

VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK



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SUBJECT CODE: CE 6302

YEAR: II

SUBJECT NAME: MECHANICS OF SOLIDS

SEM : III

QUESTION BANK**(As per Anna University 2013 Regulation)**

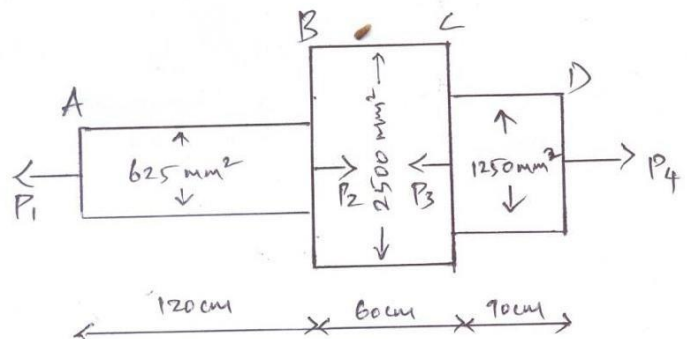
UNIT 1- STRESS AND STRAIN			
Stress and strain at a point – Tension, Compression, Shear Stress – Hooke's Law – Relationship among elastic constants – Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety – Thermal Stresses – Thin Cylinders and Shells – Strain Energy due to Axial Force – Resilience – Stresses due to impact and Suddenly Applied Load – Compound Bars			
PART – A (2 Marks)			
Q.No.	Questions	BT	Competence
1.	Define the terms young modulus, bulk modulus & shear modulus.	BT-1	Remembering
2.	State Hooke's law.	BT-2	Understanding
3	Recall modular ratio & Poisson's ratio.	BT-1	Remembering
4.	Explain longitudinal strain and lateral strain with a neat sketch.	BT-4	Analysis
5.	Outline what do you mean by principle of super position?	BT-4	Analysis
6.	Discuss the relationship between Elastic Constants	BT-2	Understanding
7.	An alloy bar of 1m length has a square section throughout which tapers from one end of 10mmx10mm to other end of 20x20mm. Find the change in length due to an axial load of 30kN. Take E=120GPa.	BT-6	Creating
8.	Relate the terms with one another a) resilience b) proof resilience c) modulus of resilience	BT-6	Creating
9.	Sketch the stress-strain diagram for TOR Steel/HYSD bars and mark the Salient points.	BT-1	Remembering
10.	Discuss about thermal stresses.	BT-1	Remembering
11.	Report what do you mean by strain energy density.	BT-3	Applying
12.	Relate shear stress and shear strain.	BT-3	Applying
13.	Determine the Poisson's ratio and modulus is $1.2 \times 10^5 \text{ N/mm}^2$ and modulus of rigidity is $4.8 \times 10^4 \text{ N/mm}^2$.	BT-3	Applying
14.	Define the term limit of proportionality elastic limit and yield point.	BT-1	Remembering
15.	List the types of stresses developed in thin cylinders subjected to internal pressure?	BT-1	Remembering
16.	A brass rod 2m long is fixed at both its ends. If the thermal stress is not to exceed 76.5 N/mm^2 . calculate the temperature through which the rod should be heated. Take the values of $\alpha = 17 \times 10^{-6} / \text{K}$ and $E = 90 \text{ Gpa}$.	BT-2	Understanding

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17.	Summarize the procedure for finding the thermal stresses in a composite bar?	BT-5	Evaluating
18.	Distinguish between cylindrical shell and spherical shell.	BT-4	Analysis
19.	Differentiate thin cylinder & thick cylinder	BT-2	Understanding
20.	Justify why wire winding is done in thin cylinder?	BT-5	Evaluating
PART – B (13 Marks)			
1.	<p>A tensile test was conducted on a mild steel bar. The following data was obtained from the test:</p> <ul style="list-style-type: none"> i. Diameter of the steel bar = 4 cm ii. Gauge length of the bar = 22 cm iii. Load at elastic limit = 250 kN iv. Extension at a load of 160 kN = 0.235 mm v. Maximum load = 390 kN vi. Total extension = 70 mm vii. Diameter of rod at failure = 2.35 cm <p>Examine:</p> <ul style="list-style-type: none"> a) The Young's modulus (4 marks) b) The stress at elastic limit (3 marks) c) The percentage of elongation (3 marks) d) The percentage decrease in area. (3 marks) 	BT-1	Remembering
2.	<p>A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown. Find P_2 required for necessary equilibrium, if $P_1 = 45\text{kN}$, $P_3 = 450\text{kN}$ and $P_4 = 130\text{kN}$. Determine the total elongation of the member.</p> 	BT-2	Understanding
3	A reinforced concrete column is 300mm x 300mm in section. The column is provided with 8 bars each of 20mm diameter. The column carries a load of 360kN. Calculate the stresses in concrete and the steel bars. Take $E_s = 210 \text{ GN/m}^2$ and $E_c = 14 \text{ GN/m}^2$	BT-2	Understanding
4.	Three bars made of copper, zinc and aluminium are of equal length and have cross section 555, 705, and 1020 sq.mm respectively. They are rigidly connected at their ends. If this compound member is subjected to a longitudinal pull of 255kN, Write the proportional of the load carried	BT-6	Creating

