VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

IV SEMESTER

CE6402–STRENGTH OF MATERIALS

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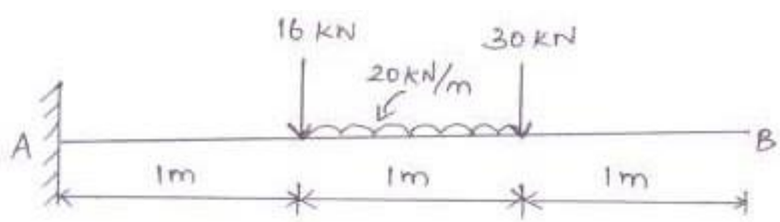
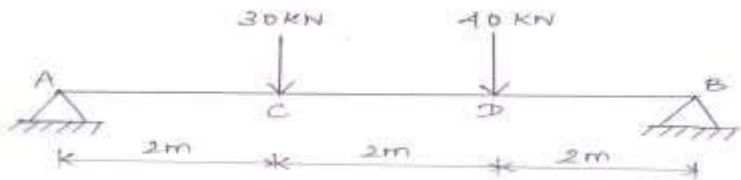
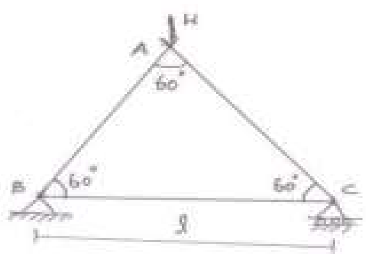
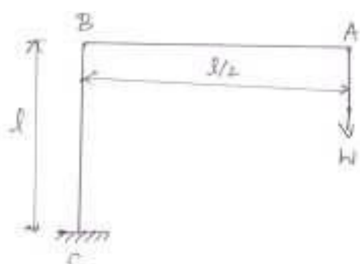
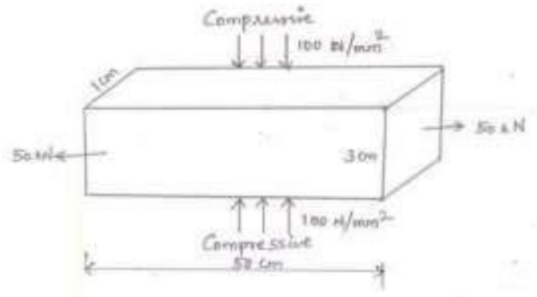
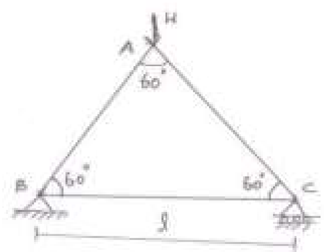
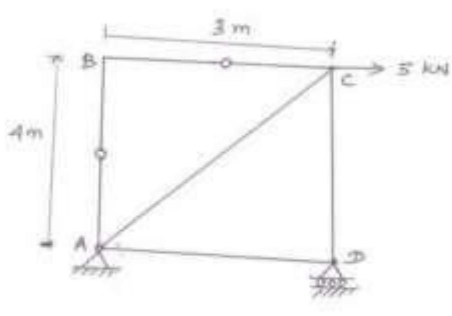
SUBJECT : STRENGTH OF MATERIALS

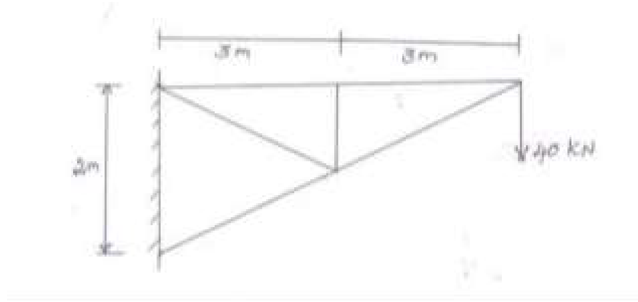
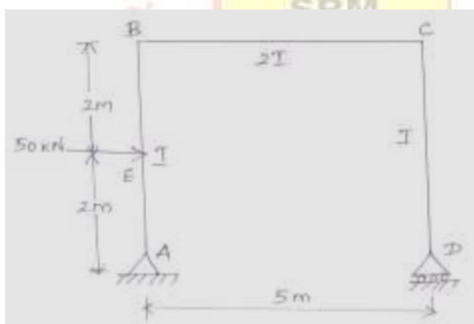
SEM / YEAR : IV/ II

