DHANALAKSHMI SRINIVASAN COLLEGEOF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF AERONAUTICAL ENGINEERING

QUESTION BANK

III SEMESTER / II YEAR

Dhanalakshmi Srinivasan College of Engineering and Technology
DEPARTMENT OF AERONAUTICAL

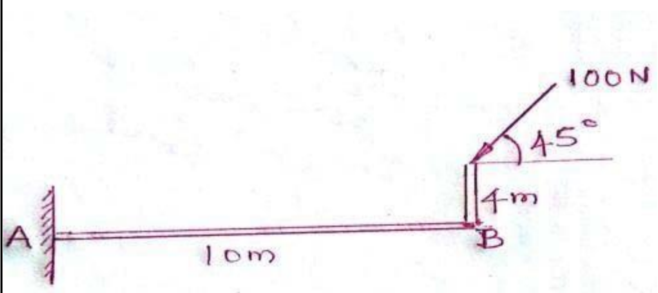
ENGINEERING

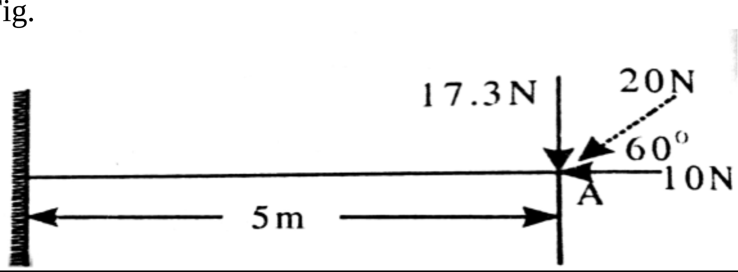
QUESTION BANK

SUBJECT CODE/NAME: AE3352 –SOLID MECHANICS

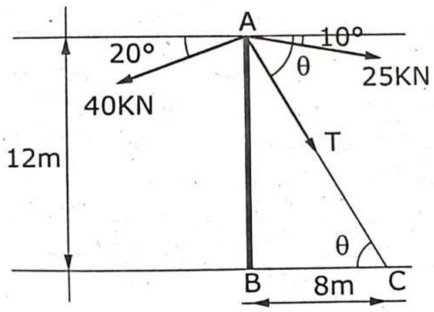
SEM/Year:III/II

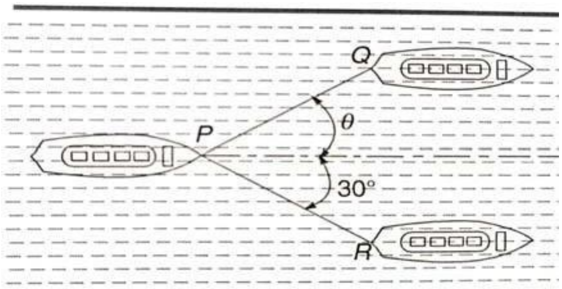
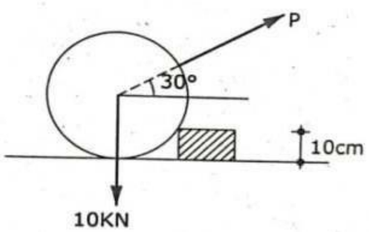
UNIT I: CONCURRENT AND NON- CONCURRENT			
Introduction, Concept of FBD, Coplanar Concurrent force system, Moments, Coplanar Non- Concurrent force system and Support Reactions – Application Problems.			
PART - A (2Marks)			
S.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	Resolve the 100N force acting 30° to horizontal into two components, one along horizontal and other along 120° to horizontal.	BT--3	Apply
2.	Define the Second Law of Newton.	BT-1	Remembering
3.	Write the equations of equilibrium of a coplanar system of forces	BT-1	Remembering
4.	State Lami's theorem with a neat sketch	BT-1	Remembering
5.	State the Parallelogram law of forces	BT-1	Remembering
6.	State the triangular law of forces	BT-1	Remembering
7.	Define principle of transmissibility	BT-1	Remembering
8.	Distinguish the following system of forces with a suitable sketch. a) Coplanar b) Collinear.	BT-2	Understanding
10.	Mention the differences exist between Kinetics and Kinematics	BT-2	Understanding
11.	State the Gravitational Law of Newton.	BT-1	Remembering
14.	Solve the following: Two forces of magnitude 50 KN and 80 KN are acting on a particle, such that the angle between the two is 135°. If both the force are acting away from the particle, calculate the resultant and find its direction.	BT-5	Evaluate
15.	Compare 'Resultant' and 'Equilibrant'	BT-2	Understanding

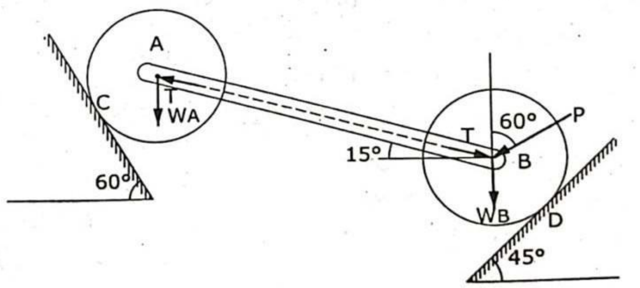
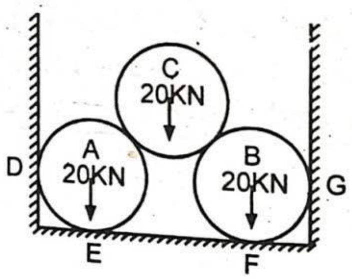
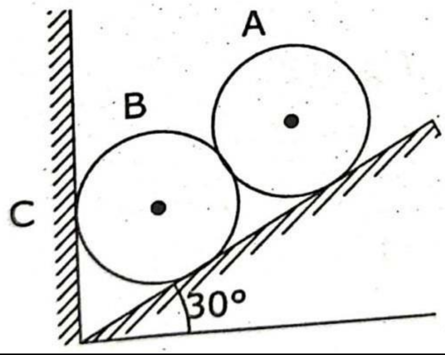
16.	Compare and contrast between particle and rigid body	BT-2	Understanding
17.	State the Polygon Law of forces.	BT-1	Remembering
18.	Imagine if the resultant of an 800N force acting towards eastern direction and a 500N force acting towards north eastern direction	BT-4	Analyze
19.	A force of 500N forms angle 60°,45° & 120° respectively x, y, z axes. Write the force in vector form.	BT-5	Evaluate
20.	Define Force.	BT-1	Remembering
2.	Define a force couple system.	BT-1	Remembering
3.	State Varignon's theorem.	BT-1	Remembering
4.	Define a couple.	BT-1	Remembering
5.	A Uniform ladder of weight 'W' leans against a vertical wall. Assuming the contact surfaces as rough, draw the free body diagram of the ladder with necessary assumptions.	BT-2	Understand
6.	Solve the following: three couples 16Nm,-45Nm and 120Nm are acting in the xy, yz and xz planes respectively. Find the resultant moment vector of these three couples.	BT-3	Apply
7.	State the different types of supports	BT-1	Remembering
8.	Write down the conditions of equilibrium of a particle in space	BT-2	Understand
9.	Identify the reactions at a fixed support of a plane beam that are possible.	BT-1	Remembering
10.	Find the moment of the 100 N force about point A and B 	BT-3	Apply
11.	List the different types of beams	BT-1	Remembering
12.	Predict how you will reduce a force into an equivalent force-couple system.	BT-5	Evaluate
14.	Distinguish between couple and moment.	BT-2	Understand

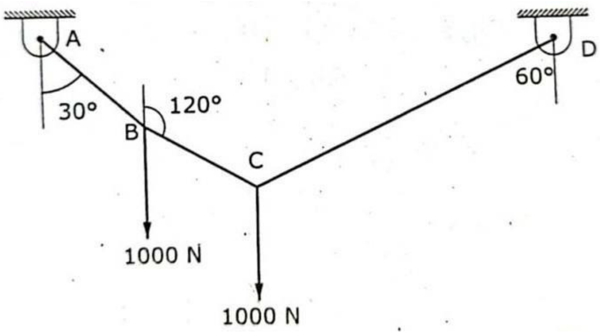
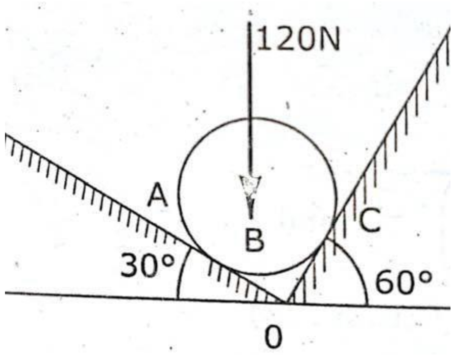
15.	Illustrate free body diagram with one example.	BT-1	Remembering
16.	Identify the reactions at the supports of a simply supported beam.	BT-1	Remembering
17.	Mention the equation of equilibrium of a rigid body.	BT-4	Analyze
18.	Find the moment of 20 N force about the point 'O' as shown in Fig.  	BT-4	Analyze
20.	Mention some applications of cantilever beam.	BT-1	Remembering
22	What is equlibrant and equlibrium	BT-2	Understanding
23	Differentiate Force and Moment	BT-2	Understand

