Reg. No.															

Question Paper Code	13265

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Fourth Semester

Civil Engineering

20CEPC402 - STRENGTH OF MATERIALS II

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	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	K1	CO1
2.	According to Castigliano's first theorem, the partial derivative of strain energy with respect to a force gives: (a) Displacement in the direction of the force (b) Stress in the direction of the force (c) Strain in the direction of the force (d) None of the above	1	K2	CO1
3.	If a load P is applied gradually, the strain energy stored is: (a) Equal to gradual loading (b) Twice of gradual loading (c) Four times of gradual loading (d) Half of gradual loading	1	K1	CO1
4.	Which of the following methods can be used to compute deflections in determinate beams? (a) Moment-area method (b) Unit load method (c) Castigliano's theorem (d) All of the above	1	K1	CO2
5.	In the context of energy theorems, the deflection at a point is obtained by: (a) Dividing the total strain energy by the applied load (b) Differentiating the strain energy with respect to the load at the point (c) Integrating the bending moment diagram (d) Multiplying load by span	1	K1	CO2
6.	When using the unit load method for deflection of a truss joint, what force is applied at the joint? (a) The actual load (b) A unit force in the desired direction of deflection (c) Twice the actual load (d) No force is applied	1	K2	CO2
7.	The fixed end moment for a beam subjected to a uniform load www over the entire span L is: (a) $wL^2/8$ (b) $wL^2/12$ (c) $wL^2/16$ (d) $wL^2/24$	1	K2	CO3
8.	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
9.	The theorem of three moments applies to: (a) Simply supported beams (b) Continuous beams (c) Cantilever beams (d) Fixed beams	1	K1	CO3
10.	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
11.	The Rankine-Gordon formula combines: (a) Elastic and plastic behavior of the column (b) Stress and strain theories (c) Euler's formula and crushing strength of the material (d) None of the above	1	K1	CO4

12. Thin spherical shells subjected to internal pressure develop: *1 K2 CO4*
    (a) Hoop stresses only (b) Longitudinal stresses only
    (c) Hoop and longitudinal stresses (d) Radial stresses only
13. Stress invariants are quantities that: *1 K1 CO5*
    (a) Depend on the orientation of the axes (b) Are equal to principal stresses
    (c) Remain constant under coordinate transformation (d) Are always zero
14. The maximum shear stress occurs on a plane inclined at: *1 K1 CO5*
    (a) 45° to the principal plane (b) 30° to the principal plane
    (c) 60° to the principal plane (d) Parallel to the principal plane
15. Theories of failure are applied to determine: *1 K1 CO5*
    (a) Strain energy (b) Failure criteria under complex stress states
    (c) Only principal stresses (d) Stress invariants
16. According to the maximum principal stress theory, failure occurs when: *1 K2 CO5*
    (a) Maximum principal stress exceeds the yield stress
    (b) Maximum shear stress exceeds the yield stress
    (c) Total strain energy exceeds the limit
    (d) Maximum distortion energy exceeds the limit
17. Unsymmetrical bending occurs when: *1 K2 CO6*
    (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
18. The point in a cross-section through which the resultant shear force acts is called: *1 K2 CO6*
    (a) Neutral axis (b) Shear centre (c) Centroid (d) Centre of gravity
19. The Winkler-Bach formula is used to determine: *1 K1 CO6*
    (a) Bending stresses in curved beams (b) Deflections in cantilever beams
    (c) Stresses in thin cylinders (d) None of the above
20. In a curved beam, the neutral axis lies: *1 K1 CO6*
    (a) At the centroid (b) At the geometric center of the cross-section
    (c) Closer to the center of curvature (d) Closer to the outer edge

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Define strain energy density. *2 K1 CO1*
22. Define the terms: Proof resilience and Modulus of resilience. *2 K1 CO1*
23. Derive relation for strain energy due to shear. *2 K1 CO2*
24. Compare the unit load method and Castigliano's first theorem. *2 K2 CO2*
25. Explain with examples the statically indeterminate structures. *2 K2 CO3*
26. Differentiate the statically determinate structures and statically indeterminate structures. *2 K2 CO3*
27. Define: Column and strut. *2 K2 CO4*
28. What are the types of column failure? *2 K1 CO4*
29. Define Stress tensor & stress transformation. *2 K1 CO5*
30. Define Shear Stress. *2 K1 CO6*

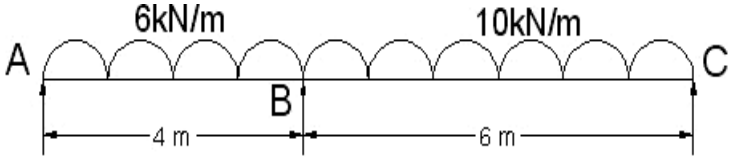
PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) A tensile load of 60 kN is gradually 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. *10 K3 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. *10 K3 CO1*

32.	a)	Using the method of virtual work, examine the deflection at the free end of the cantilever beam carrying uniformly distributed load 25kN/m throughout the length of 12m. Take E = $2x10^5$MPa, I = $825x10^7$mm^4.	*10*	*K3*	*CO2*
		OR			
	b)	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 Castigliano's theorem. Find the deflection at the centre of the beam.	*10*	*K3*	*CO2*
33.	a)	A fixed beam of 6m span is loaded with point loads of 150 kN at distance of 2m from each support. Draw the bending moment diagram and shear force diagram. Also find the maximum deflection.	*10*	*K3*	*CO3*
		OR			
	b)	Draw the S.F. and B.M. diagrams for the beam shown in the fig. Use three moment equation. 	*10*	*K3*	*CO3*
34.	a)	Derive the Eule's crippling load for a column with one end fixed and the other end free.	*10*	*K3*	*CO4*
		OR			
	b)	A hollow cylindrical cast iron column whose external diameter is 200 mm and has a thickness of 20 mm is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 2.5. Take the crushing strength of material as 550 N/mm^2 and Rankine's constant as 1/1600. Find also the ratio of Euler's to Rankine's load. Take E=150 GPa.	*10*	*K3*	*CO4*
35.	a)	The state of stress (Cartesian components of stress) at a point in three dimensional stress system are σxx= 7 MPa, σyy= 6 MPa, σzz= 5 MPa, τxy= 2 MPa,τyz= -2 MPa and τxz= 0 MPa. Determine the principal stresses at the given point.	*10*	*K3*	*CO5*
		OR			
	b)	A mild steel shaft is subjected to an end thrust producing a stress of 120 MPa and the maximum shearing stress on the surface arising from torsion is 90 MPa.The yield point of a material in simple tension was 450 MPa. Calculate the Factor of Safety of the shaft according to, Maximum shear stress theory and Maximum distortion energy theory.	*10*	*K3*	*CO5*
36.	a)	A beam of rectangular section, 80 mm wide and 120 mm deep is subjected to a bending moment of 20 kN.m. The trace of the plane of loading is inclined at 45^o to the YY axis of the section. Locate the neutral axis of the section and calculate the bending stress induced at each corner of the beam section.	*10*	*K3*	*CO6*
		OR			
	b)	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.	*10*	*K3*	*CO6*