SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR (AUTONOMOUS)

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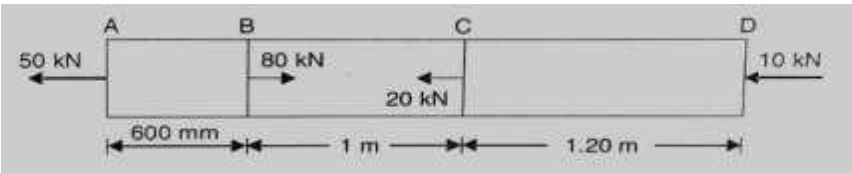
QUESTION BANK (DESCRIPTIVE)

Subject with Code: Mechanics of Solids (23ME0304)

Course & Branch: **B.Tech (ME)** **Year & Sem: II & I** **Regulation: R23**

UNIT -I

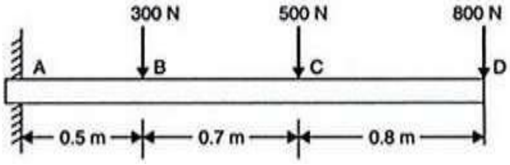
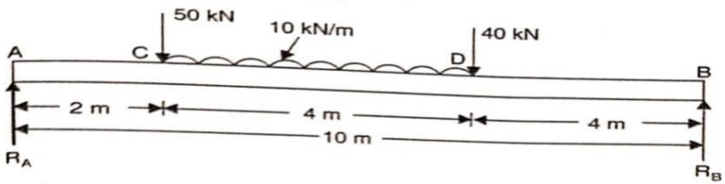
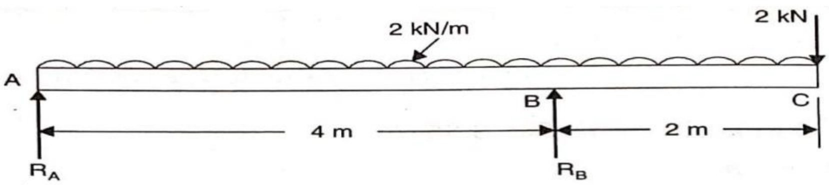
SIMPLE STRESSES & STRAINS

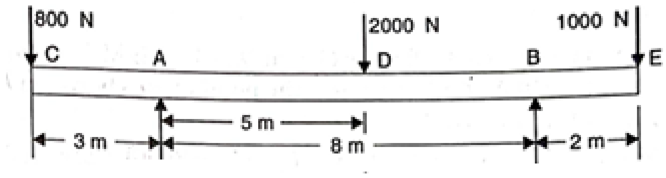
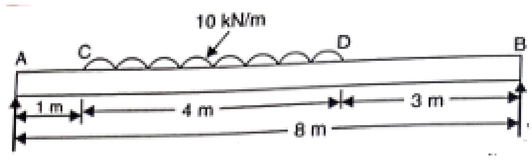
1.	**(a)**	Define strength and stiffness.	[L1][CO1]	[2M]
	(b)	State Hook's law.	[L1][CO1]	[2M]
	(c)	What are the types of elastic constants?	[L1][CO1]	[2M]
	(d)	Define Factor of safety.	[L1][CO1]	[2M]
	(e)	State strain energy.	[L1][CO1]	[2M]
2.	**a)**	Define stress and strain. Explain clearly the different types of stresses and strains.	[L2][CO1]	[5M]
	b)	Draw and explain Stress-strain curve for a mild steel bar.	[L2][CO1]	[5M]
3.	**a)**	A rod 150 cm long and of diameter 2.0 cm is subjected to an axial pull of 20 kN. If the modulus of elasticity of the material of the rod is 2 x 10^5 N/mm^2 determine :(i) stress,(ii) strain, and: (iii) elongation of the rod	[L3][CO1]	[5M]
	b)	Find the Young's Modulus of a brass rod of diameter 25 mm and of length 250 mm. which is subjected to a tensile load of 50 kN when the extension of the rod is equal to 0.3 mm.	[L3][CO1]	[5M]
4.		A brass bar, having cross-sectional area of 1000 mm^2, is subjected to axial forces as shown in figure. Find the total elongation of the bar. Take E=1.05x10^5 N/mm^2. 	[L3][CO1]	[10M]
5.		A compound tube consists of a steel tube 140 mm internal diameter and 160 mm external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The two tubes are of the same length. The compound tube carries an axial load of 900 kN. Find the stresses and the load carried by each tube and the amount it shortens. Length of each tube is 140 mm. Take E for steel as 2 x 10^5 N/mm^2 and for brass as1 x 10^5 N/mm^2	[L3][CO1]	[10M]
6.	**a)**	A rod is 2 m long at a temperature of 10°C. Find the expansion of the rod when the temperature is raised to 80°C. If this expansion is prevented, find the stress induced in the material of the rod. Take E = 1.0 x 10^5MN/m^2 and α= 0.000012 per degree centigrade.	[L3][CO1]	[5M]

