Reg. No.															

Question Paper Code	13069

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

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) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The Poission's ratio of rigid body is (a) 0 (b) 1 (c) Less than 1 (d) None of the above	1	K1	CO1
2.	Which stress is induced in a member, when expansion or contraction due to temperature variation is prevented? (a) Compressive stress (b) Thermal stress (c) Tensile stress (d) Shear stress	1	K1	CO1
3.	Limit within which Hooke's law holds good is known as (a) elastic limit (b) plastic limit (c) yield point (d) proportional limit	1	K1	CO1
4.	When a thin cylindrical shell is subjected to an internal pressure, there will be (a) a decrease in diameter and length of the shell (b) an increase in diameter and decrease in length of the shell (c) a decrease in diameter and increase in length of the shell (d) an increase in diameter and length of the shell	1	K1	CO2
5.	A thin cylindrical shell of diameter (d) and thickness (t) is subjected to an internal pressure (p). The ratio of longitudinal strain to volumetric strain is (a) m-1/2m-1 (b) 2m-1/m-1 (c) m-2/2m-4 (d) m-2/5m-4	1	K1	CO2
6.	A cylindrical steel pressure vessel 400 mm in diameter with a wall thickness of 20 mm, is subjected to an internal pressure of 4.5 MPa. The longitudinal stresses in the steel vessel is (a) 22.5 MPa (b) 45 MPa (c) 90 MPa (d) 180 MPa	1	K1	CO2
7.	Two closely coiled helical springs 'A' and 'B' are equal in all respects but the number of turns of spring 'A' is half that of spring 'B' The ratio of deflections in spring 'A' to spring 'B' is (a) 1/8 (b) ¼ (c) ½ (d) 2	1	K1	CO3
8.	When a closely-coiled helical spring is subjected to an axial load, it is said to be under (a) bending (b) Shear (c) Torsion (d) Crushing	1	K1	CO3
9.	When two shafts of same length, one of which is hollow, transmit equal torques and have equal maximum stress, then they should have equal (a) polar moment of inertia (b) Polar Modulus (c) Diameter (d) Angle of twist	1	K1	CO3
10.	In axial thrust diagram, at which point bending moment is zero? (a) Point of contra-flexure (b) Point of inflection (c) Both a. and b (d) None of the above	1	K1	CO4
11.	Which of the following statements is/are true for a simply supported beam? (a) Deflection at supports in a simply supported beam is maximum (b) Deflection is maximum at a point where slope is zero (c) Slope is minimum at supports in a simply supported beam (d) All of the above	1	K1	CO4

12. A beam of uniform strength has *1 K1 CO4*
(a) same cross-section throughout the beam (b) same bending stress at every section
(c) same bending moment at every section (d) same shear stress at every section

13. The central deflection of a simply supported beam of length L with a concentrated load W at the centre is. *1 K1 CO5*
(a) $WL^3/3EI$ (b) $WL^4/3EI$ (c) $WL^3/48EI$ (d) $5WL^4/384\ EI$

14. Bending moment at any section in a conjugate beam gives the actual beam's. *1 K1 CO5*
(a) Curvature (b) Bending moment (c) Deflection (d) Slope

15. Which of the following is a differential equation for deflection? *1 K1 CO5*
(a) $dy / dx = (M/EI)$ (b) $dy / dx = (MI/E)$
(c) $d^2y / dx^2 = (M/EI)$ (d) $d^2y / dx^2 = (ME/I)$

16. The slope and deflection at free end of cantilever beam is *1 K1 CO5*
(a) Zero (b) Maximum (c) Minimum (d) None of the above

17. Euler's formula holds good only for *1 K1 CO6*
(a) short columns (b) long columns
(c) Both long and short columns (d) weak columns

18. Compression members always tend to buckle in the direction of the *1 K1 CO6*
(a) axis of load (b) perpendicular to the axis of load
(c) minimum cross section (d) least radius of gyration

19. The Rankine's theory for active earth pressure is based on the assumption that *1 K1 CO6*
(a) the retained material is homogeneous and cohesion less
(b) the frictional resistance between the retaining wall and the retained material is neglected
(c) the failure of the retained material takes place along a plane called rupture plane
(d) all of the above

20. The Buckling load in a steel column is *1 K1 CO6*
(a) related to length
(b) Directly proportional to the slenderness ratio
(c) In directly proportional to the slenderness ratio
(d) Non-linearity to the slenderness ratio

