PSN College of Engineering and Technology

(Autonomous)

Tirunelveli - 627152

QUESTION BANK

Subject Code	: **ME630204**
Subject Name	: **STRENGTH OF MATERIALS**
Regulation	: REGULATION 2022
Semester	III
Academic Year	: 2023 – 2024 (Odd Semester)
Department	: Common to Mechanical and Mech & Auto Engineering

Prepared By

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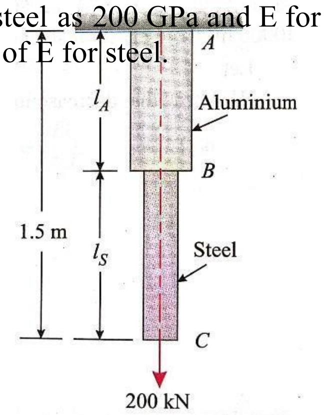
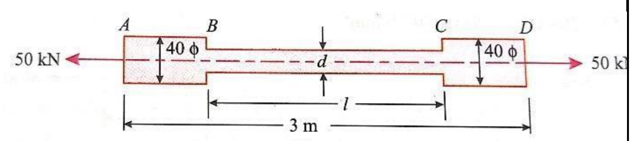
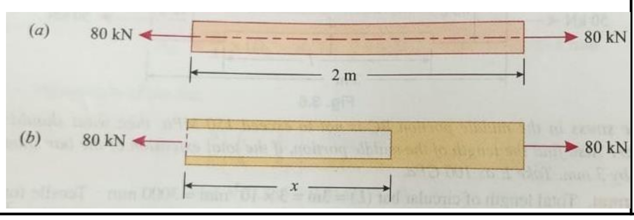
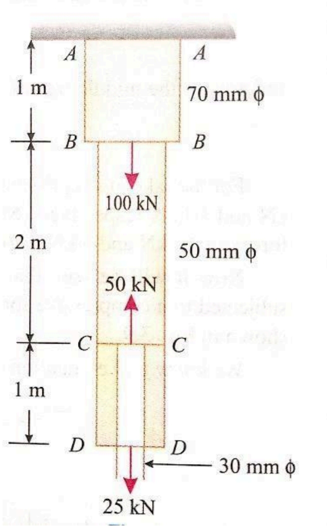
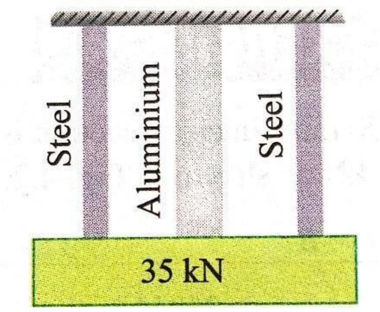
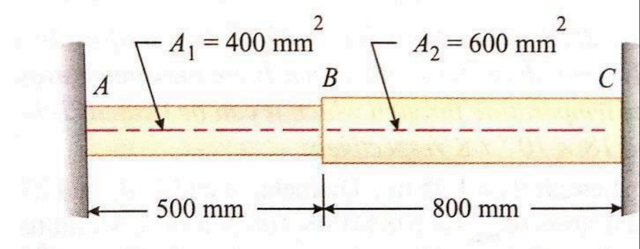
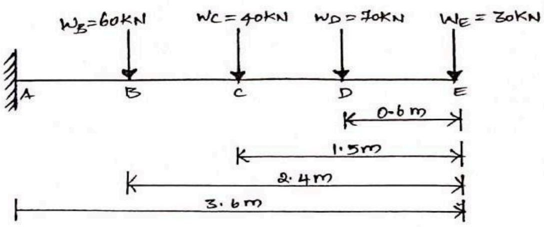
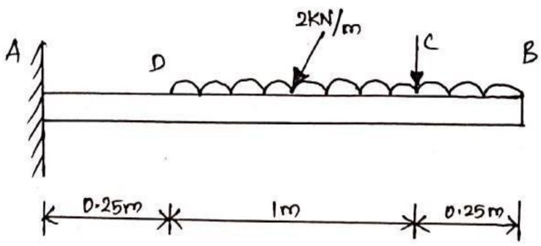
UNIT 1: STRESS, STRAIN AND DEFORMATION OF SOLIDS			
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformationof simple and compound bars – Thermal stresses – Elastic constants.			
PART – A (2 Marks)			
S.NO	**Questions**	**BT Level***	
1.	What is Hooke's Law?	2	Understand
2.	What are the Elastic Constants?	2	Understand
3.	Define Poisson's Ratio.	1	Remembering
4.	Define: Resilience	1	Remembering
5.	Define proof resilience	1	Remembering
6.	Define modulus of resilience.	1	Remembering
7.	Define principal planes and principal stresses.	1	Remembering
8.	Define stress and strain.	1	Remembering
9.	Define Shear stress and Shear strain.	1	Remembering
10.	Define elastic limit.	1	Remembering
11.	Define volumetric strain.	1	Remembering
12.	Define tensile stress and compressive stress.	1	Remembering
13.	Define young's Modulus.	1	Remembering
14.	What is the use of Mohr's circle?	2	Understand
15.	Define thermal stress.	1	Remembering
16.	Define Bulk modulus.	1	Remembering
17.	What is modulus of rigidity?	2	Understand
18.	Define factor of safety.	1	Remembering
19.	State the relationship between young's modulus and modulus of rigidity..	4	Analyse
20.	What is compound bar	2	Understand
PART – B (16 Marks)			

