SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR
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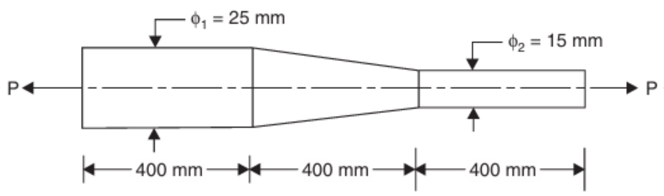
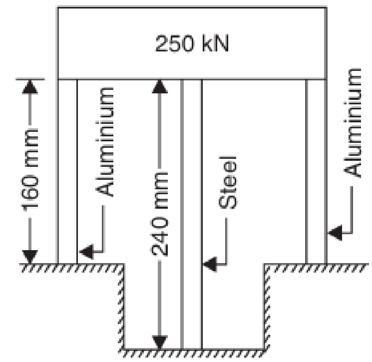
QUESTION BANK (DESCRIPTIVE)

Subject with Code: Strength of Materials (23CE0106) **Course & Branch**: CE

Year & Sem: II Year & I Sem **Regulation:** R23

UNIT –I
SIMPLE STRESSES AND STRAINS

1	**a**	Define Stress and give its units. What are different types of stress?	**[L1] [CO1]**	**[2M]**
	b	Define the terms the terms: (i) Modulus of elasticity (iii) Bulk modulus.	**[L1] [CO1]**	**[2M]**
	c	State Hooke's Law.	**[L2] [CO1]**	**[2M]**
	d	Define Poisson's Ratio.	**[L1] [CO1]**	**[2M]**
	e	Explain Elasticity and Plasticity of a body.	**[L2] [CO1]**	**[2M]**
2		Draw Stress – Strain graph for mild steel bar subjected to tensile loading and mark salient points on the graph.	**[L1] [CO1]**	**[4M]**
3		A hollow cast iron cylinder 4 m long, 300 mm outer diameter, and thickness of metal 50 mm is subjected to a central load on the top when standing straight. The stress produced is 75x10^3 kN/m^2. Assume Young's Modulus for cast iron as 1.5x10^8 kN/m^2 and find (i) magnitude of load (ii) longitudinal strain produced, and (iii) total decrease in length.	**[L1] [CO1]**	**[10M]**
4		Derive the relationship between (i) Modulus of elasticity and modulus of rigidity (ii) Modulus of elasticity and bulk modulus	**[L3] [CO1]**	**[10M]**
5		A specimen of steel 20 mm in diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80kN and the load at elastic limit is 102kN. The maximum load is 130kN. The total extension is 56 mm and diameter at the neck is 15mm. Find (i) The stress at elastic limit (ii) Young's modulus (iii) Percentage of elongation (iv) percentage reduction in area (v) Ultimate tensile stress.	**[L2] [CO1]**	**[10M]**
6		A bar of 25 mm diameter is tested in tension. It is observed that when a load of 60kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0045 mm. find the Poison's ration, Yong's modulus, bulk modulus of elasticity and modulus of rigidity.	**[L3] [CO1]**	**[10M]**
7		Tension test was conducted on a specimen and the following readings were recorded. Diameter = 25 mm Gauge length of extensometer = 200 mm Least count of extensometer = 0.001 mm At a load of 30 kN, extensometer reading = 60 At a load of 50 kN, extensometer reading = 100 Yield load = 160 kN Maximum load = 205 kN Diameter neck = 17 mm Final extension over 125 mm original length = 150 mm Find Young's Modulus, yield stress, ultimate stress, percentage elongation and percentage reduction in area.	**[L3] [CO1]**	**[10M]**

