SIDDHARTH GROUP OF INSTITUTIONS:: PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Strength of Materials II (19CE0103) **Course & Branch**: B.Tech - CE
Year & Sem: II-B.Tech & I-Sem **Regulation:** R19

UNIT I
THIN CYLINDERS AND THICK CYLINDERS

1	A cylindrical thin drum 80 cm in diameter and 3 m long has a shell thickness of 1 cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, Take E= 2x 10^5 N/mm^2 Poisson's ratio 0.25 Determine (i) change in diameter (ii) change in length and (iii) change in volume.	[L3][CO1]	**[12M]**
2	(a)A water main 80 cm diameter contains water at a pressure head of 100 m. If the weight density of water is 9810 N/m^3, find the thickness of the metal required for the water main. Given the permissible stress as 20 N/mm^2. (b)A hollow cylindrical drum 600 mm in diameter and 3 m long, has a shell thickness of 10 mm. If the drum is subjected to an internal air pressure of 3 N/mm^2, determine the increase in its volume. Take E = 2 x 10^5 N/mm^2 and Poisson's ratio = 0.3 for the material.	[L3][CO1] [L3][CO1]	**[6M]** **[6M]**
3	A thin cylindrical shell with following dimensions is filled with a liquid — atmospheric pressure Length =1.2 m, external diameter = 20 cm, thickness of metal = 8 mm. Find the value of the pressure exerted by the liquid on the walls of the cylinder and the-op stress induced if an additional volume of 25 cm^3 of liquid is pumped into the cylinder.-Take E = 2.1 x 10^5 N/mm^2 and Poisson's ratio = 0.33.	[L3][CO1]	**[12M]**
4	A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume . Take E=200 GPa and μ= 0.3.	[L3][CO1]	**[12M]**
5	(a) A cylindrical boiler has 450mm in internal diameter, 12mm thick and 0.9m long. It is initially filled with water at atmospheric pressure. Determine the pressure at which an additional water of 0.187 liters maybe pumped into the cylinder by considering water incompressible. Take E = 200 GPa, and μ = 0.3.	[L3][CO1]	**[6M]**

	(b) A cylindrical shell has the following dimensions: Length = 3 m Inside diameter = 1 m Thickness of metal = 10 mm Internal pressure = 1.5 MPa Calculate the change in dimensions of the shell and the maximum intensity of shear stress induced. Take E = 200 GPa and Poisson's ratio = 0.3	[L3][CO1]	**[6M]**
6	Derive an expression for hoop and radial stresses across thickness of the thick cylinder	[L2][CO1]	**[12M]**
7	Calculate the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to withstand an internal pressure of 8 N/mm^2 , if maximum hoop stress in the section is not exceed to 35N/mm^2 .	[L3][CO1]	**[12M]**
8	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][CO1]	**[12M]**
9	A compound cylinder is made by shrinking a cylinder of external diameter 300 mm and internal diameter of 250 mm over another cylinder of external diameter 250 mm and internal diameter 200 mm. The radial pressure at the junction after shrinking is 8 N/mm^2 . Find the final stresses set up across the section, when the compound cylinder is subjected to an internal fluid pressure of 84.5 N/mm^2	[L3][CO1]	**[12M]**
10	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][CO1]	**[12M]**

