BT MRE-II(R/S)-06-24-3238 Reg. No. | | | | | | | | |

C

B.Tech. Degree II Semester Regular/Supplementary Examination in Marine Engineering June 2024

19-208-0206 MECHANICS OF SOLIDS

(*2019 Scheme*)

Time: 3 Hours Maximum Marks: 60

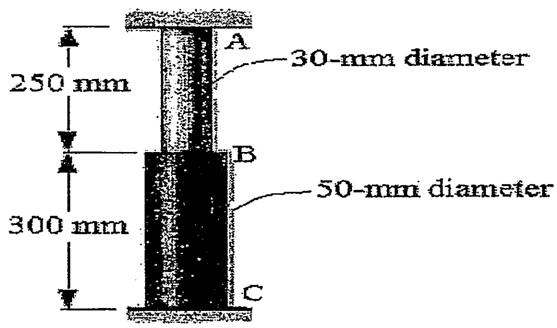
Course Outcome

On successful completion of the course, the students will be able to:

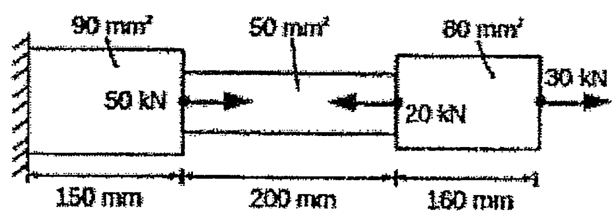
CO1: Understand and apply the concept of stress and strain to analyze statically determinate and indeterminate problems and design structural members and machine parts.
CO2: Determine principal stresses strains and apply the concept of theories of failure for design.
CO3: Determine the stresses and strains in the members subjected to axial, bending and torsional loads
CO4: Evaluate the slope and deflection of beams subjected to loads.
CO5: Analyze and design thin, thick cylinders and springs.
Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 –Analyze, L5 – Evaluate, L6 – Create
PI – Programme Indicators

(Answer *ALL* questions) (5 × 15 = 75)

			Marks	BL	CO	PI
I.	(a)	Draw the stress strain curve for a mild steel bar in tension test and show the salient points.	3	L2	1	1.2.1
	(b)	A rod consisting of two cylindrical portions AB and BC is restrained at both ends. Portion AB is made of steel (E_s = 205 GPa, α_s=11.7 × 10^{-6}/°C) and portion BC is made of brass (E_b = 100 GPa, α_b = 20.9 × 10^{-6}/°C). Knowing that the rod is initially unstressed, determine the compressive force induced in ABC when there is a temperature rise of 60°C.	8	L3	1	1.3.1

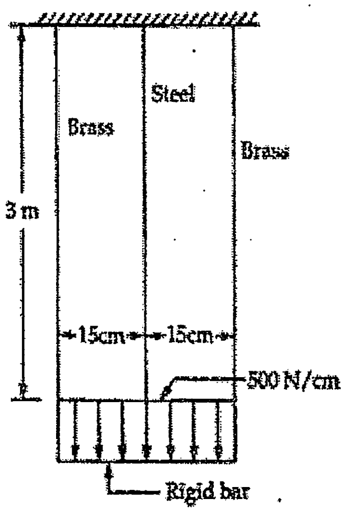


			Marks	BL	CO	PI
	(c)	A stepped bar is loaded as shown in the figure. Determine the total extension of the bar if E = 210 GPa.	4	L3	1	1.2.1

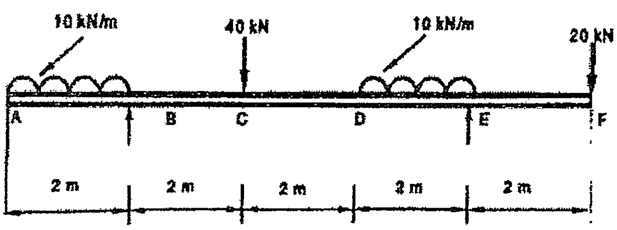


OR

		Marks	BL	CO	PI
II.	(a) At a point in a bracket the stresses on two mutually perpendicular planes are 150 MPa and 90 MPa both tensile. The shear stress across these planes is 50 MPa. Find using Mohr's stress circle the (i) principal stresses. (ii) maximum shear stress and location of maximum shear plane.	7	L2	1	1.3.1
	(b) Define strain energy and explain how it is stored in the body.	3	L1	2	1.2.1
	(c) Three parallel long wires equal in length and in the plane are supporting a rigid bar connected at their bottom as shown in the figure. Middle wire is of steel and other two are brass. All the wires are 1 cm^2 cross sectional area. Rigid bar supports a UDL as shown in the figure. Determine the forces and elongation of the wires. Given $E_s = 205$ GPa and $E_b = 100$ GPa.	5	L3	1	1.2.1



		Marks	BL	CO	PI
III.	(a) Define Point of contraflexure and moment of resistance.	3	L1	3	1.2.1
	(b) Draw the SF and BM diagrams for a beam shown in figure. Also determine Maximum BM.	8	L2	3	1.3.1