8	Find the extension of the bar shown in Figure, under an axial load of 20 kN. Take E = $200GN/m^2$  	**[L3] [CO1]**	**[10M]**
9	A steel rod of 2cm diameter is enclosed centrally in a hollow copper tube of external diameter 4cm and internal diameter of 3.5cm. The composite bar is then subjected to an axial pull of 5000N. If the length of each bar is equal to 20cm, determine (i) The stress in the rod and tube, and (ii) Load carried by each bar (iii)Take E for steel = 20 x 10^5 N/mm^2 and for copper=1 x 10^5 N/mm^2	**[L3] [CO1]**	**[10M]**
10	Three pillars, two of aluminium and one of steel support a rigid platform of 250 kN as shown in Figure. If area of each aluminium pillar is 1200 mm^2 and that of steel pillar is 1000 mm^2, find the stresses developed in each pillar. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_a = 1 \times 10^6$ N/mm^2.  	**[L3] [CO1]**	**[10M]**
11	A steel rail is 12m long and is laid at a temperature of 18ºC. The maximum temperature expected in 40ºC. (i) Estimate the minimum gap to be left between two rails so that temperature stresses do not develop. (ii) Calculate the thermal stresses developed in the rails if (a) No expansion joint is provided (b) If a 1.5 mm gap is provided for expansion (iii) If the stress developed is 20 N/m^2, what is the gap between the rails? Take E = 2 x 10^5 N/m^2 and α = 12 x 10-6 /ºC.	**[L3] [CO1]**	**[10M]**

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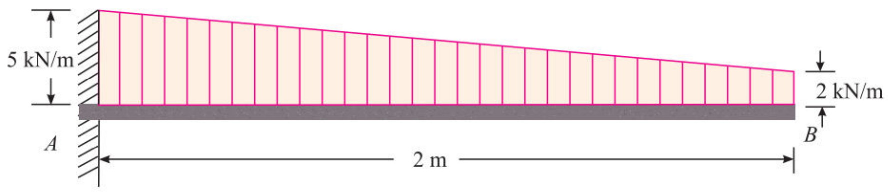
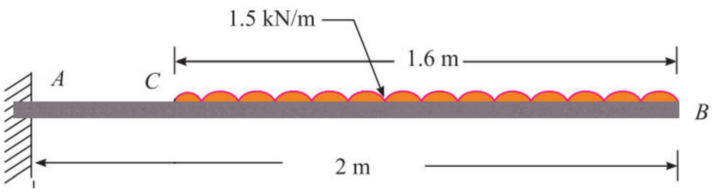
UNIT –II
SHEAR FORCE AND BENDING MOMENTS

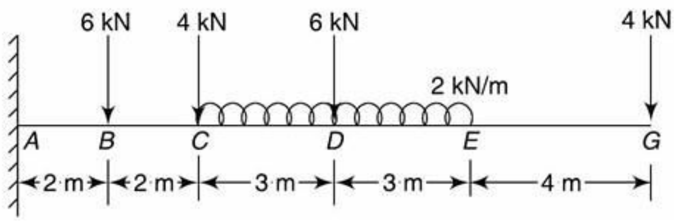
1	**a**	Define beam? What are the different types of beams?	**[L1] [CO2]**	**[2M]**
	b	Define the terms shear force and bending moment.	**[L1] [CO2]**	**[2M]**
	c	Define point of contra flexure. In which beam it occurs?	**[L1] [CO2]**	**[2M]**
	d	What is meant by positive or sagging beam?	**[L1] [CO2]**	**[2M]**
	e	Explain different types of loads.	**[L1] [CO2]**	**[2M]**
2	**a**	Define shear force and bending moment.	**[L1] [CO2]**	**[4M]**
	b	A cantilever beam of 2 m span is subjected to a gradually varying load from 2kN/m to 5 kN/m as shown in figure. Draw the shear force and bending moment diagrams for the beam.	**[L3] [CO2]**	**[6M]**



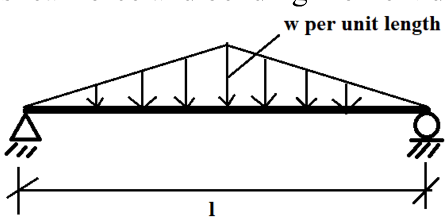
3	**a**	List and explain different types of beams based on support conditions.	**[L1] [CO2]**	**[5M]**
	b	A cantilever beam AB, 2 m long carries a uniformly distributed load of 1.5 kN/m over a length of 1.6 m from the free end. Draw shear force and bending moment diagrams for the beam.	**[L3] [CO2]**	**[5M]**