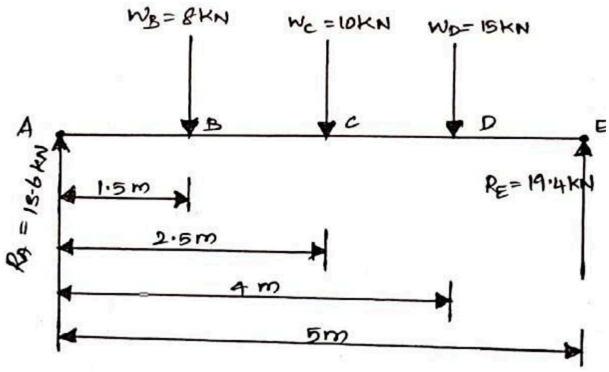
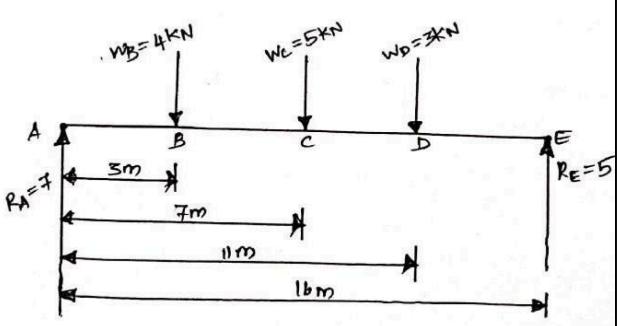
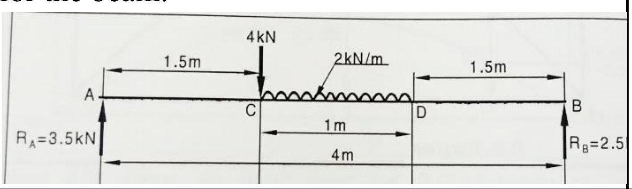
1.	A compound bar ABC 1.5 m long is made up of two parts of aluminium and steel and that cross-sectional area of aluminium bar is twice that of the steel bar. The rod is subjected to an axial tensile load of 200 kN. If the elongations of aluminium and steel parts are equal, find the lengths of the two parts of the compound bar. Take E for steel as 200 GPa and E for aluminium as one-third of E for steel. 	5	Evaluate pg-60
2.	An alloy circular bar ABCD 3 m long is subjected to a tensile force of 50 kN as shown in Fig. If the stress in the middle portion BC is not to exceed 150 MPa, then what should be its diameter? Also find the length of the middle portion, if the total extension of the bar should not exceed by 3 mm. Take E as 100 GPa. 	5	Evaluate
3.	A steel bar 2 m long and 40 mm in diameter is subjected to an axial pull of 80 KN. Find the length of the 20 mm diameter bore, which should be centrally carried out, so that the total elongation should increase by 20% under the same pull. Take E for the bar material as 200 GPa. 	5	Evaluate

