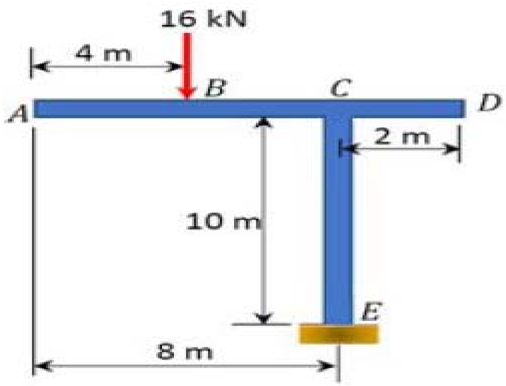
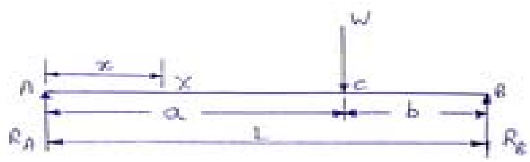
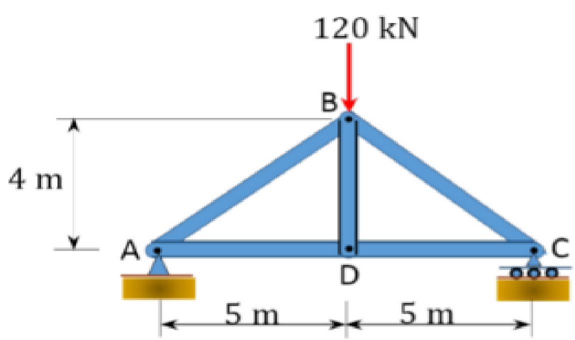
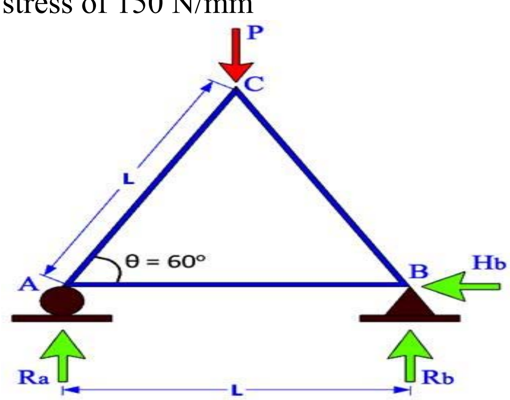
Strain energy and strain energy density – strain energy due to axial load, shear, flexure and torsion – Castigliano's theorems – Maxwell's reciprocal theorems - Principle of virtual work – Unit load method-Application of energy theorems for computing deflections in determinate beams, plane frame and plane trusses - Williot Mohr's Diagram.

PART A

Q.No	Questions	BT Level	Competence
1.	Define the terms Resilience and Proof Resilience	BT-1	Remembering
2.	Write about strain energy and strain energy density.	BT-1	Remembering
3.	Write the formula to calculate the strain energy due to torsion.	BT-1	Remembering
4.	State Castigliano's first theorem.	BT-1	Remembering
5.	State Castigliano's second theorem.	BT-1	Remembering
6.	Write the formula to calculate the strain energy due to bending.	BT-1	Remembering
7.	Determine the maximum strain energy stored in a solid shaft of diameter 100 mm and of length 1.25 m, if the maximum allowable shearstressis 50 N/mm^2. Take C = 8 x 10^4 N/mm^2.	BT-2	Understanding
8.	Write the formula to calculate the strain energy due to pure shear	BT-2	Understanding
9.	Find the strain energy per unit volume, the shear stress for a material is given as 50 N/mm^2. Take G=80000 N/mm^2.	BT-2	Understanding
10.	An axial pull of 40 KN is suddenly applied to steel rod 2m long and 1000 mm^2 in cross section .Calculate the strain energy that can be absorbed if E = 200 GN/m^2	BT-4	Analyzing
11.	Find the strain energy stored in a cantilever beam carrying a concentrated load W at the free end.	BT-3	Applying
12.	A solid steel shaft 120 mm diameter and 1.5 m long is used to transmit power from one pulley to another. Determine the maximum strain energy that can be stored in the shaft, if maximum allowable shear stress is 50 MPa. Take shear modulus as 80 GPa	BT-3	Applying
13.	Discuss about "Maxwell reciprocal theorem"	BT-3	Applying
14.	A rectangular body 500 mm long, 100 mm wide and 50 mm thick is subjected to a shear stress of 80 MPa. Determine the strain energy stored in the body. Take N = 85 GPa.	BT-4	Analyzing
15.	Name the various methods of finding deflection in structural element.	BT-4	Analyzing
16.	State the Principle of Virtual work.	BT-4	Analyzing
17.	Define Modulus of resilience	BT-5	Evaluating
18.	State the various methods for computing the joint deflection of a perfect frame.	BT-5	Evaluating
19.	A weight of 20 kN falls by 40 mm on a collar rigidly attached to a vertical bar 5000 mm long and 2000 mm^2 in the section. Find the instantaneous stress by taking E = 310 GPa.	BT-2	Understanding