	b)	A steel rod of 3 cm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stress and pull exerted when the temperature falls to 30°C, if (i) the ends do not yield, and (ii) the ends yield by 0.12 cm. Take E = 2 x 10^5 MN/m^2 and α = 12 x 10^{-6}/ ^0C	[L3][CO1]	[5M]
7.	**a)**	The stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major stress. Also determine the maximum intensity of shear stress in the material at the point.	[L3][CO1]	[5M]
	b)	The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of the minor stress.	[L3][CO1]	[5M]
8.	**a)**	Define Mohr's circle and Derive the normal, tangential and resultant stresses by Mohr's circle when a body is subjected to two mutually perpendicular principal tensile stresses of unequal intensities.	[L4][CO1]	[5M]
	b)	The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of minor stress using Mohr's circle.	[L3][CO1]	[5M]
9.	**a)**	For a material Young's modulus given as 1.4 x 10^5 N/mm^2 and possion's ratio 0.28. Calculate the bulk Modulus.	[L4][CO1]	[5M]
	b)	Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is 1.2 x 10^5 N/mm^2 and modulus of rigidity is 4.8 x 10^4 N/mm^2.	[L3][CO1]	[5M]
10.		Derive the expressions for strain energy stored in a body when load is applied (i) Gradually (ii) Suddenly	[L4][CO1]	[10M]
11.	**a)**	A tensile load of 60 kN is gradually applied to a circular bar of 4 cm diameter and 5 m long. If the value of E = 2.0 × $10^5$$N/mm^2$, determine: (i) stretch in the rod, (ii) stress in the rod, (iii) strain energy absorbed by the rod.	[L3][CO1]	[5M]
	b)	A steel rod is 2 m long and 50 mm in diameter. An axial pull of 100 kN is suddenly applied to the rod. Calculate the instantaneous stress induced and also the instantaneous elongation produced in the rod. Take E = 200 GN/m^2	[L4][CO1]	[5M]