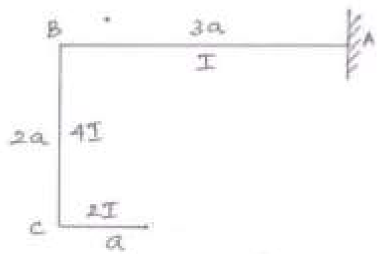
UNIT I -ENERGY PRINCIPLES			
Strain energy and strain energy density – strain energy due to axial load, shear, flexure and torsion – Castigliano‟s theorems – Maxwell‟s reciprocal theorems - Principle of virtual work – application of energy theorems for computing deflections in beams and trusses - Williot Mohr's Diagram.			
PART A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Define strain energy and write its dimensional unit.	BT-1	Remembering
2.	Write about strain energy density.	BT-1	Remembering
3.	A mild steel bar of diameter 30 mm and length 2.4 m is subjected to a tensile load of 90 kN. Find the strain energy stored in the bar if the load is applied gradually. What is the modulus of resilience if the proportional limit to 220 MPa. E = 200 GN/m^2.	BT-1	Remembering
4.	State Castigliano‟s first theorem.	BT-1	Remembering
5.	State Castigliano‟s second theorem.	BT-1	Remembering
6.	Write an expression for strain energy due to shear, torsion, axial load and bending.	BT-1	Remembering
7.	Predict the maximum strain energy stored in a solid shaft of diameter 100 mm and of length 1.25 m, if the maximum allowable shear stressis 50 N/mm^2. Take C = 8 x 10N/mm^2.	BT-2	Understanding
8.	Describe Mohr‟s correction.	BT-2	Understanding

9.	Estimate 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.	Identify the assumptions made in castigliano‟s theorem.	BT-2	Understanding
11.	Solve strain energy due to bending of a cantilever beam of span 6 m subjected to udl of 10 kN/m over entire length, EI is constant.	BT-3	Applying
12.	Show the deflections at the free end of the cantilever beam which carries a point load at the free end.	BT-3	Applying
13.	Illustrate ”Maxwell reciprocal theorem‟.	BT-3	Applying
14.	Differentiate between virtual force and virtual displacement.	BT-4	Analyzing
15.	Compare Resilience, proof resilience and modulus of resilience.	BT-4	Analyzing
16.	Distinguish between resilience modulus and toughness modulus.	BT-4	Analyzing
17.	Rewrite complementary strain energy with stress-strain curve.	BT-5	Evaluating
18.	Write the assumptions made in castigliano's theorem	BT-5	Evaluating
19.	Write the application of williotmohr's diagram.	BT-6	Creating
20.	Summarize complimentary virtual work.	BT-6	Creating
	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-1	Remembering
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/m2. Use Castigliano's theorem. Find the deflection at the centre of the beam.	BT-1	Remembering
3.	Using Castigliano's theorem, write the deflection of the free end of the cantilever beam shown in figure. Take EI = 4.9 MN/m^2 	BT-1	Remembering
4.	For the beam shown in figure, find the deflection at C. I = 40 X 10^7	BT-1	Remembering

	mm^4, E = 200 GPa. 		
5.	A beam of length L simply supported at the ends is loaded with a point load W at a distance „a‟ from left end. Assume that the beam has constant cross-section with moment of inertia „I‟ and Young‟s modulus of elasticity for the material of the beam „E‟. Predict the strain energy of the beam and hence deflection under the load.Use castigliano‟s theorem.	BT-2	Understanding
6.	Outline the vertical and horizontal displacement at the free end D in the frameshown in figure. Take EI = 12 x 10^3 N-mm^2.Use Castigliano‟s theorem. 	BT-2	Understanding
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.	(i) A 1 m long bar of rectangular cross sectiona 50 x 80 mm is subjected to an axial load of 1.2 kN. Write the maximum stress and strain energy developed in the bar if the load applied is (a) gradual	BT-3	Applying