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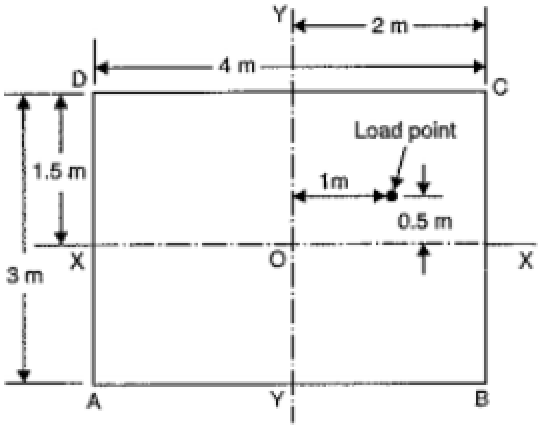
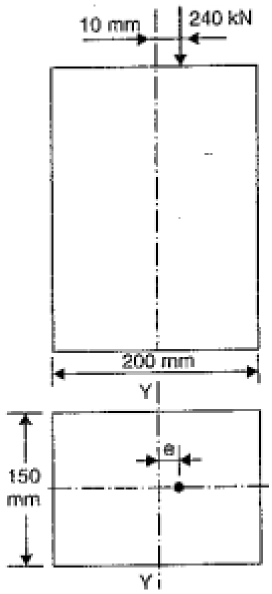
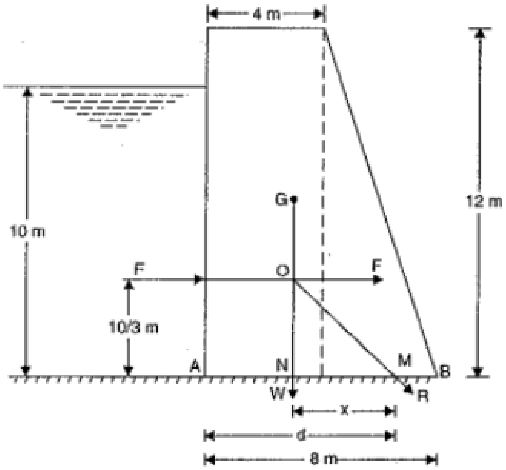
UNIT II
DIRECT AND BENDING STRESS, THEORIES OF FAILURE

1	A line of thrust, in a compression testing specimen 15 mm diameter, is parallel to the axis of the specimen but is displaced from it. Calculate the distance of the line of thrust from the axis when the maximum stress is 20 % greater than the mean stress on a normal section.	[L3][CO3]	**[12M]**
2	A masonry pier of 3 m x 4 m supports a vertical load of 80 kN as shown in Figure below. (a) Find the stresses developed at each corner of the pier. (b) What additional load should be placed at the centre of the pier, so that there is no tension anywhere in the pier section ? (c) What are the stresses at the corners with the additional load in the centre  	[L3][CO3]	**[12M]**
3	a) Determine the maximum and minimum stresses at the base of an hollow circular chimney of height 20 m with external diameter 4 m and internal diameter 2 m. The chimney is subjected to a horizontal wind pressure of intensity 1 kN/m^3. The specific weight of the material of chimney is 22 KN/m3.	[L3][CO3]	**[6M]**

	b) A rectangular column of width 200 mm and of thickness 150 mm carries a point load of 240 kN at an eccentricity of 10 mm as shown in Figure below (i). Determine the maximum and minimum stresses on the section. 	[L3][CO3]	**[6M]**
4	Derive kernel of section for (i) Rectangular section. (ii) Circular section. (iii) Hallow Circular sections.	[L2][CO2]	**[12M]**
5	A trapezoidal masonry dam having 4 m top width, 8 m bottom width and 12 m high, is retaining water upto a height of 10 m as shown in fig. The density of masonry is 2000 kg/m3 and coefficient of friction between dam and soil is 0.55. The allowable compressive stress is 343350 N/m2. Check the stability of dam. 	[L3][CO2]	**[12M]**
6	a) Explain maximum strain energy theory. b) Explain maximum principal strain theory.	[L2][CO4] [L2][CO4]	**[6M]** **[6M]**
7	a) Explain maximum shear stress theory. b) Explain maximum shear strain energy theory	[L2][CO4] [L2][CO4]	**[6M]** **[6M]**