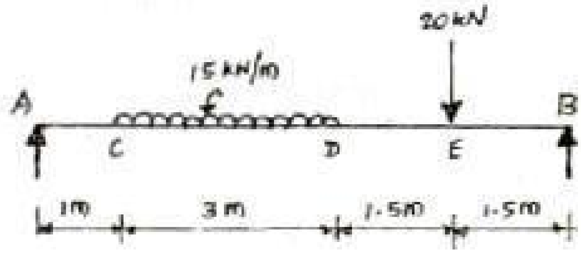
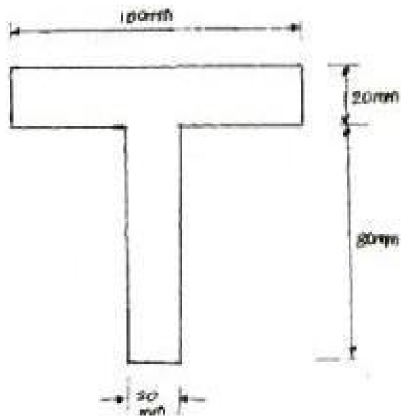
4.	A circular steel rod ABCD of different cross-sections is loaded as shown in Fig. Find the maximum stress induced in the rod and its deformation. Take E = 200 GPa.  	5	Evaluate
5.	A block shown in Fig. 4.10 weighing 35 kN is supported by three wires. The outer two wires are of steel and have an area of 100 mm² each, whereas the middle wire of aluminium and has an area of 200 mm².  	5	Evaluate
6.	A steel rod ABC is firmly held between two rigid supports A and C as shown in Fig. Find the stresses developed in the two portions of the rod, when it is heated through 15 K. Take a = 12 x 10 /K and E 200 GPa.  	5	Evaluate
7.	Descriobe the principle for finding out the stresses in the nut and bolt arrangements.	5	Evaluate

8.	Drive the relationship between modulus of elasticity and modulus of rigidity. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30 mm and of length 1.5 m if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 10 N/mm2. Take E = 1X 10^5 N/mm^2 A) what are the different types of machining operations that can be performed on a lathe? And explain any six in detail	5	Evaluate
UNIT 2: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers –Simply supported beams			
PART – A (2 Marks)			
1.	State the different types of supports.	3	Apply
2.	What is cantilever beam?	2	Understand
3.	Write the equation for the simple bending theory.	4	Analyse
4.	What do you mean by the point of contraflexure?	3	Apply
5.	What is mean by positive or sagging BM?	2	Understand
6.	Define shear force and bending moment.	1	Remembering
7.	What is Shear stress diagram?	2	Understand
8.	What is Bending moment diagram?	2	Understand
9.	What are the different types of loading?	2	Understand
10.	Write the assumption in the theory of simple bending.	4	Analyse
11.	What are the types of beams?	2	Understand
12.	When will bending moment is maximum.	2	Understand
13.	Write down relations for maximum shear force and bending moment in case of acantilever beam subjected to uniformly distributed load running over entire span.	4	Analyse
14.	Draw the shear force diagram for a cantilever beam of span 4 m and carrying apoint load of 50 KN at mid span.	5	Evaluate

15.	Sketch (a) the bending stress distribution (b) shear stress distribution for a beam of	5	Evaluate

	rectangular cross section.		
16.	A cantilever beam 3 m long carries a load of 20 KN at its free end. Calculate theshear force and bending moment at a section 2 m from the free end.	4	Analyse
17.	Derive the relation between the intensity of load and shear force, in bendingtheory.	4	Analyse
18.	A clockwise moment M is applied at the free end of a cantilever. Draw the SF andBM diagrams for the cantilever.	5	
19.	What is maximum bending moment in a simply supported beam of span ‘L’subjected to UDL of ‘w’ over entire span?	2	Understand
20.	What is mean by negative or hogging BM?	2	Understand
PART- B (16 Marks)			
1.	A cantilever 3.6 m long carries load of 30, 70, 40 and 60 KN at distance of 0, 0.6, 1.5 and 2.4 m respectively from the free end as shown in fig (a). Draw the S.F.D and B.M.D for the cantilever. 	4	Analyse
2.	A cantilever 1.5 m long is loaded with a uniformly distributed load of 2 kN/m run over a length of 1.25 m from the free end. It also carries a point load of 3 kN at a distance of 0.25 m from free end. Draw the shear force and Bending moment diagrams of cantilever. 	5	Evaluate
3.	A simply supported beam AB of length 5 m carries point load of 8 kN, 10 kN and 15 kN at 1.50 m, 2.50 and 4.0 m respectively from left	5	Evaluate