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	on each rod and the induced stresses. Take the value of E for copper = 1.3×10^5 N/mm ² , for zinc = 1×10^5 N/mm ² and for aluminium = 0.8×10^5 N/mm ²		
5.	A C.I plate, 300mm long and of 30mm x 50 mm uniform cross section, is acted upon by the following forces uniformly. 25kN(T), 35kN (T), and 45kN(T) in x,y and z axis respectively. Estimate the change in volume of the plate. E=140GN/m ² and m=4	BT-2	Understanding
6.	a) Obtain a relation for change in length of a bar hanging freely under its own weight (7 Marks) b) Assess the relationship between modulus of elasticity and modulus of rigidity (6 marks)	BT-5	Evaluating
7.	A cylindrical vessel, whose ends are closed by means of rigid flange plates, is made up of steel plate 3 mm thick. The length and internal diameter of the vessel are 55 cm and 25.5 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 3.5 N/mm ² . Also calculate the increase in length, diameter and volume of vessel. Take E = 2×10^5 N/mm ² and $\mu = 0.3$	BT-3	Applying
8.	Outline the stress–strain diagram for mild steel, brittle material and a ductile material and indicate salient points.	BT-4	Analysis
9.	A tension bar is made of 2 parts. The length of 1 st part is 300 cm and area is 20cm ² while the second part is of length 210 cm and 30cm ² . An axial load of 90kN is gradually applied. Identify the total strain energy produced in the bar and compare its value with that obtained in a uniform bar of same length and having same volume under same load. Take E = 2.1×10^5 N/mm ²	BT-1	Remembering
10.	A load of 200N falls through a height of 20mm onto a collar rigidly attached to the lower end of a vertical bar 2m long and 1.5 sq.cm c/s area. The upper end of vertical bar is fixed. Take E = 2×10^5 N/mm ² . Examine 1. Maximum instantaneous stress (4 marks) 2. Maximum instantaneous strain (3 marks) 3. Maximum instantaneous elongation (3 marks) 4. Strain energy (3 marks)	BT-1	Remembering
11.	A steel rod of 3.6cm diameter and 5m long is connected to two grips and the rod is maintained at a temperature of 105 ^o C. Examine the stress and pull exerted when the temperature falls to 40 ^o C if, i. The ends do not yield (7 marks) ii. The ends yield by 0.13cm (6 marks)	BT-1	Remembering
12.	A tensile load of 55N is acting on a rod of diameter 55mm and length	BT-4	Analysis

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	4.5m. A bore of diameter 25mm is made centrally on the rod. Analyze To what length the rod should be bored so that the total extension will increase 35% under the same tensile load. Take $E = 2 \times 10^5 \text{ N/mm}^2$		
13.	A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15.5mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, Analyze the stresses in the rod and the tube when the temperature is raised to 200°C . Take $E_s = 2.1 \times 10^5 \text{ N/mm}^2$, $E_c = 1 \times 10^5 \text{ N/mm}^2$, Co-efficient of linear expansion 11×10^{-6} per $^\circ\text{C}$ and 18×10^{-6} per $^\circ\text{C}$	BT-4	Analysis
14.	A cast iron pipe of 220 mm internal diameter and 12mm thick is wound closely with a single layer of circular steel wire of 5mm diameter, under a tension of 60 N/mm^2 . Find the initial compressive stress in the pipe section. Also find the stresses set up in the pipe BT-3 and steel wire, when water under a pressure of 3.5 N/mm^2 is admitted into the pipe. Take $E = 2 \times 10^5 \text{ N/mm}^2$ for steel and $E = 2 \times 10^5 \text{ N/mm}^2$ for cast iron and poisson's ratio as 0.3.	BT-3	Applying
PART-C (15 Marks)			
1.	Estimate the values of change in length, breadth and thickness of a steel bar 4.2m long, 35mm wide and 25mm thick. When subjected to an axial pull of 130kN in the direction of its length. Take $E=200 \text{ Gpa}$ and poisson's ratio = 0.3	BT-4	Analysis
2.	A bar of 25mm diameter is subjected to a pull of 40kN. The measured extension on gauge length of 200mm is 0.085mm and the change in diameter is 0.003mm. Estimate the values of Poisson's ratio and the three moduli	BT-5	Evaluating
3	A steel tube of 25mm external diameter and 18mm internal diameter encloses a copper rod of 15.5mm diameter to which it is rigidly joined at each end. If, at a temperature of 12°C there is no longitudinal stress, Examine the stresses in the rod and the tube when the temperature is raised to 190°C . Take $E_s = 2.1 \times 10^5 \text{ N/mm}^2$, $E_c = 1 \times 10^5 \text{ N/mm}^2$, Co-efficient of linear expansion 11×10^{-6} per $^\circ\text{C}$ and 18×10^{-6} per $^\circ\text{C}$	BT-3	Applying
4.	A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide and 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1m. If the temperature is raised by 80°C , Indicate the stresses in each metal and change in length. Take the value of E for steel = $2 \times 10^5 \text{ N/mm}^2$, for copper = $1 \times 10^5 \text{ N/mm}^2$. Coefficient of thermal expansion for steel and copper are 12×10^{-6} per $^\circ\text{C}$ and 17×10^{-6} per $^\circ\text{C}$	BT-2	Understanding

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UNIT 2- SHEAR AND BENDING IN BEAMS			
Beams and Bending- Types of loads, supports – Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, UDL, uniformly varying load. Theory of Simple Bending – Analysis of Beams for Stresses – Stress Distribution at a cross Section due to bending moment and shear force for Cantilever, simply supported and overhanging beams with different loading conditions - Flitched Beams.			
PART – A (2 Marks)			
Q.No.	Questions	BT	Competence
1.	Classify the types of beams with neat sketch	BT-4	Analysis
2.	Discuss about shear force and bending moment.	BT-2	Understanding
3.	Explain what do you meant by point of contra flexure?	BT-6	Creating
4.	Differentiate between hogging and sagging bending moment.	BT-2	Understanding
5.	Design maximum bending moment for a simply supported beam subjected to uniformly distributed load and where it occurs?	BT-6	Creating
6.	Draw the S.F. & B.M. diagrams for cantilever beam of length L carrying a UDL of W/unit length throughout its span.	BT-3	Applying
7.	Draw the SF and BM diagrams for a cantilever beam 2m long carrying a gradually varying load from zero @ free end to 2500N/m at the fixed end	BT-3	Applying
8.	A SSB of span 4m is subjected to a UDL of 2 kN/m over its entire length. Sketch the bending moment diagram for the beam.	BT-3	Applying
9.	Derive the relation between bending moment and shear force.	BT-5	Evaluating
10.	Summarize and sketch the types of supports used for a beam indicating the reactions in each case.	BT-2	Understanding
11.	Describe theory of simple bending equation.	BT-1	Remembering
12.	Discuss about moment of resistance of a beam?	BT-2	Understanding
13.	Define section modulus.	BT-1	Remembering
14.	Write any four assumptions in the theory of simple bending?	BT-4	Analysis
15.	What do you understand by neutral axis & neutral plane? How do you locate Neutral axis?	BT-1	Remembering
16.	Tell about Shear stress and also sketch the shear stress variation for symmetrical I section	BT-1	Remembering
17.	How would you find the bending stress in unsymmetrical sections?	BT-1	Remembering
18.	A beam subjected to a bending stress of 5N/mm^2 and the section modulus is 3530 cm^3 . Evaluate the moment of resistance of the beam	BT-5	Evaluating
19.	Define flitched beams. Why it is used?	BT-1	Remembering
20.	Write the formula for section modulus for a circular and hollow circular section.	BT-4	Analysis
PART – B (13 Marks)			
1.	Predict and plot the shear force and bending moment diagram for the beam shown in figure	BT-2	Understanding