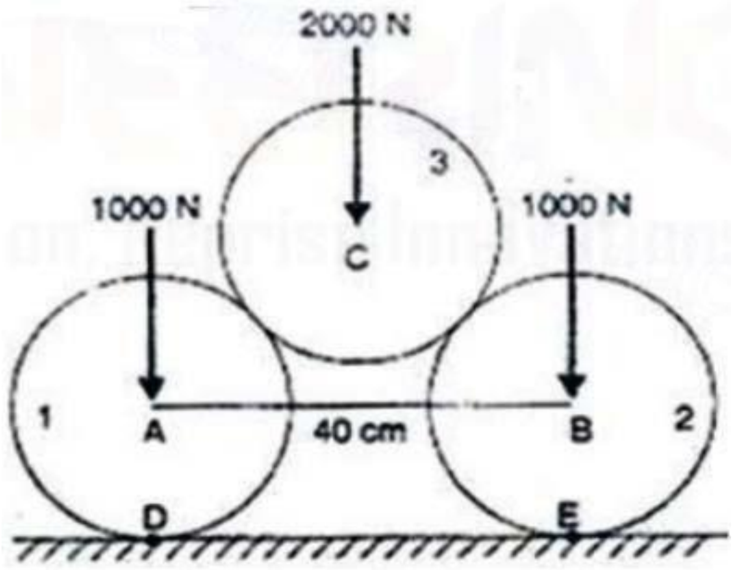
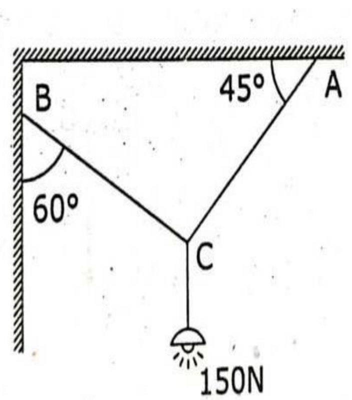
PART – B and PART-C

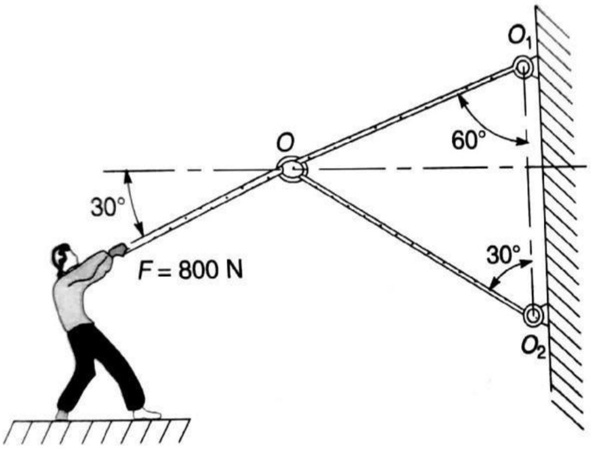
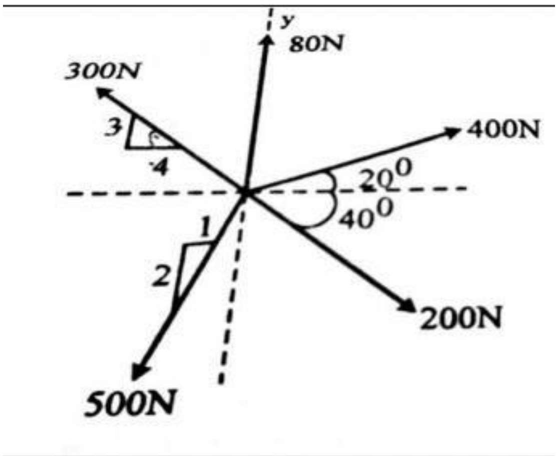
S.No	QUESTIONS	LEVEL	COMPETENCE
1	(i) The following forces act a point (i) 200 N inclined at 30° towards the North of East. (ii) 250 N towards North (iii) 300 N towards North West (iv) 350 N inclined at 40° towards South of West. Find the resultant of the force system.	BT-3	Apply
2	Two cables which have known tensions are attached to the top of a tower AB. A third cable AC is used as a guide wire as shown in the figure below. Determine the tension in AC if the resultant of the forces exerted at A by the three cables acts vertically downwards.  	BT-3	Apply

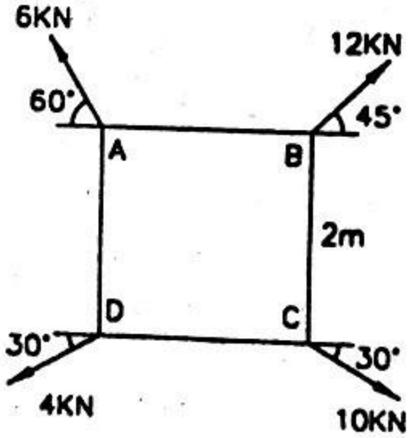
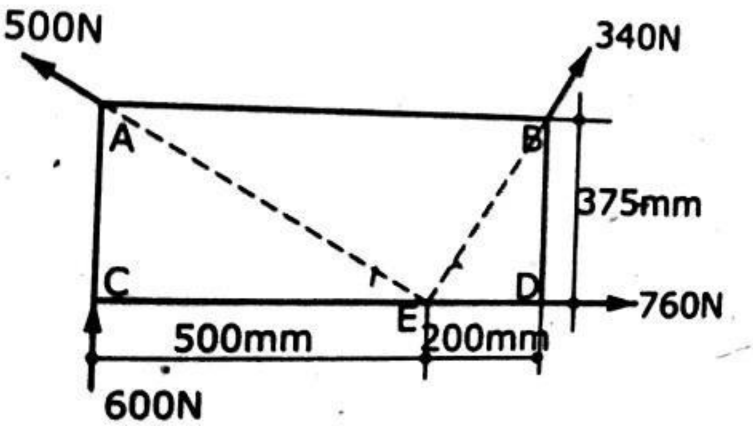
3	Forces of 2 N, 3 N , 4 N ,5 N and 6 N are acting at one of the angular points of regular hexagon towards the other angular points taken in order. Find the resultant and its direction.	BT-3	Apply
4	A disabled ship P is being pulled by two tugboats as shown in the figure.	BT-4	Analyze
	The resultant of the forces exerted by the two tugboats is 30 kN which is directed along the axis of the ship. Find (i) the required tensions in each of the ropes for Θ = 30° (ii) the value of Θ such that the tension in the rope PQ is minimum. 		
5	State and derive the expression for magnitude and direction of the resultant using the Parallelogram law of forces.	BT-1	Remembering
6	(i) Two concurrent forces acts at an angle of 30°. The resultant force is 15 N and one of the forces is 10 N. Find the other force. (ii) find the magnitude of the two forces such that if they act at right angles, their resultant is $\sqrt{10}$ N. But if they act at 60°, their resultant is $\sqrt{13}$ N.	BT-3	Apply
7	(i) A cylindrical roller has a weight of 10 kN and it is being pulled by a force which is inclined at 30° with the horizontal as shown in the figure. While moving it comes across an obstacle 10 cm high. Calculate the force required to cross the obstacle, if the diameter of the roller is 1 m. 	BT-3	Apply

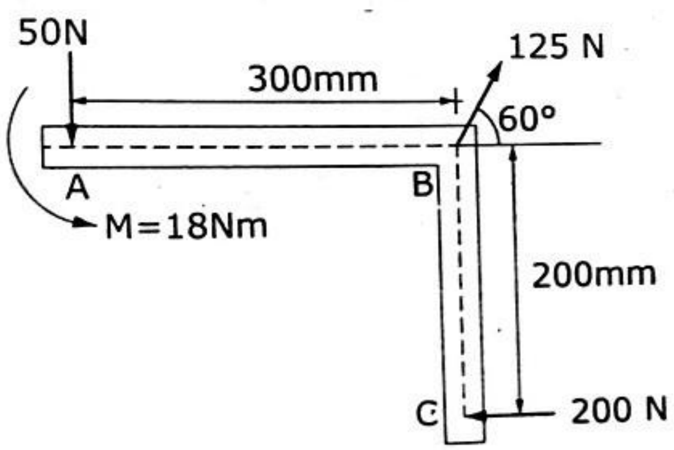
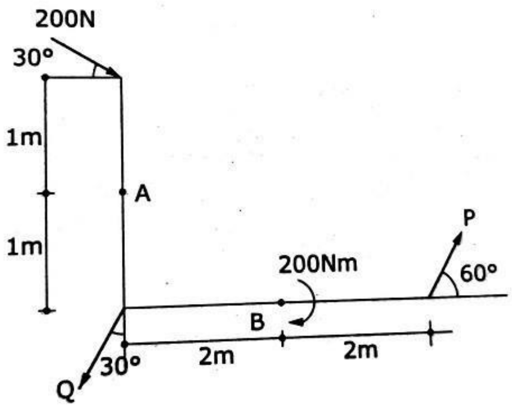
8	The figure below shows cylinders, A of weight 100 N and B of weight 50 N, resting on smooth inclined planes. They are connected by a bar of negligible weight hinged to each cylinder at their geometric centres by smooth pins. Find the force P, as shown, that holds the system in the given position. 	BT-2	Understanding
9	Three smooth pipes each weighing 20 kN and of diameter 60 cm are to be placed in a rectangular channel with horizontal base as shown in the figure. Calculate the reactions at the point of contact between the pipes and between the channel and the pipes. Take the width of the channel as 160 cm. 	BT-5	Evaluate
10	Two identical rollers, each of weight 50 N, are supported by an inclined plane and vertical walls as shown in the figure. Find the reactions at the points of supports A, B and C. Assume all the surfaces to be smooth. 	BT-5	Evaluate

