Q. Code:203961

Reg. No. | | | | | | | | | | | | | |

B.E. / B. TECH DEGREE EXAMINATIONS, MAY 2024

Third Semester

ME22302 – MECHANICS OF MATERIALS

(Common to ME and MN branches)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Students will predict the behavior of the materials for different loading and support conditions	**3**
CO 2	Students will select suitable cross sections for the beams under different loading conditions	**4**
CO 3	Students will identify the methodology to find the deflections occurred in beams under different loading conditions.	**3**
CO 4	Students will select suitable dimensional parameters for the shafts under torsional loads and springs based on calculated stresses, deflection under different conditions.	**4**
CO 5	Based on the parameters and conditions, the students will calculate safe dimension for a Pressure vessel	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

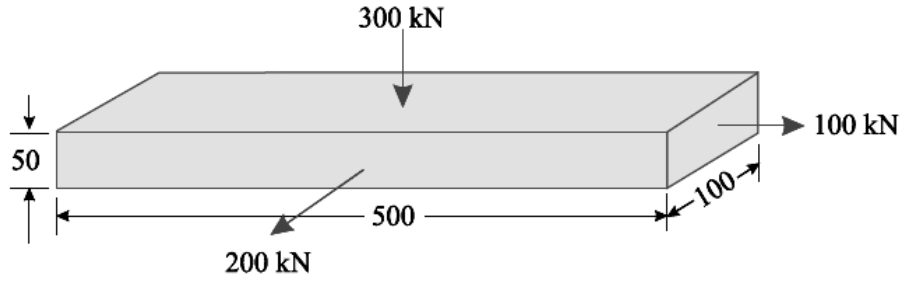
		CO	RBT LEVEL
1.	Describe Hooke's Law with a graph	**1**	**2**
2.	Justify the use of factor of safety with an example.	**1**	**2**
3.	How do you relate Longitudinal and Lateral strains?	**1**	**2**
4.	Write the relationship between Young's Modulus, Shear Modulus and Modulus of Rigidity.	**1**	**2**
5.	Explain with a neat sketch about different types of beams.	**2**	**2**
6.	Differentiate sagging and hogging bending moments.	**2**	**2**
7.	When will a beam have a point of contraflexure?	**2**	**2**
8.	Describe the term polar modulus.	**2**	**2**

9.	Discuss the advantages of Macaulay's method.	**3**	**2**	
10.	Define Mohr's Theorem for slope.	**3**	**2**	
11.	Write the differential equation for deflection of a bent beam.	**3**	**2**	
12.	When do you prefer Moment Area Method?	**3**	**2**	
13.	Write the equation for solid length and length of wire for a closed coil helical spring.	**4**	**2**	
14.	Write any four assumptions made in Torsion equation.	**4**	**2**	
15.	Hollow circular shafts are preferred when compared to solid circular shafts. Why? Give reasons.	**4**	**2**	
16.	What are the various types of springs? Give an application for each spring.	**4**	**2**	
17.	Give an application of a thin cylinder and a thick cylinder.	**5**	**2**	
18.	The hoop stress set up in a thin cylinder is $10N/mm^2$. What is the longitudinal stress for the shell?	**5**	**2**	
19.	Write the equation of principal stresses and its angle.	**5**	**2**	
20.	If Stress in X axis and Y axis are 150 MPa (tensile) and 0 MPa (No force), What will be the radius of the Mohr's circle? Draw a rough sketch and explain.	**5**	**2**	

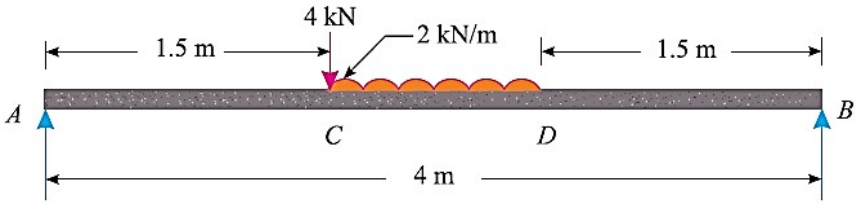
PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	A reinforced concrete circular column of 400 mm diameter has 4 steel bars of 20 mm diameter embedded in it. Find the maximum load which the column can carry, if the stresses in steel and concrete are not to exceed 120 MPa and 5 MPa respectively. Take modulus of elasticity of steel as 18 times that of concrete.	**(10)**	**1**	**3**
	(OR)			
(b)	A rectangular bar 500 mm long and 100 mm × 50 mm in cross-section is	**(10)**	**1**	**3**

subjected to forces as shown in figure. What is the change in the volume of the bar? Take Bulk modulus for the bar material as 133.34 GPa and Poisson's ratio as 0.25.



22. (a)	A simply supported beam of 4 m span is carrying loads as shown in figure. Draw the shear force and bending moment diagram for the beam. Take the reactions at A and B as 3.5 kN and 2.5 kN respectively.	**(10)**	**2**	**3**



(OR)

(b)	A beam 150mm wide and 300mm deep is simply supported over a span of 6 m. Find the maximum UDL the beam can carry if the bending stress is not exceeding 8 N/mm^2.	**(10)**	**2**	**3**
23. (a)	A beam of length 6 m is simply supported at its ends and carries two-point loads of 48 kN and 40 kN at 2 m and 4 m respectively from the left support. Evaluate the deflection under each load. Take E = 2 x 10^5 N/mm^2 and I = 42.5 x 10^6 mm^4	**(10)**	**3**	**3**

(OR)

(b)	A hollow cast iron column of 100 mm external diameter and 80 mm internal diameter is 5 m long. If both ends of the column are hinged, find the critical load on the column. Assume modulus of elasticity for the column material as 120 GPa.	**(10)**	**3**	**3**
24. (a)	A steel shaft is to require transmitting 70kW power at 150 rpm and the maximum twisting moment is 10% greater than the mean. Find the diameter	**(10)**	**4**	**3**

of the steel shaft if the maximum stress is 60 N/mm^2. Also determine the angle of twist in a length of 2 m of the shaft. Assume the modules of rigidity for steel as 90 kN/mm^2.

(OR)

(b)	It is required to design a closed coiled helical spring which shall deflect 1mm under an axial load of 150 N at a shear stress of 100 MPa. The spring is to be made of round wire having a shear modulus of 0.85 x 10^5 MPa. The mean diameter of the coil is 8 times that of the coil wire. Find the diameter and length of the wire.	**(10)**	**4**	**3**

25. (a)	A thin cylinder 1.5 m internal diameter and 5 m long is subjected to an internal pressure of 4 N/mm^2. If the maximum stress is limited to 120 N/mm^2 find the thickness of the cylinder. E= 210 kN/mm^2 and Poisson's ratio = 0.25. Also find the changes in diameter, length, and volume of the cylinder.	**(10)**	**5**	**3**

(OR)

(b)	The stresses at point of a machine component are 150 MPa and 50 MPa both tensile. Find the intensities of normal, shear and resultant stresses on a plane inclined at an angle of 55° with the axis of major tensile stress. Also find the magnitude of the maximum shear stress in the component. Conclude the stress values using Mohr's circle.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	A specimen of 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm. Identify. (i) The stress at elastic limit. (ii) Young's modulus. (iii) Percentage elongation. (iv) Percentage reduction in area. (v) Ultimate tensile stress.	**(10)**	**1**	**5**

Based on the above values justify the material of the specimen.

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