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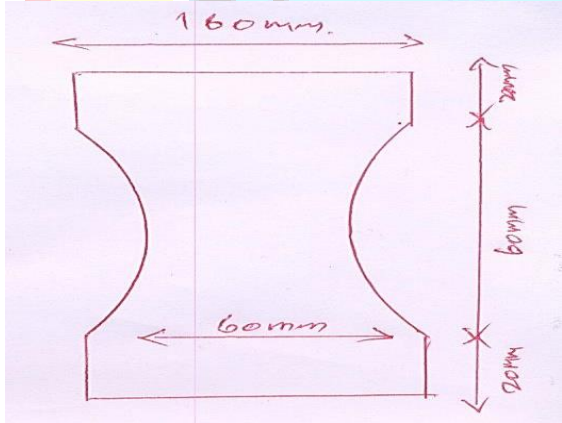
2.	A cantilever beam of 2 m long carries a uniformly distributed load of 1.5 kN/m over a length of 1.6 m from the fixed end and 2 kN at free end. Draws shear force and bending moment diagrams for the beam.	BT-3	Applying
3	A SS beam of 2 m long carries a uniformly distributed load of 1.5 kN/m over a length of 1.6 m from the right end. Draw shear force and bending moment diagrams for the beam.	BT-1	Remembering
4.	<p>A simply supported beam of length 10m carries the uniformly distributed load and two point loads as shown in Fig. Label the S.F and B.M diagram for the beam and also calculate the maximum bending moment</p>	BT-1	Remembering
5.	<p>Label the Shear force and bending moment diagram for the beam shown in Fig</p>	BT-1	Remembering
6.	<p>Locate and Plot the shear force and bending moment diagram for the beam given in Fig.,</p>	BT-1	Remembering
7.	The intensity of loading on a simply supported beam of 7m span increases gradually from 8.25kN/m run at one end to 2.5kN/m run at the other end. Intercept the position and the amount of maximum bending moment. Also Sketch the Shear force and bending moment diagram.	BT-2	Understanding
8.	Derive an expression for $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$.	BT-3	Applying
9.	A simply supported beam of span 4m carries a udl of 6kN/m over the entire	BT-2	Understanding

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	<p>span. If the maximum allowable stress due to bending is restricted to 150 N/mm^2, Estimate the cross sectional dimensions if the section is;</p> <p>(i) Rectangular with depth twice the breadth (4 marks)</p> <p>(ii) Solid circular section (5 marks)</p> <p>(iii) Hollow circular section having a diameter ratio of 0.6 (4 marks)</p>		
10.	<p>The cross section of T beam is as follows: Flange thickness = 10mm; width of the flange = 100mm; thickness of the web = 10mm; depth of the web = 120mm; If a shear force of 2kN is acting at a particular section of the beam design and draw the shear stress distribution across the section</p>	BT-5	Evaluating
11.	<p>A 100mm X 200mm rolled steel I section has the flanges 12mm thick and web 10mm thick. Formulate</p> <p>(i) The safe udl the section can carry over a span of 6m if the permissible stress is limited to 150 N/mm^2. (7 marks)</p> <p>(ii) The maximum bending stress when the beam carries a central point load of 20kN. (6 marks)</p>	BT-6	Creating
12.	<p>A simply supported beam of span 6m is subjected to a UDL of 15kn/m over its entire length. The cross section of beam is 20 cm wide and 30cm deep. Analyze and Sketch the variation of bending stress and shear stress in the beam cross section</p>	BT-4	Analysis
13.	<p>A steel section shown in figure is subjected to a shear force of 25kN. Construct the shear stress at the important points and sketch the shear distribution diagram.</p> 	BT-4	Analysis
14.	<p>A rectangular beam 300 mm deep is simply supported over the span of 4m. Evaluate the uniformly distributed load per metre which the beam may carry, if the bending stress should not exceed 120 N/mm^2. Take $I=8 \times 10^4 \text{ mm}^4$</p>	BT-4	Analysis

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PART-C (15 Marks)			
1.	A cantilever beam of 3 m long carries a uniformly distributed load of 10 kN/m over a length of 2 m from the free end. Draw shear force and bending moment diagrams for the beam.	BT-2	Understanding
2.	Derive an expression for shear force and bending moment of a simply supported beam carrying a UDL of w/m length throughout its span with neat sketch of SFD and BMD	BT-4	Analysis
3.	Discover an expression for shear force and bending moment of a simply supported beam carrying a UDL of w/metre length throughout its span with neat sketch.	BT-1	Remembering
4.	Find out the section modulus for the following a) Rectangular section (3 marks) b) Hollow rectangular section (4 marks) c) Circular section (3 marks) d) Hollow circular section (3 marks)	BT-3	Applying

