INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

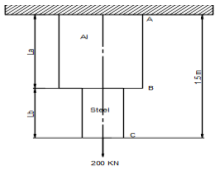
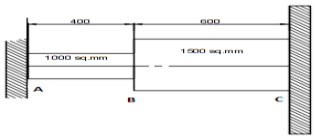
TUTORIAL QUESTION BANK

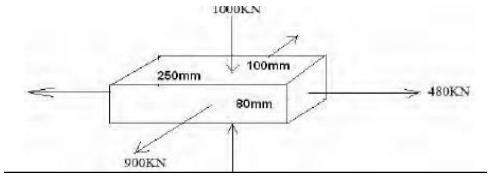
Course Name	:	**MECHANICS OF SOLIDS**
Course Code	:	**A30104**
Class	:	II B. Tech I Semester
Branch	:	MECH
Year	:	2016 – 2017
Course Coordinator	:	
Course Faculty	:	

OBJECTIVES:

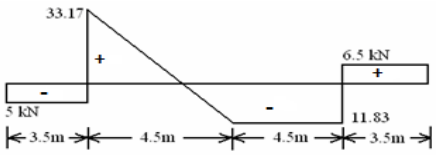
Mechanics of Solids is the physical science that deals with the reaction of a body to movement and deformation due to mechanical, thermal, or other loads. The basis of virtually all mechanical design lies in how the material reacts to outside forces. Mechanics is the core of engineering analysis and is one of the oldest of the physical sciences. An in-depth understanding of material properties as well as how certain materials react to outside stimulus is paramount to an engineering education.

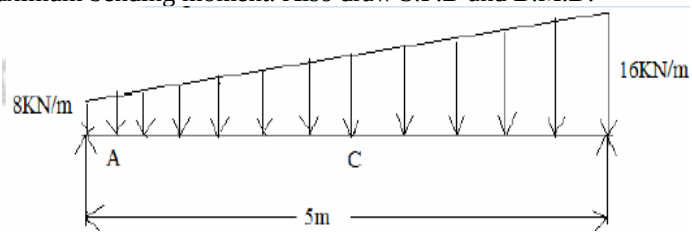
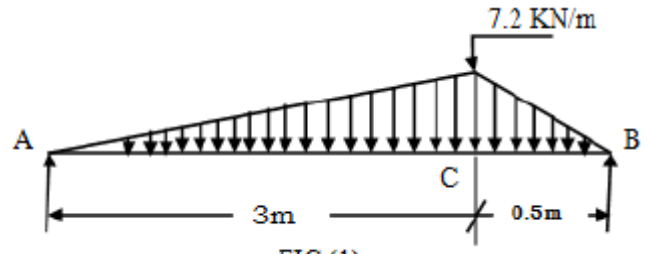
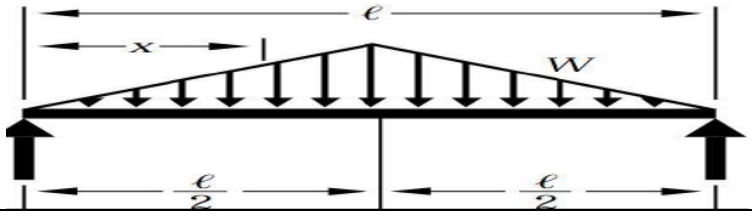
S No	QUESTION	Blooms taxonomy level	Course Outcomes
	UNIT – I		
Part - A (Short Answer Questions)			
1	Define stress and strain	Knowledge	1
2	List the different types of stress	Knowledge	1
3	List the different types of strain	Knowledge	1
4	State Hooke's law	Knowledge	1
5	Define thermal stress	Knowledge	1
6	What do you mean by bar of uniform strength.	Knowledge	1
7	Define bulk modulus	Knowledge	1
8	Define shear modulus	Knowledge	1
9	Define modulus of elasticity	Knowledge	1
10	Define longitudinal strain?	Knowledge	1
11	Define Poisson's ratio?	Knowledge	1
12	Define lateral strain?	Knowledge	1
13	Define modular ratio, Poisson's ratio	Knowledge	1
14	Explain lateral strain with a neat sketch?	Knowledge	1
15	How loads are shared in composite beams?	Knowledge	1
16	Draw stress strain diagram for brittle material	Knowledge	1

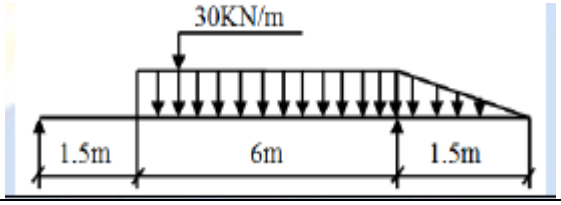
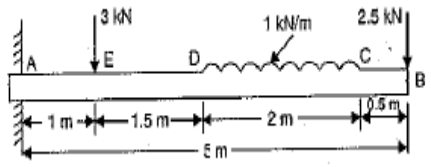
17	Write the relationship between bulk modulus, rigidity modulus and Poisson's Ratio.	Knowledge	1
18	Draw stress – strain diagram for mild steel and indicate salient points.	Knowledge	1
19	What is principle of super-position?	Knowledge	1
20	Define Factor of safety.	Knowledge	1
Part - B (Long Answer Questions)			
1	A Describe the effects of temperature changes when a body is i) Free to deform and ii) Restrained.	Understanding	1
2	A concrete column is reinforced with steel bars comprising 6 percent of the gross area of column section. What is the fraction of the compressive load sustained by steel bars, if the ratio of Young's modulii of steel and concrete is 12.5?	Applying	1
3	State the principle of superposition, and explain its significance.	Remembering	1
4	A compound bar ABC 1.5m 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, determine the lengths of the two parts of the compound bar. Take E for steel as 200 GPa and E for aluminium as 1/3rd of E for steel. 	Remembering	1
5	A prismatic member of length l and unit weight w is suspended freely from its end. Determine the elongation of the member under gravity.	Remembering	1
6	A straight bar of steel rectangular in section is 4m long and is18mm thick. The width of the rod varies uniformly from 130mm at one end 250mm at the other. If the rod is subjected to an axial tensile load of 50KN, determine the extension of the rod. Take E=2.0×10^{5} N/mm	Applying	1
7	Define composite bar how will you find the stress and load carried by each member of composite bar.	Remembering	1
8	A steel rod ABC firmly held at A and C has a cross sectional area of1000 mm^2 for 400 mm length and 1500 mm^2 for 600 mm length as shown in fig. if the rod is heated through 10 K, determine the stresses developed in the parts AB and BC. Take α = 12 x 10^{-6} /K, E = 200 GPa 	Applying	1