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Define Poisson's Ratio. *2 K1 CO1*

22. Define factor of safety. *2 K1 CO1*

23. Name the various methods of reducing the hoop stresses. *2 K1 CO2*

24. Distinguish between Circumferential stress and longitudinal stress. *2 K2 CO2*

25. Differentiate between closed coil helical spring and open coil helical spring. *2 K2 CO3*

26. Show the difference in stiffness of two springs when they are connected in series and in parallel. *2 K1 CO3*

27. List out the various types of supports. *2 K1 CO4*

28. Summarize the assumptions in the theory of simple bending. *2 K2 CO4*

29. List the important methods used to find slope and deflection. *2 K1 CO5*

30. Define buckling factor and buckling load. *2 K1 CO6*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50cm apart. Diameters and lengths of each rod are 2cm and 4m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. *10 K2 CO1*
Take E for steel = 2×10^5 N/mm^2 and E for copper = 1×10^5 N/mm^2.

OR

b) Derive the relationship between modulus of elasticity. *10 K2 CO1*

32. a) Two plans AB and AC which are right angles carry shear stress of intensity 17.5N/mm^{2}while these planes also carry a tensile stress of 70N/mm^2 and a compressive stress of 35N/mm^{2}respectively.Determine the following *10 K3 CO2*
(i) Principal planes.
(ii) Principal stresses.
(iii) Maximum shear stress and planes on which it acts.

OR

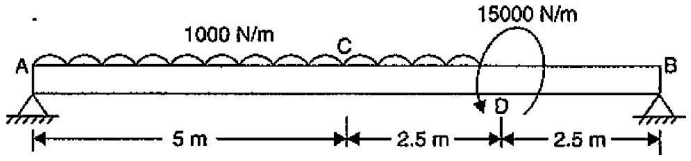
b) A cylindrical thin drum 80cm in diameter and 3m long has a shell thickness of 1cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine: 1. Change in diameter, 2. Change in length and 3. Change in volume. Take E = 2 x 105 N/mm^2 and Poisson's ratio = 0.25. *10 K3 CO2*

33. a) A steel shaft is to require to transmit 75kW power at 100 rpm and the maximum twisting moment is 13% greater than the mean. Find the diameter of the steel shaft if the maximum stress is 70N/mm^2. Also determine the angle of twist in a length of 3m of the shaft. Assume the modules of rigidity for steel as 90kN/mm^2. *10 K3 CO3*

OR

b) The stiffness of the closed coil helical spring at mean diameter 20 cm is made of 3 cm diameter rod and has 16 turns. A weight of 3 KN is dropped on this spring. Find the height by which the weight should be dropped before striking the spring so that the spring may be compressed by 18 cm. Take C= 8x10^4 N/mm^2. *10 K3 CO3*

34. a) Draw shear force and bending moment diagram for the simply supported beam in fig. Also find the maximum bending moment and its position. *10 K3 CO4*



OR

b) A cross section of a beam in the form of a triangle with base 200mm and depth 300mm. If the shear stress on the beam is 60KN study the distribution determine the maximum shear stress. *10 K3 CO4*

35. a) A beam AB of length 8 m is simply supported at its ends and carries two point loads of 50 kN and 40 kN at a distance of 2 m and 5 m respectively from left support A. Determine, deflection under each load, maximum deflection and the position at which maximum deflection occurs.
Take E = 2 x 10^5 N/mm^2 and I = 8.5 X10^6 mm^4. *10 K3 CO5*

OR

b) A horizontal beam is freely supported at its ends 8m apart and carries a UDL of 15 kN/m over the entire span. Find the maximum deflection.
Take E = 2 x 10^5 N/mm^2 and I = 2 x 10^9 mm^4. *10 K3 CO5*

36. a) A 1.5 m long cast iron has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other is free. Taking factor of safety as 3, calculate the safe load using Rankine-Gordan formula. Take yield stress as 560 MPa and constant $\alpha = 1/1600$. *10 K3 CO6*

OR

b) A solid round bar 4 m long and 60 mm in diameter is used as a strut. Determine the Euler's crippling load under the following end conditions: *10 K3 CO6*
(i) Both ends hinged.
(ii) One end fixed and the other end free.
(iii)Both ends are fixed and
(iv) One end is fixed and the other end is hinged.
Assume the modulus of elasticity of the material of the bar as 200 kN/mm^2.