

University of Mumbai

Examination May -2022

Program: Mechanical Engineering

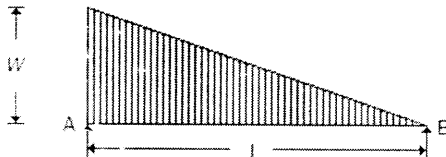
Curriculum Scheme: Rev2019

Examination: SE Semester III

Course Code: MEC302 and Course Name: Strength of Materials

Time: 2.5 hours

Max Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Which of the following has no unit
Option A:	Strain
Option B:	Surface tension
Option C:	Bulk modulus
Option D:	Elasticity
2.	A body is subjected to a tensile stress of 1200 MPa on one plane and another tensile stress of 600 MPa on a plane at right angles to the former. It is also subjected to a shear stress of 400 MPa on the same planes. The maximum normal stress will be
Option A:	400 MPa
Option B:	500 MPa
Option C:	900 MPa
Option D:	1400 MPa
3.	If the slenderness ratio for a column is 100, then it is said to be a _____ column.
Option A:	Long
Option B:	Medium
Option C:	Short
Option D:	Intermediate
4.	The extreme bending moment caused by total of UDL (W) on a cantilever beam of span (L) is
Option A:	$WL/2$
Option B:	$WL/8$
Option C:	$WL/4$
Option D:	$WL/12$
5.	The maximum bending moment for the beam shown in the below figure, lies at a distance of _____ from the end B. 
Option A:	$L/2$
Option B:	$L/3$
Option C:	$L/\sqrt{2}$

Option D:	$L/\sqrt{3}$
6.	Which of the following assumptions are made in torsion theory?
Option A:	Shaft is perfectly straight
Option B:	Material of the shaft is heterogeneous
Option C:	Twist cannot be uniform along the length of the shaft
Option D:	Torsion is not constant along the length
7.	Strain energy stored in a uniform bar is given as
Option A:	$(\sigma E/2A)$
Option B:	$(\sigma L/2AE)$
Option C:	$(\sigma^2 AL/4E)$
Option D:	$(\sigma^2 AL/2E)$
8.	Which of the following is a differential equation for deflection?
Option A:	$dy/dx = (M/EI)$
Option B:	$dy/dx = (MI/E)$
Option C:	$d^2y/dx^2 = (M/EI)$
Option D:	$d^2y/dx^2 = (ME/I)$
9.	A simply supported beam carries uniformly distributed load of 20 kN/m over the length of 5 m. If flexural rigidity is 30000 kN.m ² , what is the maximum deflection in the beam?
Option A:	5.4 mm
Option B:	1.08 mm
Option C:	6.2 mm
Option D:	8.6 mm
10.	The S.I. unit of torsional rigidity is.....
Option A:	Nm
Option B:	N.m ²
Option C:	Nm/ radian
Option D:	Nm ² / radian

Q2	Solve any Two Questions out of Three	10 marks each
A	A copper bar 50mm in diameter is placed within a steel tube 75mm external diameter and 50 mm internal diameter of exactly the same length. The two pieces are rigidly fixed together by two pins 18mm in diameter, one at each end passing through the bar and tube. Calculate the stresses induced in the copper bar, steel tube and pins if the temperature of the combination is raised by 50°C. Take $E_s = 210 \text{ GPa}$; $E_c = 105 \text{ GPa}$; Coefficient of thermal expansion of steel = $11.5 \times 10^{-6}/^\circ\text{C}$; Coefficient of thermal expansion of copper = $17 \times 10^{-6}/^\circ\text{C}$.	
B	For the beam loaded as shown in figure, Draw S.F. and S.M. diagrams. Also locate point of contraflexure if any.	

C	<p>A hollow shaft having an internal diameter 40% of its external diameter transmits 562.5 KW power at 100 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 60 N/mm² and twist in the length of 2.5 m should not exceed 1.3 degrees. Assuming maximum torque as 1.25 times the mean torque and modulus of rigidity as 9×10^4 N/mm².</p>

Q3.	Solve any Two Questions out of Three	10 marks each
A	<p>Find the deflections of points B and C for the beam shown in figure. Assume $EI = \text{constant}$. Point A is a fixed support and point E is a roller support in the figure.</p>	
B	<p>A T-shaped cross section of a beam having flange of 50x200 mm and web of 200x50 mm, is subjected to a vertical shear force of 100 kN. Calculate the shear stress at important points and draw shear stress distribution diagram. Take Moment of Inertia about horizontal neutral axis is 113.4×10^6 mm⁴.</p>	
C	<p>Find the Euler crushing load for a hollow cylindrical cast iron column 200 mm external diameter and 25 mm thick. If it is 6 m long and hinged at both ends. Take $E = 1.2 \times 10^6$ N/mm². Compare the load with crushing load as given by Rankine's formula, take $\sigma_c = 550$ N/mm² and $\alpha = 1/1600$.</p>	

Q4	Solve any Two Questions out of Three	10 marks each
A	<p>A cylindrical thin drum 800 mm in diameter and 3 m long has a shell thickness of 10 mm. If the drum is subjected to an internal pressure of 2.5 N/mm², determine (i) change in diameter, (ii) change in length and (iii) change in volume. Take $E = 2 \times 10^5$ N/mm² and Poisson's ratio = 0.25</p>	
B	<p>A rod 12.5 mm in diameter is stretched 3.2 mm under a steady load of 10 kN. What stress would be produced in the bar by a weight of 700 N, falling through 75 mm before commencing to stretch, the rod being initially unstressed? Take value of E as 2.1×10^5 N/mm².</p>	
C	<p>At a point within the body subjected to two mutually perpendicular directions, the stresses are 20 N/mm² and tensile 10 N/mm² tensile. Each of above stress is accomplished by a shear stress of 10 N/mm². Determine the principal stresses and principal planes by using Mohr circle method.</p>	