INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING
TUTORIAL QUESTION BANK

Course Name	**MECHANICS OF SOLIDS**
Course Code	**AME004**
Regulation	**IARE-R16**
Class	III Semester
Branch	MECHANICAL ENGINEERING
Year	2018 – 2019
Course Faculty	Dr. K. Viswanath Allamraju, Professor, Dept of ME Mr. G. Musalaiah, Assistant Professor, Dept of ME

OBJECTIVES:

The course should enable the students to:

I	Solve real field problems through evaluating the relationship between stress and strain.
II	Understand the shear force and bending moment diagrams of symmetrical beams.
III	Determine bending and shear stresses developed in beams of various sections.
IV	Understand various theories of failure, Mohr's circle of stresses, principle stresses and strains.
V	Understand and apply the concept of stress and strain to analyze and design structural members and machine parts under axial load, shear load, bending moment and torsion.

COURSE LEARNING OUTCOMES:

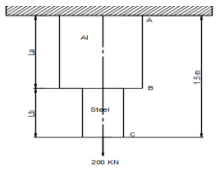
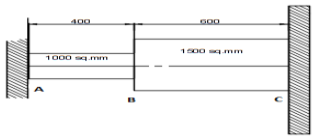
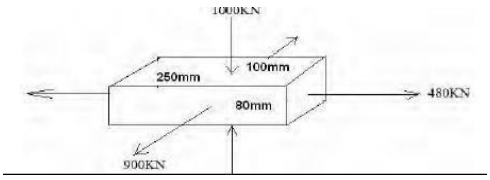
Students, who complete the course, will have demonstrated the ability to do the following:

CAME004.01	Demonstrate the statically determinate and indeterminate problems. Use algebraic equations to determine the effect of stress and strain in the bars which are made up of various materials.
CAME004.02	Understand extension and reduction of length of different bars. Explain the various stresses and strains and their relations, also comprehend the importance of elastic moduli.
CAME004.03	Explore the shear force diagrams under various loads. Explain the importance of beams in the real field by understanding the types of loads.
CAME004.04	Comprehend bending moment and its variation at various loads. Explain the bending moment diagram and its importance, understanding the supports and beams.
CAME004.05	Determine the resistance and deformation in members which are subjected to axial, flexural and torsional loads.
CAME004.06	Evaluate the principal stresses, strains and apply the concept of failure theories for design of shafts and other designed products.
CAME004.07	Able to calculate the shear stresses developed in various sections of beams.
CAME004.08	Capable of understand the loads which occur in crash analysis.
CAME004.09	Understand the effect of gradual loads on the various materials.
CAME004.10	Understand the effect of stress on materials in relation to strains.
CAME004.11	Able to calculate the flexural developed in various sections of beams of real field problems.
CAME004.12	Find principle stresses and strains and to apply theories of failure in the design of various mechanical parts.
CAME004.13	Determine stresses developed in a shaft and design of a shaft.
CAME004.14	Understand the real field problems of various pressure vessels which are made up of different materials.
CAME004.15	Able to design the thin vessels which are subjected to different stresses.
CAME004.16	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc

CAME004.17	Understand the significance of elastic constants for predicting the strengths of structures for long lasting.
CAME004.18	Understand the effect of suddenly applied loads on the various materials for anticipating the fatigue life under cyclic.
CAME004.19	Able to optimize the design of shafts by using theories of failure for minimizing the wastage of materials and product cost.
CAME004.20	Determine the stresses and strains by using graphical method for validating the analytical results in the research of self healing composite structures.