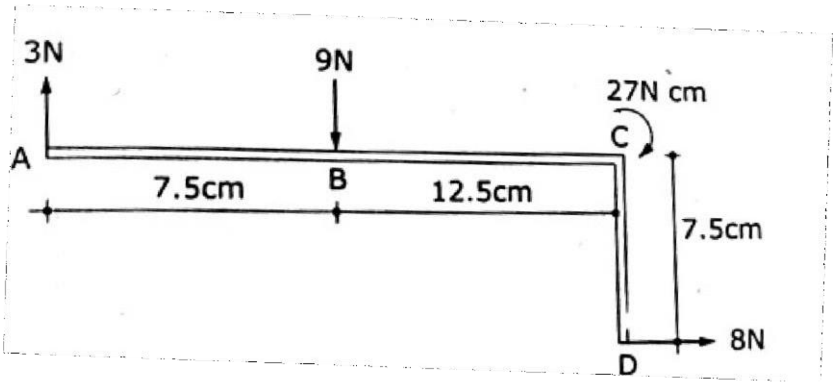
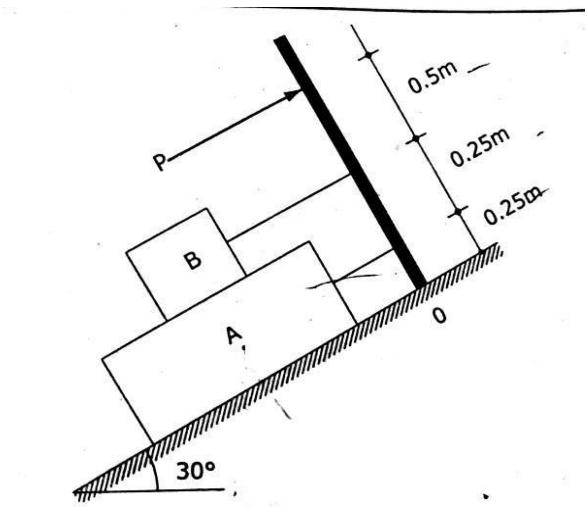
11	A string ABCD, attached to two fixed points A and D has two equal weights of 1000 N attached to it at B and C. The weights rest with the portions AB and CD inclined at the angle of 30° and 60° respectively, to the vertical as shown in the figure. Find the tensions in the portions AB, BC and CD of the string, if the inclination of the portion BC with the vertical is 120°. 	BT-5	Evaluate
12	A ball of weight 120 N rests in a right angled groove as shown in the figure. The sides of the groove are inclined at an angle of 30° and 60° to the horizontal. If all the surfaces are smooth, then determine the reactions R_A and R_C at the point of contact. 	BT-4	Analyze
13	A string of length 310mm has its extremities attached to two fixed points situated 250mm apart in a horizontal line. If the string can bear any tension up to 36N, find the greatest load that can be supported at a point of the string distance 240mm from one extremity.	BT-3	Apply
14	Two smooth circular cylinders each of weight 1000 N and radius 15 cm are connected at their centers by a string AB of length 40 cm and rest upon a horizontal plane, supporting above them a third cylinder of weight 2000 N and radius 15 cm as shown in Figure. Predict the force S in the string AB and reactions on the floor at the points of contact D and E.	BT-3	Apply

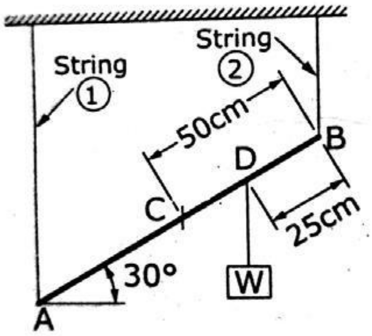
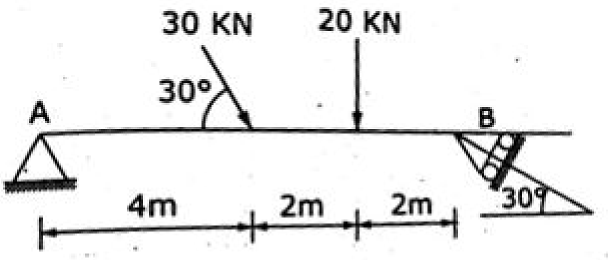
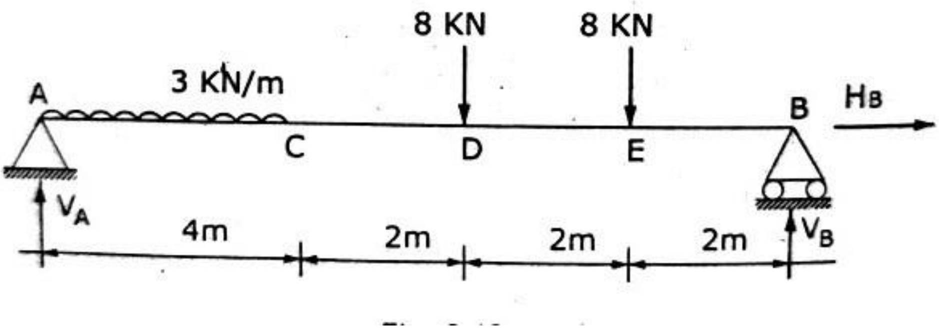
			
	PART-C (15 Marks)		
1	Five forces are acting on a particle. The magnitude of forces are 300 N, 600 N, 700 N, 900 N and P and their respective angles made with the horizontal are 0°, 60°, 135°, 210° and 270°. If the vertical component of all forces is -1000 N, find the value of P. Also calculate the magnitude and the direction of the resultant, assuming that the first force acts towards the point, while all the remaining forces act away from the point.	**BT-6**	Create
2	A electric light fixture weighing 150 N hangs from a point C, by two strings AC and BC as shown in the figure. Determine the forces in the strings AC and BC. 	BT-6	Create
3	Two cables are tied together at the point O and loaded as shown in thefigure. Determine the tensions in OO1 and OO2.	BT-5	Evaluate

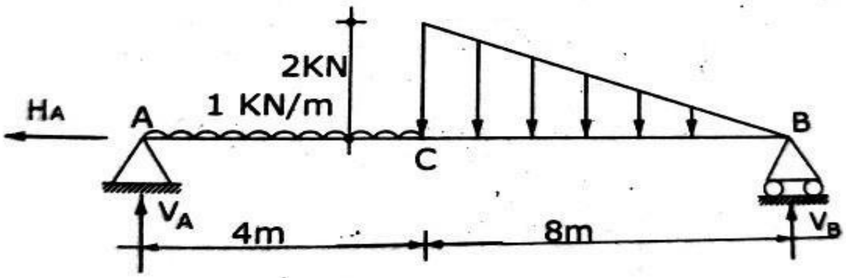
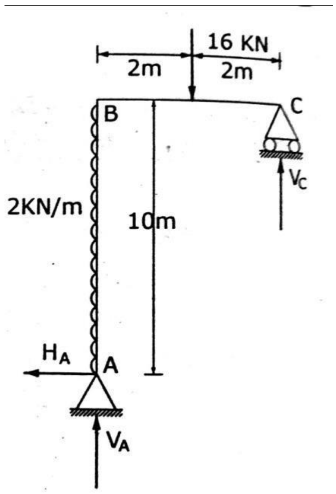
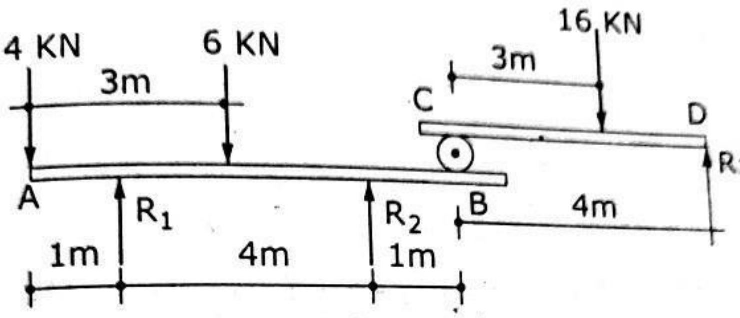
			
4	Determine the resultant of system of forces acting as shown in Fig. 	BT-3	Apply

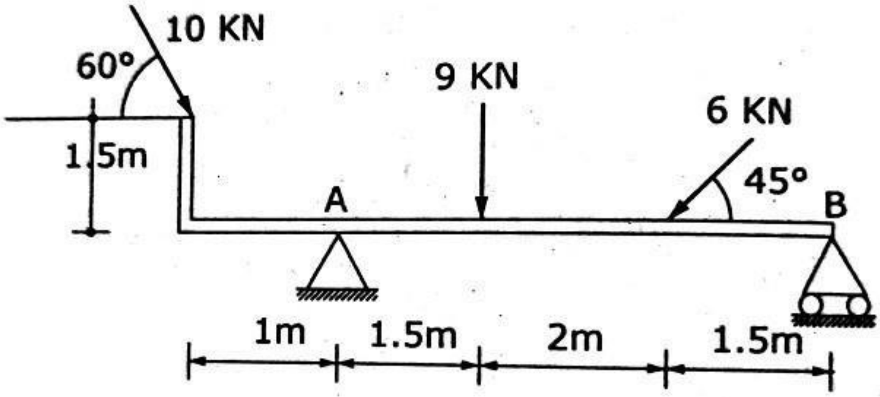
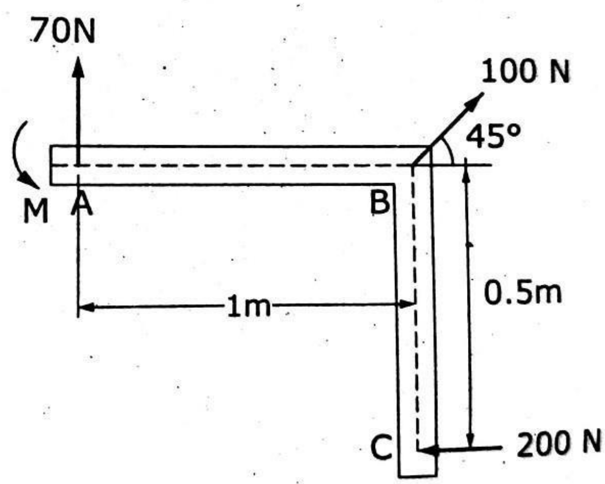
1	Four forces of magnitude and direction acting on a square ABCD of side 2 m are shown in the figure. Calculate the resultant in magnitude and direction and also locate its point of application with respect to the sides AB and AD.  	BT-5	Evaluate
2	Four forces act on a 700 mm X 375 mm plate as shown in the figure. (a) Find the resultant of these forces. (b) Locate the two points where the line of action of the resultant intersects the edge of the plate.  	BT-2	Understanding