	(b) sudden (c) falls through a height of 25 mm. Take E = 205 GPa. (7) (ii) Interpret the strain energy stored in a steel bar 50 cm long and 3 cm x 1 cm in cross-section shown in figure, when it is subjected simultaneously to an axial pull of 50 kN and compressive stress of 100 N/mm^2 on its narrow edge. (6) 		
9.	Show the vertical deflection at A and horizontal deflection at C of the truss shown in figure. Take area of cross-section of all members = A and Young‟s modulus = E. 	BT-3	Applying
10.	For the truss shown in figure, Investigate the horizontal movement of the roller at D. AB, BC, CD area = $8cm^2$. E= 2 x 10^5 N/mm^2. 	BT-4	Analyzing
11.	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 10^7mm^4.	BT-4	Analyzing

12.	A simply supported beam of span 6 m is subjected to a concentrated load of 45kN at 2 m from the left support. Identify the deflection under the load point. Take E = 200 x 10^6kN/m^2, I = 14 x $10^{-6}$$m^4$.Use unit load method.	BT-4	Analyzing
13.	Evaluate vertical deflection at the free end of the cantilever truss shown in figure. Take cross sectional area of compression members as 850 $mm^2$and tension members as 1000 mm^2. Modulus of elasticity E= 210GPa for all members. Use Willotmohr'sdiagram. 	BT-5	Evaluating
14.	Using the principle of virtual work, Write the horizontal displacement of support D of the frame shown in figure. The values of I are indicated along the members. E = 200 x 106 kN/m2 and I = 300 x 10-6 m^4. 	BT-6	Evaluating
	PART C		
1.	Find the deflection at the centre of simply supported beam carrying a uniformly distributed load of W/m throughout the span l. EI is constant. Use unit load method.	BT-1	Remembering
2.	State and prove (i) Castigliano"s theorem (ii) Maxwell Reciprocal theorem.	BT-1	Remembering

3.	(i) Create an expression for the strain energy due to bending for a beam of length "L" simply supported at the ends and carrying UDL of "w" per unit length and having flexural rigidity EI. (8) (ii) Using Castigliano"s theorem, design the central deflection and the slope at ends of asimply supported beam carrying an UDL of intensity „w" per unit length over the whole span. (7)	BT-6	Evaluating
4.	A bent cantilever frame shown in figure carries a load W at the free end D. Write the vertical displacement at free end. 	BT-3	Applying

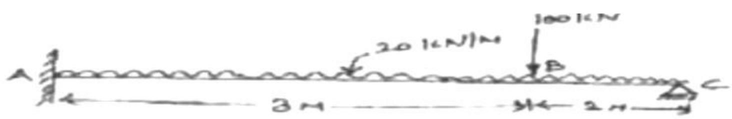
UNIT II- INDETERMINATE BEAMS

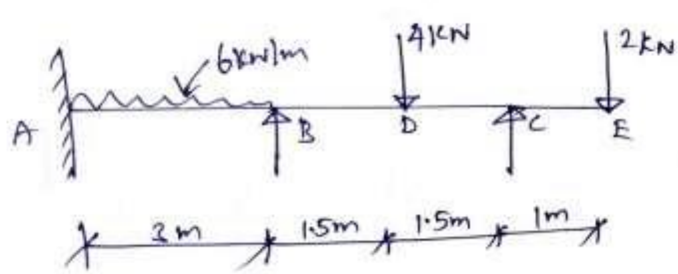
Concept of Analysis - Propped cantilever and fixed beams-fixed end moments and reactions – Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