	hand support. Draw shear force diagram and bending moment diagram.  		
4.	A simply supported beam of an effective span of 16 m carries point loads of 4 kN, 5 kN and 3 kN at 3 m, 7 m and 11 m respectively from left hand support. Determine the reactions at the support and draw the S.F.D and B.M.D.  	5	Evaluate
5.	Draw the shear force and B.M diagrams for a simply supported beam of length 8 m and carrying a uniformly distributed load of 10 kN/m for a distance of 4 m as shown in fig.	5	Evaluate
6.	A simply supported beam of 4 m span is carrying loads as shown in figure. Draw the shear force and bending moment diagrams for the beam.  	5	Evaluate
7.	For the simply supported beam loaded as shown in Fig. , draw the shear force diagram and bending moment diagram. Also, obtain the maximum bending moment.	5	Evaluate

			
8.	A cast iron beam is of T-section as shown in Fig. The beam is simply supported on a span of 6 m. The beam carries a uniformly distributed load of 2kN/m on the entire length (span). Determine the maximum tensile and maximum compressive stress. 	5	Evaluate

UNIT 3: TORSION AND SPRINGS Torsion formulation stresses and deformation in circular and hollows shafts – Stresses inhelical springs – Deflection of helical springs.			
PART – A (2 Marks)			
1.	Define torsional rigidity of the solid circular shaft.	1	Remembering
2.	Distinguish between closed coil helical spring and open coil helical spring.	4	Analyse
3.	What is meant by composite shaft?	2	Understand
4.	What is called Twisting moment?	2	Understand
5.	What is Polar Modulus ?	2	Understand
6.	Define: Torsional rigidity of a shaft	1	Remembering
7.	What do mean by strength of a shaft?	2	Understand
8.	Write down the equation for Wahl factor	1	Remembering

9.	Define: Torsional stiffness.	1	Remembering
10.	What are springs? Name the two important types.	2	Understand
11.	How will you find maximum shear stress induced in the wire of a close-coiled helical springcarrying an axial load?	3	Apply
12.	Write the expressions for stiffness of a close coiled helical spring.	4	Analyse
13.	Find the minimum diameter of shaft required to transmit a torque of 29820 Nm if the maximum shear stress is not to exceed 45 N/mm^2.	5	Evaluate
14.	Find the torque which a shaft of 50 mm diameter can transmit safely, if the allowable shearstress is 75 N/mm^2.	4	Analyse
15.	Differentiate open coiled helical spring from the close coiled helical spring and state the typeof stress induced in each spring due to an axial load.	2	Understand
16.	What is spring index ©?	4	Analyse
17.	State any two functions of springs	3	Apply
18.	Write the polar modulus for solid shaft and circular shaft	4	Analyse
19.	What are the assumptions made in Torsion equation	2	Understand
20.	Write an expression for the angle of twist for a hollow circular shaft with external diameter D, internal diameter d, length l and rigidity modulus G.	4	Analyse
PART – B (16 Marks)			
1.	Calculate the maximum torque that a shaft of 125mm can transmit if the maximum angle of twist is 1^o. In a length of 1.5m. Take the modulus of rigidity is 70GPa.	5	Evaluate
2.	Find the angle of twist per meter length of a hollow shaft of 100mm external diameter and 60mm internal diameter. If the shear stress is not to exceed 35MPa. Take modulus of rigidity, C=85GPa.	4	Analyse
3.	A solid shaft has to transmit the power 105 kW at 2000 r.p.m. The maximum torque transmitted in each revolution exceeds the mean by 16%. Find the suitable diameter of the shaft, if the	4	Analyse