8	Determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN using : (i) Maximum principal stress theory. (ii) Maximum principal strain theory. Given the elastic limit in tension = 225 N/mm2, factor of safety = 3 and Poisson's ratio = 0.3.	[L3][CO4]	**[12M]**
9	A hollow mild steel shaft having 100 mm external diameter and 50 mm internal diameter is subjected to a twisting moment of 8 kNm and a bending moment of 2.5 kNm. Calculate the principal stresses and find direct stress which, acting alone, would produce the same (i) Maximum elastic strain energy. (ii) Maximum elastic shear strain energy, as that produced by the principal stresses acting together. Take Poisson's ratio = 0.25.	[L3][CO4]	**[12M]**
10	A cylindrical shell made of mild steel plate and 1.2 m in diameter is to be subjected to an internal pressure of 1.5 MN /m2. If the material yields at 200 MN m2, calculate the thickness of the plate on the basis of the following three theories, assuming a factor of safety 3 in each case : (i) Maximum principal stress theory, (ii) Maximum shear stress theory, (iii) Maximum shear strain energy theory.	[L3][CO4]	**[12M]**

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UNIT III

TORSION OF CIRCULAR SHAFTS AND SPRINGS

1	Derive pure torsion equation for a circular shaft with assumptions.	[L2][CO2]	**[12M]**
2	(a) State the difference between twisting moment and bending moment. (b) A solid steel shaft has to transmit 75 kW at 200 r.p.m. Taking allowable shear stress as 70 N/mm^2, find suitable diameter for the shaft, if the maximum torque trans-mitted at each revolution exceeds the mean by 30%	[L3][CO2]	**[12M]**
3	The stiffness of a close-coiled helical spring is 1.5 N/mm of compression under a maximum load of 60 N. The maximum shearing stress produced in the wire of the spring is 125 N/mm^2. The solid length of the spring (when the coils are touching) is given as 5 cm. Find : (i) diameter of wire, (ii) mean diameter of the coils and (iii) number of coils required. Take C = 4.5 x 10^4 N/mm^2.	[L3][CO2]	**[12M]**
4	A hollow shaft, having an inside diameter 60% of its outer diameter, is to replace a solid shaft transmitting the same power at the same speed. Calculate the percentage saving in material, if the material to be used is also the same.	[L3][CO2]	**[12M]**
5	A closely coiled helical spring made of 10 mm diameter steel wire has 15 coils of 100 mm mean diameter. The spring is subjected to an axial load of 100 N. Calculate : (i) The maximum shear stress induced, (ii) The deflection, and (iii) Stiffness of the spring. Take modulus of rigidity, C = 8.16 x 10^4 N/mm^2	[L3][CO2]	**[12M]**
6	The maximum normal stress and the maximum shear stress analysed for a shaft of 150 mm diameter under combined bending and torsion, were found to be 120 MN/m^2 and 80 MN/m^2 respectively. Find the bending moment and torque to which the shaft is subjected. If the maximum shear stress be limited to 100 MN/m^2, find by how much the torque can be increased if the bending moment is kept constant.	[L3][CO2]	**[12M]**

7	(a) Determine the torsional stiffness of a hollow shaft of length L and having outside diameter equal to 1.5 times inside diameter d. The shear modulus of the material is G. (b) A cantilever tube of length 120 mm is subjected to an axial tension P = 9.0 kN,A torsional moment T = 72.0 Nm and a pending Load F = 1.75 kN at the free end. The material is aluminum alloy with an yield strength 276 MPa. Find the thickness of the tube limiting the outside diameter to 50 mm so as to ensure a factor of safety of 4.	[L3][CO2] [L3][CO5]	**[6M]** **[6M]**
8	(a) The ratio of inside to outside diameter of a hollow shaft is 0.6. If there is a solid shaft with same torsional strength, what is the ratio of the outside diameter of hollow shaft to the diameter of the equivalent solid shaft (b) A solid shaft is to transmit 300 kW at 120 rpm. If the shear stress is not to exceed 100 MPa, Find the diameter of the shaft, What percent saving in weight would be obtained if this shaft were replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, material and maximum allowable shear stress being the same?	[L3][CO2] [L3][CO5]	**[6M]** **[6M]**
9	(a) Define Polar modulus, Torsional rigidity. (b) A hollow steel rod 200 mm long is to be used as torsional spring. The ratio of inside to outside diameter is 1 : 2.The required stiffness of this spring is 100N.m/degree. Determine the outside diameter of the rod. Value of G is 8 x 10^4 N/mm^2.	[L1][CO2] [L3][CO2]	**[4M]** **[8M]**
10	(a) In a torsion test, the specimen is a hollow shaft with 50 mm external and 30 mm internal diameter. An applied torque of 1.6 kN-m is found to produce an angular twist of 0.4^o measured on a length of 0.2 m of the shaft. The Young's modulus of elasticity obtained from a tensile test has been found to be 200 GPa. Find the values of (i) Modulus of rigidity (ii) Poisson's ratio (b) Two hollow shafts of same diameter are used to transmit same power. One shaft is rotating at 1000 rpm while the other at 1200 rpm. What will be the nature and magnitude of the stress on the surfaces of these shafts? Will it be the same in two cases of different? Justify your answer	[L3][CO2] [L3][CO2]	**[6M]** **[6M]**