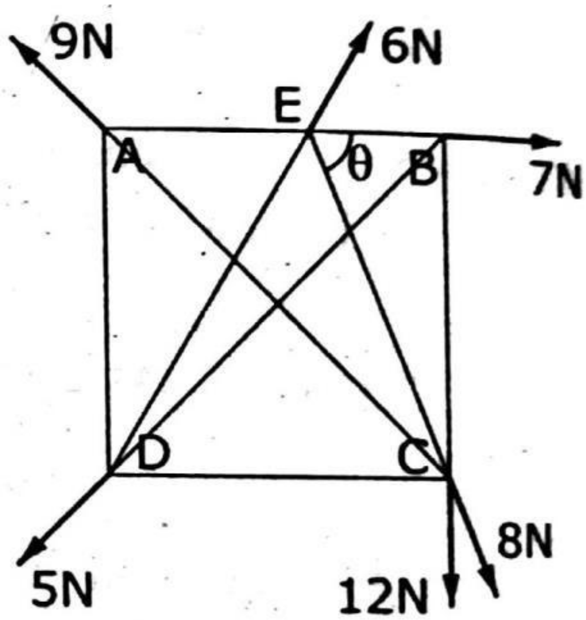
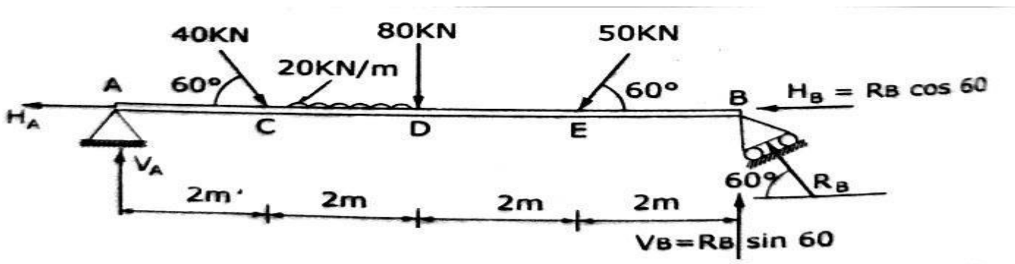
3	The three forces and a couple of magnitude, M = 18 Nm are applied to an angled bracket as shown in the figure. Find (i) Find the resultant of this system of forces. (ii) Locate the points where the line of action of the resultant intersects line AB and line BC.  	BT-3	Apply
4	For the system of forces shown in the figure, determine the magnitude of P and Q such that the resultant of the system passes through A and B.  	BT-5	Evaluate

5	For the figure shown in figure. Find (i) Find the resultant of the system. (ii) Find the points of the intersection of its line line of action with AC and CD. (iii) The 27 N-cm couple applied at C is removed and replaced by a couple of unknown Magnitude M. determine the value of M if the resultant force is to pass through C. 	BT-4	Analyze
6	Blocks A and B of the weight 200 N and 100 N respectively, rest on a 30° inclined plane and are attached to the post which is held perpendicular to the plane by a force P, parallel to the plane as shown in the figure. Assume that all surfaces are smooth and that the cords are parallel to the plane. Determine the value of P. Also find the normal reaction of the blocks A and B. 	BT-2	Understanding

7	A uniform meter rod AB, assumed rigid of the mass 0.5 kg is suspended from its ends in an inclined position and a mass of 1 kg is suspended from a point D, as shown in the figure. Determine the tension in each strings. Where the suspended mass should be placed in order to get equal tension in the strings. 	BT-3	Apply
8	Find the support reactions of the beam as shown in the figure. 	BT-5	Evaluate
9	A beam AB of span 10 m span is loaded as shown in the figure. Determine the reactions at A and B. 	BT-2	Understanding

			
11	A bent up beam ABC is shown in the figure. It is hinged at A and supported on rollers at C. If there is an uniform wind pressure of 2 kN/m on the vertical side AB and a central point load of 16 kN at middle of BC, calculate the. reactions offered by the supports 	BT-3	Apply
12	Calculate the reactions R1, R2 and R3 for the beams AB and CD supported as shown in the figure. There being a hinge connecting B and C. 	BT-3	Apply
13	A beam AB is simply supported and carries loads as shown in the figure. Calculate the reactions at A and B.	BT-4	Analyze

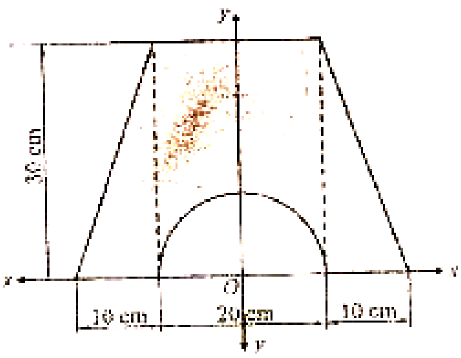
			
14	Three forces and a couple M acting on an angled bracket is shown in the figure. Find the moment of the couple if the line of action of the resultant force is to pass through (i) point A (ii) point C. 	BT-6	Create

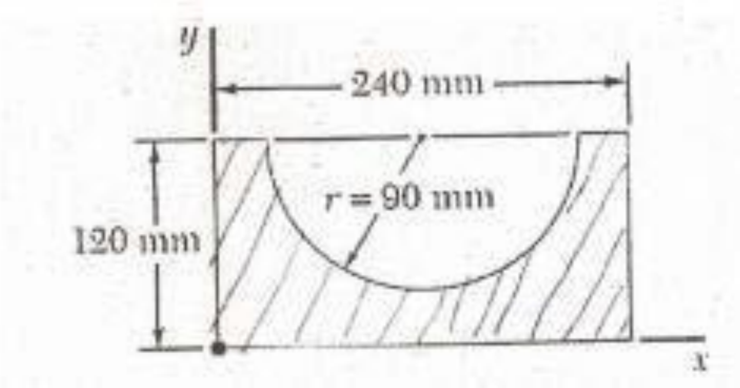
15	ABCD is a square and E is the middle point of AB. Forces of 7,8,12,5,9 and 6 N act a point in the directions AB, EC, BC, BD, CA and De respectively. Find the magnitude and direction of the single force which will keep the particle at rest. 	BT-5	Evaluate
16	Find the reactions at the supports A and B of the beam shown in the figure. 	BT-4	Analyze

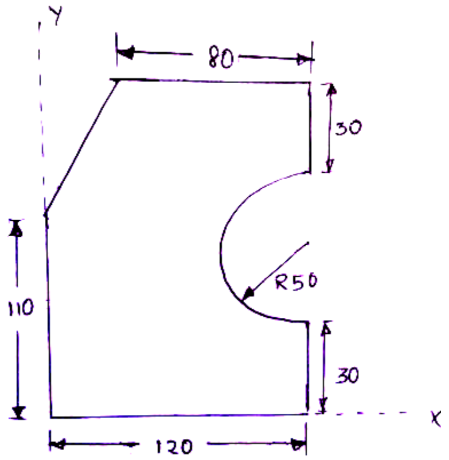
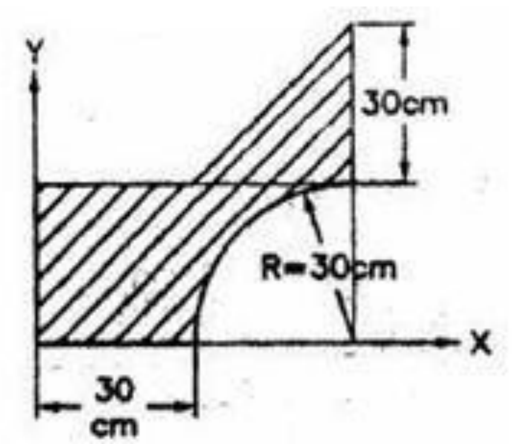
UNIT II – SHEAR FORCE AND BENDING MOMENT, SECOND AREA MOMENT PROBLEMS			
Analysis of Simple Truss, Shear Force and Bending Moment Diagrams, C.G. and M.I of Plane areas.			
PART - A (2Marks)			
S.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	Define centroid and centre of gravity.	BT-1	Remembering
2.	State parallel axis theorem.	BT-1	Remembering
3.	Define principal axes.	BT-1	Remembering
4.	Find the polar moment of inertia of a hollow circular section of external diameter ‘D’ and internal diameter ‘d’	BT-3	Apply
5.	Locate the centroid and solve the moment of inertia about centroidal axes of a semicircular lamina of radius ‘r’	BT-2	Understanding
6.	A semicircular area having radius of 100 mm is located in the XY plane such that its diameter coincides with the Y-axis. Determine the X-coordinate of the center.	BT-2	Understanding
7.	Define product of inertia.	BT-1	Remembering
8.	Define polar moment of inertia.	BT-1	Remembering
9.	Differentiate Centroid and centre of gravity	BT-2	Understanding
10.	Discuss about the expression for finding mass moment of inertia of a cylinder of radius ‘R’ and height ‘h’ about its base.	BT-2	Understanding
11.	State the Pappus guildinus area theorem	BT-1	Remembering
12.	State the Pappus guildinus volume theorem	BT-5	Evaluate
13.	Discuss about the Polar moment of Inertia and state its significant.	BT-3	Apply
14.	Compare and contrast the Area moment of Inertia with mass moment of inertia.	BT-2	Understanding
15.	Define Radius of gyration	BT-1	Remembering
16	Classify beams based on the supports.	BT1-1	Remembering