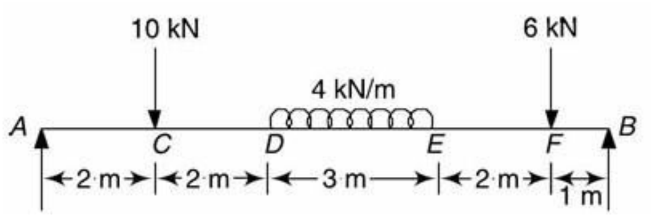
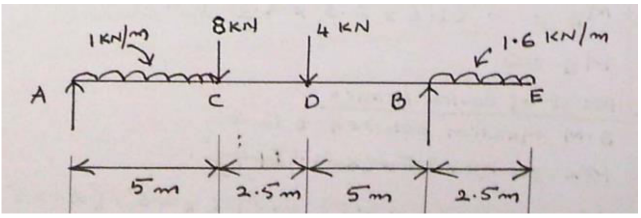
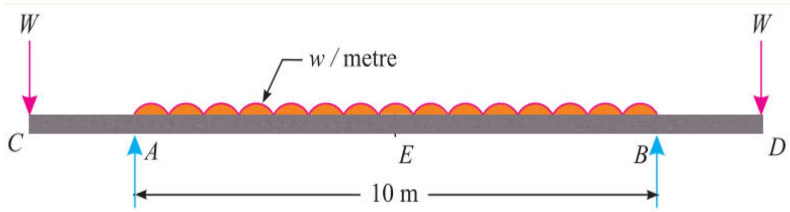
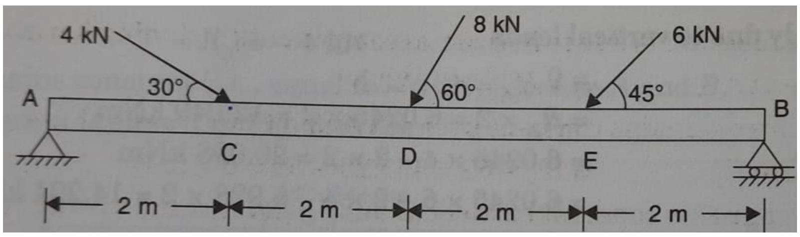


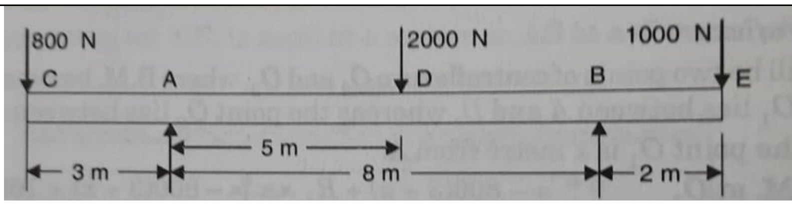
4		A cantilever of 14 m span carries loads of 6 kN, 4 kN, 6 kN and 4 kN at 2 m, 4 m, 7 m and 14 m respectively from the fixed end. It also has a uniformly distributed load of 2 kN/m run for the length between 4 m and 10 m from the fixed end. Draw the shear force and bending moment diagrams.	**[L3] [CO2]**	**[10M]**



5	**a**	Derive the relationship between load, shear force, and bending moment for beam.	**[L2] [CO2]**	**[5M]**
	b	A simply supported beam of span ‘l’ is subjected to gradually varied load as shown in the figure. Draw the shear force and bending moment diagrams.	**[L3] [CO2]**	**[5M]**



6		A 10 m long simply supported beam carries two-point loads of 10 kN and 6 kN at 2 m and 9 m respectively from the left end. It has a uniformly distributed load of 4 kN/m run for the length between 4 m and 7 m from the left-hand end. Draw shear force and bending moment diagrams. 	[L3] [CO2]	[10M]
7		Draw shear force and bending moment diagrams for the beams shown in figure. Indicate the numerical values at all important sections. 	[L3] [CO2]	[10M]
8		A simply supported beam with overhanging ends carries transverse loads as shown in figure. If W = 10w, what is the overhanging length on each side, such that the bending moment at the middle of the beam, is zero? Sketch the shear force and bending moment diagrams. 	[L4] [CO2]	[10M]
9	a	Find out the degree of static indeterminacy for the following beams: (i) Fixed beam (ii) Beam with hinges at both ends (iii) Simply supported beam	[L4] [CO2]	[5M]
	b	A simply supported beam subjected to couple 'M at its mid span. Draw shear force and bending moment diagrams.	[L3] [CO2]	[5M]
10		A horizontal beam AB of length 8 m is hinged at A and placed on rollers at B. The beam carries three inclined point loads as shown in figure. Draw the S.F, B.M and axial force diagrams of the beam. 	[L3] [CO2]	[10M]
11		Draw the S.F. and B.M. diagrams for the beam which is loaded as shown in figure. Determine the points of contraflexure within the span AB.	[L3] [CO2]	[10M]