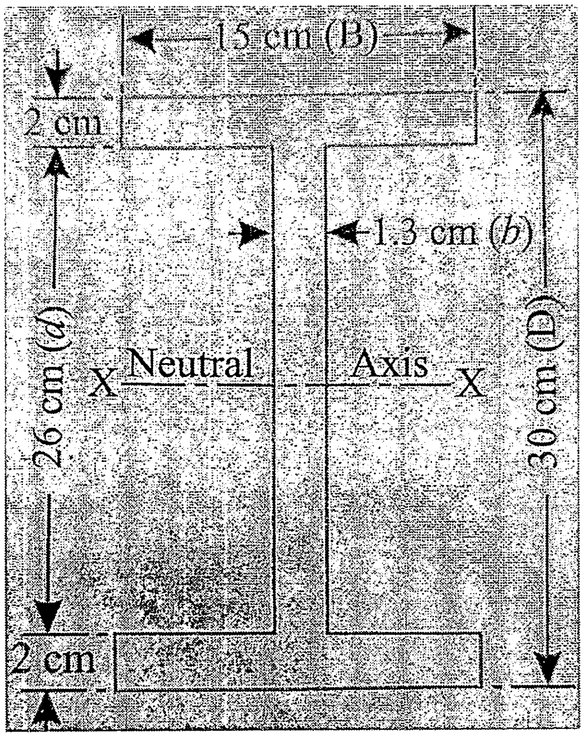


		Marks	BL	CO	PI
	(c) Obtain the relation between load, shear and bending moment.	4	L3	3	1.3.1

OR

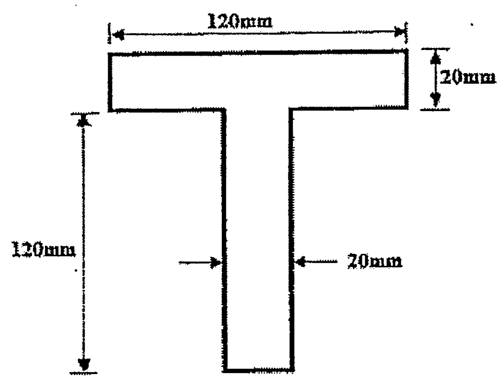
(Continued)

			Marks	BL	CO	PI
IV.	(a)	Derive the equation for theory of pure bending.	4	L2	3	1.1.1
	(b)	Derive the expression for shear stress in I cross section beam.	5	L3	3	1.3.1
	(c)	A steel joist of I section has the dimension as shown in the figure. The beam carries a UDL of 40 kN/mm^2 run on a span of 10 m. Calculate the maximum stress produced due to bending.	6	L3	3	1.3.1



			Marks	BL	CO	PI
V.	(a)	Relate slope, deflection and radius of curvature of a beam.	3	L1	4	1.3.1
	(b)	A cantilever of 5 m length and of uniform cross section 150 mm wide and 300 mm deep is loaded with a 50 kN load at its free end. In addition to this it carries UDL of 30 kN per metre run over its entire length, calculate (i) the maximum slop and deflection (ii) the slope and deflection at 2 m from the fixed end. Take E = 210 GN/mm^2.	7	L2	4	1.3.1
	(c)	Explain double integration method to find slope and deflection.	5	L3	4	1.3.1
		OR				
VI.	(a)	Explain Macaulay's method with regard to deflection of beams.	3	L1	4	1.3.1
	(b)	A fixed beam of 8 m span carries point loads of 200 kN at a distance of 3 m from left and 85 kN at a distance of 3 m from right end. Find the following (i) fixing moments at the ends. (ii) reactions at the supports.	7	L2	4	1.3.1
	(c)	A fixed beam of 6 m span is subjected to a concentrated couple of 120 kNm applied at a section 4 m from the left end. Find the end moments from the first principles.	5	L3	4	1.3.1

			Marks	BL	CO	PI
VII.	(a)	Define slenderness ratio.	2	L2	3	1.3.1
	(b)	A column of 6 m long of mild steel as shown in the figure. Find the crippling load if. (i) both ends are hinged. (ii) one end is fixed and other end is hinged Take E = 200GPa.	8	L2	3	1.3.1



			Marks	BL	CO	PI
	(c)	A hollow cast iron column 8 m long and 8 cm internal diameter and 18 cm external diameter is having its one end hinged and other rigidly fixed. Find the crippling load and safe load taking factor of safety as 6. Take E = 95GPa. Use Euler's formula.	5	L3	3	1.3.1
		OR				
VIII.	(a)	A solid steel shaft has to transmit 85 kW at 300 rpm. Determine the suitable diameter of shaft if the maximum torque transmitted is not to exceed the mean by 20% in each revolution. The shear stress is not to exceed 80 N/mm^2. Also calculate the maximum angle of twist in a length of 4 m of the shaft. G = 80 Gpa.	6	L2	3	1.3.1
	(b)	Compare the solid and hollow shaft by strength and weight by suitable assumptions.	9	L2	3	1.3.1
IX.	(a)	Show that in thin cylinders, the circumferential stress is twice the longitudinal stress when subjected to internal pressure.	5	L2	5	1.3.1
	(b)	A thin cylinder of internal diameter 4 m contains a fluid at an internal pressure of 6 N/mm^2. Determine the maximum thickness of the cylinder if (i) the longitudinal stress is not to exceed 50 N/mm^2. (ii) the hoop stress is not to exceed 30 N/mm^2.	5	L2	5	1.3.1
	(c)	A 2 m long thin cylindrical shell (both ends closed), internal diameter 60 cm and thickness 12 mm, is subjected to internal pressure 2 N/mm^2. Find (i) hoop and longitudinal stresses (ii) changes in diameter and length shell. Take $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio = 0.3.	5	L3	5	1.3.1
		OR				
X.	(a)	State the differences between close coiled and open coiled spring.	3	L1	5	1.3.1
	(b)	State the various stresses acting at a point in a thick cylinder with closed ends subjected to internal pressure. Write down the Lame's equations detailing the various terms.	6	L2	5	1.3.1
	(c)	A close-coiled helical spring has mean diameter of 95 mm and spring constant of 60 kN/m. It has 6 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 300 MN/m^2? Modulus of rigidity of spring wire material is 80 G N/m^2. What is the maximum axial load the spring can carry?	6	L2	5	1.3.1

Bloom's Taxonomy Levels

L1 - 7%, L2 - 86%, L3 - 7%.