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

Siddharth Nagar, Narayanavanam Road – 517583

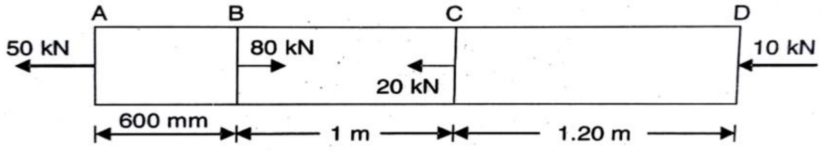
QUESTION BANK (DESCRIPTIVE)

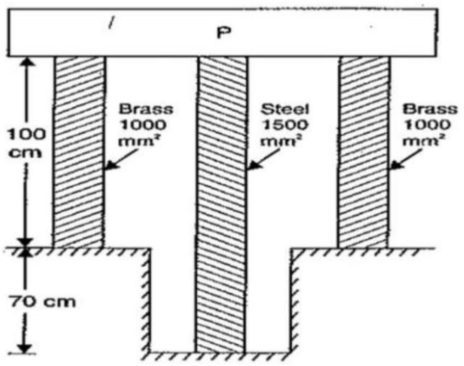
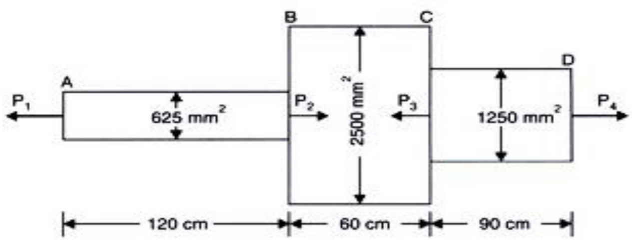
Subject with Code: Mechanics of Solids (20CE0164)

Course & Branch: **B.Tech (ME & AGE)** **Year & Sem: II & I** **Regulation: R20**

UNIT I

(Simple Stresses and Strains, Theories of failure)

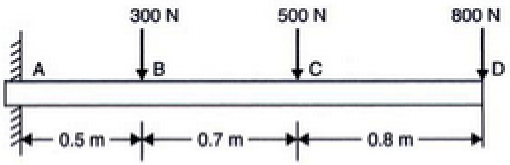
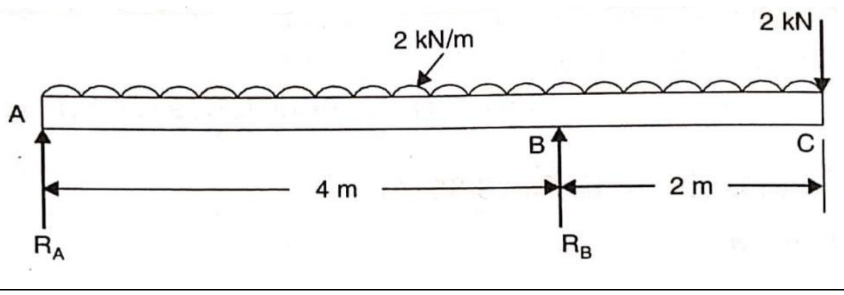
1	**a)** Define stress and strain. Explain different types of stresses and strains.	L1	CO1	6M
	b) Draw and explain Stress-strain curve for a mild steel bar.	L1	CO1	6M
2	**a)** State Hooke’s law with equation.	L1	CO1	2M
	b) A tensile test was conducted on a mild steel bar. The following data was obtained from the test: (i) Diameter of the steel bar = 3 cm (ii) Gauge length of the bar = 20 cm (iii) Load at elastic limit = 250 KN (iv) Extension at a load of 150 KN = 0.21 mm (v) Maximum load = 380 KN (vi) Total extension = 60 mm (vii) Diameter of the rod at the failure = 2.25 cm. Determine: (a) The Young's modulus, (b) The stress at elastic limit, (c) The percentage elongation, and (d) The percentage decrease in area.	L3	CO1	10M
3	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	12M

