Reg. No.															

Question Paper Code	13562

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

Fourth Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

20CEPC405 - STRENGTH OF MATERIALS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Which of the following is an axial stress? (a) Shear stress (b) Bending stress (c) Torsional stress (d) Tensile stress	1	K1	CO1
2.	Why is Poisson's ratio important in deformation analysis? (a) It determines the elastic limit. (b) It relates stress to strain. (c) It predicts lateral deformation from axial load. (d) It calculates thermal expansion.	1	K1	CO1
3.	Why is Mohr's circle useful in stress analysis? (a) It simplifies strain calculations. (b) It directly gives deformation (c) It shows principal stresses and their orientation (d) It calculates wall thickness	1	K1	CO2
4.	In thick spherical shells, is which stress is assumed to be equal in all directions at any point? (a) Shear stresses (b) Axial stress (c) Radial stress (d) Hoop stress	1	K1	CO2
5.	In a solid circular shaft, the maximum shear stress occurs at: (a) Center ` (b) Mid-radius (c) Outer surface (d) End face	1	K1	CO3
6.	The deflection in a closed-coil spring under axial load is proportional to: (Understand) (a) Number of coils (b) Square of diameter of coil (c) Cube of wire diameter (d) Length of wire only	1	K1	CO3
7.	Tell which of the following loads is a transverse load? (a) Axial load (b) Vertical point load on beam (c) Torsional moment (d) Centripetal force	1	K1	CO4
8.	Find the shear force at the supports of a simply supported beam carrying a point load at mid-span: (a) Zero (b) Equal to half of the load each (c) Maximum at the center (d) Uniform throughout	1	K1	CO4
9.	Identify the method best suited for beams with multiple point loads at unequal distances: (a) Double integration method (b) Macaulay's method (c) Conjugate beam method (d) Superposition method	1	K1	CO5
10.	Euler's formula is applicable to (a) short columns (b) medium columns (c) long columns (d) none of the above	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

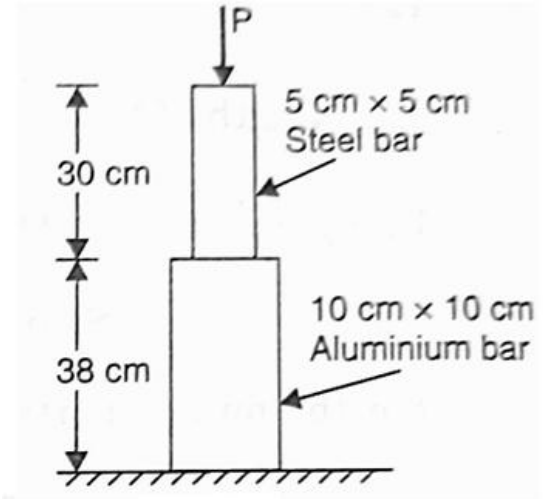
11.	Classify the types of stress.	2	K2	CO1
12.	An aluminum alloy bar, fixed at both ends, is heated through 20 K. Find the stress developed in the bar. Take modulus of elasticity, and coefficient of linear expansion for the bar material as 80 GPa and 24×10^{-6}/K respectively.	2	K2	CO1
13.	Compare a thin cylinder and a thick cylinder.	2	K2	CO2

14.	Define Lame's theorem.	2	*K1*	*CO2*
15.	A solid shaft is to transmit a torque of 25 kNm. If the shearing stress is not to exceed 60 MPa. Find the minimum diameter of the shaft.	2	*K2*	*CO3*
16.	List the applications of springs.	2	*K1*	*CO3*
17.	Define the hogging moment.	2	*K1*	*CO4*
18.	Differentiate between a cantilever beam and a simply supported beam	2	*K2*	*CO4*
19.	A cantilever of length 3 m is carrying a point load of 25 kN at the free end. If the moment of inertia of the beam = 10^8 mm^4 and the value of E = 2.1×10^5 N/mm^2, find the deflection at the free end.	2	*K2*	*CO5*
20.	Identify the deflection equation for a supported beam with an eccentric point load.	2	*K2*	*CO5*
21.	List out the assumptions made in the theory of simple bending	2	*K1*	*CO6*
22.	Differentiate between Euler's and Rankine's formulas for column buckling.	2	*K2*	*CO6*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	A member formed by connecting a steel bar to an aluminium bar is shown in Fig. Assuming that the bars are prevented from buckling sideways, measure the magnitude of force P that will cause the total length of the member to decrease by 0.25 mm. The values of elastic modulus for steel and aluminium are 2.1×10^5 N/mm^2 and 7×10^4 N / $mm^{2,}$ respectively.	*11*	*K2*	*CO1*