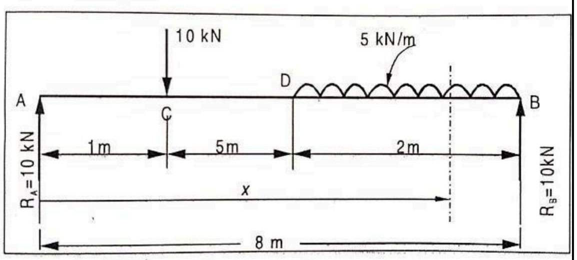
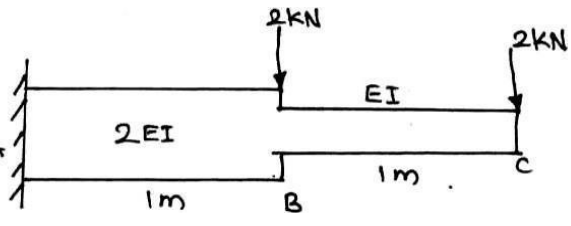
	shear stress is not to xceed 75 N/mm^2 and		

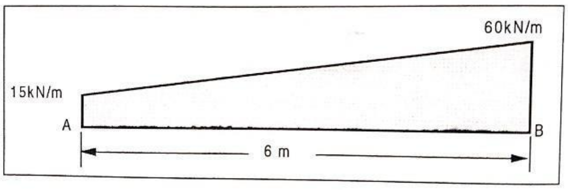
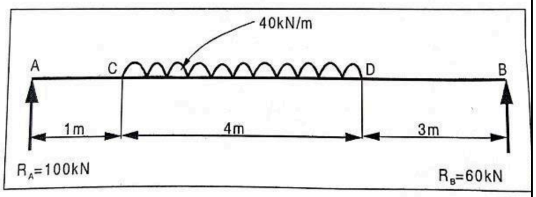
	maximum angle of twist is 1.5° in a length of 3.30 m and G = 0.80 x 105 N/mm².		
4.	A steel shaft is required to transmit 75 kW power at 10 11 r.p.m and the maximum twisting moment is 30% greater than the mean. Find the diameter of the steel shaft if the maximum stress is 70 N/mm². also determine the angle of twist in a length of 3 m of the shaft. Assume the of rigidity for steel as 90 kN/mm².	5	Evaluate
5.	Calculate the power that can be transmitted at a 300 r.p.m. by a hollow steel shaft of 75 mm external diameter and 50 mm internal diameter when the permissible shear stress for the steel is 70 N/mm2 and the maximum torque is 1.3 times the mean. Compare the strength of this hollow shaft with that of an solid shaft. The same material, weight and length of both the shafts are the same.	5	Evaluate
6.	A laminated spring 600 mm long and 60 mm wide is required to carry a load of 4 kN with the maximum stress and maximum deflection not exceeding 230 MN/m² and 15 mm respectively. Determine the thickness of the each plate and the number of plates required. Take E = 200 GN/m².	4	Analyse
7.	A leaf spring has length 1200 mm, the width and thickness of each plate being 40 mm and 8 mm respectively. Calculate the number of plates required to carry a load of 2.2 kN, if the bending stress in the plates should not exceed 120 MPa. Also find the deflection under the load and the initial radius of curvature. Take E = 200 GPa.	4	Analyse
8.	A close coiled helical spring is to have a stiffness of 1.5 N/mm of compression under a maximum load of 60 N. the maximum shearing stress produced in the wire of the spring is 125 N/mm^2 .The solid length of the spring is 50mm. Find the diameter of coil, diameter of wire andnumber of coils .C = 4.5 xl04N/mm^2	4	Analyse
UNIT 4: DEFLECTION OF BEAMS Double Integration methodand deflections in beams. –Area moment theorems for computation of slopes			
PART – A (2 Marks)			
1.	State the condition for the use of Macaulay’s	4	Analyse

	method.		