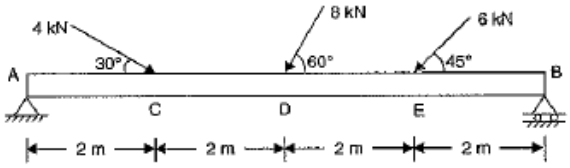
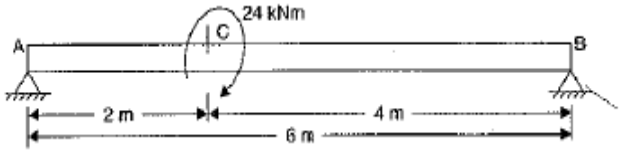
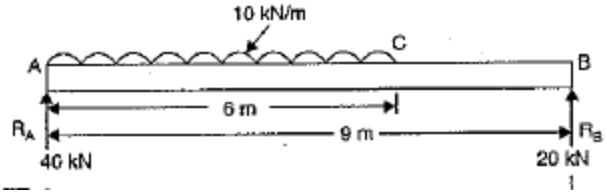
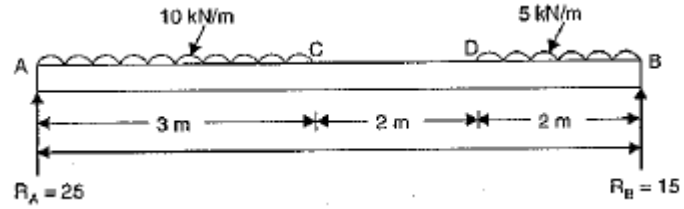
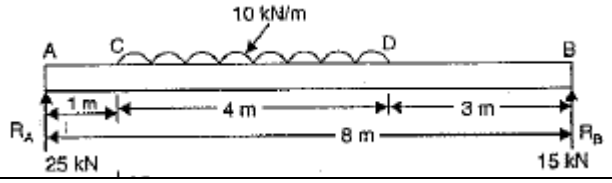
9	A rectangular block 250 mm × 100 mm × 80 mm is subjected to axial loads as follows: i) 480KN tensile in the direction of its length ii) 900KN tensile on the 250mmx80mm faces ii) 1000KN compressive on the 250mmx100mm faces. Assuming Poisson's ratio as 0.25, determine in terms of the modulus of Elasticity E of the material, the strains in the direction of each force If $E=2.0x10^5$ N/mm , determine the values of the modulus of rigidity and bulk modulus for the material of the block. Also, calculate the change in the volume of the block due to the applications of the loading specified in Fig. 	Applying	1
10	Derive an expression for total elongation of a uniformly tapering circular section.	Remembering	1
11	A circular alloy bar 2 m long uniformly tapers from 30 mm diameter to 20 mm diameter. Calculate the elongation of the rod under an axial force of 50 KN. Take E for the alloy as 140 GPa.	Applying	1
12	A reinforced concrete column 500 mm x 500 mm in section is reinforced with 4 steel bars of 25 mm diameter, one in each corner. The column is carrying a load of 1000 KN. Determine the stresses in the concrete and steel bars. Take E for steel as 210 GPa and E for concrete as 14 GPa.	Applying	1
13	A mild steel rod 1 m long and 20 mm diameter is subjected to an axial pull of 62.5 KN. What is the elongation of the rod, when the load is applied (i) gradually, and (ii) suddenly? Take E = 200 GPa.	Applying	1
14	Define composite bar and how will you find the stress and load carried by each member of composite bar.	Remembering	1
15	Determine the change in length breath and thickness of steel bar which is 5m long, 40 mm wide 30 mm thick and is subjected to axial pull of 35KN in the direction of its length. ($E=2\times10^5 N/mm^2$ Poisson's ratio=0.32)	Applying	1
16	Prove that the total extension of uniformly taper rod of diameter D_1 and D_2, when rod is subjected to axial load **P ;**	Remembering	1
17	Calculate the strain energy that can be stored in a steel bar 2.4m long and $1000mm^2$ cross sectional area, when subjected to a tensile stress of 50MPa. Take E = 200GPa.	Applying	1
18	Define and explain the following terms: i) Poisson's ratio ii) Strain energy iii) Resilience iv) Proof Resilience	Remembering	1
19	Determine the young's modulus and Passion's ratio of a metallic bar of length 25cm breadth 3cm depth 2cm when the beam is subjected to an axial compressive load 240KN. The decrease in length is given by 0.05cm and increase in breath 0.002.	Applying	1
20	Draw stress and strain diagram for mild steel. Indicate salient points and define them	Remembering	1
Part - C (Problem Solving and Critical Thinking Questions)			