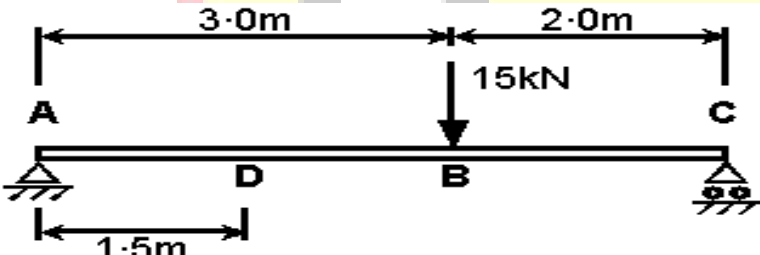
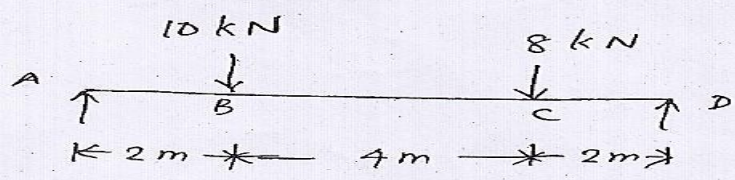
UNIT 3- DEFLECTION			
Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams.			
PART – A (2 Marks)			
Q.No.	Questions	BT	Competence
1.	Illustrate what is meant by deflection of beam with neat sketch.	BT-2	Understanding
2.	Recall the methods for finding out the slope and deflection at a section?	BT-1	Remembering
3.	Summarize double integration method.	BT-5	Evaluating
4.	Express the principle of actual beam over conjugate beam.	BT-6	Creating
5.	State the two theorems in moment area method.	BT-1	Remembering
6.	Give the differential relation between bending moment, slope and the deflection?	BT-1	Remembering
7.	Give the maximum slope and maximum deflection of a cantilever beam subjected to UDL?	BT-1	Remembering
8.	Illustrate when Macaulay's method is preferred?	BT-2	Understanding
9.	Demonstrate Moment area method with a example.	BT-3	Applying
10.	Identify the values of slope and deflection for a cantilever beam of length 'L' subjected to Moment 'M' at the free end?	BT-1	Remembering
11.	Distinguish between statically determinate and indeterminate beams.	BT-2	Understanding
12.	Relate the 2 theorems of conjugate beam method with one another.	BT-3	Applying
13.	Formulate the slope at the support for a simply supported beam of length L, constant EI and carrying central concentrated load?	BT-5	Evaluating
14.	Justify why moment method is more useful when compared with double integration?	BT-6	Creating
15.	Write down the formula used to find the deflection of beam by Moment-	BT-4	Analysis

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	Area method.		
16.	Compare and contrast working stress & allowable stress	BT-2	Understanding
17.	Write the maximum value of deflection for a cantilever beam of length L , constant EI and carrying concentrated load W at the end.	BT-4	Analysis
18.	Write the relation between deflection of bending moment and flexural rigidity for a beam.	BT-4	Analysis
19.	Recall method of Singularity functions.	BT-1	Remembering
20.	Among 4 methods of analyzing the beams for deflection and slope, relate the situations when each methods are used.	BT-3	Applying
PART – B (13 Marks)			
1.	A beam of length 5 m is simply supported at its ends and carries two point loads of 47 kN and 30 kN at a distance of 1.1 m and 3.2 m respectively from the left support. Identify (i) Deflection under each load (4 marks) (ii) Maximum deflection (4 marks) (iii) The point at which the maximum deflection occurs. (5 marks) Take $I=85 \times 10^6 \text{ mm}^4$ $E = 2 \times 10^5 \text{ N/mm}^2$	BT-1	Remembering
2.	A steel joist, simply supported over a span of 6 m carries a point load of 50 kN at 1.2 m from the left hand support. Find the position and magnitude of the maximum deflection. Take $EI = 14 \times 10^{12} \text{ N/mm}^2$	BT-1	Remembering
3.	For the beam shown in fig Identify the deflection at the B. Use Macaulay's method. 	BT-1	Remembering
4.	Identify the slope at the supports and deflection of the beam shown in figure. Take $E=2 \times 10^5 \text{ N/mm}^2$ and $I= 20 \times 10^6 \text{ mm}^4$. Use Macaulay's method 	BT-1	Remembering
5.	A cantilever of length 2.5m is loaded with an udlof 10 kN/m over a length 1.5m from the fixed end and point load 2kN at 2m from free end. Use Moment area method. a) Design the beam for slope (6 marks) b) Design the beam for deflection at the free end. (7 marks)	BT-6	Creating
6.	Indicate and solve the slope and deflection at the free end of the	BT-2	Understanding

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	<p>cantilever shows in fig. Take $EI = 1 \times 10^{10} \text{ kN/mm}^2$</p>		
7.	<p>Using conjugate beam method, Indicate the slope and deflections at A, B, C and D of the beam shown in fig. Take $E = 200\text{GPa}$ and $I = 2 \times 10^{-2} \text{ m}^4$.</p>	BT-2	Understanding
8.	<p>For the beam shown in fig Predict the deflection at the B. Use Macaulay's method</p>	BT-3	Applying
9.	<p>Point out the deflection under the greater load for the beam shown in fig using the Moment Area method.</p>	BT-4	Analysis
10.	<p>A beam AB of span 6m is simply supported at its ends is subjected to a point load of 20kN at C at a distance of 2m from left end. Using moment area method, Predict the deflection at the point C, slope at the points A, B and C. Take $I = 6 \times 10^8 \text{ mm}^4$ and $E = 200\text{GPa}$</p>	BT-2	Understanding
11.	<p>Indicate and solve the slope and deflection at the free end of the cantilever shows in fig. Take $EI = 1 \times 10^{10} \text{ kN/mm}^2$</p>	BT-3	Applying
12.	<p>A simply supported beam carrying a triangular distributed load. Label a) the slope at left end (7 marks) b) deflection at Centre (6 marks)</p>	BT-1	Remembering