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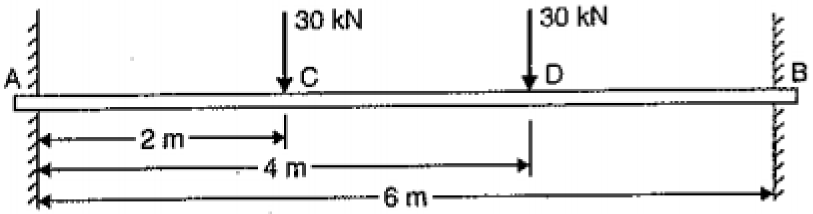
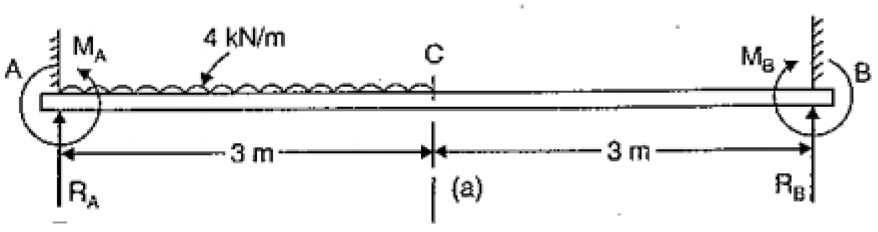
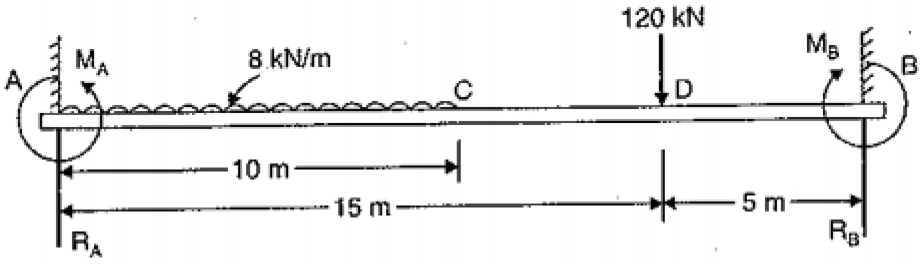
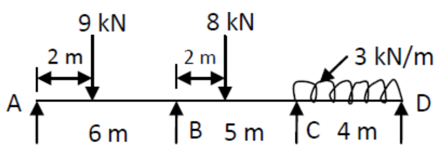
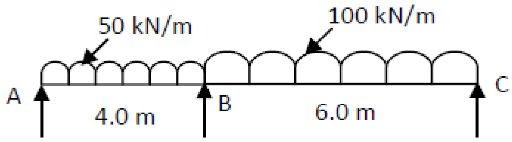
UNIT IV
ANALYSIS OF FIXED BEAMS, ANALYSIS OF CONTINUOUS BEAMS