TUTORIAL QUESTION BANK

UNIT – I			
SIMPLE STRESSES AND STRAINS			
PART-A SHORT ANSWER TYPE QUESTIONS			
S No	**Question**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
1	Define stress and strain	Understand	CAME004.01
2	List the different types of stress	Remember	CAME004.02
3	List the different types of strain	Remember	CAME004.01
4	State Hooke's law.	Remember	CAME004.02
5	Define thermal stress.	Remember	CAME004.05
6	What do you mean by bar of uniform strength.	Understand	CAME004.01
7	Define bulk modulus.	Remember	CAME004.02
8	Define shear modulus	Understand	CAME004.08
9	Define modulus of elasticity	Understand	CAME004.09
10	Define longitudinal strain?	Understand	CAME004.10
11	Define Poisson's ratio?	Remember	CAME004.16
12	Define lateral strain?	Understand	CAME004.08
13	Define modular ratio, Poisson's ratio	Understand	CAME004.09
14	Explain lateral strain with a neat sketch?	Remember	CAME004.08
15	How loads are shared in composite beams?	Remember	CAME004.09
16	Draw stress strain diagram for brittle material	Remember	CAME004.16
17	Write the relationship between bulk modulus, rigidity modulus and Poisson's Ratio.	Understand	CAME004.01
18	Draw stress – strain diagram for mild steel and indicate salient points.	Understand	CAME004.02
19	What is principle of super-position?	Remember	CAME004.01
20	Define Factor of safety.	Remember	CAME004.16
Part - B (LONG ANSWER TYPE QUESTIONS)			
S No	**Question**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
1	Describe the effects of temperature changes when a body is i) Free to deform and ii) Restrained.	Understand	CAME004.01
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?	Understand	CAME004.02
3	State the principle of superposition, and explain its significance.	Understand	CAME004.01

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.  	Understand	CAME004.02
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.	Understand	CAME004.05
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	Understand	CAME004.01
7	Define composite bar how will you find the stress and load carried by each member of composite bar.	Understand	CAME004.02
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 $\alpha = 12 \times 10^{-6}$ /K, E = 200 GPa.  	Understand	CAME004.02
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 iii)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=2.0×10^5 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.  	Understand	CAME004.17
10	Derive an expression for total elongation of a uniformly tapering circular section.	Remember	CAME004.02
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.	Understand	CAME004.01

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.	Understand	CAME004.05
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.	Understand	CAME004.02
14	Define composite bar and how will you find the stress and load carried by each member of composite bar.	Remember	CAME004.02
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)	Remember	CAME004.08
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 ;**	Understand	CAME004.09
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.	Remember	CAME004.08
18	Define and explain the following terms: i) Poisson's ratio ii) Strain energy iii) Resilience iv) Proof Resilience	Remember	CAME004.10
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.	Remember	CAME004.08
20	Draw stress and strain diagram for mild steel. Indicate salient points and define them.	Remember	CAME004.05

Part - C (Problem Solving and Critical Thinking Questions)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	The extension in a rectangular steel bar of length 400mm and thickness 10 mm, is found to be 0.21mm.The bar tapers uniformly in width from 100mm to 50mm. If E for the bar is 2x105 N/mm^2, determine the axial tensile load on the bar.	Remember	CAME004.01
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.	Understand	CAME004.02
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	Understand	CAME004.01
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.	Remember	CAME004.04
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	Remember	CAME004.04

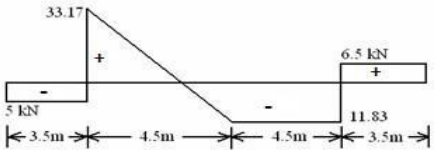
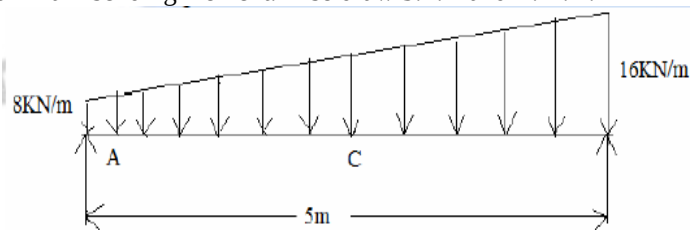
6	A steel rod of 3 cm diameter is enclosed centrally in a hollow copper tube of external diameter 5 cm and internal diameter of 4 cm. the composite bar is then subjected to an axial pull of 45000N.If thelength of each bar is equal to 15cm,determine) The stress in the rod and tube II) load carried by each bar Take E for steel = 2.1x105 N/mm2 and for copper =1.1x105 N/mm2	Understand	CAME004.05
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	Remember	CAME004.08
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.	Remember	CAME004.09
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	Remember	CAME004.02
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	Understand	CAME004.05