20.	What down the expression for the strain energy stored in a rod of length l and cross sectional area A subjected in to tensile load?	BT-2	Understanding
PART B			
1.	A beam of 4 m length is simply supported at the ends and carries a uniformly distributed load of 6 kN/m length. Find the strain energy and hence deflection. Take E = 200 GPa and I = 1440 cm^4.Use Strain energy method.	BT-3	Applying
2.	A beam of simply supported over a span of 3 m carries a uniformly distributed load of 20 KN/m over the entire span. Take EI = 2.25 MN/m^2. Use Castigliano's theorem. Find the deflection at the centreof the beam.	BT-3	Applying
3.	a) A steel bar 3 m long and 2500 mm2 in area hangs vertically, which is securely fixed on a collar at its lower end. If a weight of 15 kN falls on the collar from a height of 10 mm, determine the stress developed in the bar. What will be the strain energy stored in the bar? Take E as 200 GPa. *b)* A rectangular body 500 mm long, 100 mm wide and 50 mm thick is subjected to a shear stress of 80 MPa. Determine the strain energy stored in the body. Take N = 85 GP*a*. c) Calculate the strain energy strored in a bar 2 m long, 50 mm wide and 40 mm thick when it is subjected to a tensile load of 60kN. Take E as 200 GPa.	BT-3	Applying
4.	A simply supported beam of 8m carries two concentrated loads of 32 KN and 48 KN at a distance of 3m and 6m from left support.Calculate the deflection at the centre by strain energy principle	BT-3	Applying
5.	An axial pull of 40 KN is suddenly applied to steel rod 2m long and 1000 mm^2 in cross section .Calculate the strain energy that can be absorbed if E = 200 GN/m^2	BT-2	Understanding
6.	a) The external diameter of a hollow shaft is twice the internal diameter. It is subjected to pure torque and it attains a maximum shear stress 'τ'. Show that the strain energy stored per unit volume of the shaft is $5\tau^2$ / 16C. Such a shaft is required to transmit 5400 kw at110 r.p.m. with uniform torque, the maximum stress not exceeding 84 MN / m^2. b) Determine the diameter of an aluminum shaft which is designed to store the same amount of strain energy per unit volume as a 50mm diameter steel shaft of the same length. Both shafts are subjected to equal compressive axial loads. What will be the ratio of the stresses set up in the two shafts? Take E_{steel} = 200 GN/m^2 ;$E_{aluminum}$ = 67 GN/m^2 .	BT-4	Analyzing
7.	Identify the vertical and the horizontal deflection at the free end of the bent (linear arch) shown in figure. Assume uniform flexural rigidity EI throughout.	BT-2	Understanding

			
8.	Using the method of virtual work, examine the deflection at the free end of the cantilever beam carrying uniformly distributed load 25 kN/m throughout the length of 12m. Take E = 2 x 10^5MPa, I = 825 x $10^7$$mm^4$.	BT-3	Applying
9.	Determine the maximum deflection of a simply supported beam with point load at the centre using principle of virtual work method.	BT-3	Applying
10.	Using castigliano's theorem, calculate the central deflection of a simply supported beam carrying a UDL of intensity per unit length over the whole span.	BT-3	Applying
11.	Find the vertical deflection at A of the truss shown in figure. Take area of cross section of all members as 'a' and Young's modulus as 'E'. 	BT-2	Understanding
12.	Determine the deflection at C for the pin joint truss shown below. Take E = 200 x 10^6 kN/m^2 and A = 150 * 10^{-6} m^2 	BT-4	Analyzing
13.	A beam of length L is simply supported at the ends with eccentric point load W at a distance of 'a' from left end. Take EI as constant, Find the strain energy and deflection of the beam.	BT-4	Analyzing

<table>
<tr><td>14.</td><td>Using the principle of virtual work, Write the vertical displacement at A of the frame shown below. E = 200 x 10^6 kN/m^2 and I = 250 x 10^{-6} mm^4.