1	A fixed beam of length 6 m carries two point loads of 30 kN each at a distance of 2 m from both ends. Determine the fixed end moments and draw the B.M. diagram.  	[L3][CO5]	**[12M]**
2	A fixed beam AB of length 3 m carries a point load of 45 kN at a distance of 2 in from A. If the flexural rigidity (i.e., EI) of the beam is 1 x 10^4 kNm^2, determine : (i) Fixed end moments at A and B, (ii) Deflection under the load, (iii) Maximum deflection, and (iv) Position of maximum deflection.	[L3][CO5]	**[12M]**
3	Find the fixing moments and support reactions of a fixed beam AB of length 6m, carrying a uniformly distributed load of 4 kN/ m over the left half of the span.  	[L3][CO5]	**[12M]**
4	(a) State advantages of fixed ends or fixed supports (b) A fixed beam AB of length 3 m is having moment of inertia I = 3 x 10^6 mm^4. The support B sinks down by 3 mm. If E = 2 x 10^8 N/mm^2, find the fixing moments.	[L2][CO5] [L3][CO5]	**[12M]** **[12M]**

5	A fixed beam of length 20 m, carries a uniformly distributed load of 8 kN/m on the left hand half together with a 120 kN load at 15 m from the left hand end. Find the end reactions and fixing moments and magnitude and the position of the maximum deflection. Take E = 2 x 10^8 kN/m^3 and I = 4 x 10^8 mm^4 . 	[L3][CO5]	**[12M]**
6	Derive Clapeyron's Equation of three Moments.	[L2][CO5]	**[12M]**
7	A continuous beam ABC of constant moment of Inertia carries a load of 10 kN in mid span AB and a central clockwise moment of 30 kN-min span BC. Span AB = 10 m and span BC = 15 m. Find the support moments and plot the shear froce and bending moment diagram	[L3][CO5]	**[12M]**
8	Analyze the continuous beam ABCD shown in the figure below using theorem of three moments. Draw SFD and BMD. 	[L3][CO5]	**[12M]**
9	Analyze the beam and draw BMD and SFD 	[L3][CO5]	**[12M]**
10	A continuous beam ABC of uniform section with span AB and BC as 4 m each, is fixed at A and simply supported at B and C. The beam is carrying a uniformly distributed load of 6 kN/m run throughout its length. Find the support moments and the reactions using theorem of three moments. Also draw SFD and BMD.	[L3][CO5]	**[12M]**

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UNIT V
BEAMS CURVED IN PLAN

1	Define curved beam and write a note on stresses generated in curved beams.	[L2][CO6]	**[12M]**
2	Explain the importance of curved beams in structures.	[L2][CO6]	**[12M]**
3	Calculate the stresses in curved beams and state the assumptions made in the analysis of curved beams	[L2][CO6]	**[12M]**
4	A metal rod of circular cross-section of radius 'r' has a shape of a semicircle of radius 'R'. The rod is bent sharply at B and extends along a radius to the centre 'C' of the semicircle. The rod is fixed at 'A' and carries a load `P' at the free end 'C' as shown in . Find the deflection at free end.	[L3][CO6]	**[12M]**
5	Draw the B.M. and torsion diagrams for a semicircular beam of radius `R. The cross-section of the beam is circular with radius It is loaded with a load at the mid-point of the semicircle.	[L3][CO6]	**[12M]**
6	Analyse the quarter circle beam fixed at one end and free at other carrying a load 'p' at the free end.	[L3][CO6]	**[12M]**
7	Analyse the circular beam loaded uniformly and supported on symmetrically placed columns.	[L3][CO6]	**[12M]**
8	State the differences between straight beam and curved beam with examples.	[L2][CO6]	**[12M]**
8	Analyse the semicircular beam simply supported on three supports equally spaced.	[L3][CO6]	**[12M]**
9	Explain the importance of circular beam loaded uniformly and supported on symmetrically placed columns.	[L2][CO6]	**[12M]**
10	Explain the importance of simply supported on three supports equally spaced.	[L2][CO6]	**[12M]**