PART A

Q.No	Questions	BT Level	Competence
1.	Define fixed beam.	BT-1	Remembering
2.	State "Degree of static indeterminancy".	BT-1	Remembering
3.	Define prop and explain propped cantilever beam.	BT-1	Remembering
4.	Define "compatability condition".	BT-1	Remembering
5.	How compatability condition is related to degree of static indeterminancy?	BT-1	Remembering
6.	List the methods of analysis of indeterminate beams.	BT-1	Remembering

7.	Describe statically determinate and statically indeterminate with an example.	BT-2	Understanding
8.	Classify structure based on degree of static indeterminacy.	BT-2	Understanding
9.	Outline the shear force diagram and bending moment diagram for the fixed beam for the following conditions and mark the salient points. (i) Central point load (ii) Eccentric point load	BT-2	Understanding
10.	Explain the advantages and disadvantages of the fixed beam.	BT-2	Understanding
11.	What is a continuous beam and classify its types?	BT-3	Applying
12.	Show the BM diagram (qualitative) of a propped cantilever of 1 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.	Explain about sinking of supports.	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.	Asses the degree of indeterminacy for a) propped cantilever b) fixed beam c) continuous beam?	BT-5	Evaluating
19.	Write the compatability equation for propped cantilever beam and fixed beam.	BT-6	Creating
20.	Write the principle by which a continuous beam can be analyzed.	BT-6	Creating
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-1	Remembering

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 contraflexure and draw the SFD and BMD. Assume prop sinks by 20 mm. E = 200 x 10^6kN/m^2 and I=15x10^{-6} m^4	BT-1	Remembering
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-1	Remembering
4.	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-1	Remembering
5.	Analyse the beam shown in fig. EI = constant. Outline the bending moment diagram. 	BT-2	Understanding
6.	A fixed beam of 6 m span is loaded with point loads of 150 kN at a distance of 2 m From each support. Predict the shear force and bending moment diagram. Also find the maximum deflection. Take E = 200 GPa and I = 8 x 108 mm^4.	BT-2	Understanding
7.	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-2	Understanding
8.	A fixed beam of length 6 m carries a couple of 500 Nm at its centre. Solve the following: (i) Maximum deflection (ii) Draw SFD and BMD	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 kNm2.	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 continuous beam shown in figure, draw SFD and BMD. All the supports are at the same level.  	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 6 m carries a central point load of 40 kN. Span BC of 7 m length carries 50 kN to the right of 3 m from support B. Span CD of length 6 m carries a UDL of 10 kN/m throughout its length. If the support B sinks by 10 mm, Identify the following. (i) Moment at the supports (ii) Reactions at the supports (iii) Draw SFD and BMD.	BT-4	Analyzing

PART C			
1.	Draw the SFD and BMD of a propped cantilever beam for the following cases. (i) Central point load (7) (ii) UDL throughout its length (8)	BT-1	Remembering
2.	State an expression for the end moments of a fixed beam of length L for the following conditions. (i) Central point load (7) (ii) UDL throughout its length and also draw the SFD and BMD for the beam. (8)	BT-1	Remembering
3.	Find the following for the fixed beam, continuous beam and propped cantilever beam. (i) Degree of static indeterminacy (5) (ii) Compatibility condition (5) (iii) Draw the reactions and moments developed at support. (5)	BT-1	Remembering
4.	Outline the shear force and bending moment diagram for a simply supported beam with UDL and propped at the centre.	BT-2	Understanding

UNIT 3-COLUMNS AND THICK CYLINDERS

Euler‟s theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – Eccentrically loaded short columns – middle third rule – core section – Thick cylinders – Compound cylinders.