</td><td>BT-6</td><td>Evaluating</td></tr>
<tr><td colspan="4">PART C</td></tr>
<tr><td>1.</td><td>Determine the maximum deflection of a simply supported beam shown below using principle of virtual work method.

</td><td></td><td>Analyzing</td></tr>
<tr><td>2.</td><td>A beam of length 4m is loaded with a single concentrated load of 60 kN at a distance of 3m from the left end. Using Castigliano’s theorem, obtain the deflection under the concentrated load. EI = 2.2MNm^2</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>3.</td><td>Using the virtual work method, determine the vertical deflection at joint D of the truss shown in Figure below. Take E=200GPa and A=5 cm^2

</td><td>BT-5</td><td>Evaluating</td></tr>
<tr><td>4.</td><td>Find the displacement of points B & C of thr truss shown in figure by Willot's mohr diagram.E = 200 GPa with compression members subjected to a stress of 100 N/mm^2, While the tension members subjected to a stress of 150 N/mm^2

</td><td>BT-4</td><td>Analyzing</td></tr>
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UNIT II- INDETERMINATE BEAMS

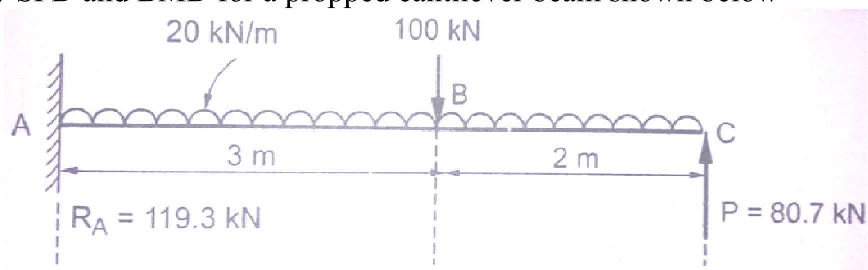
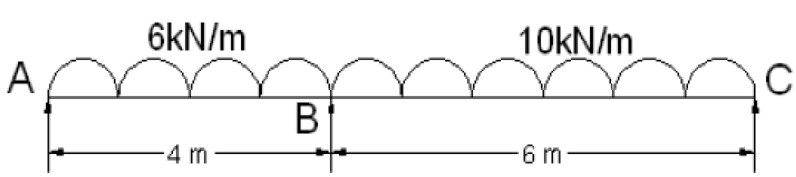
Propped cantilever and fixed beams-fixed end moments and reactions – Sinking and rotation of supports - Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

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-2	Understanding
10.	Explain the advantages and disadvantages of the fixed beam.	BT-2	Understanding
11.	What is continuous beam and classify its types?	BT-3	Applying
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.	Illustrate the advantages of continuous beam. Also draw its deflected shape.	BT-3	Applying
14.	State the theorem of three moments	BT-4	Analyzing
15.	Examine fixed end moment when the support sinks by amount of deflection.	BT-4	Analyzing
16.	Compare statically determinate and statically indeterminate structure.	BT-4	Analyzing
17.	A fixed beam of length 3 m is having moment of inertia $I=3X10^6$ mm^4, the support sinks down by 3 mm. If $E = 2 X 10^5$ N/mm^2, find the fixed end moments.	BT-5	Evaluating
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-3	Applying

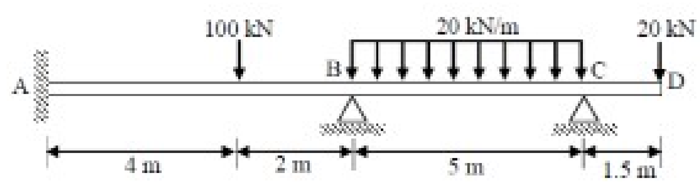
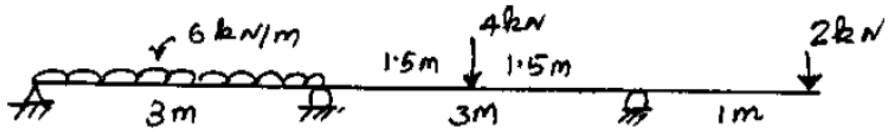
PART B