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13.	Derive an expression for deflection of a simply supported beam carrying an eccentric point load.	BT-4	Analysis
14.	A beam of 4m span is carrying a point load of 40kN at a distance of 3m from the left end. Calculate the slope at the supports and deflection under the load. Also calculate the maximum deflection. $EI = 2.6 \times 10^7 \text{ N-m}^2$	BT-4	Analysis
PART-C (15 Marks)			
1.	Derive an expression for slope and deflection of a cantilever beam carrying point load at free end	BT-2	Understanding
2.	Derive an expression for deflection of a simply supported beam carrying UDL throughout its span	BT-4	Analysis
3	Obtain an expression for Slope and deflection of a simply supported beam carrying point load at mid-span	BT-3	Applying
4.	A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Find (i) Deflection under each load (ii) Maximum deflection (iii) The point at which the maximum deflection occurs. Take $E = 2 \times 10^5 \text{ N/mm}^2$, $I = 85 \times 10^6 \text{ mm}^4$.	BT-5	Evaluating
UNIT 4- TORSION			
Torsion of Circular and Hollow Shafts – Elastic Theory of Torsion – Stresses and Deflection in Circular Solid and Hollow Shafts – combined bending moment and torsion of shafts - strain energy due to torsion - Modulus of Rupture – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Leaf Springs – Springs in series and parallel – Design of buffer springs`			
PART – A (2 Marks)			
Q.No.	Questions	BT	Competence
1.	Compare and contrast between torsion, bending and torque	BT-1	Remembering
2.	List the assumptions made in the theory of torsion?	BT-2	Understanding
3	Write about Torsional equation and torsional rigidity	BT-1	Remembering
4.	Write about modulus of rupture	BT-4	Analysis
5.	Write the expression for power transmitted by a shaft.	BT-4	Analysis
6.	A circular shaft of 80mm diameter is required to transmit torque. Find the safe torque if the shear stress is not to exceed 80Mpa	BT-2	Understanding
7.	Why hollow circular shafts are preferred when compared to solid circular shafts?	BT-6	Creating
8.	Define springs. What are the different types of springs?	BT-6	Creating
9.	What is leaf spring? State the uses of leaf spring.	BT-1	Remembering
10.	Write down the expression for torque transmitted by hollow shaft and solid circular section.	BT-1	Remembering

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11.	Define spring stiffness and Spring index	BT-3	Applying
12.	Compare close coiled and open coiled springs under the action of an axial load.	BT-3	Applying
13.	What is the value of maximum shear stress in a close coiled helical spring subjected to an axial force?	BT-3	Applying
14.	A circular shaft is subjected to a torque of 10kNm. The power transmitted by the shaft is 209.33kW. Find the speed of shaft in revolution per minute.	BT-1	Remembering
15.	State the types of stresses when a closed coiled spring is subjected to (i) axial load and (ii) axial twisting moment.	BT-1	Remembering
16.	Write the equation for strain energy stored in a shaft due to torsion.	BT-2	Understanding
17.	What is meant by stiffness? Write the formula for stiffness of a close coiled helical spring subjected to axial load.	BT-5	Evaluating
18.	Give shear stress and deflection relation for close-coiled helical spring	BT-4	Analysis
19.	How will you apply a moment to produce bending and torque in a shaft?	BT-2	Understanding
20.	Design the equivalent bending moment for a shaft subjected to moment M and torsion T?	BT-5	Evaluating
PART – B (13 Marks)			
1.	A solid steel shaft is subjected to a torque of 45kNm. If the angle of twist is 0.5° per metre length of the shaft and the shear stress is not to be allowed to exceed 90MN/m^2 . & $C = 80\text{GN/m}^2$. Evaluate a) Suitable diameter for the shaft (3 marks) b) Final maximum shear stress (3 marks) c) Angle of twist (3 marks) d) Maximum shear strain in the shaft (4 marks)	BT-1	Remembering
2.	In a tensile test, a test piece of 25mm diameter, 200mm gauge length stretched 0.0950mm under a pull of 50kN. In a torsion test, the same rod is twisted about 0.03radian over a length of 150mm when a torque of 0.5kN.m was applied. Evaluate a) Poisson's ratio (3 marks) b) Young's modulus (3 marks) c) Bulk modulus and (3 marks) d) Rigidity modulus for a material (4 marks)	BT-2	Understanding
3	A steel shaft ABCD having a total length of 2400mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80mm and 50mm respectively, BC is solid and 80mm diameter. CD is also solid and 70mm in diameter. If the angle of twist is same for each section, Solve for the length of each portion and the total angle of twist. Maximum permissible shear stress is 50 MPa and shear modulus $0.82 \times 10^5 \text{MPa}$.	BT-2	Understanding
4.	A composite shaft consists of copper rod of 25mm diameter enclosed in a steel tube of external diameter 45mm and 5mm thick. The shaft is required to transmit a torque of 1100N.m and both the shaft have equal lengths, welded to a plate at each end so that their twists are equal. If the	BT-6	Creating

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	modulus of rigidity for the steel as twice that of copper, find a) Shear stress developed in copper (6 marks) b) Shear stress developed in steel (7 marks)		
5.	A solid circular shaft transmits 75kW power at 200rpm. Estimate the values of shaft diameter, if the twist in the shaft is not to exceed one degree in 2m length of shaft and shear stress is not exceed 50 N/mm ² . Assume the modulus of rigidity of the material of the shaft as 100 kN/mm ²	BT-2	Understanding
6.	Derive the following torsional equation $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$	BT-5	Evaluating
7.	Derive an expression for strain energy stored in a body due to torsion	BT-3	Applying
8.	A closely coiled helical spring made out of a 10mm diameter steel bar has 12 complete coils, each of mean diameter of 100mm. Calculate a) the stress induced in the section of rod, (4 marks) b) the deflection under the pull and (4 marks) c) Amount of energy stored in the spring during the extension. (5 marks) If It is subjected to an axial pull of 200N. Modulus of rigidity is 0.84x10 ⁵ N/mm ²	BT-4	Analysis
9.	A close coiled helical spring has a stiffness of 5N/mm. its length when fully compressed with adjacent coils touching each other is 40 cm. the modulus of rigidity of the material of the spring is 8x10 ⁴ N/mm ² . Determine the wire diameter and mean coil diameter if their ratio is 1/10. What is the corresponding maximum shear stress in the spring	BT-1	Remembering
10.	a) A circular shaft of 1000mm diameter and 2m length is subjected to a twisting moment. This creates a shear stress of 20N/mm ² at 30mm from the axis of the shaft. Calculate the angle of twist and the strain energy stored in the shaft. Take G=8x10 ⁴ N/mm ² (6 marks) b) A leaf spring 750mm long is required to carry a central load of 8kN. If the central deflection is not to exceed 20mm and the bending stress is not to be greater than 200N/mm ² . Determine the thickness, width and number of plates. Assume the width of the plates is 12 times, their thickness and modulus of elasticity of the springs material as 200kN/mm ² (7 marks)	BT-1	Remembering
11.	a) A solid shaft is subjected to a bending moment of 2.3 KN-m and twisting moment of 3.45KN-m find the diameter of shaft if the permissible tensile and shear stress for the material of the shaft are limited to 703 MN/m ² and 421.8 MN/m ² . (6 marks) b) A open coil helical spring is made up 5mm diameter wire has 16 coils 100mm diameter with helix angel of 16 ⁰ calculate the deflection maximum direct and shear stress induced due to an axial load of 300N. Take G=90GPa and E=200GPa. (7 marks)	BT-1	Remembering