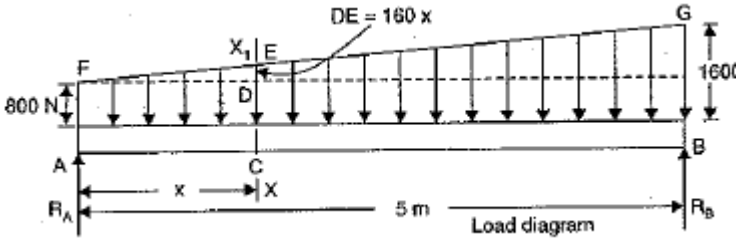
1	The extension in a rectangular steel bar of length 400mm and thickness 10mm, is found to be 0.21mm.The bar tapers uniformly in width from 100mm to 50mm. If E for the bar is 2x105 N/mm2, determine the axial tensile load on the bar	Analysis	5
2	The ultimate tensile stress for a hollow steel column which carries an axial load of 2MN is 500N/mm2.If the external diameter of the column is 250mm, determine the internal diameter. Take FOS as 4.0.	Understanding	5
3	Determine the changes in length and breadth and thickness of a steel bar which is 5m long, 40mm wide and 30mm thick and is subjected to an axial pull of 35kN in the direction of the length. Take E = 2x105 N/mm2 and Poisson's ratio 0.23	Understanding	5
4	A bar 30 mm in diameter and 200mm long was subjected to an axial pull of 60 kN. The extension of the bar was found to be 0.1 mm, while decrease in the diameter was found to be 0.004 mm. Find the Young's modulus, Poisson's ratio, rigidity modulus and bulk modulus of the material of the bar.	Understanding	5
5	A reinforced concrete column 500x500 mm in section is reinforced with a steel bar of 25mm diameter, one in each corner, the column is carrying the load of 1000 KN Find the stresses induced in the concrete and steel bar. Take E for steel = 2.1x105 N/mm2 and E for concrete = 1.4x103 N/mm2	Understanding	5
6	A steel rod of 3 cm diameter is enclosed centrally in a hollow copper tube of external diameter 5 cm and internal diameter of 4 cm. the composite bar is then subjected to an axial pull of 45000N.If thelength of each bar is equal to 15cm,determine) The stress in the rod and tube II) load carried by each bar Take E for steel = 2.1x105 N/mm2 and for copper =1.1x105 N/mm2	Understanding	5
7	A copper bar is 900mm long and circular in section. It consists of 200mm long of 40mm diameter,500mm long bar of 15mm diameter and 200mm long bar of 30 mm diameter. If the bar is subjected to a tensile load of 60 kn. Find the total extension of the bar. Take e for the bar material as 100Gpa	Understanding	5
8	A concrete column of 350mm diameter is reinforced with four bars of 25 mm diameter. Find the stress I steel when the concrete is subjected to a stress of 4.5 MPa. Also find the safe load the column can carry. Take Es / Ec= 15.	Understanding	5
9	A steel rod of 25 mm diameter axially passes through a brass tube of 25 mm internal diameter and 35 mm external diameter when the nut on the rod is tightened, initial stress of 10 MPa is developed in the rod. The temperature of the tube is then raised by 600. Calculate the final stresses in the rod and tube. Take Es=200gpa, Eb= 80Gpa.αs=11.7x10-6/0C and αb=19x10-6/0C	Understanding	5
10	A round bar 40 mm diameter is subjected to an axial pull of 80KN and reduction in diameter was found to be 0.00775mm. Find poison's ratio and young's modulus for the material of the bar. Take value of shear modulus as 40 GPa	Understanding	5
	UNIT - II		
Part – A (Short Answer Questions)			
1	Define Shear force?	Knowledge	1,2
2	What are the different types of beams?	Knowledge	1,2

3	What are the different types of loads acting on the beam	Knowledge	1,2
4	What are the sign conventions to be followed for shear force and bending moment	Knowledge	1,2
5	How many points of contra flexure you will have for a simply supported beam overhanging at one end only?	Knowledge	1,2
6	Differentiate between a point load and an UDL	Knowledge	1,2
7	What is the maximum b.m in a simply supported beam with point load at center?	Knowledge	1,2
8	What is meant by section modulus?	Knowledge	1,2
9	What is the differential relation between bending moment, shear force and the applied load?	Knowledge	1,2
10	Sketch the shear stress variation for symmetrical I section	Knowledge	1,2
11	What do you meant by point of contra flexure?	Knowledge	1,2
12	What is meant by moment of resistance of a beam?	Knowledge	1,2
13	Write any two assumptions in the theory of simple bending.	Knowledge	1,2
14	Differentiate between hogging and sagging bending moment.	Knowledge	1,2
15	Sketch any type of support used for a beam indicating the reactions.	Knowledge	1,2
16	Define bending moment?	Knowledge	1,2
17	How would you find the bending stress in unsymmetrical sections?	Knowledge	1,2
18	What do you understand by neutral axis & moment of resistance? How do you locate neutral axis?	Knowledge	1,2
19	What is the maximum b.m in a simply supported beam with UDL?	Knowledge	1,2
20	What is the maximum b.m in a cantilever with a point load at free end?	Knowledge	1,2
Part - B (Long Answer Questions)			
1	Develop Bending moment and Shear force for the Figure 1 given below indicating the maximum and minimum values.	Analyzing	2
2	A cantilever beam 4 m long carries a gradually varying load, zero at the free end to 3 KN/m at the fixed end. Draw bending moment and shear force diagrams for the beam.	Analyzing	2
3	The following Figure indicates the Shear Force diagram. Develop the loading and Bending Moment diagram for the beam. 	Analyzing	2
4	Develop Bending moment and Shear force for the Figure 2 given below indicating the maximum and minimum values.	Analyzing	2
5	A Beam of length 6.0m is simply supported at the ends and carries a u.d.l of intensity 1.5KN/m run and three concentrated loads of 1KN, 2KN and 3KN acting at a distance of 1.5m, 3.0m and 4.5m respectively from left end. Draw the S.F.D and B.M.D and also determine the maximum bending moment.	Analyzing	2