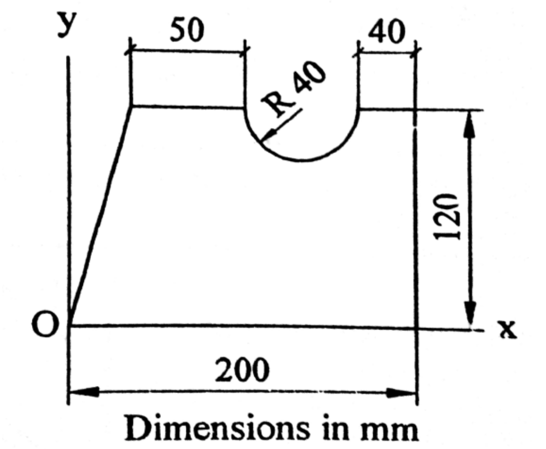
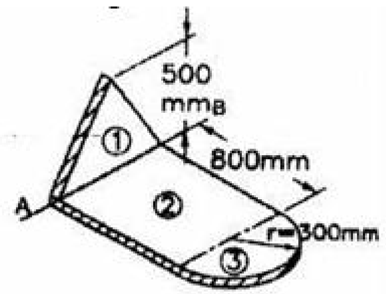
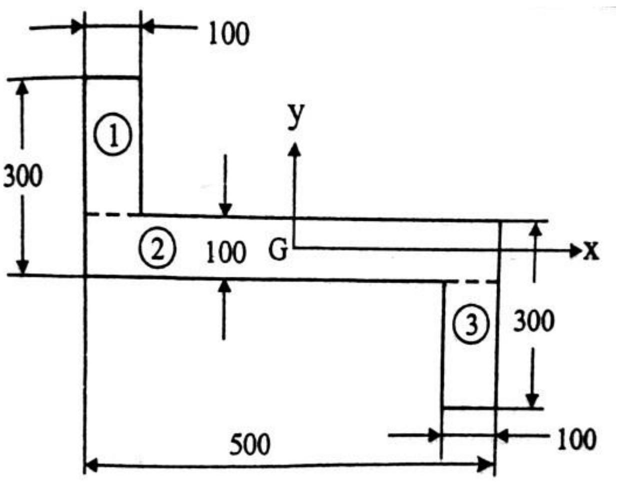
17	Name the various types of loading.	BT1	Remembering
18	Define shear force and bending moment.	BT-1	Remembering
19	When the bending moment will be maximu?	BT-1	Remembering
20	List out the various types of supports.	BT-1	Remembering
21	Describe the term “Point of contraflexure”.	BT-1	Remembering
22	Differentiate sagging and hogging bending moment.	BT-2	Understanding
23	Estimate the shear force and bending moment at a section 2 m from the free end A of a cantilever beam of 3 m long carries a load of 20 KN at its free end.	BT-2	Understanding
24	A fixed beam 3 m long carries a load of 40 KN at its mid span. Calculate the shear force and bending moment at the midsection.	BT-2	Understanding
25	Differentiate UDL with UVL with respect to bending moment diagram.	BT-2	Understanding
26	Determine MI of an isosceles triangle with base 150mm and sides of 125mm about its base.	BT-4	Analyze
27	State the relationship between the second moment of area and mass moment of inertia of a uniform plate.	BT-4	Analyze

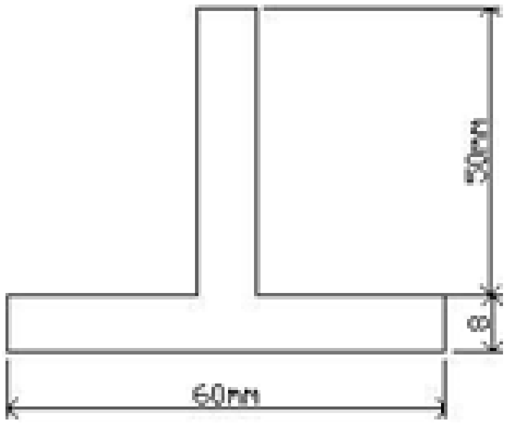
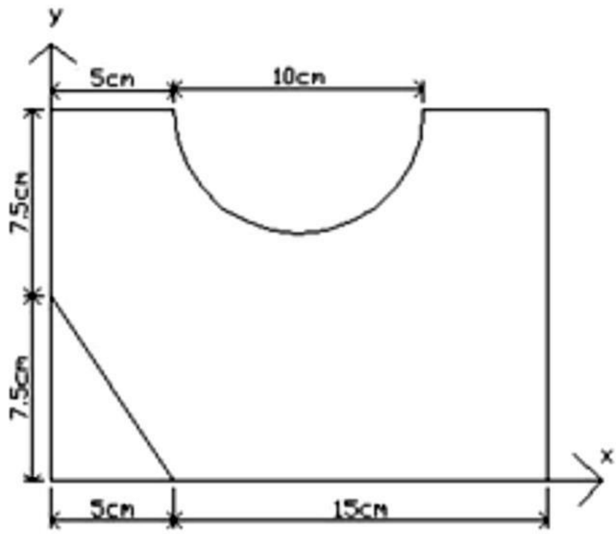
PART - B (13 Marks)

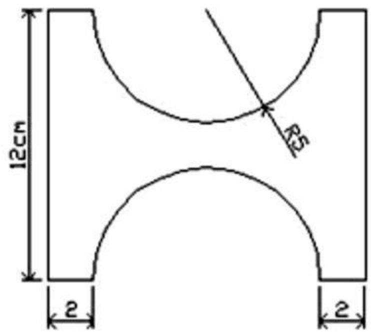
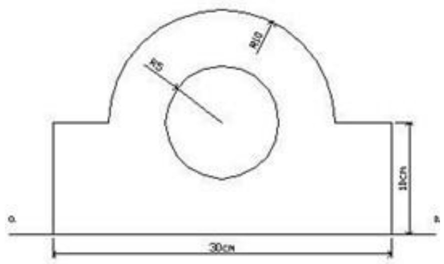
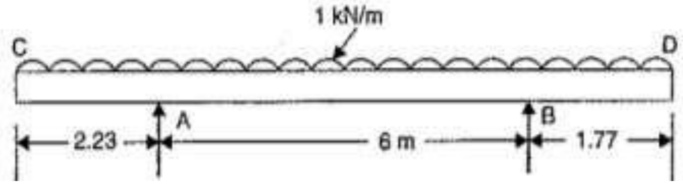
S.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1	Find the moment of inertia of shaded area as shown in figure about Ixx axis and Iyy axis. 	BT-5	Evaluate
2	Determine the moment of inertia of the shaded area as shown in figure with respect to the x axis		

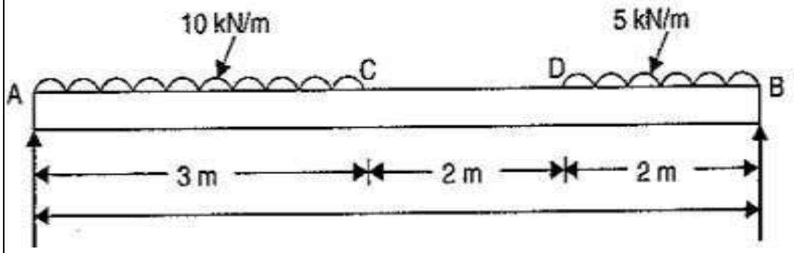
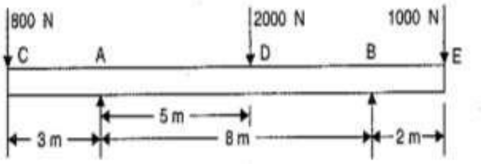
		BT-5	Evaluate
3	A solid hemisphere of density 2ρ is attached centrally to a solid cylinder of density ρ. Find the height of the cylindrical portion to have the CG of the solid combination on the axis of symmetry at the junction between the hemisphere and the cylinder. Take the cylinder diameter as 100mm.	BT-5	Evaluate

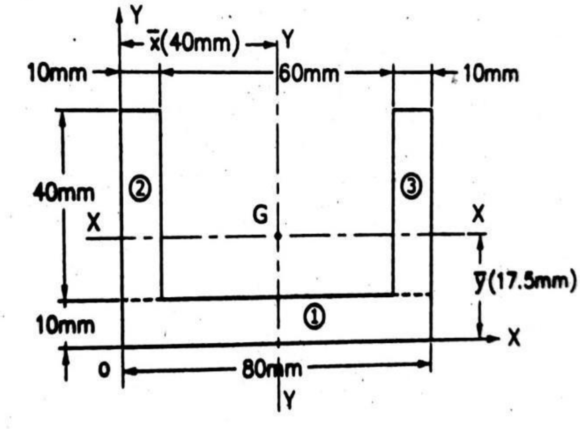
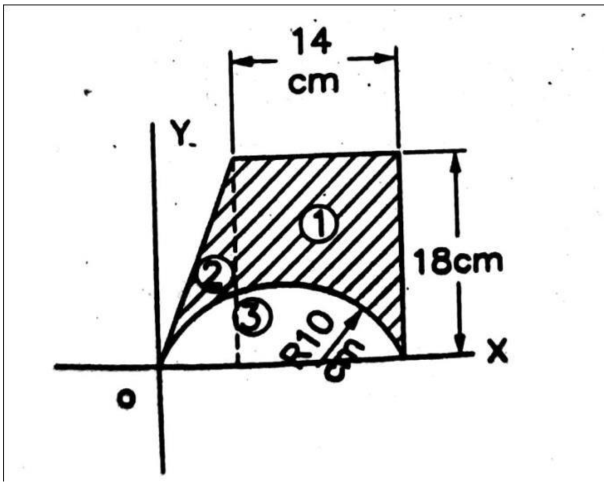
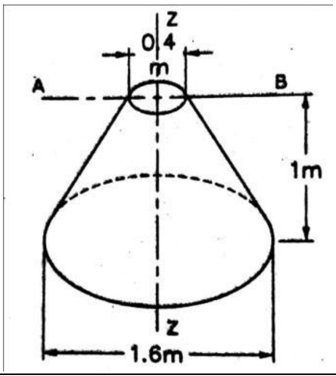
4	Locate the centroid of the area shown in figure below. The dimensions are in mm. 	BT-4	Analyze
5	Determine the co-ordinates of centroid of the shaded area shown in figure. 	BT-5	Evaluate
6	A Cylinder of height of 10 cm and radius of base 4 cm is placed under sphere of radius 4 cm such that they have a common vertical axis. If both of them are made of the same material, find the centre of gravity of the combined unit.	BT-2	Understanding
7	Find the moment of inertia of the section shown in the figure about the centroidal axes.		