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12.	Two solid shafts AB and BC of aluminum and steel respectively are rigidly fastened together at B and attached to two rigid supports at A and C. Shaft AB is 7.5cm in diameter and 2m in length. Shaft BC is 5.5 cm in diameter and 1m in length. A torque of 20000 N-cm is applied at the junction B. compute the maximum shearing stresses in each material. What is the angle of twist at the junction? Take $C_{al} = 0.3 \times 10^5$ N/mm ² and $C_{st} = 0.9$ N/mm ² .	BT-4	Analysis
13.	<p>a) Find the size of a square shaft to transmit 75kW at 120 rpm if shear stress is not to exceed 50N/mm² (3 marks)</p> <p>b) Hollow shaft having inside diameter 60% of its outside diameter is to replace a solid shaft transmitting a same power at the same speed calculate the % saving in material, if the materials to be used is also the same. (6 marks)</p> <p>c) Calculate the maximum torque that a shaft of 125 mm diameter can transmit, if the maximum angle of twist 1° in a length of 1.5 m. $C=7 \times 10^5$ N/mm² (4 marks)</p>	BT-4	Analysis
14.	Two close coiled helical springs wound from the same wire, but with different core radii having equal no.of coils are compressed between rigid plates at their ends. Calculate the maximum shear stress induced in each spring, if the wire diameter is 10mm and the load applied between the rigid plates is 500N. the core radii of the spring 100 mm and 75mm respectively.	BT-3	Applying
PART-C (15 Marks)			
1.	<p>A shaft has to transmit 245 kW power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft is not to exceed 40 N/mm² and the twist must not exceed 1° per metre length, find a suitable diameter. If</p> <p>a) The shaft is solid (7 marks)</p> <p>b) The shaft is hollow with external diameter twice the internal diameter</p> <p>Take $C = 8 \times 10^4$ N/mm⁴ (8 marks)</p>	BT-2	Understanding
2.	A helical spring in which mean diameter of the coil is 8 times the wire diameter is to be designed to observe 0.2 KN of energy with an extension of 100mm. the maximum shear stress is not to exceed 125N/mm ² . determine the mean diameter of wire and diameter of springs and number of turns also find the load with an extension of 40 mm could be produced in the spring assume $G= 84$ KN/mm ²	BT-4	Analysis
3	What is the speed of circular shaft is subjected to a torque of 15kNm. The power transmitted by the shaft is 209.33kW	BT-3	Applying
4.	A composite concrete shaft is made up of a solid steel shaft of 25mm radius encased in a hollow steel tube of 40mm inner radius and 60 mm outer radius. If both the shafts is of length 1m, find shear stress induced in both the shafts and angle of twist. $C= 1 \times 10^5$ MPa $T= 1$ kN.m	BT-6	Creating

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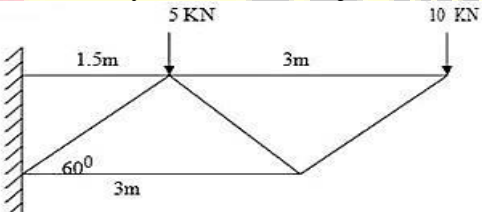
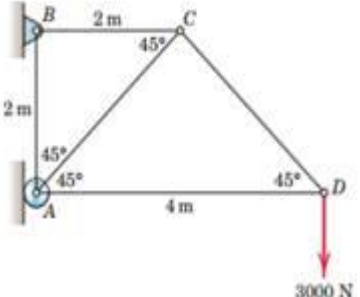
UNIT 5- COMPLEX STRESSES AND PLANE TRUSSES			
2 D State of Stress – 2 D Normal and Shear Stresses on any plane – Principal Stresses and Principal Planes – Mohr's circle - Plane trusses: Analysis of plane trusses - method of joints - method of sections			
PART – A (2 Marks)			
Q.No.	Questions	BT	Competence
1.	What is mean by Circumferential stress (or hoop stress) and Longitudinal stress?	BT-1	Remembering
2.	Give the maximum shear stresses at any point in a cylinder?	BT-2	Understanding
3.	Define state of stress at a point	BT-1	Remembering
4.	Define principal plane	BT-4	Analysis
5.	Define principal stress	BT-4	Analysis
6.	Generalize the formula for finding circumferential strain and longitudinal strain?	BT-2	Understanding
7.	Define plane stress problem with example	BT-6	Creating
8.	Define plane strain problem with example	BT-6	Creating
9.	Distinguish between uniform and non-uniform state of stress	BT-1	Remembering
10.	Draw the Mohr's circle for a state of pure shear and indicate the principal stresses	BT-1	Remembering
11.	Distinguish between perfect and imperfect frame?	BT-3	Applying
12.	Compare and contrast deficient and redundant frame.	BT-3	Applying
13.	Justify how method of joints applied to Trusses carrying Horizontal and inclined loads	BT-3	Applying
14.	Discuss the assumptions made in finding out the forces in a frame?	BT-1	Remembering
15.	List the methods available for analyzing the frames.	BT-1	Remembering
16.	Differentiate a frame and truss	BT-2	Understanding
17.	State the advantages of method of section over method of joints	BT-5	Evaluating
18.	A perfect frame consists of 7 members. Decide the number of joints.	BT-4	Analysis
19.	Show the difference between a cantilever and simply supported frame? How will you find the reactions in both the cases?	BT-2	Understanding
20.	Differentiate a strut from tie	BT-5	Evaluating
PART – B (13 Marks)			
1.	A rectangular block of material is subjected to a tensile stress of 110N/mm^2 on one plane and a tensile of 47N/mm^2 on a plane at right angles to the former. Each of the above stresses is accompanied by a shear stress of 63N/mm^2 . Determine the principal stresses, principal planes and the maximum shear stresses.	BT-1	Remembering
2.	At a point in a strained material, the principal stresses are 100N/mm^2 (T) and 40N/mm^2 (C). Determine the resultant stress in magnitude and direction in a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the	BT-2	Understanding

