Reg. No.															

Question Paper Code	13531

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Fourth Semester

Civil Engineering

20CEPC402 - STRENGTH OF MATERIALS II

Regulations - 2020

(Assume any data if necessary)

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	What is the formula for strain energy stored in a body due to axial loading? (a) $U=\sigma^2V/2E$ (b) $U=P^2/2AE$ (c) $U=1/2P\delta$ (d) All of the above	1	K1	CO1
2.	Strain energy density is defined as: (a) Total strain energy stored in the entire volume (b) Strain energy stored per unit volume (c) The area under the stress-strain curve (d) All of the above	1	K2	CO1
3.	Castigliano's second theorem is applicable for structures that are: (a) Plastic and elastic (b) Linear and elastic (c) Rigid and inelastic (d) Viscoelastic	1	K1	CO2
4.	In the unit load method, deflection at a point is found by applying: (a) Actual load at that point (b) A load equal to the total load (c) A hypothetical load of unit magnitude (d) No load	1	K2	CO2
5.	The fixed end moment for a beam subjected to a uniform load w over the entire span L is: (a) $wL^2/8$ (b) $wL^2/12$ (c) $wL^2/16$ (d) $wL^2/4$	1	K1	CO3
6.	The propped cantilever beam has: (a) One fixed and one simply supported end (b) Both ends fixed (c) One fixed and one free end (d) None of the above	1	K2	CO3
7.	Euler's formula is valid for: (a) Long columns (b) Short columns (c) Columns under eccentric loading (d) None of the above	1	K1	CO4
8.	The Rankine-Gordon formula combines: (a) Elastic and plastic behavior of the column (b) Euler's formula and crushing strength of the material (c) Stress and strain theories (d) None of the above	1	K2	CO4
9.	Stress invariants are quantities that: (a) Depend on the orientation of the axes (b) Remain constant under coordinate transformation (c) Are always zero (d) Are equal to principal stresses	1	K1	CO5
10.	Unsymmetrical bending occurs when: (a) The section is symmetrical but the load is inclined (b) The section is unsymmetrical (c) Both A and B (d) None of the above	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

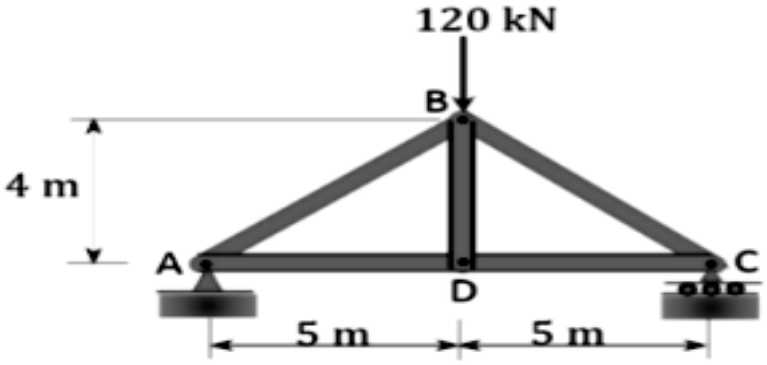
		Marks	K – Level	CO
11.	Define strain energy density.	2	K1	CO1
12.	Define the terms: Proof resilience and Modulus of resilience.	2	K1	CO1
13.	Derive relation for strain energy due to shear.	2	K1	CO2
14.	Compare the unit load method and Castigliano's first theorem.	2	K2	CO2

15.	Explain the statically indeterminate structures with examples.	2	K2	CO3
16.	Define theorem of three moments.	2	K1	CO3
17.	Define thick cylinders.	2	K1	CO4
18.	State the assumptions made in Lame's theory.	2	K1	CO4
19.	Define Stress tensor & stress transformation.	2	K1	CO5
20.	Give the expressions for Maximum and Minimum Principal Stresses on a plane.	2	K1	CO5
21.	Write the expression for position of neutral axis in case of curved bars.	2	K1	CO6
22.	When is Winkler-Bach theory used?	2	K1	CO6