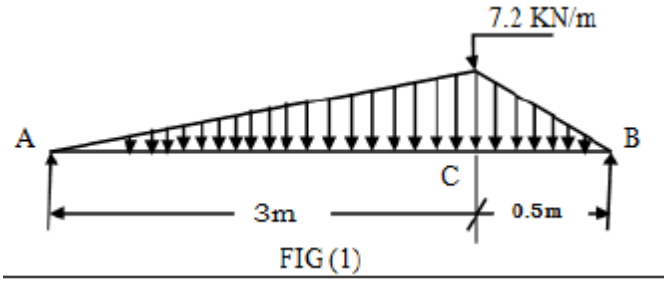
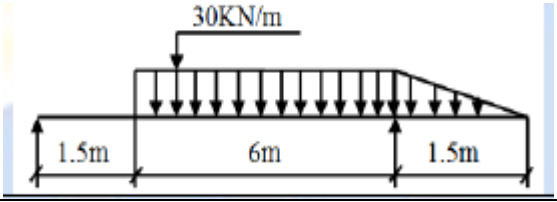
UNIT – II

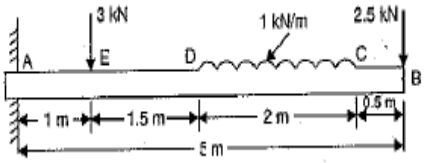
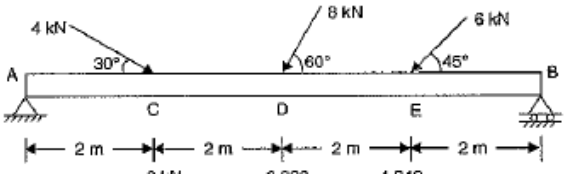
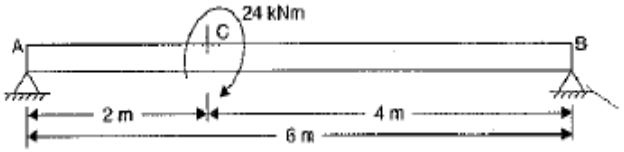
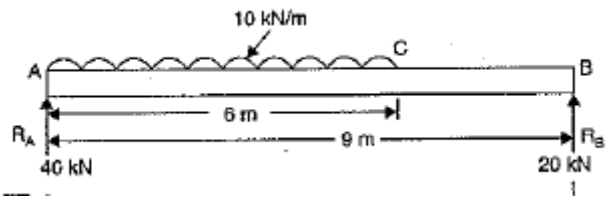
SHEAR FORCE AND BENDING MOMENT

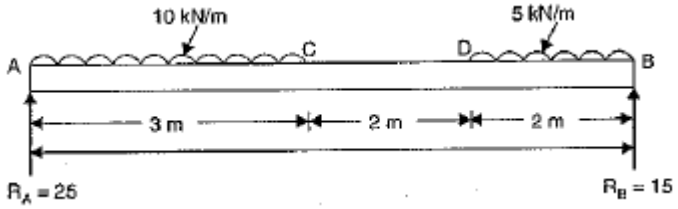
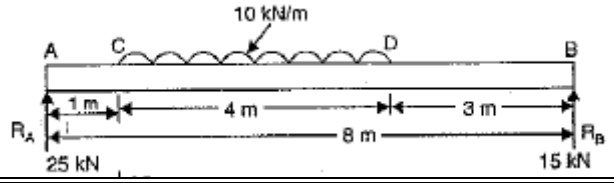
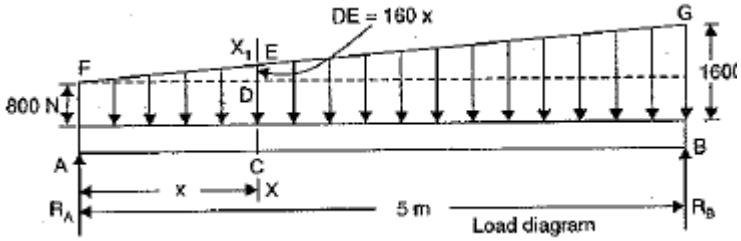
Part – A (SHORT ANSWER TYPE QUESTIONS)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	Define Shear force?	Understand	CAME004.03
2	What are the different types of beams?	Remember	CAME004.04
3	What are the different types of loads acting on the beam	Understand	CAME004.08
4	What are the sign conventions to be followed for shear force and bending moment	Remember	CAME004.07
5	How many points of contra flexure you will have for a simply supported beam overhanging at one end only?	Remember	CAME004.08
6	Differentiate between a point load and an UDL	Remember	CAME004.16
7	What is the maximum b.m in a simply supported beam with point load at center?	Remember	CAME004.08
8	What is meant by section modulus?	Remember	CAME004.07
9	What is the differential relation between bending moment, shear force and the applied load?	Remember	CAME004.08
10	Sketch the shear stress variation for symmetrical I section	Remember	CAME004.16
11	What do you meant by point of contra flexure?	Remember	CAME004.08
12	What is meant by moment of resistance of a beam?	Remember	CAME004.07
13	Write any two assumptions in the theory of simple bending.	Remember	CAME004.08
14	Differentiate between hogging and sagging bending moment.	Remember	CAME004.16
15	Sketch any type of support used for a beam indicating the reactions.	Remember	CAME004.08
16	Define bending moment?	Understand	CAME004.07