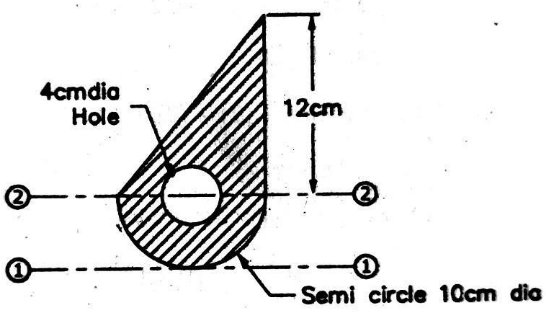
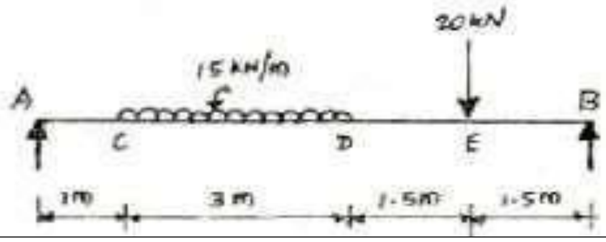
		BT-3	Apply
8	Find the mass moment of inertia of the plate shown in fig with respect to the axis AB. Thickness of the plate is 5mm and density of the material is 6500kg/m^3. 	BT-4	Analyze
9	Derive the expression for mass moment of inertia of prism along three axes.	BT-3	Apply
10	Calculate Moment of Inertia about the co-ordinate axes of plane area shown in fig. Also find Polar Moment of Inertia. All the dimensions are in 'mm'. 	BT-2	Understanding

11	Determine the principal moments of inertia and find location of principal axes of surface shown in figure 	BT-5	Evaluate
12	Determine the Moment of Inertia and radius of gyration of surface about x axis shown in fig. Also find MOIabout centroidal x axis. 	(BT4)	Analyze

13	Illustrate the Mass moment of inertia of plane area about centroidal axes shown in fig.  	BT-5	Evaluate
14	Explain second moment of area about the centroidal XX axis and a-a axis of the surface shown in fig 	(BT4)	Analyze
15	A simply supported beam of span 6 m is carrying a uniformly distributed load of 2 kN/m over the entire span. Calculate the magnitude of shear force and bending moment at every section, 2 m from the left support. Draw the shear force and bending moment diagrams for the beam.	(BT4)	Analyze
16	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 the free end. Draw the shear force and bending moment diagrams of the cantilever.	(BT4)	Analyze
17	(a) Draw the shear force and bending moment diagrams for the beam ofspan 10 m long shown in figure. Determine the maximum bending moment and locate the point of (a) contra flexure for the given beam.  	(BT4)	Analyze

18	A Simply supported beam is carrying loads as shown in fig. draw the shearforce and bending moment diagrams for the beam.  	(BT4)	Analyze
19	A beam of length 10 m is simply supported at its ends carries two concentrated loads of 5 kN each at a distance of 3 m and 7 m from the left support and also a uniformly distributed load of 1 kN/m between the point loads. i) Draw the shear force and bending moment diagrams. Calculate the maximum bending moment	(BT4)	Analyze
20	A cantilever of length 6 m carries two point loads of 2 kN and 3 kN at a distance of 1 m and 6 m from the fixed end respectively. In addition to this the beam also carries a uniformly distributed load of 1 kN/m over a length of 2 m at a distance of 3 m from the fixed end. Draw the shear force and bending moment diagrams.	(BT4)	Analyze
21	A simply supported beam of length 5 m carries a uniformly varying load of 800 N/m run at one end to zero at other end. Draw the shear force and bending moment diagrams for the beam. Also calculate the position and magnitude of maximum bending moment	(BT4)	Analyze
22	Draw the shear force and bending moment diagram of the beam loaded as shown in fig. Determine the point of contraflexure if any.  		
	PART-C (15 Marks)		

1	Find the moment of inertia of the section shown below. 	BT-5	Evaluate
2	Calculate the principal moments of inertia of the section shown in the figure. 	BT-4	Analyze
3	Calculate the mass moment of inertia of the frustum of cone shown in the figure about the AB and ZZ axes. Assume the density is 2500 kg/m^3 	BT-6	Create
4	For the section shown in the figure. Determine the moment of inertia values about the (1) – (1) and (2) – (2) axes	BT-5	Evaluate

			
5	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 	(BT5)	Evaluate
6	A beam AB of length 7 m is simply supported at two supports 5 m distance apart with an overhang of 2 m on right side of the beam. The beam carries a UVL of 6 kN/m at left end to zero kN/m at right end of SSB and point load of 4 kN at the right end of overhang part. Draw the SFD and BMD. Also locate the maximum bending moment.	(BT5)	Evaluate

UNIT I STRESS STRAIN DEFORMATION OF SOLIDS

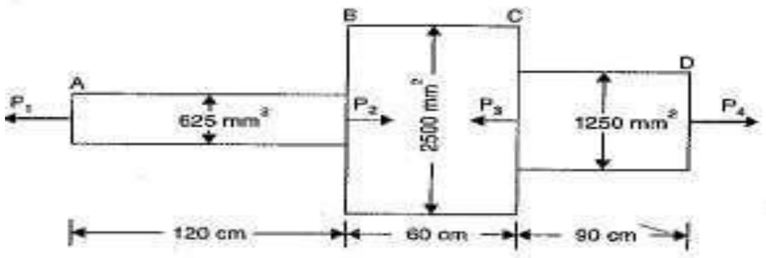
Simple stress and Strain, Mechanical Properties of Materials, Statically Determinate Problems and Elastic Constants, Tension, Compression, and Shear, Elasticity, Plasticity and Creep, Hooke's Law. Allowable stresses.

PART-A(2 MARKS)

Q.No	Questions	BT Level	Competence
1	Describe Hooke's Law with a graph.	(BT1)	Remembering
2	List various Elastic Constants.	(BT1)	Remembering
3	Define Poisson's Ratio.	(BT1)	Remembering
4	Differentiate between rigid and deformable bodies.	(BT2)	Understanding
5	Show the relation between modulus of elasticity and modulus of rigidity.	(BT2)	Understanding
6	Evaluate the load carried by a bar if the axial stress is 10 N/mm^2 and the diameter of bar is 10 mm.	(BT2)	Understanding

7	A circular rod 2 m long and 15 mm diameter is subjected to an axial tensile loadof 30 kN. Calculate the elongation of the rod if the modulus of elasticity of the material of the rod is 120 kN/mm^2.	(BT2)	Understanding
8	Express Young's modulus in terms of Bulk and Rigidity modulus.	(BT2)	Understanding
9	Define factor of safety.	(BT1)	Remembering
10	Differentiate tensile stress from compressive stress.	(BT2)	Understanding
11	State the principle of super position.	(BT2)	Understanding
12	Compare longitudinal and lateral strain.	(BT2)	Understanding
13	Deduce the two equations used to find the forces in compound bars made of two materials subjected to tension.	(BT1)	Remembering
14	Calculate the total elongation when a bar of varying cross–section consists of two sections of lengths L_1 and L_2 with cross sections A_1 and A_2. It is subjectedto an axial pull F.	(BT2)	Understanding
15	Compare compound bar and simple bar.	(BT2)	Understanding
Q.No	**PART B (13 MARKS)**	**BT Level**	**Competence**
1	(a) Draw stress strain curve for mild steel and explain about the silent points (7)	(BT4)	Analyze
	(b) Derive a relation for change in length of a uniformly varying circular bar subjected to axial load. (6)	(BT2)	Understanding
2	(a) A bar of varying cross section consists of two sections of length 700 mmand 900 mm with cross sections 400 mm^2 and 625 mm^2 respectively. it is subjected to an axial pull of 100 kN. Take E = 200 kN/ mm ^{2}. Find the total elongation.	(BT3)	Apply
	(b) A rod 3 m long is initially at a temperature of 15^{o}C and it is raised to 90^o C. Find the expansion of the rod and if the expansion is prevented, find the stressin the material. Take E = 2*10^5 N/mm^2; α = 12*10^{-6} /^{o}C.	(BT3)	Apply
3	A reinforced concrete column 500 mm × 500 mm in a section is reinforced with 4 steel bars of 25 mm diameter; one in each corner, the column is carrying a load of 1000 kN. Find the stress in the concrete and steel bars. Take E for steel = 210×10^3 N/mm^2 and E for concrete = 14×10^3 N/mm^2.	(BT4)	Analyze
4	(a) A bar of 30 mm diameter is subjected to a pull of 60 kN. The measuredextension of gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. calculate young's modulus, shear modulus and Poisson ratio. (7)	(BT4)	Analyze

	(b) Derive the relationship between modulus of elasticity and Bulk modulus.(6)	(BT3)	Apply
5	Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take E for steel = 2×10^5 N/mm^2 and E for copper = 1×10^5 N/mm^2.	(BT4)	Analyze
6	A steel rod of 30 mm diameter passes centrally through a copper tube of 60 mm external diameter and 50 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly home on the projecting parts of the rod. If the temperature of the assembly is raised by 60˚C, calculate the stress developed in copper and steel. Take E for steel and copper as 200 GN/ m^2 and 100 GN/m^2 and α for steel and copper as 12×10^{-6} per ˚C and 18×10^{-6} per ˚C.	(BT3)	Apply
7	A mild steel rod of 25 mm internal diameter and 400 mm long is enclosed centrally inside a hollow copper tube of external diameter 35 mm and internal diameter of 30 mm. The ends of the tube and rods are brazed together and the composite bar is subjected to an axial pull of 50 kN. If E for steel and copper is 200 GN/m^2 and 100 GN/m^2 respectively, find the stresses developed in the rod and tube.	(BT4)	Analyze
8	(a) Find the young's modulus of a rod of diameter 30 mm and of length 300 mm which is subjected to a tensile load of 60 kN and the extension of therod is equal to 0.4 mm. (7)	(BT3)	Apply
	(b) The ultimate stress for a hollow steel column which carries an axial load of 2 MN is 500 N/mm$^{2.}$ If the external diameter of the column is 250 mm, determine the internal diameter. Take the factor of safety as 4.0.	(BT4)	Analyze
9	The bar shown in fig. is subjected to a tensile load of 160 KN. If the stress in the middle portion is limited to 150 N/mm^2, determine the diameter of the middle portion. Find also the length of the middle portion if the total elongationof the bar is to be 0.2 mm. Young's modulus is given as equal to2.1×10^5 N/mm^2.	(BT3)	Apply