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.	A propped cantilever of length 6 m is fixed at one end and supported on a rigid prop at other end. It carries a point load of 20 kN at a distance of 4 m from the fixed end. Find the prop reaction and point of contra flexure and draw the SFD and BMD. Assume prop sinks by 20 mm. $E = 200 \times 10^6 kN/m^2$	BT-4	Analyzing

	and I=15x10^{-6} m^4		
3.	A propped cantilever of span 6 m is subjected to a UDL of 2 kN/m over a length of 4 m from the fixed end. Write the prop reaction and draw the SFD and BMD.	BT-4	Analyzing
4.	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. a) Determine the reaction at the Prop b) Draw S.F& B.M Diagrams	BT-4	Analyzing
5	Draw SFD and BMD for a propped cantilever beam shown below  	BT-4	Analyzing
6.	A fixed beam of 6 m span is loaded with point loads of 300 kN at a distance of 2 m From each support. Find the fixing end moments and draw the shear force and bending moment diagram. Also find the maximum deflection. Take E = 200 kN/mm^2 and I = 9 x 10^8 mm^4.	BT-2	Understanding
7.	A fixed beam of AB, length 6 m carries point loads of 150 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-2	Understanding
8.	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-3	Applying
9.	A fixed beam AB of span 10 m carries point load of 180 kN and clockwise moment of 160 kNm at distances 3 m and 6 m from left end respectively. If the left end support sinks by 15 mm, Examine the fixed end moments and reactions at the supports. Draw also SFD and BMD for the beam. Take EI = 6000 kNm^2.	BT-3	Applying
10.	A fixed beam AB of span 4.5 m carries a point load of 80 kN at its mid span and a uniformly distributed load of 15 kN/m throughout its length. Investigate (i) Fixed End Moments (ii) Reactions. Also draw the SFD and BMD.	BT-4	Analyzing
11.	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.	BT-4	Analyzing
12.	For the beam shown below, Find the support moments and Draw the SFD & BMD  	BT-5	Evaluating

13	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.	BT-6	Creating
14.	A continuous beam ABCD simply supported at all its end. Span AB of length 5 m carries a point load of 80 kN at 2m to the right of support A. Span BC of 7 m length carries 50 kN to the right of 2 m from support B. Span CD of length 8 m carries a UDL of 10 kN/m throughout its length. EI is constant for the entire length of the beam. Find the support moments and draw the BMD and SFD.	BT-4	Analyzing

PART C

1.	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-1	Remembering
2.	For the beam shown below, sketch the SFD and BMD 	BT-1	Remembering
3.	State an expression for the end moments of a fixed beam of length L for the following conditions. (i) Central point load (ii) UDL throughout its length Also draw the SFD and BMD for the beam	BT-1	Remembering
4.	For the continuous beam shown in Fig., draw SFD and BMD all the supports are at same level 	BT-2	Understanding

UNIT 3-COLUMNS AND CYLINDERS

Euler'scolumn theory – critical loads for prismatic columns with different end conditions- Effective length-limitations-Rankine-Gordon formula -Eccentrically loaded columns –middle third rule – core of a section – Thin cylindrical and spherical shells- Stresses and change in dimensions- Thick cylinders – Compound 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’sEquations?	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.	Distinguish between thick and thin cylinder.	BT-2	Understanding
8.	Define slenderness ratio.	BT-2	Understanding
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-3	Applying
13.	Define column and strut	BT-3	Applying
14.	What are the advantages of compound cylinders?	BT-4	Analyzing
15.	Differentiate Rankine method and Euler's method.	BT-2	Understanding
16.	Differentiate short and long column.	BT-2	Understanding
17.	How many types of stresses are developed in thick cylinders?	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.	Write Rankine"s-Gordon formula.	BT-2	Understanding
PART B			
1.	Derive the relation for Euler's crippling load for a column with both endshinged.	BT-4	Analyzing
2.	Derive the relation for Euler's crippling load for a column with both ends fixed.	BT-4	Analyzing
3.	Describe the relation for the Euler's crippling load for a column with one end fixed and other end hinged along with the assumptions.	BT-4	Analyzing
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-4	Analyzing
5.	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 otherendhinged iii. Both ends fixed	BT-1	Remembering
6.	Identify the Euler's critical load for a strut of T-section. The flange width is10cm, over all depth is 80cm, and both the flange & stem are 1cm thick. The strut is 3m longand is built in at both ends. Take E= $2x10^5$ N/mm^2.	BT-2	Understanding