17	How would you find the bending stress in unsymmetrical sections?	Remember	CAME004.08
18	What do you understand by neutral axis & amp; moment of resistance? How do you locate neutral axis?	Remember	CAME004.16
19	What is the maximum b.m in a simply supported beam with UDL?	Remember	CAME004.08
20	What is the maximum b.m in a cantilever with a point load at free end?	Remember	CAME004.07
	Part - B (Long Answer Questions)		
S No	**QUESTION**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
1	Develop Bending moment and Shear force for the Figure 1 given below indicating the maximum and minimum values.	Understand	CAME004.16
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.	Understand	CAME004.08
3	The following Figure indicates the Shear Force diagram. Develop the loading and Bending Moment diagram for the beam. 	Remember	CAME004.08
4	Derive the equations of shear force and bending moment for the overhanging beam, which is subjected to uniformly distributed load throughout the length.	Understand	CAME004.07
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.	Remember	CAME004.07
6	Define point of contra flexure with a neat diagram.	Understand	CAME004.07
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. 	Understand	CAME004.08

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). i)Draw the shear force diagram for the beam and calculate the distance where the shear force is zero. ii)Draw the bending moment diagram for the beam and find out the maximum bending moment.  FIG (1)	Understand	CAME004.09
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.	Understand	CAME004.08
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.	Understand	CAME004.09
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).i)Derive the equations for shear force and bending moment at section X-X, and ii) Draw SFD and BMD for the beam.	Remember	CAME004.16
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.	Remember	CAME004.09
13	Define and explain the following terms i) Shear force ii) Bending moment iii) Shear force diagram iv) Bending moment diagram	Remember	CAME004.16
14	Draw shear force and bending moment diagram for the beam shown below. 	Understand	CAME004.09
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.	Understand	CAME004.16
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.	Remember	CAME004.09
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	Remember	CAME004.16
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.	Remember	CAME004.09

19	A piece of material is subjected to tensile stresses of 70N/mm^2 and 30N/mm^2 at right angles to each other. Find the stresses on a plane the normal of which makes an angle of 400 with the 70N/mm^2 stress	Remember	CAME004.08
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.	Remember	CAME004.08
Part – C (Problem Solving and Critical Thinking)			
S No	**QUESTION**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
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?	Understand	CAME004.08
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?	Understand	CAME004.08
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?	Remember	CAME004.09
4	A cantilever of length 5.0m is loaded as shown in fig. Draw the S.F and B.M diagrams for the cantilever beam. 	Remember	CAME004.09
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. 	Understand	CAME004.08
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 	Understand	CAME004.09
7	Draw the S.F and B.M diagrams for 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. 	Remember	CAME004.08

8	Draw the S.F and B.M diagrams for a simply supported beam of length 7m and carrying a uniformly distributed loads as shown in the figure. 	Understand	CAME004.09
9	Draw the S.F and B.M diagrams for 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. 	Understand	CAME004.09
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. 	Remember	CAME004.16

UNIT-III (CIE-I)

FLEXURAL STRESSES, SHEAR STRESSES

Part - A (Short Answer Questions)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	What is equivalent section?	Understand	CAME004.09
2	What is pure bending?	Remember	CAME004.09
3	What is strength of section?	Remember	CAME004.07
4	Define modular ratio.	Remember	CAME004.08
5	Define the terms: section modulus, Moment of resistance?	Understand	CAME004.09
6	Write bending equation and indicate parameters.	Remember	CAME004.09
7	What is neutral axis?	Remember	CAME004.07
8	Where the tensile and compressive stresses occur for cantilever beam and simply supported beam	Remember	CAME004.08
9	Indicate bending stress distribution in a rectangular beam.	Understand	CAME004.09
10	Define area moment of inertia.	Remember	CAME004.09

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.	Remember	CAME004.08
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	Understand	CAME004.08