UNIT -II

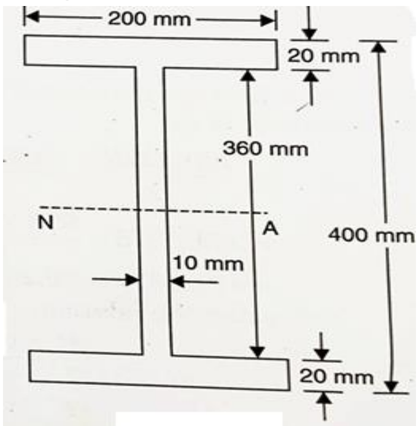
SHEAR FORCE AND BENDING MOMENT

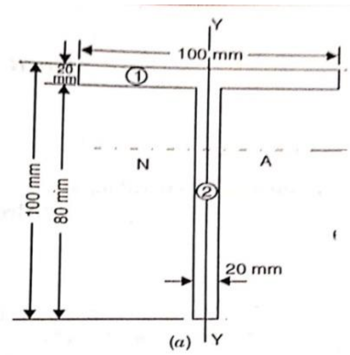
1.	**(a)**	Classify the types of beams.	[L2][CO2][2M]	
	(b)	What is meant by cantilever beam?	[L1][CO2][2M]	
	(c)	Define shear force and bending moment at a section.	[L1][CO2][2M]	
	(d)	What are the types of transverse loads?	[L1][CO2][2M]	
	(e)	State point of contra flexure.	[L1][CO2][2M]	
2.		A cantilever beam of length 2m carries the point loads as shown in Fig. Draw the SFD and BMD for the given beam.  	[L3][CO2]	[10M]
3.		A cantilever of length 2.0m carries a uniformly distributed load of 1kN/m run over a length of 1.5m from the free end. Draw the shear force and bending moment diagrams for the cantilever.	[L3][CO2]	[10M]
4.		Draw the shear force and bending moment diagram for a simply supported beam of length 9m and carrying a uniformly distributed load of 10 kN/m for a distance of 6m from the left end. Also calculate the maximum bending moment in the section.	[L3][CO2]	[10M]
5.		A simply supported beam of length 10m carries the UDL and two point loads as shown in fig. Draw S.F. and B.M. diagram for the beam shown in figure. Also calculate the maximum bending moment.  	[L3][CO2]	[10M]
6.		Draw the shear force and bending moment diagram for overhanging beam carrying uniformly distributed load of 2 KN/m over the entire length and a point load of 2 KN as shown in figure. Locate the point of contra flexure.  	[L4][CO2]	[10M]
7.		A cantilever of length 4.0 m carries a gradually varying load, zero at the free end to 2kN/m at the fixed end. Draw the S.F and B.M diagram for the beam.	[L3][CO2]	[10M]
8.		A simply supported beam of length 5m carries a uniformly increasing load of 800N/m run at one end to 1600N/m run at the other end. Draw the S.F and B.M diagrams for the beam. Also calculate the position and magnitude of maximum bending moment.	[L4][CO2]	[10M]

9.		Draw S.F and B.M diagrams for the beam which is loaded as shown in fig. determine the points of contra flexure within the span AB. 	[L4][CO2]	[10M]
10.		Draw S.F and B.M diagrams for a simply supported beam of length 8m and carrying a UDL of 10kN/m for a distance of 4m as shown in fig. 	[L3][CO2]	[10M]
11.		A cantilever of length 2.0 m carries a uniformly distributed load of 2kN/m length over the whole length and point load of 3kN at the free end. Draw the S.F and B.M diagrams for the cantilever.	[L3][CO2]	[10M]

UNIT III

(Flexural stress and Shear stress)

1.	**(a)** State the theory of simple bending.		[L1][CO3]	[2M]
	(b) Write the assumptions of simple bending.		[L1][CO3]	[2M]
	(c) Define section modulus		[L1][CO3]	[2M]
	(d) Define shear stress distribution		[L1][CO3]	[2M]
	(e) Draw the shear stress distribution in solid circular shaft		[L2][CO3]	[2M]
2.		Derive the expression for simple bending moment equation with assumptions.	[L3][CO3]	[10M]
3.		A rectangular beam 300 mm deep is simply supported over a span of 4 metres. Determine the uniformly distributed load per metre which the beam may carry, if the bending stress should not exceed 120 N/mm^2.Take I = 8 x 10^6 mm^4	[L3][C O3]	[10M]
4.		A square beam 20 mm x 20 mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40 mm wide, 60 mm deep and 3 m long	[L4][C O3]	[10M]
5.		A beam is simply supported and carries a uniformly distributed load of 40 kN/m run over the whole span. The section of the beam is rectangular having depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment of inertia of the section is 7 x 10^8 mm^4 , find the span of the beam.	[L3][C O3]	[10M]
6.		A rolled steel joint of I section has the dimensions as shown in fig. this beam of I section carries a U.D.L of 40kN/m run on a span of 10m, calculate the maximum stress produced due to bending. 	[L4][C O3]	[10M]
7.		A timber beam of rectangular section is simply supported at the ends and carries a point load at the center of the beam. The maximum bending stress is 12 N/mm^2 and maximum shearing stress is 1 N/mm^2, find the ratio of the span to the depth.	[L3][C O3]	[10M]
8.		A rectangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN. Determine: (i) Average shear stress, (ii) Maximum shear stress, and (iii) Shear stress at a distance of 25 mm above the neutral axis.	[L3][C O3]	[10M]
9.	**a)**	Draw the shear stress distribution across: (i)Rectangular section. (ii)Circular section.	[L4][C O3]	[04M]