PART A

Q.No	Questions	BT Level	Competence
1.	Define column and strut	BT-1	Remembering
2.	What are the assumptions made in the Euler‟s theory?	BT-1	Remembering
3.	Describe the two stages to draw BMD for a continuous beam under any system of loading.	BT-1	Remembering
4.	Define buckling load and safe load	BT-1	Remembering
5.	Define thick and thin cylinders.	BT-1	Remembering

6.	Write equivalent length of column.	BT-1	Remembering
7.	Distinguish between thick and thin cylinder.	BT-2	Understanding
8.	Outline qualitative stress and pressure diagram across the cross section of a thick cylinder subjected to internal pressure.	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.	The actual length of a column is 10 m. Solve its effective length when both endsof the column are (a) Hinged, (b) Fixed.	BT-3	Applying
12.	What is known as crippling load?	BT-3	Applying
13.	Illustrate the core (or) kern of a column section.	BT-3	Applying
14.	Compare the failure of long column with that of a short column due to axial compression.	BT-4	Analyzing
15.	Differentiate Rankine method and Euler‟s method.	BT-4	Analyzing
16.	Distinguish between long column and short column.	BT-4	Analyzing
17.	Write the effective length of column for the following end condition. (i) Both ends are fixed (ii) One end fixed and one end hinged (iii) One end fixed other end is free	BT-5	Evaluating
18.	How columns are classified depending upon slenderness ratio.	BT-5	Evaluating
19.	Construct the elastic curve for a fixed beam of length l carrying a central point load W.	BT-6	Creating
20.	Write Rankine‟s-Gordon formula.	BT-6	Creating
PART B			
1.	A column of circular section is subjected to a load of 120KN. The load is parallel to the axis but eccentric by an amount of 2.5 mm. the external and internal diameters are 60mm and 50mm respectively. If both the ends of the column are hinged and column is 2.1 m long, find the maximum stress in the column. Take E= 200 GN/m^2	BT-1	Remembering
2.	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 both ends. Calculate the safe load by Rankine‟s formula using a	BT-1	Remembering

	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 of Euler"s to Rankine"s load. Take E=150GPa.		
3.	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 (4) ii. One end fixed and the other end hinged (5) iii. Both ends fixed (4)	BT-1	Remembering
4.	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 (9) (ii) Upto what eccentricity, there is no tensile stress in column (4)	BT-1	Remembering
5.	Identify the Euler"s critical load for a strut of T-section. The flange width is100mm, over all depth is 80mm, and both the flange & stem are 10mm thick. The strut is 3m longand is built in at both ends.Take $E= 2x10^5$ N/mm^2 .	BT-2	Understanding
6.	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 $\sigma_c = 560$ N/mm^2 and α=1/1600 for pinned ends (6) (ii) Euler"s formula. Take $E= 1.2 \times 10^5$ N/mm^2. (7)	BT-2	Understanding
7.	Describe the relation for a crippling load by Euler"s method when the column is fixed at one end and free at the other end.	BT-2	Understanding
8.	i) A slender pin ended aluminum column 2m long and of circular cross-section is to have an outside diameter of 50cm. Solve the	BT-3	Applying

	necessary internal diameter to prevent failure by buckling if the actual load applied is 12kN and the critical load applied is twice the actual load. Take E for aluminum as 70 GN/m^2 (8) ii) An I-section 400 mm X 200 mm X 20 mm and 6m long is used as strut with both ends fixed. Write the Euler‟s crippling load for a column. Take E = 200GPa (7)		
9.	A pipe of 200mm internal diameter and 50 mm thickness carries a fluid at a pressure of 10MPa. Solve the maximum and minimum intensities of circumferential stress distribution across the section.	BT-3	Applying
10.	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-4	Analyzing
11.	Explain the Euler‟s assumption in column theory. And derive a relation for theEuler‟s crippling load for a column with both ends hinged.	BT-4	Analyzing
12.	i) Differentiate thick and thin cylinders. (3) ii) State the assumptions in thick cylinders (3) iii) Examine the stress acting in the thick cylinders (4) iv) Explain about compound cylinders (3)	BT-4	Analyzing
13.	A steel tube of 300 mm external diameter is to be shrunk on to another steel tube of90mm internal diameter, after shrinking the diameter at the junction is 180 mm, before shrinking on the difference of diameter at the junction is 0.12 mm. Rewrite the (i) The radial pressure at the junction (8) (ii) The circumferential stress developed in the two tubes after shrinking on. Take E= 200 GN/mm^2. (7)	BT-5	Evaluating
14.	Evaluate the ratio of the buckling strengths of columns of circular section one with hollow and other solid of the sane material, having the same length, same cross sectional area and same end condition. The internal diameter of the hollow column is half of the external diameter.	BT-6	Creating