2.	What is the maximum deflection in a simply supported beam subjected to uniformly distributed load over the entire span?	2	Understand
3.	What is crippling load? Give the effective length of columns when both ends hinged and when both ends fixed.	2	Understand
4.	Find the critical load of an Euler's column having 4 m length, 50 mm x 100 mm cross sectionand hinged at both the ends E = 200 kn/mm2.	4	Analyse
5.	Calculate the maximum deflection of a simply supported beam carrying a point load of 100 KN at mid span. Span = 6 m, E= 20000 kn/m2.	4	Analyse
6.	A cantilever beam of spring 2 m is carrying a point load of 20 kn at its free end. Calculate the slope at the free end. Assume EI = 12 x 10^3 KNm^2.	4	Analyse
7.	Calculate the effective length of a long column, whose actual length is 4 m when : a. Bothends are fixed b. One end fixed while the other end is free.	4	Analyse
8.	A cantilever is subjected to a point load W at the free end. What is the slope and deflection atthe free end?	4	Analyse
9.	What are the methods for finding out the slope and deflection at a section?	2	Understand
10.	Why moment area method is more useful, when compared with double integration?	2	Understand
11.	Explain the Theorem for conjugate beam method?	4	Analyse
12.	What are the points to be worth for conjugate beam method**?**	2	Understand
13.	What are the different modes of failures of a column?	2	Understand
14.	Write down the Rankine formula for columns.	4	Analyse
15.	What is effective or equivalent length of column?	2	Understand
16.	Define Slenderness Ratio.	1	Remembering
17.	Define the terms column and strut.	1	Remembering
18.	What are the advantages of Macaulay method over the double integration method, for finding the slope and deflections of beams?	2	Understand
19.	State the limitations of Euler's formula	3	Apply

20.	A cantilever beam of spring 4 m is carrying a point load of $2x10^3$Nat its free end. Calculate the slope at the free end. Assume EI = $2X10^5 N/mm^2$	4	Analyse

PART – B (16 Marks)			
1.	A beam AB of length 8 m is simply supported at its ends and carries two point loads of 50 kN and 40 kN at a distance of 2 m and 5 m respectively from left support A. Determine, deflection under each load, maximum deflection and the position at which maximum deflection occurs. Take E = 2 x 10^5 N/mm^2 and I = 8.5 $X10^6$ mm^4	4	Analyse
2.	A beam AB of 8 m span is simply supported at the ends. It carries a point load of 10 kN at a distance of 1 m from the end A and a unifomly distributed load of 5 kN/m for a length of 2 m from the end B. If 1= 10 × 106 m², determine: (i) Deflection at the mid-span; (ii) Maximum deflection; (iii) Slope at the end A. Assume $E = 200 \times 10^6$ kN/m^2; $I = 10 \times 10^{-6} m^4$ 	4	Analyse
3.	For the cantilever beam shown in Fig.3. Find the deflection and slope at the free end. EI = 10000 kN/m^2 	5	Evaluate
4.	A beam is simply supported at its ends over a span of 10 m and carries two concentrated loads of 100 kN and 60 kN at a distance of 2 m and 5 m respectively from the left support. Calculate (i) slope at the left support (ii)slope and deflection under the 100 kN load. Assume EI = 36 x 104kN-m^2	4	Analyse
5.	A 3 m long cantilever of uniform rectangular cross–section 150 mm wide and 300 mm deep is loaded with a point load of 3 kN at the free end and a udl of 2 kN/m over the entire length. Find the maximum deflection. E = 210 kN/mm2. Use Macaulay’s method	4	Analyse

6.	A horizontal beam, simply supported at the ends, carries a load whose intensity varies uniformly from 15 kN/m at one end to 60 kN/m at the other end. Determine the central deflection if the span is 6 m and 1=4.26 × 104 m². Take E = 2 x 10 N/m² 	4	Analyse
7.	Figure shows a simply supported beam of uniform crop section whose moment of inertia is 4.3 × 108 mm. For the loading shown find the position and magnitude of the maximum deflection Takz E = 200 kN/mm² $E = 200 \times 10^6$ kN/m²; $I = 4.3 \times 10^{-4}$ m⁴ $EI = 86{,}000$ kN – m² 	4	Analyse
8.	Derive double integration method for cantilever beam concentrated load at free end	5	Evaluate
UNIT 5: THIN CYLINDERS AND SPHERES Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells.			
PART – A (2 Marks)			
1.	A cylindrical pipe of diameter 1.5 m and thickness 1.5 cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Determine the longitudinal stress developed in the pipe.	4	Analyse
2.	Find the thickness of the pipe due to an internal pressure of 10 N/mm^2 if the permissible stress is 120 N/mm^2. The diameter of pipe is 750 mm.	4	Analyse
3.	The principal stress at a point are 100 N/mm^2 (tensile) and 50 N/mm^2 (compressive) respectively. Calculate the maximum shear stress at this point.	4	Analyse
4.	A spherical shell of 1 m diameter is subjected to an internal pressure 0.5N/mm^2. Find the thickness if the thickness of the shell, if the allowable stress in the material of the shell is 75 N/mm^2.	4	Analyse