800 N
2000 N
1000 N
C
A
D
B
E
5 m
3 m
8 m
2 m

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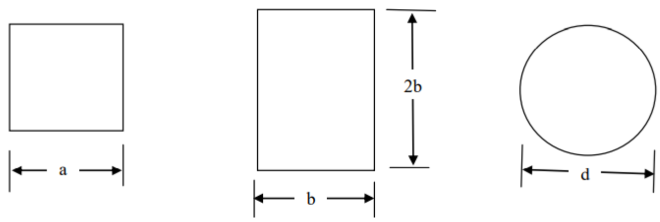
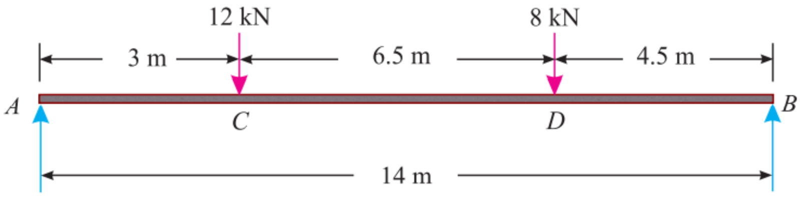
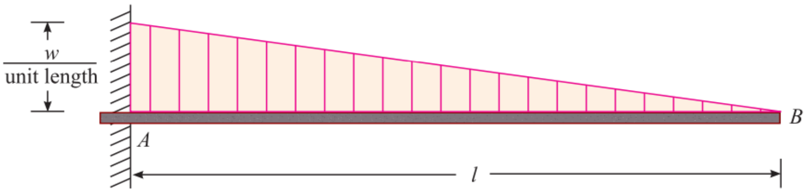
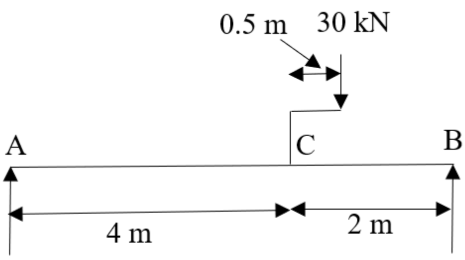
UNIT –III

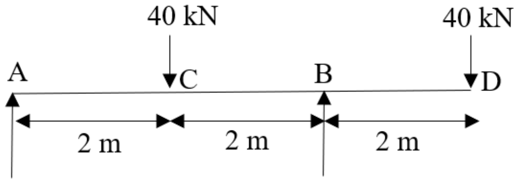
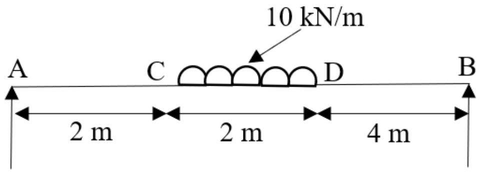
FLEXURAL, SHEAR STRESSES AND TORSION