PART C			
1.	Find out the kern of a column cross-section for the follwing a) Rectangular section b) Square section c) Circular section d) Hollow circular section	BT-1	Remembering
2.	State the Euler‟s assumption in column theory. And derive a relation for theEuler‟s crippling load for a column with both ends fixed.	BT-1	Remembering
3.	Describethe relation for theEuler‟s crippling load for a column with one end fixed and other end hinged along with the assumptions.	BT-2	Understanding
4.	Estimate the maximum and minimum hoop stress across the sections of pipe of 400 mm internal diameter and 100 mm thick, the pipe contains a fluid at a pressure of $8N/mm^2$. Also sketch the radial pressure distribution and hoop stress distribution across the section.	BT-2	Understanding

UNIT 4- STATE OF STRESS IN THREE DIMENSIONS

Determination of principal stresses and principal planes – Volumetric strain –Theories of failure – Principal stress - Principal strain – shear stress – Strain energy and distortion energy theories – application in analysis of stress, load carrying capacity.

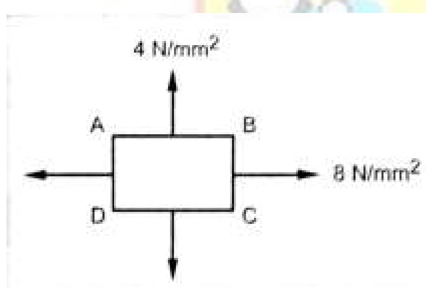
PART A

Q.No	Questions	BT Level	Competence
1.	What do you mean by principal plane and principal stress?	BT-1	Remembering
2.	Define principal strain.	BT-1	Remembering
3.	State "Rankine‟s theorem of failures"	BT-1	Remembering
4.	Define octahedral stress.	BT-1	Remembering
5.	State Guests Treca‟s theories of failure.	BT-1	Remembering
6.	State maximum strain energy theory or Haigh‟s theory.	BT-1	Remembering
7.	Explain Von-mises theory or Shear strain energy theory.	BT-2	Understanding

8.	Maximum principal strain theory (or) St. Venant‟s theory- Report it.	BT-2	Understanding
9.	Summarize octahedral stress.	BT-2	Understanding
10.	Describe octahedral shearing stress theory.	BT-2	Understanding
11.	Illustrate the theories used for ductile failure.	BT-3	Applying
12.	Write the limitations of maximum principal stress theory and maximum shear stress theory.	BT-3	Applying
13.	Examine stress tensor.	BT-3	Applying
14.	Differentiate principal plane and octahedral plane.	BT-4	Analyzing
15.	Analyze the state of stress at a point.	BT-4	Analyzing
16.	Interpret the principal stress due to combined bending and torsion.	BT-4	Analyzing
17.	Generalize the term stress invariants.	BT-5	Evaluating
18.	Rewrite the cubic equation used to analyse the 3D system of stresses.	BT-5	Evaluating
19.	Explain hydrostatic types of stress.	BT-6	Creating
20.	Summarize strain rosette.	BT-6	Creating
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 each case.	BT-1	Remembering