7.	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 factor of safety as 3, Report the safe load using. (i) Rankin's formula. Take yield stress σ_c = 560 N/mm^{2}and α=1/1600 forpinnedends (6) (ii) Euler's formula. Take E= 1.2 x10^{5}N/mm^2. (7)	BT-2	Understanding
8.	A thin walled steel cylindrical shell of internal diameter 150mm and external diameter 500mm is subjected to fluid pressure of 100 MPa. Calculate the principal stress at a point on the inside surface of the cylinder and calculate the increase in inside diameter due to fluid pressure. Assume E=200 kN/mm^2.	BT-2	Understanding
9.	A mild steel tube 4m long, 3cm internal diameter and 4mm thick is used as a strut with both ends hinged. Find the collapsing load, what will be the crippling load? i) Both ends are built in ii) One end is built-in and one end is free.	BT-3	Applying
10.	A rectangular strut is 20 cm wide and 15 cm thick. It carries a load of 60 kN at an eccentricity of 2 cm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section.	BT-3	Applying
11.	Identify the ratio of thickness to internal diameter for a tube subjected to internal pressure when the pressure is 5/8 of the value of the maximum permissible circumferential stress. Find the increase in internal diameter of such a tube 100 mm internal diameter when the internal pressure is 80MN/mm^2. Also find the change in wall thickness. Take E=205GN/m^2 and 1/m = 0.29	BT-3	Applying
12.	A hollow cylindrical cast iron column whose external diameter is 200 mm and has a thickness of 20 mm is 4.5 m long and is fixed at the both ends. Calculate the safe loadby Rankine's formulausing a factor of safety of 2.5. Take the crushing strength of material as 550 N/mm^2 and Rankine's constant as 1/1600. Find also the ratio ofEuler's to Rankine's load. Take E=150GPa.	BT-4	Analyzing
13.	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
14.	i. 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. ii. 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

PART C			
1.	Recall and arrive at the kern of a column for the following C/S a) Rectangularsection b) Square section c) Circularsection d) Hollow circularsection	BT-1	Remembering
2.	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-1	Remembering
3.	A pipe of 600 mm internal diameter and 800 mm external diameter 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-2	Understanding
4.	i. A solid round bar 4m long and 5cm diameter was found to extend 4.6mm under the tensile load of 50KN.This bar is used as a strut with both ends hinged. Determine the buckling load for the bar and also safe load taking factor of safety as 4. ii. A hollow alloy tube 5m long with external and internal diameters 40mm and 25mm was found to extend 6.4mm under the tensile load of 60KN. Find the buckling load for the tube of column with both ends pinned. Also find the safe load for the tube, taking FOS=4.	BT-2	Understanding

UNIT 4- STATE OF STRESS IN THREE DIMENSIONS

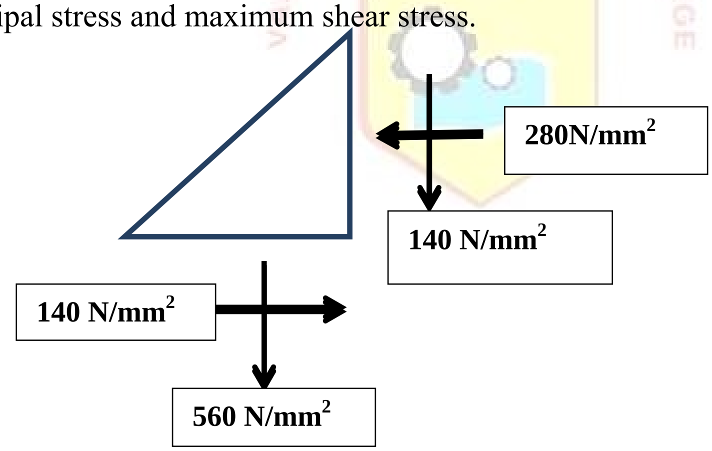
Stress tensor - Stress invariants- Volumetric strain –Theories of failure; Maximum Principal stress theory –Maximum Principal strain theory – Maximum shear stress theory – Total Strain energy theory – Maximum distortion energy theory– Application problems.