	b)	An I-section beam 350 mm x 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. If the shear force acting on the section is 40 KN, find the maximum shear stress developed in the I-section.	[L3][C O3]	[06M]
10.		The shear force acting on a section of a beam is 50 kN. The section of the beam is of T-shaped of dimensions 100 mm x 100 mm x 20 mm as shown in figure. The moment of inertia about the horizontal neutral axis is 314.221 x 10^4 mm^4. Calculate the shear stress at the neutral axis and at the junction of the web and the flange. 	[L4][C O3]	[10M]
11.		A circular beam of 100mm diameter is subjected to a shear force of 5kN. Calculate (i) Average shear stress (ii) Maximum shear stress and (iii) Shear stress at a distance of 40mm from NA.	[L4][C O3]	[10M]

UNIT IV

(Deflection of Beams and Torsion)

1.	**(a)**	What are the methods for finding slope and deflection of a beam.	[L1][CO4]	[2M]
	(b)	Define deflection of beam.	[L1][CO4]	[2M]
	(c)	State MacAulay's method.	[L1][CO4]	[2M]
	(d)	Write Torsion equation.	[L1][CO4]	[2M]
	(e)	What are the assumptions made in Torsion equation?	[L1][CO4]	[2M]
2.		A beam 6 m long, simply supported at its ends, is carrying a point load of 50 kN at its centre. The moment of inertia of the beam is given as equal to 78 x 10^6 mm^4. If E for the material of the beam =2.1 x 10s N/mm^2, calculate (i) deflection at the centre of the beam and (ii) slope at the supports.	[L4][CO4]	[10M]
3.		A beam of uniform rectangular section 200 mm wide and 300 mm deep is simply supported at its ends. It carries a uniformly distributed load of 9 KN/m run over the entire span of 5 m. If the value of E for the beam material is 1 x 10^4 N/mm^2, find: (i) The slope at the supports and (ii) Maximum deflection.	[L3][CO4]	[10M]
4.		Determine: (i) slope at the left support, (ii) deflection under the load and (iii) maximum deflection of a simply supported beam of length 5 m, which is carrying a point load of 5 KN at a distance of 3 m from the left end. Take E = 2 x 10^5 N/mm^2 and I =1 x 10^8 mm^4.	[L3][C O4]	[10M]
5.		A beam of length 5 m and of uniform rectangular section is supported at its ends and carries uniformly distributed load over the entire length. Calculate the depth of the section if the maximum permissible bending stress is 8 N/mm^2 and central deflection is not to exceed 10 mm. Take the value of E = 1.2 x 10^4 N/mm^2.	[L4][C O4]	[10M]
6.		A cantilever of length 3 in carries two point loads of 2 KN at the free end and 4 KN at a distance of 1 m from the free end. Find the deflection at the free end. Take E = 2 x $10^5 N/mm^2$ and I = 10^8 mm^4.	[L3][CO4]	[10M]
7.		Derive an expression for the shear stress produced in a circular shaft Subjected to torsion. What are the assumptions made in the derivation?	[L4][CO4]	[10M]
8.		A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 r.p.m. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 N/mm^2.	[L3][CO4]	[10M]
9.		A solid steel shaft has to transmit 75 KW at 200 rpm. Taking allowable shear stress as 70 N/mm2, find suitable diameter for the shaft, if the maximum torque transmitted at each revolution exceeds the mean by 30%.	[L3][CO4]	[10M]
10.		Determine the diameter of a solid steel shaft which will transmit 90 kW at 160 r.p.m. Also determine the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60 N/mm^2.Take the value of modulus of rigidity= 8 x 10^4 N/mm^2.	[L3][CO4]	[10M]
11.		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.	[L4][CO4]	[10M]