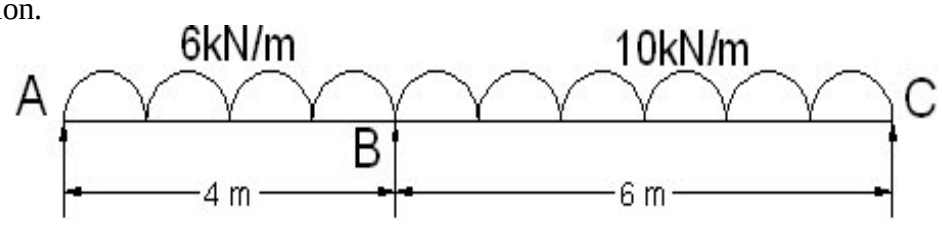
PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	A tensile load of 80 kN is Suddenly applied on a circular bar of 4 cm in diameter and 5 m long. Calculate the strain energy in the rod if E = $2x10^5$ N/mm^2.	11	K2	CO1
		OR			
	b)	A weight of 10 KN falls by 30 mm on a collar rigidly attached to a vertical bar 4m long and 1000 mm^2 in section. Find the instantaneous stress of the bar. Take E = 210 GPa.	11	K2	CO1
24.	a)	A beam of simply supported over a span of 3 m carries a uniformly distributed load of 20 KN/m over the entire span. Take EI=2.25MN/m^2. Use Castiglione's theorem. Find the deflection at the centre of the beam.	11	K3	CO2
		OR			
	b)	Using the virtual work method, determine the vertical deflection at joint D of the truss shown in Figure below. Take E=200GPa and A=5 cm^2	11	K3	CO2



25.	a)	A propped cantilever of span 6m is subjected to a u.d.l of 2kN/m over a length of 4m from the fixed end. Determine the prop reaction and draw the shear force and bending moment diagrams.	11	K3	CO3
		OR			
	b)	Draw the S.F. and B.M. diagrams for the beam shown in the fig. Use three moment equation.	11	K3	CO3



26. a) A pipe of 200 mm internal diameter and 50 mm thickness carries a fluid at a pressure of 10 MPa. Calculate the maximum and minimum intensities of circumferential stress across the section. Also sketch the radial stress distribution and circumferential stress distribution across the section. *11 K2 CO4*

OR

b) (i) What are the assumptions made in Euler's Column theory? *4 K2 CO4*

(ii) Derive the Euler's crippling load for a column with one end fixed and the other end free. *7 K2 CO4*

27. a) Determine the principal stresses and direction cosines of principal stresses and maximum shear stress for the following 3D- stress field. *11 K2 CO5*

$$\sigma = \begin{bmatrix} 110 & 60 & 0 \\ 60 & -86 & 0 \\ 0 & 0 & 55 \end{bmatrix} \text{MPa}$$

OR

b) A cylindrical shell 1.2m diameter is to be made of mild steel plates. It is subjected to an internal pressure of 1.5 MN/m^2. If the material yields at 200 kN/m^2, calculate the thickness of the plate on the basis of following theories of failure assuming a FOS of 2 in each case. *11 K2 CO5*

(i)Maximum principal stress theory
(ii)Maximum shear stress theory
(iii)Maximum shear strain energy theory

28. a) A curved beam of rectangular cross section is subjected to pure bending with a moment of 400 N-m. The beam has width of 20 mm, depth of 40 mm and is curved in plane to the depth. The mean radius of curvature is 50 mm. Determine the position of neutral axis and the ratio of maximum to the minimum stress. *11 K3 CO6*

OR

b) A beam of T-section (flange: 100 × 20 mm, web: 150 mm × 10 mm) is 2.5 m in length and is simply supported at ends. It carries a load of 3.2 kN inclined 20° to the vertical and passing through the centroid of the section. If E= $2x10^5$MPa. Calculate the maximum tensile stress and maximum compressive stress. Also find the position of the neutral axis and deflection due to the load. *11 K3 CO6*