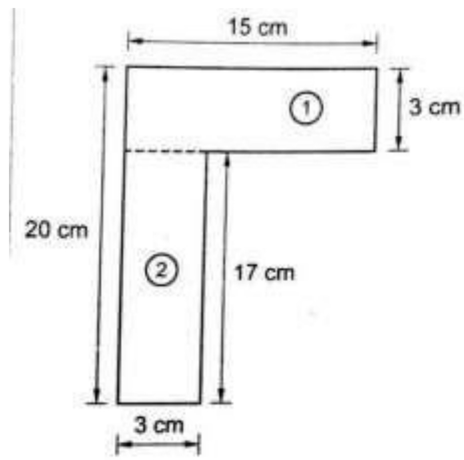
	(i) maximum principal stress theory (5) (ii) maximum shear stress theory (4) (iii) maximum shear strain energy theory. (4)		
4.	At a section of a mild steel shaft, the maximum torque is 8437.5 Nm and maximum bending moment is 5062.5 Nm. The diameter of shaft is 90 mm and the stress at the elastic limit 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^o with the major principal plane. (ii) the 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 and (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 200 MN/m^2 and the minor principal stress is compressive. If the tensile yield point of the steel is 235 MN/m^2, Estimate 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 and (4) (iii) Maximum shear strain energy. Take poisson ratio = 0.26 (4)	BT-2	Understanding
8.	(i) Illustrate Maximum shear stress theory. (3)	BT-3	Applying

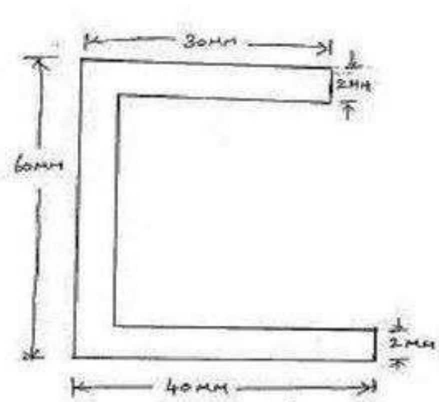
	(ii) A shaft is subjected to a maximum torque of 10 kNm and a maximum of bending moment of 8 kNm at a particular section. If the allowable equivalent stress in simple tension is 160 MN/m^2, Calculate the diameter of the shaft according to the (a) Maximum shear stress theory. (5) (b) Octahedral shear stress theory (5)		
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 rincipal 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 MPaand 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	At a point in a two-dimensional stressed system strains measured with a rectangular rosette as shown below: Take e_A= 500 microns, e_B= 250 microns and e_C= -150 microns, E = 2 x 10^5 N/mm^2 and 1/m = 0.3.Analyze the principal strain and principal stress.	BT-4	Analyzing
12	A strain energy rosette has axes of three gauges OA, OB, OC at 120^o to each other. The observed strains are e_A= 600 microns, e_B= -450 microns and e_C= -100 microns. Calculate the principal stresses. Take E = 2 x 10^5 N/mm^2 and 1/m = 0.3.	BT-4	Analyzing

13	A block of material is subjected to a tensile strain of 12 x 10^{-6} and a compression strain of 15 x 10^{-6} on planes at right angles to each other. There is also a shear strain of 12 x 10^{-6} and there is no strain on planes at right angles to the above planes. Rewrite the principal strain in magnitude and direction.	BT-5	Evaluating
14	Assess the principalstresses acting on steel plate which gave the following results: Principal strain, e_1 = 3.24 x 10^{-4} Pricipal strain, e_2 = 1.28 x 10^{-4} Modulus of elasticity, E = 200 GN/m^2 Poisson‟s ratio (1/m) = μ = 0.25	BT-6	Creating
	PART C		
1.	(i) Briefly describethe spherical and deviatory components of stress tensor. (5) (ii) Write the importance of theories of failure. (5) (iii) For the state of stressshown in figure, find the principal plane and principal stress. (5) 	BT-1	Remembering
2.	Illustrate in detail about the following.(5x3=15) (i) Rankine‟s theories of failure (ii) Guest‟s or Tresca‟stheroy (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	BT-1	Remembering

