Reg. No.																

Question Paper Code	14355

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Fourth Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

20CEPC405 - STRENGTH OF MATERIALS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Within elastic limit in a loaded material, stress is a) inversely proportional to strain b) directly proportional to strain c) equal to strain d) none of the above	1	K1	CO1
2.	E, G, K, and μ represent the elastic modulus, shear modulus, bulk modulus, and Poisson's ratio, respectively. To express the stress-strain relations completely for this material, at least _____. a) Any two of the four must be known b) All the four must be known c) E, K, and μ must be known d) E, G, and μ must be known	1	K2	CO1
3.	Which law is also called as the elasticity law? a) Poisson's law b) Bernoulli's law c) Stress law d) Hooke's law	1	K1	CO1
4.	The tangential or shear stress on an oblique plane at an angle θ to the cross-section of a body which is subjected to a direct tensile stress (σ) is equal to a) $\frac{\sigma}{2} sin2\theta$ b) $\sigma\ cos\theta$ c) $\sigma\ cos^2\theta$ d) $\sigma\ sin^2\theta$	1	K2	CO2
5.	If a member is subjected to an axial tensile load, the plane normal to the axis of loading carries a) minimum normal stress b) maximum normal stress c) maximum shear stress d) minimum shear stress	1	K1	CO2
6.	Oil tanks, steam boilers, gas pipes are examples of a) thick shells b) thin cylinders c) hoop cylinders d) longitudinal cylinders	1	K1	CO2
7.	Twisting moment is a product of _____ and the radius. a) direction b) velocity c) force d) acceleration	1	K1	CO3
8.	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) $\frac{m-1}{2m-1}$ b) $\frac{2m-1}{m-1}$ c) $\frac{m-2}{3m-4}$ d) $\frac{m-2}{5m-4}$	1	K2	CO3
9.	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) 1/4 c) 1/2 d) 4	1	K2	CO3
10.	The point of contraflexure is a point where a) shear force changes sign b) bending moment changes sign c) shear force is maximum d) bending moment is maximum	1	K1	CO4

11.	The simply supported beam 'A' of length l carries a central point load W. Another beam 'B' is loaded with a uniformly distributed load such that the total load on the beam is W. The ratio of maximum deflections between beams A and B is a) 5/8 b) 8/5 c) 5/4 d) 4/5	*1*	*K2*	*CO4*
12.	When shear force at a point is zero, then bending moment is _____ at that point. a) zero b) minimum c) maximum d) infinity	*1*	*K2*	*CO4*
13.	In cantilever beams, the deflection is zero at _____. a) free end b) fixed end c) at supports d) through out	*1*	*K1*	*CO5*
14.	Which of the following method is not used for determining slope and deflection at a point? a) moment area method b) double integration method c) isoheytal method d) Macaulay's method	*1*	*K1*	*CO5*
15.	Calculate the maximum deflection of a simply supported beam if the maximum slope at A is 0.0075 radians and the distance of centre of gravity of bending moment diagram to support A is 1.33 metres. a) 9.975 mm b) 9.5 mm c) 9.25 mm d) 9.785 mm	*1*	*K1*	*CO6*
16.	Where will be the center of gravity of an I section will be if the dimension of web is 2x20cm and that of flange is 2x15cm If the y-axis will pass through the center of the section? a) 8.5cm b) 9.5cm c) 10.5cm d) 11.5cm	*1*	*K1*	*CO6*

PART – A (ii) (Short Answer Questions)
(6 × 3 = 18 Marks)
Answer ALL Questions

17.	Summarize Hooke's Law.	*3*	*K2*	*CO1*
18.	Determine the magnitude of maximum principal stress in an element of a stressed body which is subjected to a pure shear stress of 40 N/mm^2.	*3*	*K3*	*CO2*
19.	A weight of 3 kN is dropped onto a helical spring with mean diameter 200 mm, wire diameter 30 mm and having 16 coils. In doing so the spring is compressed by 180 mm. If the height of fall is 162 mm determine the spring stiffness. Take G = 80 GPa.	*3*	*K3*	*CO3*
20.	Explain the term "Point of contraflexure".	*3*	*K2*	*CO4*
21.	A beam simply supported at ends over a span of 4 m carries a uniformly distributed load of 15kN/m throughout its entire span. If EI = 25 $MN\text{-}m^2$, calculate the maximum deflection in the beam.	*3*	*K3*	*CO5*
22.	Show the assumptions made in Euler's column theory.	*3*	*K2*	*CO6*