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'.	Understand	CAME004.08
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.	Remember	CAME004.08
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	Remember	CAME004.07
6	Derive an expression for bending stress.	Remember	CAME004.08
7	What do you mean by theory of simple bending?	Remember	CAME004.09
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	Understand	CAME004.16
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.	Remember	CAME004.08
10	Define and explain the following terms: i) Bending stress ii) Neutral axis iii) Section modulus iv) Moment of resistance	Remember	CAME004.08
	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 = $2x10^5$ N/mm^2	Understand	CAME004.04
2	A copper plate of width 70mm and thickness 20mm is bent into a Circular arc of radius 2m. Determine the max stress induced and The bending moment which will produce the max stress. Take E = $1.5x10^5$ N/mm^2	Remember	CAME004.11
3	Two wooden planks 150 mm x 50mm each are connected to form a T section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at the extreme fibers of the cross section. Also calculate the total tensile force on the cross secion.	Remember	CAME004.12
4	A cast iron beam has an I-section with top flange 100mm × 40mm, web 140mm×20mm and bottom flange 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.	Remember	CAME004.04
5	A mild steel bracket has a cross section of T-section with top flange of 200mm × 50mm, web 150mm×20mm If tensile stress is not to exceed 45MPa and compressive stress 95MPa, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6.5m.	Remember	CAME004.13

UNIT-III (CIE-II)

FLEXURAL STRESSES, SHEAR STRESSES

Part - A (Short Answer Questions)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	Write formula for maximum shear stress in a beam of isosceles triangular cross section and explain the parameters.	Remember	CAME004.07
2	Write formula for shear stress at centroidal axis of isosceles triangular section and explain the parameters.	Remember	CAME004.09
3	Find the maximum shear stress in a rectangular beam 100mm wide, and 250 mm deep when it is subjected to 50 KN shear force.	Understand	CAME004.09
4	Indicate shear stress distribution in an I-beam	Remember	CAME004.07
5	Find the maximum shear stress in a circular beam of diameter 10 mm when it is subjected to a shear force 4 KN	Remember	CAME004.08
6	Indicate shear stress distribution in a circular section	Remember	CAME004.09
7	Explain shear stress in a beam	Understand	CAME004.09
8	Indicate shear stress distribution in a beam of T-section	Remember	CAME004.07
9	Write formula for shear stress in a beam and indicate the parameters including units.	Remember	CAME004.07
10	Indicate the shear stress distribution in a beam of channel section.	Remember	CAME004.08

Part – B (Long Answer Questions)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	With a neat sketch illustrate the existence of vertical and horizontal shear stresses in a beam	Understand	CAME004.08
2	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.	Remember	CAME004.08
3	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.	Understand	CAME004.09
4	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.	Remember	CAME004.08
5	Derive an equation for shear stress across a beam.	Understand	CAME004.09
6	Determine out the maximum shear stress in a shaft of dia 40 mm subjected to a shear force of 30 KN.	Remember	CAME004.08
7	Explain complimentary shear stress.	Remember	CAME004.08
8	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.	Remember	CAME004.08
9	Show that the maximum shear stress in a beam of square section with a diagonal horizontal is 9/8 times of average shear stress.	Remember	CAME004.08

10	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	Remember	CAME004.01
	Part – C (Problem Solving and Critical Thinking)		
S No	**QUESTION**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
1	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.	Remember	CAME004.16
2	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	Understand	CAME004.04
3	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.	Remember	CAME004.11
4	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/mm^2, find the ratio of span to the depth.	Remember	CAME004.12
5	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.	Remember	CAME004.03
	UNIT-IV		
	PRINCIPAL STRESSES AND STRAINS, THEORIES OF FAILURE		
	Part – A (Short Answer Questions)		
S No	**QUESTION**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
1	What is principal stress?	Understand	CAME004.01
2	What is principal plane?	Understand	CAME004.02
3	What is normal stress?	Remember	CAME004.08
4	What is tangential stress?	Remember	CAME004.12
5	Explain maximum principal stress theory?	Understand	CAME004.16
6	What is maximum principal strain theory?	Understand	CAME004.05
7	Explain maximum strain energy theory?	Remember	CAME004.01
8	What is maximum shear strain energy theory?	Remember	CAME004.02
9	What are the theories of failure?	Understand	CAME004.08
10	What is the stress on a plane inclined at an angle ɵ?	Understand	CAME004.12
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?	Understand	CAME004.01
12	Write an equation for maximum shear stress when a body is subjected to direct stresses in two perpendicular directions?	Understand	CAME004.02
13	Write an equation for maximum shear stress when a body is subjected to a direct stress in one plane and accompanied by a simple shear stress?	Remember	CAME004.08
14	Write an equation for maximum principal stress when a body is subjected to a direct stress in one plane and accompanied by a simple shear stress?	Remember	CAME004.12