6	Define point of contra flexure with a neat digram.		
7	The intensity of loading on a simply supported beam of 5.0m span increases uniformly from 8KN/m at one end to 16KN/m at the other end as shown in Fig.1. Find the position and magnitude of the maximum bending moment. Also draw S.F.D and B.M.D. 	Analyzing	2
8	A simply supported beam AB of span 3.5 m carries a triangular load of maximum intensity 7.2 KN/m as shown in figure (1). a) Draw the shear force diagram for the beam and calculate the distance where the shear force is zero. b) Draw the bending moment diagram for the beam and find out the maximum bending moment.  FIG (1)	Analyzing	2
9	A cantilever beam AB, 1.8 m long carries a point load of 2.5 KN at its free end and a uniformly distributed load of 1KN/m from A to B. Draw shear force and bending moment diagrams for the beam.	Analyzing	2
10	A simply supported beam of 3 m span carries two loads of 5 KN each at 1 m and 2 m from the left hand support. Draw shear force and bending moment diagrams for the beam.	Analyzing	2
11	A simply supported beam of length 'l' carries a triangular load whose intensity varies uniformly from zero at both ends to 'w' load per unit length at the mid span as shown in figure (1). a) Derive the equations for shear force and bending moment at section X-X, and b) Draw SFD and BMD for the beam. 	Analyzing	2
12	A beam of length 6m is simply supported at it's ends, It is loaded with gradually varying load of 10KN/m from left support 750KN/m to right support then draw the shear force and bending moment diagrams for beam.	Analyzing	2
13	Define and explain the following terms i) Shear force ii) Bending moment iii) Shear force diagram iv) Bending moment diagram	Remembering	2

14	Draw shear force and bending moment diagram for the beam shown below. 	Analyzing	2
15	A cantilever beam of length 2m carries a point load of 1kN at its free end and another load of 2kN at a distance of 1m from the free end. Draw the SF and BM diagrams for the cantilever.	Analyzing	2
16	Draw a Shear force and bending moment diagram for a simply supported beam carrying a udl from zero to each end to w per unit length at the center.		2
17	A simply supported beam of length 5 m carries a uniformly increasing load of 800 N/m run at one end to 1600 N/m at the other end. Draw shear force and bending moment for the beam.Also calculate the position and magnitude of maximum bending	Analyzing	2
18	Draw the shear force and bending moment diagram for a simply supported beam of length 9m and carrying the UDL OF 10KN/m for a distance of 6m from the left end and also carrying point load 3KN for a distance of 2m from the left end. Calculate the shear force and bending moment also calculates the maximum bending moment	Analyzing	2
19	A piece of material is subjected to tensile stresses of 70N/mm2 and 30N/mm2 at right angles to each other. Find the stresses on a plane the normal of which makes an angle of 400 with the 70N/mm2 stress	Analyzing	2
20	Find the maximum torque that can be safely applied to a shaft of 200 mm diameter if the permissible angle of twist is 10 in a length of 5m and the permissible shear stress is 45N/ mm2. Take N=0.8×105 N/ mm2.	Analyzing	2
Part – C (Problem Solving and Critical Thinking)			
1	A cantilever of length 2.0m carries a uniformly distributed load of 1kN/m run over a length of 1.5m from free end. Draw shear force and bending moment diagrams for the cantilever?	Applying	2
2	A cantilever of length 2.0m carries a uniformly distributed load of 2kN/m run over the whole length and a point load of 3KN at the free end. Draw shear force and bending moment diagrams for the cantilever?	Applying	2
3	A cantilever of length 2.0m carries a uniformly distributed load of 1.5kN/m run over the whole length and a point load of 2KN at a distance of 0.5m from the free end. Draw shear force and bending moment diagrams for the cantilever?	Applying	2
4	A cantilever of length 5.0m is loaded as shown in fig.Draw the S.F and B.M diagrams for the cantiliver 	Applying	2

5	A horizontal beam AB of length 8m is hinged at A and placed on rollers at B. The beam carries three inclined point loads as shown in fig. draw the S.F and B.M and axial force diagrams of the beam. 	Applying	2
6	A simply supported beam AB of length6m is hinged at A and B. It is subjected to a clockwise couple of 24KNat a distance of 2m from the left end A. Draw the S.F and B.M diagram 	Applying	2
7	Draw the S.F and B.M diagramsfor a simply supported beam of length 9m and carrying a uniformly distributed load of 10KN for a distance of 6m from the left end. Also calculate the maximum B.M on the sections. 	Applying	2
8	Draw the S.F and B.M diagramsfor a simply supported beam of length 7m and carrying a uniformly distributed loads as shown in the figure. 	Applying	2
9	Draw the S.F and B.M diagramsfor a simply supported beam of length 8m and carrying a uniformly distributed load of 10KN for a distance of 4m as shown in the fig. 	Applying	2