	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 N/mm^2. Find change in dimensions and change in volume.		
4.	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 stress theory The tensile stress at yield point is 250 N/mm^2. Use factor of safety of 2.5	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**.**			
PART A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	List the assumptions made in the analysis of curved bars.	BT-1	Remembering
2.	Write the formula for stress using Winkler-Bach theory	BT-1	Remembering
3.	Tell the concept behind unsymmetrical bending.	BT-1	Remembering
4.	Name the reasons for unsymmetrical bending	BT-1	Remembering
5.	How will you calculate the stress due to unsymmetrical bending?	BT-1	Remembering
6.	How will you calculate the distance of neutral axis from centroidal axis?	BT-1	Remembering
7.	How will you predict the angle of inclination of neutral axis with respect to principal axis?	BT-2	Understanding
8.	Restate the formula for deflection of a beam causing unsymmetrical bending.	BT-2	Understanding
9.	How will you interpret the resultant stress in a curved bar subjected to direct stress and bending stress?	BT-2	Understanding
10.	How will you predict resultant stress in a chain link?	BT-2	Understanding
11.	Write about shear center or angle of twist.	BT-3	Applying
12.	Examine endurance limit and endurance ratio.	BT-3	Applying

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.	Compare polar moment of inertia and the product of inertia.	BT-6	Creating
20.	Generalize stress concentration.	BT-6	Creating
	PART B		
1.	Find the principal moments of inertia and directions of principal axes for the angle section shown in figure. 	BT-1	Remembering
2.	An 80 x 80 x 10 mm angle is used as a simply supported beam over a span of 2.4 m. BT-5 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
3.	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
4.	Estimate principal moment of inertia of angle section 100 mm x 40 mm x 60 mm	BT-2	Remembering

5.	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
6.	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-3	Understanding
7.	A curved bar is formed of a tube 120mm outside diameter and 7.5mm thickness. The center line of this beam is a circular arc of radius 225mm. A bending moment of 3kN.m tending to increase curvature of the bar is applied. Calculate the maximum tensile and compressive stresses set up in the bar.	BT-3	Analyzing
8.	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
9.	Analyze the shear center of a channel section of 400 mm X 200 mm outside and 5 mm thick.	BT-4	Analyzing
10	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
11	Evaluate the principal moment of inertia of channel section shown in fig. 	BT-5	Evaluating

12	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
13	A curved bar of rectangular section, initially unstressed is subjected to pure bending moment of 400 N.m tends to straighten the bar. The section is 20 mm wide and 40 mm deep is curved in plane parallel to the depth and the mean radius of curvature is 50 mm. Assess the position of N.A and the ratio of maximum to the minimum stress.	BT-6	Creating
14	A beam of Tee section having flange of 100 mm x 20 mm and web of 150mm X 10mm and 3 m long is simply supported at its ends. It carries 4 kN at 30° tovertical and passing through the centroid of the section. Calculate the maximum tensile stresses and maximum compressive stresses. E = 200 kN/mm^2	BT-1	Remembering
	PART C		
1.	Write an expression for product of inertia of an right angled triangle.	BT-1	Remembering
2.	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
3.	Show the expression for wrinklerbach formula	BT-3	Applying
4.	Locate and derive the shear centre of an unequal I-section	BT-2	Understanding

VALLIAMMAI ENGINEERING COLLEGE
DEPARTMENT OF CIVIL ENGINEERING

CE6402- STRENGTH OF MATERIALS

S.no	Unit		BT1	BT2	BT3	BT4	BT5	BT6	Total Question
1	Unit-1	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	2	-	1	-	-	1	4
2	Unit-2	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	3	1	-	-	-	-	4
3	Unit-3	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	2	2	-	-	-	-	4
4	Unit-4	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	2	-	2	-	-	-	4
5	Unit-5	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	1	2	1	-	-	-	4

TOTAL NO OF QUESTIONS IN EACH PART

PART A	100
PART B	70
PART C	20
TOTAL	190