15	A rectangular bar of cross sectional area 100mm*80mm is subjected to an axial load of 20KN.Determine the normal stress on a section which is inclined at an angle of 30° with normal cross section of the bar?	Understand	CAME004.16
16	A square bar of cross sectional area 200mm*200mm is subjected to an axial load of 30KN.Dtermine the shear stress on a section which is inclined at an angle of 40° with normal cross section of the bar?	Understand	CAME004.05
17	Write the equation for principal stress when a body is subjected to two direct stresses mutually perpendicular accompanied by a simple shear?	Remember	CAME004.01
18	Write an equation for resultant stress when a body is subjected to direct stresses in two perpendicular directions?	Remember	CAME004.02
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?	Understand	CAME004.08
20	Write the equation for maximum shear stress when a body is subjected to two direct stresses mutually perpendicular accompanied by a simple shear?	Understand	CAME004.12
	Part – B (Long Answer Questions)		
S No	**QUESTION**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
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.	Understand	CAME004.01
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.	Understand	CAME004.02
3	Describe an equation for normal and shear stress when a material is subjected to biaxial stresses P1 and P2.	Remember	CAME004.08
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.	Remember	CAME004.12
5	Define Principal plane.	Understand	CAME004.16
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.	Understand	CAME004.05
7	Explain the construction of Mohr's circle for two like stresses P1 and P2.	Remember	CAME004.01
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	Remember	CAME004.02
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.	Remember	CAME004.08
10	At a point in an elastic material under strain, normal stresses 60N/mm^2 and 40N/mm^2 (both tensile and right angles to each other) with a shearing stress 20N/mm2. Find i) The principal stresses and their positions. ii) Maximum shear stress and it's plane.	Remember	CAME004.01
11	Explain maximum principal stress theory and indicate the materials for which it is suitable.	Remember	CAME004.02
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.	Remember	CAME004.08
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.	Remember	CAME004.12

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.	Remember	CAME004.16
15	Explain maximum strain theory and indicate materials for which it is suitable.	Remember	CAME004.05
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.	Remember	CAME004.01
17	Explain maximum shear stress theory and indicate the type of material for which this theory gives reasonable results.	Remember	CAME004.02
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.	Remember	CAME004.08
19	Explain maximum strain energy theory.	Remember	CAME004.12
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	Remember	CAME004.16
Part – C (Problem Solving and Critical Thinking)			
S No	**QUESTION**	**Bloom's Taxonomy level**	**Course Learning Outcomes**
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.	Remember	CAME004.01
2	A plane element in a body is subjected to a tensile stress of 100MPA accompanied 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.	Remember	CAME004.01
3	At a point in a strained material, the principal stresses are 100 Mpa ad 50 MPa both tensile. Find the normal ad shear stresses at a section at 600 with the axis of the major principle stresses.	Remember	CAME004.02
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	Remember	CAME004.08
5	A plane element in a body is subjected to a tensile stress of 100Mpa accompanied by a clockwise shear stress of 25Mpa. Find (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.	Remember	CAME004.01
6	At a point in a stressed element, the normal stresses in two mutually perpendicular directions are 45Mpa and 25 MPa both are tensile. The complementary shear stress in those directions is 15 MPa. By using Mohr's circle method, or otherwise, determine the maximum and minimum principal stresses.	Remember	CAME004.02
7	How will you find out graphically the resultant stress of an oblique section when the body is subjected to direct stresses in two mutually perpendicular directions?	Remember	CAME004.08
8	Find the diameter of the circular bar which is subjected to an axial load of 160 kN, if the maximum allowable shear stress on any section is 65N/mm^2.	Remember	CAME004.01

9	A rectangular bar of cross sectional area 10000mm2 is subjected to an axial load of 20 kN. Determine the normal and shear stresses on a section which is inclined at an angle of 30° with normal cross section of the bar.	Remember	CAME004.02
10	A rectangular bar of cross sectional area 11000 mm2 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.	Remember	CAME004.08