5.	Normal stresses *s x* and *s y* and shear stress *t* act at a point. Find the principal stresses and the principal planes.	4	Analyse
6.	Derive an expression for the longitudinal stress in a thin cylinder subjected to an uniform internal fluid pressure.	5	Evaluate
7.	Distinguish between thick and thin cylinders.	4	Analyse
8.	What is mean by compressive and tensile force?	2	Understand
9.	How will you determine the forces in a member by method of joints?	3	Apply
10.	Define thin cylinder?	1	Remembering
11.	What are types of stress in a thin cylindrical vessel subjected to internal pressure?	2	Understand
12.	What is mean by Circumferential stress (or hoop stress) and Longitudinal stress?	2	Understand
13.	What are the formula for finding circumferential stress and longitudinal stress?	2	Understand
14.	What are maximum shear stresses at any point in a cylinder	2	Understand
15.	What are the formula for finding circumferential strain and longitudinal strain?	2	Understand
16.	What are the formula for finding change in diameter, change in length and change volume of a cylindrical shell subjected to internal fluid pressure p?	2	Understand
17.	Distinguish between Circumferential stress (or hoop stress) and Longitudinal stress?	4	Analyse
18.	Find the thickness of the pipe due to an internal pressure of 10 N/mm^2 if the permissiblestress is 120 N/mm^2. The diameter of pipe is 750 mm.	4	Analyse
19.	what do you mean by a thick compound cylinder? how will you determine the hoop stressesin a thick compound cylinder?	3	Apply
20.	what are the different methods of reducing hoop stresses?	2	Understand
PART – B (16 Marks)			
1.	A thin cylinder 1.5 m internal diameter and 5 m long is subjected to an internal pressure of 2 N/mm^2. If the maximum stress is limited to 160 N/mm^2, find the thickness of the cylinder. E = 200 kN/mm^2 and Poisson's ratio = 0.3. Also find the changes in diameter, length and volume of the cylinder.	4	Analyse

2.	A cylindrical thin drum 80 cm in diameter and 3 m long has a shell thickness of 1 cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine	4	Analyse

	(i) change in diameter (ii) Change in length (iii) Change in volume Take E=2×10 N/mm² and poisson's ratio = 0.25		
3.	A thin cylinder 3.5 m long, 90cm in diameter is subjected to an internal pressure of 2.8 N/mm². If the thickness of the shell is 12 mm, find the circumferential and longitudinal stresses. Find also the maximum shear stress and the changes in dimensions of the shell. Take E= 2 × 105 N/mm²; μ == 0.3	4	Analyse
4.	A cylindrical shell 5 m long 100 cm in diameter and 1 cm thick is subjected to an internal pressure of 3 MPa. Calculate the change in dimensions of the shell and the maximum shear stress induced E= 2 × 105 MPa. Poisson ratio = 0.3	4	Analyse
5.	A cylindrical shell 3 m long which is closed at the ends has an internal diameter 1m and wall thickness of 15 mm. Calculate the change in dimensions and change in volume if the internal pressure is 1.5 N/mm^2,E = 2 x 10^5 N/min2, μ= 0.3	4	Analyse
6.	Calculate: (i) the change in diameter, (ii) change in length and (iii) change in volume of a thin cylindrical shell 100 cm diameter, 1 cm thick and 5 m long when subjected to internal pressure of 3 N/mm². Take the value of E = 2 × 105 N/mm² and Poisson's ratio, μ=0.3.	4	Analyse
7.	Determine the maximum hoop stress across the section of a pipe of external diameter 600mmand internal diameter 440mm. when the pipe is subjected to an internal fluid pressure of 50N/mm^2.	5	Evaluate