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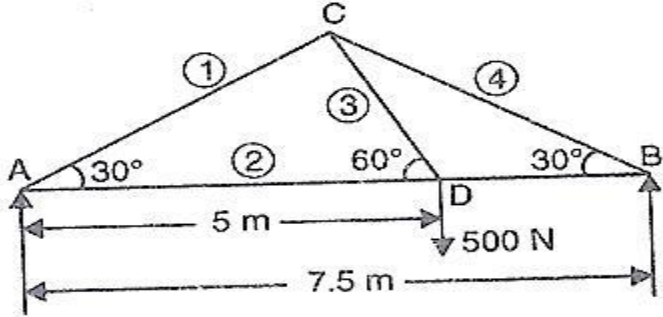
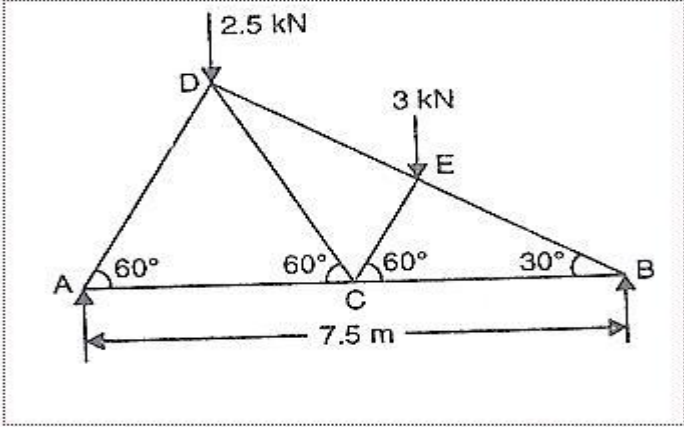
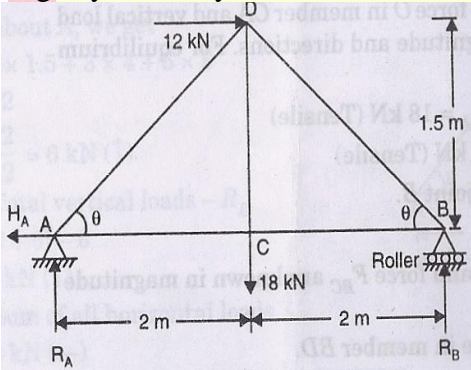
	point?		
3	The stresses at a point in a strained material is $P_x = 200 \text{ N/mm}^2$, $P_y = -150 \text{ N/mm}^2$ and $Q = 80 \text{ N/mm}^2$. Solve for the principal plane and principal stress using graphical method and verify with the analytical results.	BT-2	Understanding
4.	The principal stresses in the wall of a container are 40 MN/m^2 and 80 MN/m^2 . Determine the normal, shear and resultant stresses in magnitude and direction in a plane, the normal of which makes an angle of 30° with the direction of maximum principal stress	BT-6	Creating
5.	An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the mohr's circle if stresses and hence determine the magnitudes and direction of principal stresses and also the greatest shear stress.	BT-2	Understanding
6.	Derive relations for normal and shear stresses acting on an inclined plane at a point in a stained material subjected to two mutually perpendicular direct stresses method	BT-5	Evaluating
7.	A cantilever truss is show in fig. conclude the forces and its nature in the members of the truss by the method of joint 	BT-3	Applying
8.	Analyze the forces in all members of the truss shown in figure by method of Joints/sections 	BT-4	Analysis
9.	A truss loaded shown in fig. Analyze and find the reaction and forces in the members by using any one analytical methods	BT-1	Remembering

