Enrollment No......................................

Faculty of Engineering

End Sem Examination Dec-2023

RA3CO23

Strength of Materials for Mechanical Engineers

Programme: B.Tech. Branch/Specialisation: RA

Duration: 3 Hrs. Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The maximum shear stress in a Mohr's Circle is equal to its _____. **1**
(a) Area (b) Radius (c) Diameter (d) Circumference

ii. What will be the modulus of rigidity if the value of modulus of elasticity is 200 and Poisson's ratio is 0.25? **1**
(a) 70 (b) 80 (c) 125 (d) 250

iii. At the point of contraflexure, the value of bending moment is _____. **1**
(a) Zero (b) Maximum (c) Minimum (d) Can't be determined

iv. Shear stress distribution over rectangular section will be _______. **1**
(a) Parabolic (b) Elliptical (c) Triangular (d) Trapezoidal

v. What are the units of torsional rigidity? **1**
(a) N-mm^2 (b) N/mm (c) N-mm (d) N

vi. Which of the following function can the spring perform? **1**
(a) Store energy (b) Absorb shock
(c) Measure force (d) All of these

vii. In cantilever beams, the slope is _______ at fixed end. **1**
(a) Maximum (b) Zero (c) Minimum (d) Uniform

viii. Elastic curve is also known as ______. **1**
(a) Refraction curve (b) Reflection curve
(c) Deflection curve (d) Newton curve

ix. The cylinder has a tendency to split up along _______ due to circumferential stress. **1**
(a) Area (b) Radius (c) Diameter (d) Length

x. In thin cylinders, the thickness should be ________ times of internal diameter. **1**
(a) 1/40 (b) 1/15 (c) 1/30 (d) 1/20

Q.2 i. What are principal planes and principal stresses? **2**

ii. Explain thermal stress and thermal strain. **2**

iii. Derive the expression for extension of a circular tapered bar due to axial load. **6**

OR iv. A rod of steel 60 mm wide & 15 mm thick is 8 m long. It extends by 5.31 mm when an axial pull of 120 kN is applied on it. Find the Young's Modulus of Elasticity for steel. **6**

Q.3 i. What are the assumptions made in theory of simple bending? **2**

ii. Derive the relation between bending moment and shear force in a beam. What do you mean by point of contraflexure? **8**

OR iii. A rectangular beam 200 mm deep and 300 mm wide is simply supported over a span of 8 m. What uniformly distributed load per meter the beam may carry, if the bending stress is not to exceed 120 N/mm^2. **8**

Q.4 i. Define the following terms: Torsional Rigidity, Polar modulus of section, Spring Index. **3**

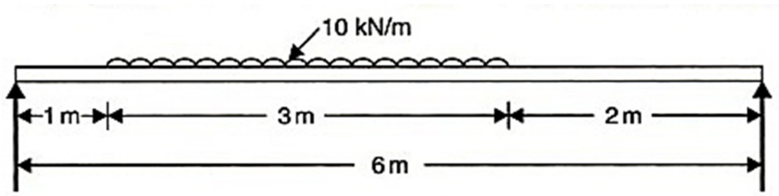
ii. Derive the equation $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$, where the symbols have their usual meanings. **7**

OR iii. A close coiled helical spring of 10 cm mean diameter is made up of 1 cm diameter rod and has 20 turns. The spring carries an axial load of 200 N. Determine the shearing stress induced in spring material. Also determine the axial deflection due to this load. Take the value of shear modulus as 84 GPa. **7**

Q.5 i. Explain the moment area method? Where it is conveniently used? **4**

ii. A beam of length 6 m is simply supported at its ends. It carries a uniformly distributed load of 10 kN/m as shown in figure. Determine the deflection of the beam at its mid-point. Also find the maximum deflection and position of maximum deflection. **6**

Take EI = 4.5×10^5 N/mm^2



OR iii. Describe the Macaulay's method for deflection of beams. **6**

Q.6 Attempt any two:

i. Define the term hoop stress and longitudinal stress of a thin shell? Show that in thin cylinder shells subjected to internal fluid pressure, the circumferential stress is twice the longitudinal stress. **5**

ii. A thin cylindrical shell of 120 cm diameter, 1.5 cm thick and 6 m long is subjected to internal fluid pressure of 2.5 MPa. If the value of E = 2×10^5 N/mm^2 and $\mu = 0.3$, calculate hoop stress, longitudinal stress, change in diameter, change in length and change in volume. **5**

iii. Describe the lames theorem for thick cylindrical shells. **5**

******

Marking Scheme

RA3CO23 (T)-Strength of Materials for Mechanical Engineers

Q.1	i)	(b) Radius	1 Marks	**1**
	ii)	(b) 80	1 Marks	**1**
	iii)	(a) Zero	1 Marks	**1**
	iv)	(a) Parabolic	1 Marks	**1**
	v)	(a) N-mm^2	1 Marks	**1**
	vi)	(d) All of the mentioned	1 Marks	**1**
	vii	(b) Zero	1 Marks	**1**
	vii	(c) Deflection curve	1 Marks	**1**
	ix)	(d) Length	1 Marks	**1**
	x)	(d) 1/20	1 Marks	**1**
Q.2	i.	Principal planes	1 Marks	**2**
		Principal stresses	1 Marks	
	ii.	Thermal stress	1 Marks	**2**
		Thermal strain	1 Marks	
	iii.	Diagram	1 Marks	**6**
		Derive the expression	5 Marks	
OR	iv.	As per attempt	6 Marks	**6**
Q.3	i.	Assumptions (at least 4)	2 Marks	**2**
	ii.	Derive the relation	6 Marks	**8**
		Point of contraflexure	2 Marks	
OR	iii.	As per attempt	8 Marks	**8**
Q.4	i.	Torsional Rigidity	1 Marks	**3**
		Polar modulus of section	1 Marks	
		Spring Index.	1 Marks	
	ii.	Diagram	1 Marks	**7**
		Proper meaning of symbols	1 Marks	
		Derive the equation	5 Marks	
OR	iii.	Mention proper given values	1 Marks	**7**
		Shearing stress induced in spring material	3 Marks	
		Axial deflection.	3 Marks	
Q.5	i.	Explain the moment area method?	2 Marks	**4**
		Where it is conveniently used?	2 Marks	
	ii.	Deflection of the beam at its mid-point.	2 Marks	**6**
		The maximum deflection and	2 Marks	
		Position of maximum deflection.	2 Marks	
OR	iii.	Diagram	1 Marks	**6**
		Explanation	3 Marks	
		Expression	2 Marks	
Q.6	i.	Hoop stress	1 Marks	**5**
		Longitudinal stress of a thin shell	1 Marks	
		Proof	3 Marks	
	ii.	Hoop stress,	1 Marks	**5**
		Longitudinal stress,	1 Marks	
		Change in diameter,	1 Marks	
		Change in length and	1 Marks	
		Change in volume.	1 Marks	
OR	iii.	Diagram	1 Marks	**5**
		Explanation	2 Marks	
		Expression	2 Marks	

******