1	**a**	Define the terms Bending stress and section modulus.	**[L1] [CO3]**	**[2M]**
	b	What are the assumptions made in theory of simple bending?	**[L1] [CO3]**	**[2M]**
	c	What is shear stress? Write the shear stress formula for various cross sections of the beam.	**[L1] [CO3]**	**[2M]**
	d	Define polar modulus. Write the polar modulus for solid shaft and circular shaft.	**[L1] [CO3]**	**[2M]**
	e	Define Torsion. What are the assumptions made in Torsion equation?	**[L1] [CO4]**	**[2M]**
2		List the assumptions made in deriving the flexure formula. Derive the equation $\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$.	**[L2] [CO3]**	**[10M]**
3		A timber beam of rectangular section supports a load of 20kN uniformly distributed over a span of 3.6 m. If depth of the beam section is twice the width and maximum stress is not to exceed 7 MPa, find the dimensions of the beam section.	**[L3] [CO3]**	**[10M]**
4		A cast iron water pipe of 500 mm inside diameter and 20 mm thick is supported over a span of 10 m. Find the maximum stress in the pipe metal, when the pipe is running full. Take density of cast iron as 70.6 kN/m^3 and that of water as 9.8 kN/m^3.	**[L4] [CO3]**	**[10M]**
5		Three beams have the same length, the same allowable stress and the same bending moment. The cross-section of the beams, are a square, a rectangle with depth twice the width and a circle as shown in Figure. Find the ratios of weights of the circular and the rectangular beams with respect to the square beam. 	**[L5] [CO3]**	**[10M]**
6		A circular log of timber has diameter 'D'. Find the dimensions of the strongest rectangular section to resist moment, one can cut from this log.	**[L4] [CO3]**	**[10M]**
7	**a**	Derive the formula for horizontal shearing stress for a beam subjected to transvers loading.	**[L2] [CO3]**	**[5M]**
	b	Draw the shear stress distribution for a rectangular section of width 'b' and depth 'd'.	**[L3] [CO3]**	**[5M]**
8		A timber beam of rectangular section is simply supported at the ends and carries a point load at the centre of the beam. The maximum bending stress in 12 N/mm^2 and maximum shearing stress is 1 N/mm^2, find the ratio of the span to the depth.	**[L3] [CO3]**	**[10M]**
9		An I section is having a overall depth of 'D' and breadth 'B'. The depth of the web is 'd' and breadth of the web and thickness of the flange is 'b'. Draw the shear stress distribution for the section.	**[L3] [CO4]**	**[10M]**
10		Derive the relation for a circular shaft when subjected to torsion as below: $\frac{T}{J} = \frac{\tau}{R} = \frac{C\Theta}{L}$. Where T = torque transmitted, J = Polar moment of inertia, τ = Maximum shear stress, R = Radius of the shaft, C = Polar moment of inertia, Θ = Ange of twist, and L = Length of the shaft.	**[L3] [CO4]**	**[10M]**
11	**a**	Define the terms: Torsion, torsional rigidity and polar moment of inertia.	**[L3] [CO4]**	**[5M]**
	b	A solid shaft of 150 mm diameter is used to transit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45 kN/mm^2.	**[L3] [CO4]**	**[5M]**

UNIT –IV

DEFLECTIONS OF BEAMS

1	**a**	What is deflection of beam? What are the causes of deflection in beams?	**[L1] [CO5]**	**[2M]**
	b	What are the methods for finding out the slope and deflection at a section?	**[L1] [CO5]**	**[2M]**
	c	Define: Mohr's Theorem for slope and deflection	**[L1] [CO5]**	**[2M]**
	d	What is the relation between slope, deflection and radius of curvature of a beam?	**[L1] [CO5]**	**[2M]**
	b	What is Macaulay's method for finding the slope and deflection of a beam?	**[L1] [CO5]**	**[2M]**
2		State the assumptions and derive the equation $M = EI\,\frac{d^2y}{dx^2}$.	**[L2] [CO5]**	**[10M]**
3		Using double integration method determine the maximum slope and deflection for a simply supported beam subjected to uniformly distributed load throughout the length of the beam.	**[L3] [CO5]**	**[10M]**
4		A timber beam of rectangular section has a span of 4.8 m and is simply supported at its ends. It is required to carry a total load of 45kN uniformly distributed over the whole span. Find the value of the breadth (b) and depth (d) of the beam, if maximum bending stress is not to exceed 7 Mpa and maximum deflection is limited to 9.5 mm. Take E for the timber as 10.5 GPa.	**[L4] [CO5]**	**[10M]**
5		A horizontal steel girder having uniform cross-section is 14 m long and is simply supported at its ends. It carries two concentrated loads as shown in figure. Calculate the deflections of the beam under the loads C and D. Take E = 200 GPa and I = 160 x 10^6 mm^4. 	**[L3] [CO5]**	**[10M]**
6		Find slope and deflection for a cantilever beam subjected to gradually distributed load as shown in the figure at the free end B. 	**[L3] [CO5]**	**[10M]**
7		Find the deflection at C in the beam loaded as shown in figure. Take EI = 10000 kN-m^2. 	**[L3] [CO5]**	**[10M]**
8		Determine the deflection under the loads in the beam shown in figure. Take flexural rigidity as EI throughout.	**[L3] [CO5]**	**[10M]**