PART - B (Descriptive Answer Questions)
(6 × 11 = 66 Marks)
Answer ALL Questions

23.	a)	A copper rod with a diameter of 15 mm is enclosed in a steel tube with an external diameter of 30 mm and an interior diameter of 20 mm. The tube is firmly attached to the rod at both ends. Analyse the stresses in the rod and tube when the temperature is increased to 200°C if there is no longitudinal stress at 10°C. Consider E to be $2.1x10^5$ N/mm^2 for steel and $1x10^5$ N/mm^2 for copper. For steel and copper, the coefficient of linear expansion is $11x10^{-6}$ per °C and $18x10^{-6}$ per °C, respectively.	*11*	*K3*	*CO1*

OR

b) A metallic bar 250 mm x 100 mm x 50 mm is loaded as shown in figure 23. b). Identify the change in volume. Take E = 2 x 10^5 N/mm^2 and Poisson's ratio = 0.25. Also find the change that should be made in the 4 MN load, in order that there should be no change in the volume of the bar. *11 K3 CO1*

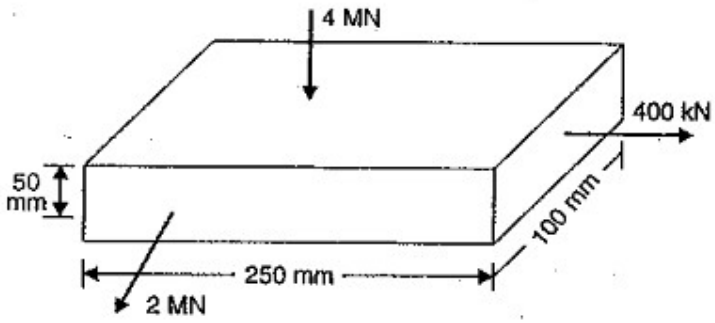

Figure. 23. b).

24. a) Two mutually perpendicular planes of an element of material are subjected to direct stresses of 10.5 N/mm^2 (tensile) and 3.5 N/mm^2 (compressive) and shear stress of 7 N/mm^2. Graphically or otherwise determine the magnitude and direction of principal stress. *11 K3 CO2*

OR

b) A thin cylindrical shell 1 m in diameter, 3 m length and a wall thickness of 10 mm is subjected to an internal pressure of 1.5 MN/m^2. Discover the stresses, strain, change in dimensions. Assume the modulus of elasticity and Poisson's ratio of the shell material as 200 GN/m^2 and 0.3 respectively. *11 K3 CO2*

25. a) A hollow circular shaft 20 mm thick transmits 300 kW power at 200 r.p.m. Determine the external diameter of the shaft if the shear strain due to torsion is not to exceed 0.00086. Take modulus of rigidity = 0.8x10^5 N/mm^2. *11 K3 CO3*

OR

b) A closed coil helical spring is to deflect 1 mm under the axial load of 100 N at shearing of 90 N/mm^2. The spring is to be made of round wire having rigidity modulus of 80x10^4 N/mm^2. The mean diameter of the spring is to be 10 times the diameter of the wire. Determine the diameter and length of the wire necessary to form the spring. *11 K3 CO3*

26. a) A beam of 8 m span simply supported at its end carries loads of 2 kN and 5 kN at a distance of 3 m and 6 m respectively from right support. In addition, the beam carries a UDL of 4 kN/m for its entire length. Build the SF and BM diagrams. *11 K3 CO4*

OR

b) A rectangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN. Determine: (i) Average shear stress, (ii) Maximum shear stress and (iii) Shear stress at a distance of 25 mm above the neutral axis. *11 K3 CO4*

27. a) A beam with a span of 4.5 metres carries a point load of 30 kN at 3 metres from the left support. If for the section, I_{XX} = 54.97 × 10^{-6} m4 and E = 200 GPa, calculate the deflection under the load. *11 K3 CO5*

OR

b) A simply supported beam of 8 m length carries two-point loads of 64 kN and 48 kN at 1 m and 4 m respectively from the left-hand end. Construct the deflection under each load and the maximum deflection using Macaulay's method. E = 210 GPa and I = 180x10^6 mm^4. *11 K3 CO5*

28. a) A column of timber section 15 cm x 20 cm is 6 m long both ends being fixed. If the young's modulus for timber = 17.5 kN/mm^2, determine: (i) Crippling load and (ii) Safe load for the column if factor of safety = 3. *11* *K3* *CO6*

OR

b) Identify the safe compressive load on a hollow cast iron column (one end rigidly fixed and other hinged) of 15 cm external diameter, 10 cm internal diameter and 10 m in length. Use Euler's formula with a factor of safety of 5 and E = 95 kN/mm^2. *11* *K3* *CO6*