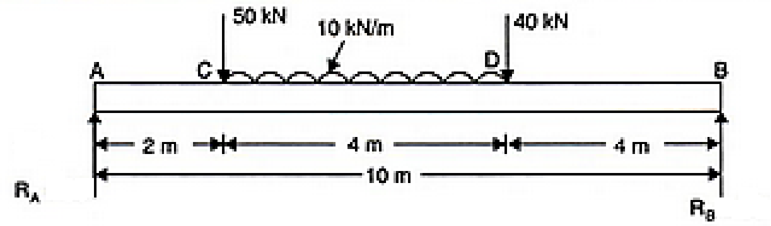
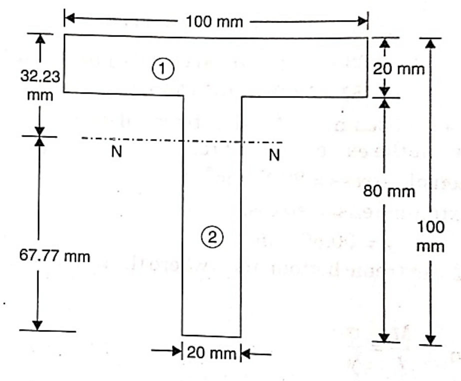
4	Two brass rods and one steel rod together support a load as shown in fig. If the stresses in brass and steel are not to exceed 60 N/mm^2 and 120 N/mm^2, find the safe load that can be supported. Take E for steel = 2x105 N/mm^2 and for brass $=1x10^5$ N/mm^2. The cross-sectional area of steel rod is 1500 mm^2 and of each brass rod is 1000 mm^2 	L3	CO1	12M
5	**a)** Define Bulk Modulus and Poisson's Ratio.	L1	CO1	4M
	b) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take E for steel and copper as 2.1×10^5 N/mm^2 and $l \times 10^5$ N/mm^2 respectively. The value of co-efficient of linear expansion for steel and copper is given as 11×10^{-6} per °C and 18×10^{-6} per °C respectively.	L3	CO1	8M
6	A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 shown in below Fig.  If $P_1 = 45$ kN, $P_2 = 365$ kN , $P_3 = 450$ kN , $P_4 = 130$ kN . Determine the total elongation of the member. Assuming the modulus of elasticity is 2.1×10^5 N/mm^2.	L2	CO1	12M
7	**a)** Explain maximum shear stress theory.	L2	CO1	6M
	b) Explain maximum shear strain energy theory.	L2	CO1	6M
8	**a)** Explain maximum principal strain theory.	L2	CO1	6M
	b) Explain maximum strain energy theory.	L2	CO1	6M

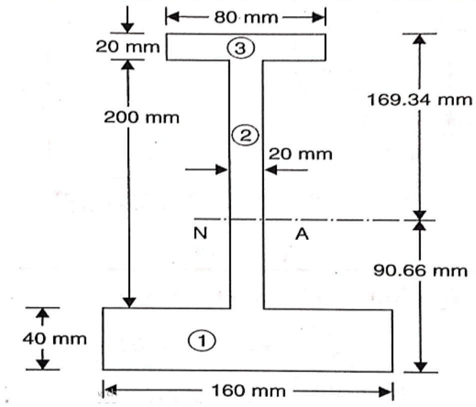
9	The load on the screw consists of an axial pull of 10 kN together with the transverse shear force of 5kN. Find the diameter of the bolt required according to (i) Maximum principal stress theory. (ii) Maximum principal strain theory. Take Permissible tensile stress at elastic limit = 100 MPa and and Poisson's ratio = 0.3, factor of safety = 1.	L3	CO1	12M
10	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 shear stress theory. (ii) Maximum strain energy theory. Given the elastic limit in tension = 225 N/mm^2, factor of safety = 3 and Poisson's ratio = 0.3.	L3	CO1	12M

UNIT II

(Shear Force and Bending Moments, Theory of Simple Bending)

1	A cantilever beam of length 3 m carries a uniformly distributed load of 1.5 kN/m run over a length of 2 m from the free end. Draw SFD and BMD for the beam.	L3	CO2	12M
2	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 6 m from the left end. Also calculate the maximum bending moment in the section.	L3	CO2	12M
3	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	12M
4	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. 	L3	CO2	12M