10	A member ABCD is subjected to point loads P_1, P_2, P_3, P_4 as shown in fig. calculate the force P_2 necessary for equilibrium, if P_1 = 45 kN, P_3 = 450 kN andP_4 = 139 kN. Determine the total elongation of the member, assuming the modulus of elasticity to be 2.1 x 10^5 N/mm^2. 	(BT4)	Analyze
11	A cast iron flat 300 mm long and 30 mm (thickness) × 60 mm (width) uniform cross section, is acted upon by the following forces : 30 kN tensile in the direction of the length 360 kN compression in the direction of the width 240 kN tensile in the direction of the thickness. Calculate (i) The direct strain, (ii) Net strain in each direction and (iii) Change in volume of the flat. Assume the modulus of elasticity and Poisson's ratio for cast iron as 140 kN/mm^2 and 0.25 respectively.	(BT3)	Apply

UNIT IV BEAM BENDING AND TORSION

Axially loaded members, Statically indeterminate structures, Thermal effects, misfits, and Prestrains.

Torsion of circular bar, Transmission of power by circular shafts. Stresses in beams, Pure bending and

Non-uniform bending, Design of beams for bending stresses, Shear stresses in beams of rectangular cross section..

PART-A(2 MARKS)

Q. No	Questions	BT Level	Competence
1	Describe the theory of simple bending.	(BT2)	Understanding
2	Define flitched beam.	(BT1)	Remembering
3	Illustrate the shear stress distribution in a solid circular section.	(BT3)	Apply
4	Calculate the moment of resistance of a beam subjected to a bending stress of 5 N/mm^2 and section modulus is 3500 cm^3.	(BT3)	Apply

5	Compare overhanging beam with continuous beam.	(BT2)	Understanding
6	What is the maximum bending moment in a simply supported beam of span 'L' meters subjected to UDL of 'w' KN/m over entire span.	(BT2)	Understanding
7	Compare the bending stress distribution and shear stress distribution for a beam of rectangular cross section.	(BT2)	Understanding
8	Formulate the mathematical form of bending moment theory.	(BT2)	Understanding
9	Summarize the assumptions in the theory of simple bending.	(BT2)	Understanding
10	Define torsional rigidity of the solid circular shaft.	(BT1)	Remembering
11	When are hollow circular shafts more suitable than solid circular shafts?	(BT1)	Remembering
12	Describe the term polar modulus.	(BT1)	Remembering
13	Define torsion.	(BT1)	Remembering
14	Evaluate the torque which a shaft of 50 mm diameter can transmit safely, if the allowable shear stress is 75 N/mm^2.	(BT5)	Evaluate
15	Quote the expressions for polar modulus of solid and hollow circular shaft.	(BT1)	Remembering
16	Summarize the assumptions made in torsional equation.	(BT2)	Understanding
17	Give the expression for the angle of twist for a hollow circular shaft with external diameter D, internal diameter, length l and rigidity modulus G.	(BT2)	Understanding
18	Calculate 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.	(BT3)	Apply
Q. No	**PART-B(13 MARKS)**	**BT Level**	**Competence**
1	The internal and external diameter of a hollow shaft is in the ratio of 2:3. The hollow shaft is to transmit a 400 kW power at 120 rpm. The maximum expected torque is 15% greater than the mean value. If the shear stresses not to exceed 50 MPa, find section of the shaft which would satisfy the shear stress and twist condition. Take G = 0.85×105MPa.	(BT4)	Analyze
2	(a) What are the assumptions made in the torque equations? (5)	(BT1)	Remembering
	(b) Derive the expression for power transmitted by a shaft. (8)	(BT4)	Analyze
3	(a) A steel shaft is to require transmitting 75 kW power at 100 rpm and the maximum twisting moment is 13% 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 modules of rigidity for steel as 90 KN/mm^2. (7)	(BT3)	Apply

	(b) Obtain a relation for the torque and power, a solid shaft can transmit. (6)	(BT4)	Analyze
4	(a) Find the diameter of the solid shaft to transmit 90 KW at 160 rpm such that the shear stress is limited to 60 N/mm2. The maximum torque is likely to exceed the mean torque by 20%. Also find the permissible length of the shaft, if the twist is not to exceed 1° over the entire length. Take rigidity modulus as 0.8×105N/mm2. (7)	(BT4)	Analyze
	(b) What do you mean by the strength of the shaft? Compare the strength of solid and hollow circular shafts. (6)	(BT2)	Understanding
5	(a) Determine the dimensions of a hollow circular shaft with a diameter ratio of 3:4 which is to transmit 60 KW at 200 rpm. The maximum shear stress in the shaft is limited to 70 GPa and the angle of twist to 3.8° in a length of 4 m. For the shaft material, the modulus of rigidity is 80 GPa. (7)	(BT4)	Analyze
	(b) Derive the expression for the shear stress produced in a circular solid shaft subjected to torsion. (6)	(BT4)	Analyze
6	(a) Calculate the power that can be transmitted at 300 rpm 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 is1.3 times the mean. Compare the strength of this hollow shaft with that of a solid shaft. The material, weight and length of both the shafts are same. (7)	(BT4)	Analyze
	(b) Derive the expression for angle of twist of two shafts when they are connected in series. (6)	(BT4)	Analyze
7	A steel shaft ABCD having a total length of 2400 mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80 mm and 50 mm respectively, BC is solid and 80 mm diameter. CD is also solid and 70 mm diameter. If the angle of twist is samefor each section, determine the length of each portion and the total angle of twist. Maximum permissible shear stress is 50 Mpa and shear modulusas 0.82 x 10^5 MPa	(BT3)	Apply
8	A timber beam of rectangular section is to support a load of 20 KN uniformly distributed over a span of 3.6 m, when the beam is simply supported. If the depth of the section is to be twice the breadth and the stress in the timber is not to exceed 7 N/mm2, find the breadth and depth of the cross section. How will you modify the cross section of the beam, if it carries a concentrated load of 30 kN placed at the mid- span with same ratio of breadth to depth?	(BT4)	Analyze
9	(a) State the assumptions made in theory of simple bending equation. (5)	(BT1)	Remembering
	(b) A beam 150 mm wide and 300 mm deep is simply supported over a span of 6 m. Find the maximum UDL the beam can carry if the bending stress is not exceed 8 N/mm^2. (8)	(BT4)	Analyze

10	A cross section of a beam in the form of a triangle with base 200 mm and depth 300 mm. If the shear stress on the beam is 60 kN study the distribution determine the maximum shear stress.	(BT4)	Analyze
11	A rectangular beam 300 mm deep is simply supported over a span of 4 meters. Determine the uniformly distributed load per meter which the beam may carry, if the bending stress should not exceed 120 N/mm^2. Take I = 8 x 106 mm4.	(BT5)	Evaluate
12	A cast iron beam is of I-section as shown in Fig. The beam is supported on a span of 5 meters. If the tensile stress is not to exceed 20 N/ mm^2, find the safe uniformly load which the beam can carry. Find also the maximum compressive stress.	(BT4)	Analyze

PART-C

Q. No	Questions	BT Level	Competence
1	A T-section of a simply supported beam has the width of flange 100 mm, over all depth = 100 mm, thickness of flange and stem = 20 mm. Determine the maximum stress in beam when the bending moment of 12 kN-m is acting on the section. For the above T -section calculate the shear stress at neutral axis and at the junction of web and flange when shear force of 50 kN acting on beam.	(BT5)	Evaluate
2	A simply supported beam of span 4 m carries an UDL of 6 kN/m over the entire span. If the maximum allowable stress due to bending is restricted to 150 N/mm$_2$, determine the cross sectional dimensions if the section is; (i) Rectangular with depth twice the breadth (ii) Solid circular section (iii) Hollow circular section having a diameter ratio of 0.6	(BT5)	Evaluate
3	A hollow shaft with diameter ratio 3/5 is required to transmit 450 KW at 120 rpm. The shearing stress in the shaft must not exceed 60 N/mm^2 and the twist in a length of 2.5 m is not to exceed 1°. Calculate the maximum external diameter of the shaft. C= 80 kN/mm^2.	(BT5)	Evaluate
4	A solid shaft is to transmit 300 kW at 100 rpm if the shear stress is not to exceed 80 N/mm^2. Find diameter of the shaft. If this shaft was to be replaced by hollow shaft of same material and length with an internal diameter of 0.6 times the external diameter. What percentage saving in weight is possible?	(BT5)	Evaluate

UNIT V STRESS TRANSFORMATION, DEFLECTION OF BEAM AND BUCKLING OF COLUMN

Plane stress, Principal stresses, Mohr's circle and Hooke's law for plane stresses. Spherical and Cylindrical pressure vessels. Deflection of beams, Column buckling.