10	A simply supported beam of length 5m carries a uniformly increasing load of 800N/m run at one end to 1600 N/m run at the other end. Draw the S.F and B.Mdiagrams for the beam.Also calculate the position and magnitude of maximum bending moment.  	Applying	2
	UNIT-III		
Part - A (Short Answer Questions)			
1	What is equivalent section	Knowledge	1,3
2	What is pure bending	Knowledge	1,3
3	What is strength of section	Knowledge	1,3
4	Define modular ratio	Knowledge	1,3
5	Define the terms: section modulus, fletched beams	Knowledge	1,3
6	Explain shear stress in a beam	Knowledge	1,3
7	Write formula for shear stress in a beam and indicate the parameters including units	Knowledge	1,3
8	Maximum shear stress in a rectangular beam is how many times of average shear stress and where it occurs.	Knowledge	1,3
9	Indicate shear stress distribution in a rectangular beam	Knowledge	1,3
10	Indicate formula for maximum shear stress in a circular beam in terms of average shear stress	Knowledge	1,3
11	Write formula for maximum shear stress in a beam of isosceles triangular cross section and explain the parameters.	Knowledge	1,3
12	Write formula for shear stress at centroidal axis of isosceles triangular section and explain the parameters.	Knowledge	1,3
13	Find the maximum shear stress in a rectangular beam 100mm wide, and 250 mm deep when it is subjected to 50 KN shear force.	Knowledge	1,3
14	Indicate shear stress distribution in an I-beam	Knowledge	1,3
15	Find the maximum shear stress in a circular beam of diameter 10 mm when it is subjected to a shear force 4 KN	Knowledge	1,3
16	Indicate shear stress distribution in a circular section	Knowledge	1,3
17	Write bending equation and indicate parameters	Knowledge	1,3
18	Indicate shear stress distribution in a beam of T-section	Knowledge	1,3
19	What is neutral axis?	Knowledge	1,3
20	Indicate the shear stress distribution in a beam of channel section.	Knowledge	1,3
Part – B (Long Answer Questions)			
1	Show that for a beam subjected to pure bending, neutral axis coincides with the centroid of the cross- section.	Applying	3

2	A cantilever of square section 200 mm × 200 mm, 2.0 m long, just fails in flexure when a load of 12 KN is placed at its free end. A beam of the same material and having a rectangular cross-section 150 mm wide and 300 mm deep is simply supported over a span of 3.0 m. Calculate the minimum central concentrated load required to break the beam	Applying	3
3	Compare the section moduli of two beams of the weight and length and the beam is solid Circular beam of diameter 'd' and the second is a circular tube of outer diameter 'D1' and inner diameter 'D2'.	understanding	3
4	A copper wire of 2mm diameter is required to be wound around a drum. Determine the min. radius of the drum, if the stress in the wire is not to exceed 80MPa. Take E as 100GPa for the copper.	Analyzing	3
5	A rectangular beam 300mm deep is simply supported over a span of 4.0m. Determine the uniformly distributed load per meter which the beam may carry, if bending stress should not exceed 120N/mm2. Take I=8.0x106mm4	Analyzing	3
6	Derive an expression for bending stress.	Remembering	3
7	What do you mean by theory of simple bending?	Remembering	3
8	A cast iron beam section is of I-section with a top flange 80 mm x 20 mm thick, bottom flange 160 mm x 40 mm thick and the web 200 mm deep and 20 mm thick. The beam is freely supported on a span of 5 m. If the tensile stress is not to exceed 20 N/mm2, Determine the safe uniformly distributed load which the beam can carry.	Analyzing	3
9	A T-section beam having flange 2cm*10cm, web 10cm*2cm is simply supported over a span of 6m. it carries a U.D.L of 3KN/m run including its own weight over its entire span, together with a load of 2.5KN at mid span. Determine the maximum tensile and compressive stresses occurring in beam section. Define and explain the following terms: i) Bending stress ii) Neutral axis iii) Section modulusiv) Moment of resistance	Analyzing	3
10	Define and explain the following terms: i) Bending stress ii) Neutral axis iii) Section modulusiv) Moment of resistance	Remembering	3
11	With a neat sketch illustrate the existence of vertical and horizontal shear stresses in a beam	Analyzing	
12	A 300 mm × 150 mm I –girder has 12 mm thick flanges and 8 mm thick web it is subjected to a shear force of 150KN at a particular section. Find the maximum shear stress in the web and flange.	Analyzing	3
13	Show that the maximum shear stress in a rectangular beam is 1.5 times of average shear stress when it is subjected to a bending moment.	Remembering	3
14	A wooden beam supports udl of 40 KN/m over a simple supported span of 4m. It is of rectangular cross-section of 200mm wide and 400mm deep. Calculate average and maximum shear stress.	Analyzing	3
15	Derive an equation for shear stress across a beam.		
16	Determine out the maximum shear stress in a shaft of dia 40 mm subjected to a shear force of 30 KN.	Analyzing	3
17	Explain complimentary shear stress.	Remembering	3
18	Show that max shear stress in a solid circular shaft is 1.33 times of average shear stress when it is subjected to a bending moment.		
19	Show that the maximum shear stress in a beam of square section with a diagonal horizontal is 9/8 times of average shear stress.	Analyzing	3
20	A square of 20mm side is used as a beam with diagonal horizontal and subjected to a vertical shear force 2KN at a section. Determine the maximum shear stress	Analyzing	3