OR

	b)	Determine the values of Young's modulus and Poisson's ratio of a metallic bar with a length of 30 cm, breadth of 4 cm, and depth of 4 cm when the bar is subjected to an axial compressive load of 400 kN. The decrease in length is given as 0.075 cm, and the increase in breadth is 0.003 cm.	*11*	*K2*	*CO1*
24.	a)	At a point in a strained material, the principal stresses are 100 N/mm² (tensile) and 60 N/mm² (compressive). Determine the normal stress, shear stress, and resultant stress on a plane inclined at 50° to the axis of the major principal stress. Also, determine the maximum shear stress at the point.	*11*	*K3*	*CO2*

OR

	b)	A thick metallic cylindrical shell of 150 mm internal diameter is required to withstand an internal pressure of 8 N/mm^2. Identify the necessary thickness of the shell if the permissible tensile stress in the section is 20 N/mm^2	*11*	*K3*	*CO2*
25.	a)	A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 r.p.m. Determine the maximum internal diameter if the maximum shear stress in the shaft is not to exceed 60 N/mm^2.	*11*	*K3*	*CO3*

OR

	b)	A closely-coiled helical spring is made up of 10 mm diameter steel wire having 10 coils with 80 mm mean diameter. If the spring is subjected to an axial twist of 10 kN-mm, determine the bending stress and increase in the number of turns. Take E as 200 GPa.	*11*	*K3*	*CO3*
26.	a)	A simply supported beam of length 6 m carries a point load of 3 kN and 6 kN at a distance of 2 m and 4 m from the left end. Illustrate these effects through detailed shear force and bending moment diagrams.	*11*	*K3*	*CO4*
		OR			
	b)	A 6m long cantilever beam carries loads of 5kN, 8kN, and 15kN at 1m, 2.5m, and 5m respectively from the free end and a uniformly distributed load of 12 kN/m over a length of 4m from the fixed end. Construct the shear force and bending moment diagrams.	*11*	*K3*	*CO4*
27.	a)	A beam 6 m long, simply supported at its ends, is carrying a point load of 50 kN at its centre. The moment of inertia of the beam (i.e., I) is given as equal to 78×10^6 mm^4. If E for the material of the beam = 2.1×10^5 N/mm^2, calculate: (i) deflection at the centre of the beam and (ii) slope at the supports.	*11*	*K3*	*CO5*
		OR			
	b)	A cantilever of length 3 m is subjected to a point load of 20 kN at a distance of 1 m from the free end. Identify the slope and deflection of the cantilever at the free end by using the moment area method. Take EI = 8×10^{12} $N\text{-}mm^2$ for the cantilever.	*11*	*K3*	*CO5*
28.	a)	Determine the crippling load of a hollow cast iron column using Rankine's formula. The column has an external diameter of 5 cm and an internal diameter of 4 cm, with a length of 3 m and both ends fixed. Use σ_c = 550 N / mm^2 and a = 1/1600 in Rankine's formula to determine the crippling load.	*11*	*K3*	*CO6*
		OR			
	b)	A solid round bar 4m long and 6cm in diameter is used as a strut. Determine the crippling load if (i) Both ends are hinged (ii) One end is fixed and other end is free (iii) Both ends are fixed E = 200GPa.	*11*	*K3*	*CO6*