UNIT V

(Thin Cylinders , Thick Cylinders and Columns)

1.	**(a)**	Define thin and thick cylinder.	[L1][CO5]	[10M]
	(b)	State circumferential stress (or) hoop stress.	[L1][CO5]	[10M]
	(c)	What is the stress developed in the cylinders under pressure.	[L1][CO5]	[10M]
	(d)	Define Column	[L1][CO5]	[10M]
	(e)	Write limitations of Rankin's formula	[L1][CO5]	[10M]
2.	**a)**	Derive expression for circumferential stress in thin cylinder.	[L3][CO5]	[5M]
	b)	A cylindrical pipe of diameter 1.5m and thickness 1.5cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Determine: (i) Longitudinal stress developed in the pipe, and ii) Circumferential stress developed in the pipe.	[L3][CO5]	[5M]
3.		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= 2x 10^5 N/mm^{2}and Poisson's ratio 0.25 Determine (i) change in diameter (ii) change in length and (iii) Change in volume.	[L3][CO5]	[10M]
4.		A cylindrical shell 90 cm long 20 cm internal diameter having thickness of metal as 8 mm is filled with fluid at atmospheric pressure. If an additional 20 cm^3 of fluid is pumped into the cylinder, find (i) the pressure exerted by the fluid on the cylinder and (ii) the hoop stress induced. Take E = 2 x 10^5 N/mm^2 and μ = 0.3.	[L3][CO5]	[10M]
5.		A closed cylindrical vessel made of steel plates 4 mm thick with plane and, carries fluid under a pressure of 3 N/ mm^2. The dia. of cylinder is 30 cm and length is 80 cm, calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and volume of the cylinder. Take E = 2 X 10 ^{5} N/ mm^2 and Poisson's ratio is 0.286	[L4][CO5]	[10M]
6.	**a)**	A vessel in the shape of a spherical shell of 1.20 m internal diameter and 12 mm. shell thickness is subjected to pressure of 1.6 N/mm^2. Determine the stress induced in the material of the vessel.	[L3][CO5]	[5M]
	b)	A spherical vessel 1.5 m diameter is subjected to an internal pressure of 2 N/mm^2. Find the thickness of the plate required if maximum stress is not to exceed 150 N/mm2 and joint efficiency is 75%.	[L3][CO5]	[5M]
7.		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][CO5]	[10M]
8.		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][CO5]	[10M]
9	**a)**	Write the assumptions made in the Euler's column theory.	[L1][CO5]	[5M]
	b)	Write the end conditions for long columns and state the difference between long columns and short columns.	[L2][CO5]	[5M]

10.		A column of timber section 15 cm x 20 cm is 6 metre long both ends being fixed. If the Young's modulus for timber =17.5 KN/mm^2, determine: i) Crippling load and ii) Safe load for the column if factor of safety = 3.	[L3][CO5]	[10M]
11.		Using Euler's formula, calculate the critical stresses for a series of struts having slenderness ratio of 40, 80, 120, 160 and 200 under the following conditions: (i) Both ends hinged and (ii) Both ends fixed. Take E = 2.05 x 10^5 N/ mm^2	[L4][CO5]	[10M]

PREPARED BY: A ASHA