UNIT-V

DESIGN OF CIRCULAR SHAFTS AND STRESSES IN PRESSURE VESSELS

Part - A (Short Answer Questions)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	What are the assumptions made in the theory of torsion?	Remember	CAME004.05
2	Define torsion?	Remember	CAME004.16
3	Write Torsional equation.	Remember	CAME004.06
4	Why hollow circular shafts are preferred when compared to solid circular shafts?	Remember	CAME004.14
5	Write the expression for power transmitted by a shaft.	Remember	CAME004.15
6	Define polar modulus?	Understand	CAME004.05
7	What is the maximum principle stress in a spherical thin shell?	Remember	CAME004.16
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.	Understand	CAME004.06
9	What is hoop stress?	Remember	CAME004.14
10	What is a stepped shaft?	Understand	CAME004.15
11	Write an equation for longitudinal stress in a thin cylinder?	Remember	CAME004.05
12	Write an equation for volumetric strain of cylinder?	Understand	CAME004.16
13	What is the volumetric strain for a spherical thin shell?	Remember	CAME004.06
14	Write the equation for strain energy stored in a shaft due to torsion.	Understand	CAME004.14
15	What is the equivalent bending moment for a shaft subjected to moment M and torsion T?	Remember	CAME004.15
16	A shaft is having a diameter of 30mm. What is its polar moment of inertia?	Understand	CAME004.05
17	What is joint efficiency of a thin shell?	Remember	CAME004.16
18	What is the maximum shear stress in a thin cylindrical shell?	Remember	CAME004.05
19	What is the maximum principle stress in a cylindrical thin shell?	Understand	CAME004.16
20	What is torsional rigidity?	Remember	CAME004.06

Part - B (Long Answer Questions)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
1	Derive torsion formula	Remember	CAME004.15
2	Determine the torque which a shaft of 200mm diameter can safely transmit if the shear stress is not to exceed 50N/mm2.	Understand	CAME004.05
3	Derive a formula for resisting torque.	Remember	CAME004.16
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	Understand	CAME004.05

5	Derive an equation for power transmitted by a shaft.	Remember	CAME004.16
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.	Understand	CAME004.06
7	Explain torsion section modulus, torsional rigidity, polar moment of inertia.	Remember	CAME004.14
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.	Understand	CAME004.15
9	Derive an equation for strain energy stored in a shaft under torsion.	Remember	CAME004.05
10	A solid shaft of 120mm diameter is transmitting 300KW at 120 rpm determine the strain energy stored.	Understand	CAME004.16
11	A compound shaft consisting of shaft 1 and shaft 2 in series, what is the angle of twist of the compound shaft.	Remember	CAME004.06
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.	Remember	CAME004.14
13	Derive formulae for principal stress and its position for a shaft which is subjected torque T and bending moment M.	Understand	CAME004.15
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	Remember	CAME004.05
15	Derive expression for the stresses developed in a thin cylindrical vessel subjected to internal pressure.	Understand	CAME004.16
16	A steel water pipe 0.6 m in diameter 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	Remember	CAME004.06
17	Derive an expression for volumetric strain of thin cylindrical shell.	Understand	CAME004.05
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.	Remember	CAME004.16
19	Derive an expression for volumetric strain of thin spherical shell.	Understand	CAME004.06
20	A spherical shell is of 0.8 m diameter 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.	Remember	CAME004.05

Part – C (Problem Solving and Critical Thinking)

S No	QUESTION	Bloom's Taxonomy level	Course Learning Outcomes
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	Remember	CAME004.06
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.	Understand	CAME004.14
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	Remember	CAME004.15

4	Find the angle of twist per meter 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	Remember	CAME004.14
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	Remember	CAME004.05
6	The maximum allowable stress in a cylinder of 700.0 mm inner diameter and 150 mm thickness is 6.3 MPa. Determine the maximum allowable internal and external pressures on the cylinder, when applied separately.	Remember	CAME004.16
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	Remember	CAME004.06
8	A cylindrical pipe of diameter 105cm and thickness 10.5cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Determine: i) Longitudinal stress developed in the pipe. ii) Circumferential stress developed in the pipe.	Remember	CAME004.14
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.	Remember	CAME004.05
10	A cylinder of internal diameter 0.50m contains air at a pressure of 7 N/mm^2 (gauge). If the maximum permissible stress induced in the material is 80N/mm2, find the thickness of the cylinder.	Remember	CAME004.16

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