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-1	Remembering
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-2	Understanding
10.	Describe octahedral shearing stress theory.	BT-2	Understanding
11.	What are the theories used for ductile failure?	BT-3	Applying
12.	Define Major and minor principal stress theory.	BT-3	Applying
13.	Examine stress tensor and Stress deviator.	BT-3	Applying
14.	What are the assumptions involved in analysis of thin cylindrical Shells?	BT-4	Analyzing
15.	Define Dilatation.	BT-4	Analyzing
16.	Define residual stresses.	BT-4	Analyzing
17.	Generalize the term stress invariants.	BT-5	Evaluating
18.	State distortion energy theory for failure.	BT-5	Evaluating
19.	Explain hydrostatic types of stress.	BT-2	Understanding
20.	Summarize deviator tensor.	BT-2	Understanding
PART B			
1.	The rectangular stress components of a point in three dimensional stress system are defined as σ_x = 20 MPa, σ_y = -40 MPa,σ_z = 20 MPa, τ_{xy} = 40 MPa, τ_{yz} = -60 MPa and τ_{zx} = 20MPa. Examine the principal stresses and principal planes. Also determine associated direction of the state of stress.	BT-1	Remembering
2.	In a material, the principal stresses are 60 MN/m^2 , 48 MN/m^2 and -36 MN/m^2, find the following: (i) Total strain energy (ii) Volumetric strain energy (iii) Shear strain energy (iv) Factor of safety on the total strain energy criterion if the material yields at 120 MN/m^2. Take E = 200 GN/m^2, 1/m =0.3.	BT-1	Remembering
3.	A cylindrical shell made of mild steel plate and 1.2m in diameter is to be subjected to an internal pressure of 1.5 MN/m^2. If the material yields at 200 MN/m^2, find the thickness of the plate on the basis of the following three theories. Assuming factor of safety 2 in eachcase. (i) maximum principa lstress theory (5) (ii) maximum shear stress theory (4) (iii) maximum shear strain energy theory (4)	BT-1	Remembering
4.	At a section of a mild steel shaft, the maximum torque is 8437.5 Nm and maximum bending moment is 5062.5 Nm. The diameter of shaft is 90 mm and the stress at the elastic limit in simple tension for the material of the shaft is 220 N/mm^2.Tell whether the failure of the material will occur or not according to maximum shear stress theory. If not then find the factor of safety.	BT-1	Remembering

5.	The principal tensile stresses at a point across two perpendicular planes are 120 MN/m^2 and 60 MN/m^2. Predict (i) the normal and tangential stress and the resultant stress and its obliquity on a plane at 20 with the major principal plane. (ii) intensity of stress which acting alone can produce the same maximum strain. Take poisson's ratio =1/4	BT-2	Understanding
6.	The inside and outside diameters of a cast-iron cylinder are 240 mm and 150 mm respectively. If the ultimate strength of a cast iron is 180 MN/m^2,Identifyaccording to each of the following theories the internal pressure which would cause rupture: (i) maximum principal stress theory (ii) maximum strain theory (iii) maximum strain energy theory. Poison's ratio = 0.25. Assume no longitudinal stress in the cylinder.	BT-2	Understanding
7.	In a steel member, at a point the major principal stress is 180 MN/m^2 and the minor principal stress is compressive. If the tensile yield point of the steel is 225 MN/m^2, Find the value of the minor principal stress at which yielding will commence, according to each of the following criteria of failure (i) Maximum shearing stress (5) (ii) Maximum total strain energy (4) (iii) Maximum shear strain energy. Take poisson ratio = 0.26(4)	BT-2	Understanding
8.	(i) Illustrate Maximum shear stress theory. (3) (ii) A shaft is subjected to a maximum torque of 10 kNm and a maximum of bending moment of 8 kNm at a particular section. If the allowable equivalent stress in simple tension is 160MN/m^2, Calculate the diameter of the shaft according to the a) Maximum shear stress theory. (5) b) Octahedral shear stress theory (5)	BT-3	Applying
9.	A bolt is subjected to an axial pull of 10 kN together with a transverse shear force of 5 kN. Solve the diameter of the bolt by using (i) maximum principal stress theory (4) (ii) maximum strain theory (4) (iii)Octahedral shear stress theory (5)	BT-3	Applying
10	(i) In a metallic body the principal stress are 40 MN/m^2 and -100 MN/m^2, third principal stress being zero. The elastic limit stress in simple tension as well as in simple compression is 80 and 400 MN/m^2.Analyze the factor of safety based on the elastic limit if the criterion of failure is the maximum principal stress theory. (4) (ii) A steel shaft is subjected to an end thrust producing a stress of compression 90 MPa and maximum shearing stress on the surface arising from torsion is 60 MPa. The yield point of the material in simple tension was found to be 300 MPa. Examine the FOS of the shaft according to (i) maximum shear stress theory (5) (ii) maximum distortion energy theory. (4)	BT-4	Analyzing

11	A thick steel cylinder with an internal diameter 200 mm has to withstand an internal fluid pressure of 30 N/mm^2, Calculate the thickness of the metal by using, (i) Maximum principal stress theory (ii) Maximum shear stresstheory The tensile stress at yield point is 250 N/mm^2. Use factor of safety of 2.5	BT-4	Analyzing
12	The Stress tensor at a point is given by the following array $\begin{bmatrix} 40 & 20 & 30 \\ 20 & 30 & 40 \\ 30 & 40 & 20 \end{bmatrix} (kPa)$ Calculate the deviator and spherical stress tensors.	BT-4	Analyzing
13	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-5	Evaluating
14	For the state of stress shown in figure. Find the principal plane, principal stress and maximum shear stress.  	BT-6	Creating
	PART C		
1.	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 and principal directions.	BT-1	Remembering