			
9	A beam AB of span 8 m is simply supported at the ends A and B and is loaded as shown in Figure. If E = 200 x 10^6 kN/m^2 and I = 120 x 10^{-6} m^4 determine: (i) Deflection at the mid span (ii) Maximum deflection (iii) Slope at the end A. 	**[L3] [CO5]**	**[10M]**
10	State and prove Mohr's theorems for calculating slope and deflection	**[L3] [CO5]**	**[10M]**
11	Using Moment Area Method calculate maximum slope and deflection when a cantilever beam of length l is subjected to (i) point load W at the free end (ii) uniformly distributed load w per/unit length over entire span.	**[L3] [CO5]**	**[10M]**

UNIT –V

COLUMNS, THIN AND THICK CYLINDRICAL

1	a	Define the terms Column, Strut and Crippling load.	[L1] [CO6]	[2M]
	b	What are the different types of end Conditions of Columns?	[L1] [CO6]	[2M]
	c	Explain the term Slenderness ratio and describe its mathematical expression.	[L2] [CO6]	[2M]
	d	Distinguish between thin-walled cylinder and thick-walled cylinder?	[L2] [CO6]	[2M]
	e	Define Circumferential stress (or hoop stress) and Longitudinal stress along with formulas.	[L1] [CO6]	[2M]
2	a	What are the assumptions made in Euler's theory?	[L1] [CO6]	[4M]
	b	Find the ratio of buckling strength of a solid column to that of a hollow column of the same material and having the same cross –sectional area. The internal diameter of the hollow column is half of its external diameter. Both the columns are hinged and the same length.	[L3] [CO6]	[6M]
3		A hollow alloy tube 4 m long with external and internal diameters of 40 mm and 25 mm respectively was found to extend 4.8 mm under a tensile load of 60 kN. Find the buckling load for the tube with both ends pinned. Also find the safe load on the tube, taking a factor of safety as 5.	[L3] [CO6]	[10M]
4		A bar of length 4 m when used as a simply supported beam and subjected to a UDL of 30 kN/m over the whole span, deflects 15 mm at the centre. Determine the crippling loads when it is used as a column with following end conditions: (i) Both ends pin-joined (ii) One end fixed and other end hinged (iii) Both ends fixed.	[L3] [CO6]	[10M]
5		A slender pin ended aluminum column 1.8 m long and of circular cross-section is to have an outside diameter of 50 mm. Calculate the necessary internal diameter to prevent failure by buckling if the actual load applied is 13.6 kN and the critical load applied is twice the actual load. Take E for aluminum as 70 GN/m^2.	[L3] [CO6]	[10M]
6		A 2 m long pin ended column of square cross-section is to be made of wood. Assuming E = 12 GPa, determine the size of the column to support the following loads safely. (i) 95 kN and (ii) 200 kN. Use factor of safety of 3 and Eluer's crippling load for buckling.	[L3] [CO6]	[10M]
7		A cylindrical thin drum 80cm in diameter and 3m long has a shell thickness of 1cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, Take E= 2x10^5 N/mm^2 and Poisson's ratio 0.25 Determine (i) change in diameter (ii) change in length and (iii) Change in volume.	[L3] [CO6]	[10M]
8		A cylindrical shell 90cm long 20cm internal diameter having thickness of a metal as 8mm is filled with a fluid at atmospheric pressure. If an additional 20cm^3 pumped into the cylinder, Take E = 2 X 10^5 N/mm^2 and Poisson's ratio is 0.3. Find (i) The pressure exerted by the fluid on the cylinder and (ii) The hoop stress induced.	[L3] [CO6]	[10M]
9		Derive an expression for hoop and radial stresses across thickness of the thick cylinder.	[L3] [CO6]	[10M]
10		Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of 8 N/mm^2. Also sketch the radial pressure and hoop stress distribution across the section.	[L3] [CO6]	[10M]
11		A steel cylinder of 300 mm external diameter is to be shrunk to another steel cylinder of 150 mm internal diameter. After shrinking, the diameter at the junction is 250 mm and radial pressure at the common junction is 28 N/mm^2. Find the original difference in radii at the junction. Take E = 2 x 10^5 N/mm^2.	[L3] [CO6]	[10M]