Part – C (Problem Solving and Critical Thinking)			
1	A steel plate of width 60mm and thickness 10mm is bent into a Circular arc of radius 10m. Determine the max stress induced and The bending moment which will produce the max stress. Take E = 2x105 N/mm2	Analysis	3
2	A steel plate of width 60mm and thickness 10mm is bent into a Circular arc of radius 10m. Determine the max stress induced and The bending moment which will produce the max stress. Take E = 2x105 N/mm2	Analysis	3
3	A rectangular beam 100mm wide and 150mm deep is subjected to a shear force of 30kN. Determine the average stress, max shear stress	Analysis	3
4	A cast iron beam has an I-section with top angle 100mm × 40mm, web 140mm×20mm and bottom angle 180mm × 40mm. If tensile stress is not to exceed 35MPa and compressive stress 95MPa, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6.5m	Analysis	3
5	A flicthed beam consists of a wooden joist 10 cm wide and 20 cm deep strengthened by two steel plates 10 mm thick and 20 cm deep. If the maximum stress in the wooden joist is 7N/mm2, find the corresponding maximum stress attained in the steel. Find also the moment of resistance of composite section. Take young's modulus for steel=2.1x105 N/mm2 and for wood = 1x104 N/mm2	Analysis	3
6	A beam of I-section is having overall depth of 700mm and overall width as 230mm. The thickness of the flanges is 25mm where as the thickness of the web is 20mm. If the section carries a shear force of 64kN, Calculate the shear stress at salient points.	Analysis	3
7	A rectangular beam 125mm wide is subjected to maximum shear force of 110kN. Find the depth of the beam if the maximum permissible shear stress is 7MPa	Knowledge	3
8	A wooden beam 100mm wide and 150mm deep is simply supported over a span of 4m. If shear force at a section of the beam is 4500N,find the shear stress at a distance 25mm above the N.A.	Applying	3
9	A timber beam of rectangular section is simply supported at the ends and carries appoint load at the center of the beam. The maximum bending stress is 12N/mm2, find the ratio of span to the depth.	Applying	3
10	A I section beam 350mm*150mm has a web thickness of 10mm and a flange thickness of 20mm.if the shear force acting on the section is 40KN.find the maximum shear stress developed in the I section.	Applying	3
	UNIT-IV		
Part – A (Short Answer Questions)			
1	What is principal stress?	Knowledge	1,4
2	What is principal plane?	Knowledge	1,4
3	What is normal stress?	Knowledge	1,4
4	What is tangential stress?	Knowledge	1,4
5	Explain maximum principal stress theory?	Knowledge	1,4
6	What is maximum principal strain theory?	Knowledge	1,4
7	Explain maximum strain energy theory?	Knowledge	1,4
8	What is maximum shear strain energy theory?	Knowledge	1,4
9	What are the theories of failure?	Knowledge	1,4
10	What is the stress on a plane inclined at an angle ɵ?	Knowledge	1,4

11	A circular bar of diameter 80mm is subjected to an axial load of 20KN.Dtermine the shear stress on a section which is inclined at an angle of 30° with normal cross section of the bar?	Knowledge	1,4
12	Write an equation for maximum shear stress when a body is subjected to direct stresses in two perpendicular directions?	Knowledge	1,4
13	Write an equation for maximum shear stress when a body is subjected to a direct stress in one plane and accompined by a simple shear stress?	Knowledge	1,4
14	Write an equation for maximum principal stress when a body is subjected to a direct stress in one plane and accompined by a simple shear stress?	Knowledge	1,4
15	A rectangular bar of coss sectional area 100mm*80mm is subjected to an axial load of 20KN.Dtermine the normal stress on a section which is inclined at an angle of 30° with normal cross section of the bar?	Knowledge	1,4
16	A rectangular bar of coss sectional area 100mm*80mm is subjected to an axial load of 20KN.Dtermine the shear stress on a section which is inclined at an angle of 30° with normal cross section of the bar?	Knowledge	1,4
17	Write the equation for principal stress when abody is subjected to two direct stresses mutually perpendicular accompanied by a simple shear?	Knowledge	1,4
18	Write an equation for resultant stress when a body is subjected to direct stresses in two perpendicular directions?	Knowledge	1,4
19	A circular bar of diameter 80mm is subjected to an axial load of 20KN.Dtermine the normal stress on a section which is inclined at an angle of 30° with normal cross section of the bar?	Knowledge	1,4
20	Write the equation for maximum shear stress when a body is subjected to two direct stresses mutually perpendicular accompanied by a simple shear?	Knowledge	1,4
Part – B (Long Answer Questions)			
1	Derive equations for normal stress, shear stress and resultant stress on a plane the normal to which is inclined at 300 to the axis of the bar.	Applying	4
2	A tie bar is subjected to a uniform tensile stress of 100N/mm2. Find the intensity of normal stress, shear stress and resultant stress on a plane the normal to which is inclined to the axis at 300 to the axis of the bar. Also estimate the max shear stress in the bar.	Applying	4
3	Describe an equation for normal and shear stress when a material is subjected to biaxial stresses P1 and P2.	Understanding	4
4	A piece of material is subjected to tensile stresses of 70N/ mm2 and 50N/mm2 at right angles to each other. Find the stresses on a plane the normal of which makes an angle 350 with the 70N/ mm2 stress.	Applying	4
5	Define Principal plane.	Remembering	4
6	An element in a plane is subjected to stresses P1=120N/ mm2 P2=45N/ mm2 (both tensile and perpendicular to each other) and shearing stress of 30N/ mm2. Determine the stresses on a plane normal to which is inclined to the stress 120N/ mm2 at an angle 450.	Applying	4
7	Explain the construction of Mohr's circle for two like stresses P1 and P2.	Remembering	4
8	A piece of material is subjected to tensile stresses of 70N/mm2 and 30N/mm2 at right angles to each other. Find the stresses on a plane the normal of which makes an angle of 400 with the 70N/mm2 stress	Applying	4
9	A piece of material is subjected to stresses P1 and P2 (both tensile and mutually perpendicular) and a shear stress q. Indicate the principal stresses and their positions.	Remembering	4