2.	Explain in detail about the following.(5x3=15) (i) Rankine's theories of failure (ii) Guest'sorTresca's theroy (iii) Haigh's theory (iv) Von Mises-Henky theory (v) St. Venant theory	BT-3	Applying
3.	A steel flat of 250 mm long and 30 mm x 50 mm uniform section is acted upon by a tensile force of 30 kN along its length. A compressive force of 350 kN along its width, a compressive force of 200 kN along its thickness. Assuming Poisson's ratio of 0.3 and E =2 x 10^5 N/mm^2. Find change in dimensions and change in volume.	BT-1	Remembering
4.	The components of strain at a point in a body are as follows : ε_x =0.10, ε_y= -0.05, ε_z = 0.05, γ_{xy}= 0.3, γ_{yz}=0.1, γ_{zx}= -0.08. Determine the principal strains and the principal directions	BT-3	Applying

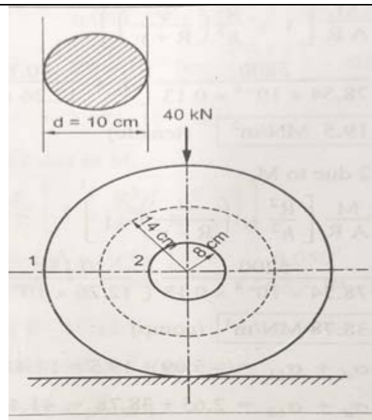
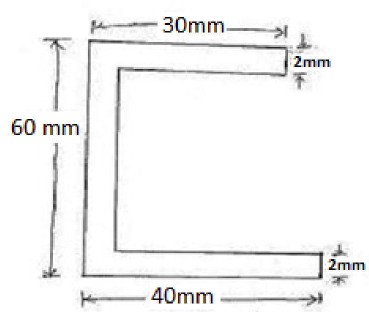
UNIT V - ADVANCED TOPICS IN BENDING OF BEAMS

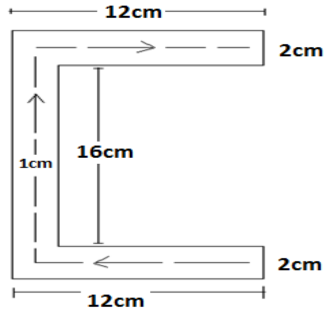
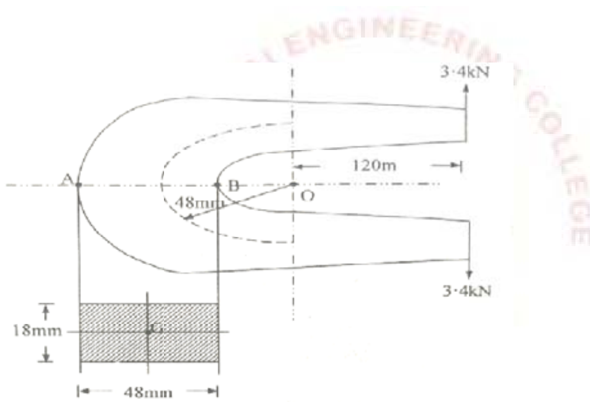
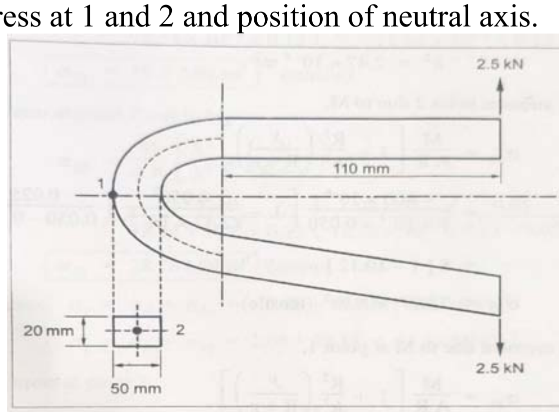
Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Shear Centre - curved beams – Winkler Bach formula– stresses in hooks.