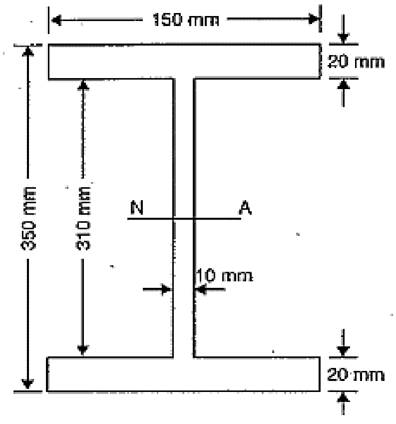
5	A simply supported beam oflength10m carries the UDL and two-point loads as shown in fig. Draw S.F. and B.M. diagram for the beam shown in figure. Also calculate the maximum bending moment. 	L3	CO2	12M
6	**a)** Derive the simple bending equation.	L2	CO3	8M
	b) State the assumptions made in the theory of simple bending.	L2	CO3	4M
7	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?	L3	CO3	12M
8	**a)** Derive section modulus for rectangular section.	L2	CO3	4M
	b) A beam 500 mm deep of a symmetrical section has I = 1 x 10^8 mm^4 and is simply supported over a span of 10 m. Calculate: (i) The uniformly distributed load it may carry if the maximum bending stress is not to exceed150 N/mm^2. (ii) The bending stress if the beam carries a central point load of 25 kN.	L3	CO3	8M
9	A cast iron beam is of T-section as shown in figure. The beam is simply supported on a span of 8m. The beam carries a UDL of 1.5kN/m length on the entire span. Determine the maximum tensile and compressive stresses.  Fig.	L3	CO3	12M
10	A cast iron beam is of I-section as shown in figure. The beam is simply supported on a span of 5 m. If the tensile stress is not to exceed 20 N/mm^2, find the safe uniform load which the beam can carry. Find also the maximum compressive stress.	L3	CO3	12M



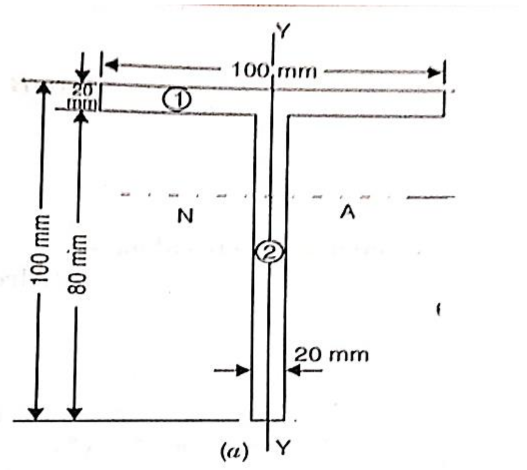
UNIT III

(Shear Stress Distribution, Torsion of Circular Shafts and Springs)

1	Derive shear stress distribution formula for rectangular section with a neat sketch.	L1	CO3	12M
2	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 is 12 N/mm^2 and maximum shearing stress is 1 N/mm^2, find the ratio of the span to the depth.	L3	CO3	12M
3	**a)** Draw the shear stress distribution across: (i) Rectangular section. (ii) Triangular section. (iii) Circular section. (iv) I & T Sections	L2	CO3	6M
	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	CO3	6M

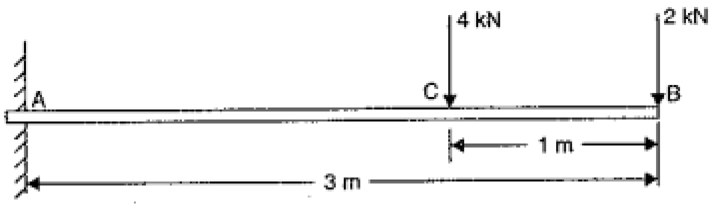
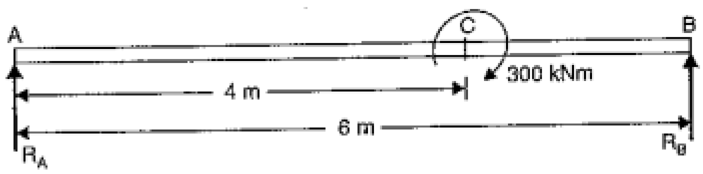