10	At a point in an elastic material under strain, normal stresses 60N/mm2 and 40N/mm2 (both tensile and right angles to each other) with a shearing stress 20N/mm2. Find i) The principal stresses and their position. ii) Maximum shear stress and its plane	Applying	4
11	Explain maximum principal stress theory and indicate the materials for which it is suitable.	Remembering	4
12	The load on a bolt consists of an axial pull of 15 KN together with a transverse shear of 7.5 KN. Determine the diameter of the bolt according to maximum principal stress theory.	Applying	4
13	At a point in an elastic material there are stresses P1 and P2 (both tensile and mutually perpendicular) and shear stress q. Explain how to draw Mohr's circle with a neat diagram.	Remembering	4
14	At a point in a component a direct tensile stress of 70N/mm2 and a direct compressive stress of 50N/ mm2 are applied on planes at right angles to each other. If the maximum principal stress is limited to 75N/ mm2 find out the shear stress that may be allowed on the planes. Also determine magnitude and direction of the minimum principal stress and the maximum shear stress.	Applying	4
15	Explain maximum strain theory and indicate materials for which it is suitable.	Remembering	4
16	The load on a bolt consists of an axial pull of 15 KN together with a transverse shear of 7.5 KN. Determine the diameter of the bolt according to maximum strain theory. Take μ=0.3.	Applying	4
17	Explain maximum shear stress theory and indicate the type of material for which this theory gives reasonable results.	Remembering	4
18	The load on a bolt consists of an axial pull of 15 KN together with a transverse shear of 7.5 KN. Determine the diameter of the bolt by maximum shear stress theory.	Applying	4
19	Explain maximum strain energy theory.	Remembering	4
20	The load on a bolt consists of an axial pull of 15 KN together with a transverse shear of 7.5 KN. Determine the diameter of the bolt according to max. strain energy theory	Applying	4
Part – C (Problem Solving and Critical Thinking)			
1	The stresses at a point in a component are 100 mpa tensile and 50 mpa compressive. Determine the magnitude of the normal and shear stresses on a plane inclined at an angle of 250 with tensile stress. Also determine the direction of the resultant stress and thje magnitude of the maximum intensity of shear stress.	Knowledge	4
2	A plane element in a body is subjected to a tensile stress of 100MPA accopained by a clock shear stress of 25 Mpa. Find(i) the normal and shear stress on a plane inclined at an angle 200 with the tensile stress; and (ii) the maximum shear stress on the plane.	Analysis	4
3	At a point in a strained material, the principal stresses are 100Mpa ad 50 MPa both tensile. find the normal ad shear stresses at a section at 600 with the axis of the major principle stresses.	Analysis	4
4	An element is a strained body is subjected to a tensile stress of 150Mpa ad a shear of 50Mpa tending to rotate the element in a anticlockwise direction. find (i) the magnitude of the normal and shear stresses a section inclined at 400 with the tensile stress an (ii) the magnitude ad direction of maximum shear stress that ca exit on the element	Knowledge	4

5	A plane element in a body is subjected to a tensile stress of 100Mpa accompanied by a clockwise shear stress of 25Mpa. Fid (i) The normal shear stress on a inclined plane at an angle of 200 with the tensile stress; and (ii) the maximum shear stress o the plane.	Analysis	4
6	At a point in a stressed element, the normal stresses in two mutually perpendicular directions are45Mpa and 25 MPa both tensile. the complementary shear stress is these directions is 15 MPa . By using Mohr's circle method, or otherwise, determine the maximum and minimum principal stresses.	Analysis	4
7	How will you find out graphically the resultant stress o an oblique section when the body is subjected to direct stresses in two mutually perpendicular directions	Knowledge	4
8	Find the diameter of the circular bar which is subjected to an axial load of 160KN, if the maximum allowable shear stress on any section is 65N/mm2.	Applying	3
9	A rectangular bar of cross sectional area 10000mm2 is subjected to an axial load of 20KN.Determine the normal and shear stresses on a section which is inclined at an angle of 30° with normal cross section of the bar.	Applying	3
10	A rectangular bar of cross sectional area 11000mm2 is subjected to a tensile load P as shown in fig.The permissible normal and shear stresses on the oblique plane BC are given as 7N/mm2 and 3.5n/mm2 respectively.Determine the safe value of p.	Applying	3
	UNIT-V		
Part - A (Short Answer Questions)			
1	What are the assumptions made in the theory of torsion?	Knowledge	1,5
2	Define torsion?	Knowledge	1,5
3	Write Torsional equation.	Knowledge	1,5
4	Why hollow circular shafts are preferred when compared to solid circular shafts?	Knowledge	1,5
5	Write the expression for power transmitted by a shaft.	Knowledge	1,5
6	Define polar modulus?	Knowledge	1,5
7	What is the maximum principle stress in a spherical thin shell?	Knowledge	1,5
8	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.	Knowledge	1,5
9	What is hoop stress?	Knowledge	1,5
10	What is a stepped shaft?	Knowledge	1,5
11	Write an equation for longitudinal stress in a thin cylinder?	Knowledge	1,5
12	Write an equation for volumetric strain of cylinder?	Knowledge	1,5
13	What is the volumetric strain for a spherical thin shell?	Knowledge	1,5
14	Write the equation for strain energy stored in a shaft due to torsion.	Knowledge	1,5
15	What is the equivalent bending moment for a shaft subjected to moment M and torsion T?	Knowledge	1,5
16	A shaft is having a diameter of 30mm. What is its polar moment of inertia?	Knowledge	1,5
17	What is joint effincency of a thin shell?	Knowledge	1,5