PART-A(2 MARKS)

Q. No	Questions	BT Level	Competence
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. Calculate the longitudinal stress developedin the pipe.	(BT 2)	Understanding
2	Estimate 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.	(BT 2)	Understanding
3	Define circumferential stress.	(BT 1)	Remembering
4	A spherical shell of 1 m diameter is subjected to an internal pressure 0.5 N/mm^2. Discover the thickness of the shell, if the allowable stress in the material of theshell is 75 N/mm^2.	(BT 2)	Understanding
5	Define longitudinal stress.	(BT 1)	Remembering
6	Write the expression for longitudinal stress in a thin cylinder subjected to a uniform internal fluid pressure.	(BT 1)	Remembering
7	A cylinder of diameter 1.3 m and thickness 12 mm is subjected to an internal pressure of 1 N/mm^2. Identify the type of cylinder.	(BT 1)	Remembering
8	Where the hoop stresses and longitudinal stresses are acting in a thin cylindrical shell?	(BT 1)	Remembering
9	Name the various methods of reducing the hoop stresses.	(BT 1)	Remembering
10	Formulate the mathematical expressions of Lame's theorem.	(BT 1)	Remembering
11	Formulate an expression for the longitudinal stress in a thin cylinder subjected to a uniform internal fluid pressure.	(BT 1)	Remembering
12	When will the longitudinal stress in a thin cylinder be zero?	(BT 1)	Remembering
13	Mention the relationship between longitudinal stress and circumferential stress.	(BT 2)	Understanding
14	Compare the cylindrical shell and spherical shell.	(BT 2)	Understanding
15	Differentiate the thick cylinder from thin cylinder.	(BT 2)	Understanding
16	List out the formulae for finding change in diameter, change in length and change in volume of a thin cylindrical shell subjected to internal fluid pressure?	(BT 1)	Remembering
17	List the important methods used to find slope and deflection.	(BT1)	Remembering

18	Where does the maximum deflection occur in cantilever beam?	(BT1)	Remembering
19	Where does the maximum deflection occur for simply supported beam loaded symmetrically about mid-point and having same cross- section through their length?	(BT1)	Remember
20	Calculate the stored stain energy if tensile load = 30 kN; length = 1 m; width = 25 mm; thickness = 20 mm.. Take E = 200 GPa.	(BT2)	Understanding
21	Classify the types of loading on a body.	(BT3)	Apply
22	Define modulus of resilience.	(BT1)	Remembering
23	List the advantages of Macaulay's method.	(BT2)	Understanding
24	Define proof resilience.	(BT1)	Remembering
25	Give the disadvantage of double integration method.	(BT2)	Understanding
26	Define conjugate beam method.	(BT1)	Remembering
27	Define strain energy.	(BT1)	Remembering
28	Express the units of slope and deflection.	(BT2)	Understanding
29	Express the value of slope at the free end of a cantilever beam of constant EI.	(BT2)	Understanding
30	Write the expression for stress induced in a body when impact load is applied.	(BT1)	Remember
31	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/m^2.	(BT2)	Understanding
32	Modify the cantilever beam with a point load at free end into conjugate beam.	(BT2)	Understanding
33	Compare the moment area method with conjugate beam method for finding the deflection of a simply supported beam with UDL over the entire span.	(BT2)	Understanding
34	Define Mohr's first theorem.	(BT1)	Remembering
35	Analyze the strain energy method.	(BT1)	Remembering
36	A cantilever beam of spring 2 m is carrying a point load of 20 kN at its free end. Measure the slope at the free end. Assume EI = 12 x 10^3 kN-m^2.	(BT2)	Understanding
37	Define principal planes and principal stresses.	(BT1)	Remembering
38	Along which planes does greatest shear stress occur?	(BT1)	Remembering
39	Quote the expression for stresses on an inclined plane when it is subjected to an axial pull.	(BT2)	Understanding
40	Write the expressions for the stresses acting on two mutually perpendicular planes to find the major and minor principal stresses.	(BT1)	Remembering
1.	What are the types of column failure?	BT-1	Remembering
2.	What are the assumptions made in the Euler'sEquations?	BT-1	Remembering

3.	Write the limitations of Euler's Formula.	BT-1	Remembering
4.	Define buckling load and safe load	BT-1	Remembering
5.	Give the parameters influencing buckling load of a long column.	BT-1	Remembering
6.	What are the assumptions made in Lame's Theory	BT-1	Remembering
7.	Distinguish between thick and thin cylinder.	BT-2	Understanding
8.	Define slenderness ratio.	BT-2	Understanding
9.	Differentiate between eccentrically loaded column and axially loaded column.	BT-2	Understanding
10.	Explain middle third rule.	BT-2	Understanding
11.	What are the classification of columns based on end conditions?	BT-1	Remembering
12.	What is known as crippling load?	BT-3	Applying
13.	Define column and strut	BT-3	Applying
14.	What are the advantages of compound cylinders?	BT-4	Analyzing
15.	Differentiate Rankine method and Euler's method.	BT-2	Understanding
16.	Differentiate short and long column.	BT-2	Understanding
17.	How many types of stresses are developed in thick cylinders?	BT-1	Remembering
18.	How columns are classified depending upon slenderness ratio.	BT-1	Remembering

Q. No	**PART-B (13 MARKS)**	**BT Level**	**Competence**
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.	(BT4)	Analyze
2	Explain the Macaulay's method for finding the slope and deflection of beams with example.	(BT4)	Analyze

3	(a) 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 loads. Assume EI = 36 x 10^4 kN-m^2.	(BT4)	Analyze
	(b) Explain the moment area method for finding the deflection and slope of beams with example. (6)	(BT3)	Apply
4	(a) Explain the conjugate beam method for finding the deflection of beams with example. (6)	(BT3)	Apply
	(b) A horizontal beam is freely supported at its ends 8 m apart and carries a UDL of 15 kN/m over the entire span. Find the maximum deflection. Take E = 2 x 10^5 N/mm^2 and I = 2 x 10^9 mm^4. (7)	(BT4)	Analyze
5	Explain double integration method for finding deflection of beams with example.	(BT3)	Apply
6	A cantilever beam with a span of 3 m carries a point load of 30 kN at a distance of 2 m from the fixed end. Determine the slope and deflectionat the free end and at the point where load is applied. Take M.O.I of the section = 11924 cm^4 and E = 200 GN/m^2.	(BT4)	Analyze
7	At a certain point in a strained material, the stresses on two planes, at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of a magnitude of 10 N/mm^2. Find graphically or otherwise, the location of principal planes and evaluate the principal stresses.	(BT3)	Apply
8	An elemental cube is subjected to tensile stresses of 30 N/$mm^2$and 10 N/mm^2acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress.	(BT4)	Analyze
9	Two plans AB and AC which are right angles carry shear stress of intensity 17.5 N/mm2 while these planes also carry a tensile stress of 70N/mm2 and a compressive stress of 35 N/mm2 respectively. Determine the following (i) Principal planes. (ii) Principal stresses. (iii) Maximum shear stress and planes on which it acts.	(BT4)	Analyze

10	Derive the relation for Euler’s crippling load for a column with both Ends hinged.	BT-4	Analyzing
11	Derive the relation for Euler’s crippling load for a column with both ends fixed.	BT-4	Analyzing
12	Describe the relation for the Euler's crippling load for a column with one end fixed and other end hinged along with the assumptions.	BT-4	Analyzing
13	State the Euler's assumption in column theory. And derive a relation for the Euler's crippling load for a column with both ends fixed.	BT-4	Analyzing
14	A bar of length 4m when used as a SSB and subjected to UDL of 30kN/m over the whole span, deflects 15mm at the centre. Find the EI value for the above beam and hence determine the crippling loads when it is used as a column with the following end conditions i. Both ends pin-jointed ii. One end fixed and the otherendhinged iii. Both ends fixed	BT-1	Remembering
15	Identify the Euler’s critical load for a strut of T-section. The flange width is10cm, over all depth is 80cm, and both the flange & stem are 1cm thick. The strut is 3m long and is built in at both ends. Take E= $2x10^5$ N/mm^2.	BT-2	Understanding
16	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 σc = 560 $N/mm^2$and α=1/1600 forpinnedends (6) (ii) Euler’s formula. Take E= 1.2 x105N/mm^2. (7)	BT-2	Understanding
17	A thin walled steel cylindrical shell of internal diameter 150mm and external diameter 500mm is subjected to fluid pressure of 100 MPa. Calculate the principal stress at a point on the inside surface of the cylinder and calculate the increase in inside diameter due to fluid pressure. Assume E=200 kN/mm^2.	BT-2	Understanding
18	A mild steel tube 4m long, 3cm internal diameter and 4mm thick is used as a strut with both ends hinged. Find the collapsing load, what will be the crippling load? i) Both ends are built in ii) One end is built-in and one end is free.	BT-3	Applying
19	A rectangular strut is 20 cm wide and 15 cm thick. It carries a load of 60 kN at an eccentricity of 2 cm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section.	BT-3	Applying
20	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/mm2. Also find the change in wall thickness. Take E=205GN/m2 and 1/m = 0.29	BT-3	Applying

21.	A hollow cylindrical cast iron column whose external diameter is 200 mm and has a thickness of 20 mm is 4.5 m long and is fixed at the both ends. Calculate the safe loadby Rankine's formulausing a factor of safety of 2.5. Take the crushing strength of material as 550N/mm^2 and Rankine's constant as 1/1600. Find also the ratio of Euler's to Rankine's load. Take E=150GPa.	BT-4	Analyzing
22.	A load of 75kN is carried by a column made of cast-iron. The external and internal diameters are 20cm and 18cm respectively. If the eccentricity of the load is 3.5cm Find (i) The maximum and minimum stress intensities (ii) Upto what eccentricity, there is no tensile stress in column?	BT-4	Analyzing
23	i. A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pressure of 2 N/mm^2. If the thickness of the vessel is 20mm, find the hoop stress, longitudinal stress and the maximum shear stress. ii. Find the thickness for a tube of Internal diameter 100mm subjected to an internal pressure which is 5/8 of the value of the maximum permissible circumferential stress, Also find the increase in internal diameter of such a tube when the internal pressure is 90 N/mm^2. Take E = 205kN/mm^2 and μ=0.29. Neglect longitudinal strain.	BT-4	Analyzing
24	Recall and arrive at the kern of a column for the following C/S a) Rectangular section b) Square section c) Circular section d) Hollow circular section	BT-1	Remembering
25	Determine the critical stresses for a series of columns having slenderness ratio of 50, 100, 150 and 200 under the following conditions by Euler's formula. Take E = 2.1 x 10^5 N/mm^2 a) Both ends hinged b) Both ends fixed	BT-1	Remembering