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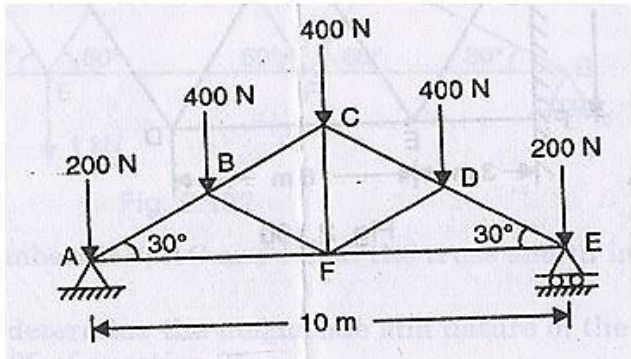
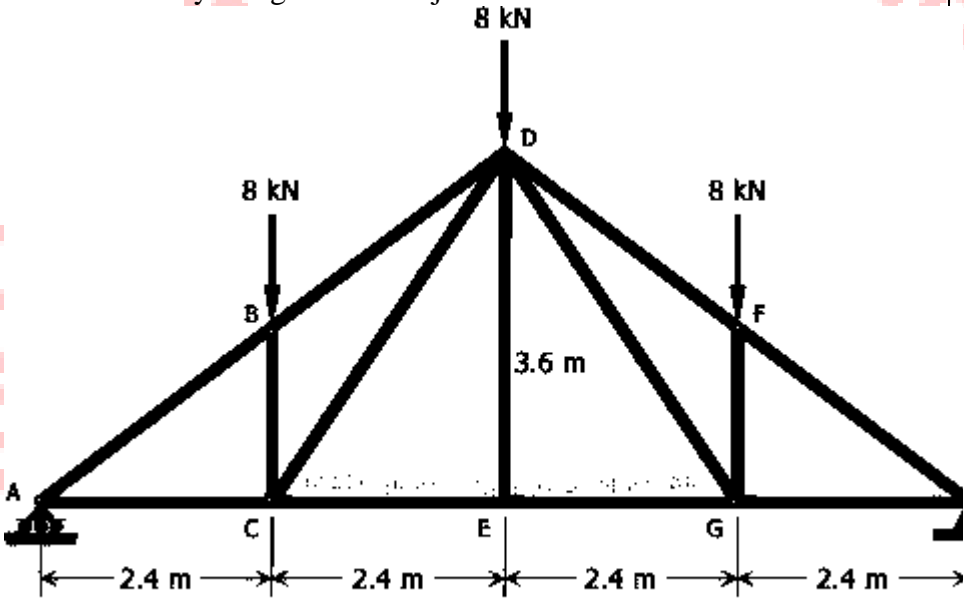
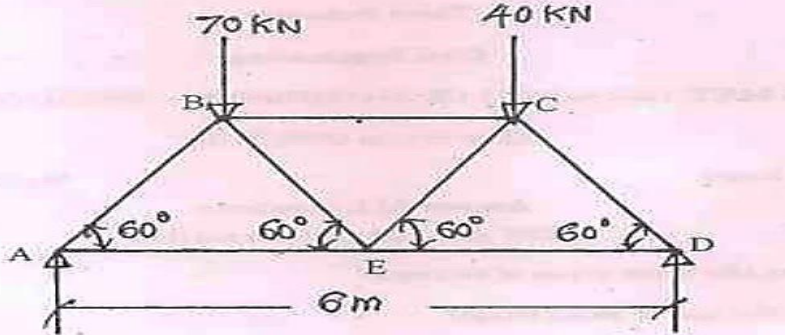
			
<p>10.</p>	<p>Analyze the truss by method of Joints</p> 	<p>BT-1</p>	<p>Remembering</p>
<p>11.</p>	<p>A short metallic column of 500mm^2 cross sectional area carries a axial compressive load of 100kN. For a plane inclined at 60° with the direction of the load arrive at</p> <ol style="list-style-type: none"> Normal stress (3 marks) Resultant stress (2 marks) Tangential stress (3 marks) Maximum shear stress (2 marks) Obliquity of resultant stress (3 marks) 	<p>BT-1</p>	<p>Remembering</p>
<p>12.</p>	<p>A truss loaded shown in fig. Analyze and find the reaction and forces in the members by using anyone analytical methods</p> 	<p>BT-4</p>	<p>Analysis</p>
<p>13.</p>	<p>Analyze and predict the forces in all members of the truss shown in figure by method of sections</p>	<p>BT-4</p>	<p>Analysis</p>

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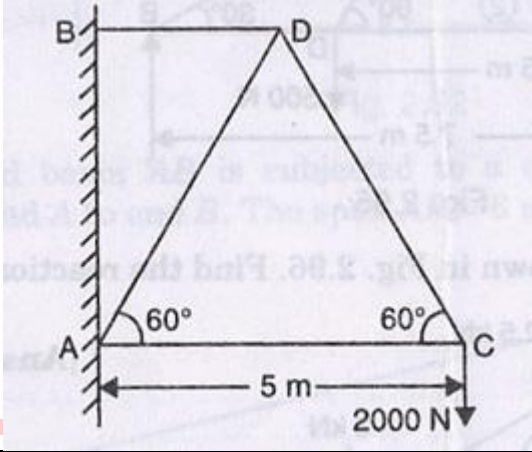
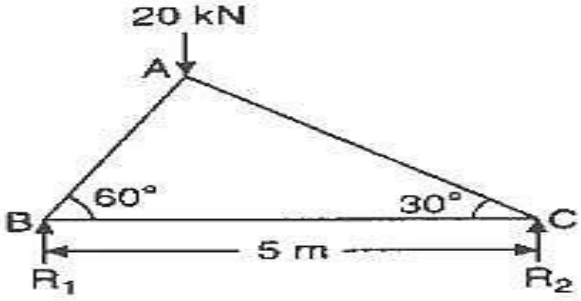
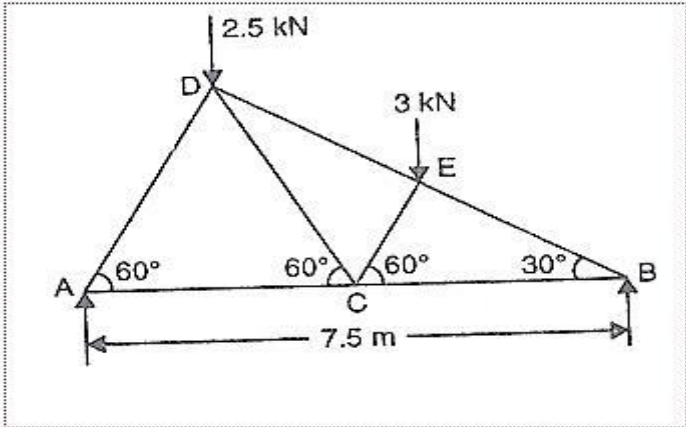
			
<p>14.</p>	<p>A truss loaded shown in fig. Analyze and find the reaction and forces in the members by using method of joints</p> 	<p>BT-3</p>	<p>Applying</p>
<p>PART-C (15 Marks)</p>			
<p>1.</p>	<p>Analyze and predict the forces in all members of the truss shown in figure by using any one analytical method</p> 	<p>BT-3</p>	<p>Applying</p>
<p>2.</p>	<p>A truss loaded shown in fig. Analyze and find the reaction and forces in the members by using method of joints</p>	<p>BT-4</p>	<p>Analysis</p>

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<p>3</p>	<p>A truss loaded shown in fig. Analyze and find the reaction and forces in the members by using method of joints</p> 	<p>BT-1</p>	<p>Remembering</p>
<p>4.</p>	<p>Analyze and find the reaction and forces in the members of a truss shown below by using any one analytical method</p> 	<p>BT-5</p>	<p>Evaluating</p>

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