18	What is the maximum shear stress in a thin cylindrical shell?	Knowledge	1,5
19	What is the maximum principle stress in a cylindrical thin shell?	Knowledge	1,5
20	What is torsional rigidity?	Knowledge	1,5
Part - B (Long Answer Questions)			
1	Derive torsion formula	Remembering	5
2	Determine the torque which a shaft of 200mm diameter can safely transmit if the shear stress is not to exceed 50N/mm2.	Applying	5
3	Derive a formula for resisting torque.	Remembering	5
4	A solid shaft is required to transmit 120 KW power at 200 rpm. Find the suitable diameter of the shaft if the maximum torque transmitted in each revolution exceeds the mean by 20%. Take allowable shear stress as 70N/ mm2 for the material of the shaft	Applying	5
5	Derive an equation for power transmitted by a shaft.	Remembering	5
6	A solid shaft of 80mm diameter is transmitting 100 KW power at 200 rpm. Calculate the maximum shear stress induced in the shaft and the angle of twist in degrees for a length of 6m. Take N=8×104 N/ mm2.	Applying	5
7	Explain torsion section modulus, torsional rigidity, polar moment of inertia.	Remembering	5
8	Find the maximum torque that can be safely applied to a shaft of 200 mm diameter if the permissible angle of twist is 10 in a length of 5m and the permissible shear stress is 45N/ mm2. Take N=0.8×105 N/ mm2.	Applying	5
9	Derive an equation for strain energy stored in a shaft under torsion.	Remembering	5
10	A solid shaft of 120mm diameter is transmitting 300KW at 120 rpm determine the strain energy stored.	Applying	5
11	A compound shaft consisting of shaft 1 and shaft 2 in series, what is the angle of twist of the compound shaft.	Applying	5
12	A solid circular shaft of length 3m has diameters of 60 mm, 70 mm and 40 mm of each 1m length. Determine the angle of twist if shaft is transmitting 20KW at 200 rpm. Take N=8×104 N/ mm2.	Applying	5
13	Derive formulae for principal stress and its position for a shaft which is subjected torque T and bending moment M.	Remembering	5
14	At a certain cross section, a shaft of 80mm diameter is subjected to a bending moment 6 KNm and a twisting moment of 9 KNm. Compute the maximum and minimum principle stresses	Applying	5
15	Derive expression for the stresses developed in a thin cylindrical vessel subjected to internal pressure.	Remembering	5
16	A steel water pipe 0.6 m in dia has to resist the pressure due to a head of 120 m of water. To what thickness should it be made if the working stress in the metal is to be 32 N/ mm2 after the pipe has lost 2.5 mm of its thickness due to corrosion. Take specific weight of water10KN/m3	Applying	5
17	Derive an expression for volumetric strain of thin cylindrical shell.	Remembering	5
18	A copper cylinder 900 mm long 400 mm internal dia. and 6 mm thick initially at atmospheric pressure. Calculate the volume of oil which must be pumped into the cylinder in order to raise the pressure to 5 N/ mm2 above atmospheric pressure. For copper take E=1×105N/ mm2 and poisons ratio =1/3, Bulk Modulus of oil as 2580 N/mm3.	Applying	5
19	Derive an expression for volumetric strain of thin spherical shell.	Remembering	5

20	A spherical shell is of 0.8 m dia and 4mm thickness. It is filled with fluid under pressure until its volume increases by 50 cubic centimeters. Determine the fluid pressure, taking E=2×105N/ mm2 poisons ratio=0.3.	Applying	5
Part – C (Problem Solving and Critical Thinking)			
1	A solid shaft is subjected to a torque of1.6kn-m. find the diameter of the shaft, if the allowable shear stress is 60 mpa. The allowable twist is 10for every 20 diameters length of the shaft. Take C= 80 Gpa	Applying	5
2	Determine the max. and min. hoop stress across the section of a pipe 400 mm internal diameter and 100 mm thick when the pipe contains a fluid at a pressure of 8 N/mm2. Also sketch the radial pressure distribution and hoop stress distribution across the section.	Applying	5
3	A solid steel shaft is required to transmit a torque of 6.5 KN-m. What should be the minimum diameter of the shaft, if the maximum shear stress is 40Mpa	Applying	5
4	Find the angle of twist per metre length of a hollow shaft of 100mm external and 60mm internal diameter, if the shear stress is not to exceed 35 MPa. take C = 85Gpa	Applying	5
5	A solid shaft ad a hollow circular shaft, whose inside diameter is 3/4 of the outside diameter are of equal length under required to transmit given torque. compare the weight of these two shafts, if maximum shear stress developed in both shafts is also equal	Applying	5
6	The maximum allowable stress in a cylinder of 700.0 mm inner diameter and 150.0 mm thickness is 6.3 MPa. Determine the maximum allowable internal and external pressures on the cylinder, when applied separately.	Applying	5
7	The volume of a hollow cylinder of 800.0 mm diameter, 1.4 m length and 10.0 mm thickness increases by 1245.0 ml when Subjected to an internal pressure of 4.5 MPa. Determine the Poisson's ratio of the material, if E = 190.0 GPa	Applying	5
8	A cylindrical pipe of dia 105m and thickness 105cm is subjected to an internal fluid pressure of 1.2 N/mm2. Determine: 1) Longitudinal stress developed in the pipe. 2) Circumferential stress developed in the pipe.	Applying	5
9	A cylinder of internal diameter 205m and of thickness 5cm contains a gas. If the tensile stress in the material is not to exceed 80 N/mm2. Determine the internal pressure of the gas.	Applying	5
10	A cylinder of internal diameter 0.50m contains air at a pressure of 7 N/mm2 (guage). If the max.permissible stress induced in the material is 80N/mm2, find the thickness of the cylinder.	Applying	5

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