PART A

Q.No	Questions	BT Level	Competence
1.	Write the shear centre equation for channel section.	BT-3	Applying
2.	Write the formula for stress using Winkler-Bach theory	BT-1	Remembering
3.	List the assumptions made in the analysis of curved bars.	BT-1	Remembering
4.	Tell the concept behind unsymmetrical bending.	BT-1	Remembering
5.	Name the reasons for unsymmetrical bending.	BT-1	Remembering
6.	Define Unsymmetrical Bending. State two reasons for unsymmetrical bending.	BT-1	Remembering
7.	How will you calculate the stress due to unsymmetrical bending?	BT-1	Remembering
8.	How will you calculate the distance of neutral axis from centroidal axis?	BT-1	Remembering
9.	How will you predict the angle of inclination of neutral axis with respect to principal axis?	BT-2	Understanding
10.	Restate the formula for deflection of a beam causing unsymmetrical bending.	BT-2	Understanding
11.	How will you interpret the resultant stress in a curved bar subjected to direct stress and bending stress?	BT-2	Understanding
12.	How will you predict resultant stress in a chain link?	BT-2	Understanding
13.	Show the shape of distribution of bending stress in a curved beam.	BT-3	Applying
14.	Investigate where the neutral axis lies in a curved beam.	BT-4	Analyzing
15.	Identify the nature of stress in the inside section of a crane hook.	BT-4	Analyzing
16.	Analyze where the maximum stress in a ring under tension occur.	BT-4	Analyzing

17.	Assess the most suitable section for a crane from your knowledge.	BT-5	Evaluating
18.	Rewrite fatigue strength and list out the causes for fatigue failure?	BT-5	Evaluating
19.	Generalize stress concentration.	BT-6	Creating
20.	Compare polar moment of inertia and the product of inertia.	BT-6	Creating
PART B			
1.	Derive the equation of shear center for channel section	BT-6	Creating
2.	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-3	Analyzing
3.	An 80 x 80 x 10 mm angle is used as a simply supported beam over a span of 2.4 m. It carries a load of 400 kN along the vertical axis passing through the centroid of the section. Find the resulting bending stress on the outer corners of the section along the middle section of the beam.	BT-1	Remembering
4.	A beam of rectangular cross section is subjected to pure bending with a moment of 20kN.m. The trace of the plane of loading is inclined at 45^0 to the YY axis of the section. Identify the N.A of the section and calculate the bending stress induced at each corner of the beam section.	BT-1	Remembering
5.	Estimate principal moment of inertia of angle section 100 mm x 40 mm x 60 mm	BT-2	Remembering
6.	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-2	Understanding
7.	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 $45x10^5$ N.mm. Solve the intensity of maximum stresses in the beam. Also plot the bending stress across the section.	BT-3	Understanding
8.	The figure shows a ring carrying a load of 30 kN. Calculate the stresses at 1 & 2.	BT-3	Analyzing

			
9.	A curved bar of rectangular section, initially unstressed is subjected to bending moment of 2000 N.m tends to straighten the bar. The section is 5 cm wide and 6 cm deep in the plane of bending and the mean radius of curvature is 10 cm. Judge the position of N.A and the stress at the inner and outer face.	BT-4	Applying
10	Analyze the shear center of a channel section of 400 mm X 200 mm outside and 5 mm thick.	BT-4	Analyzing
11	An I-Section of a beam consists of top flange 140mmX40mm and bottom flange 140mm X 40mm, web 20mm X 220mm. The center line of web is 80mm from the left edge of flange and 60mm from the right edge. Evaluate the shear center of the beam.	BT-4	Analyzing
12	Evaluate the principal moment of inertia of channel section shown. 	BT-5	Evaluating
13	An equal angle section 150 mm x 150 mm x 10 mm is used as a simply supported beam of 4.2 m length is subjected to a vertical load passing through the centroid. Predict bending stress at any one point in the section.	BT-2	Understanding
14	A channel section has flanges 12cm x 2cm and web 16cm x 1cm as shown. Determine the shear centre of the channel.	BT-5	Evaluating

			
	PART C		
1.	Describe brief technical notes on: a) Unsymmetrical bending on beams (4 Marks) b) Curved beams (4 Marks) c) Stress concentration (3 Marks) d) Significance of shear centre (4 Marks)	BT-2	Understanding
2.	Locate and derive the shear centre of an unequal I-section	BT-2	Understanding
3.	For a frame shown in figure subjected to a load of 3.4 kN. Find the resultant stress at A and B. 	BT-5	Evaluating
4.	For a frame shown in figure subjected to a load of 2.5 kN. Find the resultant stress at 1 and 2 and position of neutral axis. 	BT-5	Evaluating