4	Derive shear stress distribution formula for circular section with a neat sketch.	L1	CO3	12M

5	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. 	L3	CO3	12M
6	Derive pure torsion equation for a circular shaft with assumptions.	L2	CO3	12M
7	**a)** State the difference between twisting moment and bending moment.	L1	CO3	4M
	b) A solid steel shaft has to transmit 75 KW at 200 rpm. Taking allowable shear stress as 70 N/mm^2, find suitable diameter for the shaft, if the maximum torque transmitted at each revolution exceeds the mean by 30%.	L3	CO3	8M
8	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) The 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	CO3	12M
9	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	CO3	12M
10	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	CO3	12M

UNIT IV

(Deflection of Beams and Columns)

1	Derive the relation between slope, deflection and radius of curvature.	L2	CO4	12M
2	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	12M
3	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	CO4	12M
4	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 10^5N/mm^2 and I = 10^8 mm^4  	L3	CO4	12M
5	A horizontal beam AB is simply supported at A and B, 6 m apart. The beam is subjected to a clockwise couple of 300 KN-m at a distance of 4 m from the left end as shown in figure below If E = 2 x 10^5N/mm^2 and I= 2 x 10^8 mm^4, determine: (i) Deflection at the point where couple is acting and (ii) The maximum deflection.  	L3	CO4	12M
6	**a)** Write the assumptions made in the Euler's column theory.	L2	CO5	4M
	b) Write the end conditions for long columns and state the difference between long columns and short columns.	L2	CO5	8M
7	Derive an expression for crippling load when both ends of the column are hinged.	L2	CO5	12M

8	A solid round bar 3 m long and 5 cm in diameter is used as a strut with both ends hinged. (Take E = 2.0 x 10^5 N/mm^2). Determine the crippling load, when the given strut is used with the following conditions: (i) One end of the strut is fixed and the other end is free (ii) Both the ends of strut are fixed (iii) One end is fixed and other is hinged.	L3	CO5	12M
9	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	12M
10	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	L3	CO5	12M

UNIT V

(Thin Cylinders and Thick Cylinders)

1	**a)** Derive expression for circumferential stress in thin cylinder.	L2	CO6	6M
	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	CO6	6M
2	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	CO6	12M
3	A cylindrical shell 100mm long 200mm internal diameter having thickness of a metal as 10mm is filled with a fluid at atmospheric pressure. If an additional 200mm^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	12M
4	A copper cylinder, 90 cm long, 40 cm external diameter and wall thickness 6 mm has its both ends closed by rigid blank flanges. It is initially full of oil at atmospheric pressure. Calculate additional volume of oil which must be pumped into it in order to raise the oil pressure to 5 N/mm^2 above atmospheric pressure. For copper assume E= 1.0 x 10^5 N/mm^{2}and Poisson's ratio 1/3. Take bulk modulus of oil as K= 2.6 x 10^{3}N/mm^2.	L3	CO6	12M
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	L3	CO6	12M
6	**a)** A cylinder of thickness 1.5cm has to withstand maximum internal pressure of 1.5N/mm^2. If the ultimate tensile stress in the material of the cylinder is 300N/mm^2, factor of safety 3.0 and joint efficiency 80%, determine the diameter of the cylinder.	L3	CO6	6M

	b) A spherical shell of internal diameter 0.9m and of thickness 10mm is subjected to an internal pressure of 1.4 N/mm^2. Determine the increase in diameter and increase in volume. Take $E=2X10^5$ N/mm^2 and $\mu=1/3$.	L3	CO6	6M
7	Derive an expression for hoop and radial stresses across thickness of the thick cylinder.	L2	CO6	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	CO6	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	CO6	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 $E = 2 \times 10^5$ N/mm^2.	L3	CO6	12M

PREPARED BY: Mrs. A Asha, Mr. S Venkataraman