Reg. No.																

Question Paper Code	13081

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

Third Semester

Civil Engineering

20CEPC301 - STRENGTH OF MATERIALS - I

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The ultimate stress of a material is: (a) The maximum stress it can withstand before breaking (b) The stress at the elastic limit (c) The stress at the proportional limit (d) The stress just before yielding	1	K1	CO1
2.	In the stress-strain diagram, which point indicates the limit beyond which permanent deformation occurs? (a) Proportional limit (b) Elastic limit (c) Yield point (d) Ultimate point	1	K1	CO1
3.	The elongation of an axially loaded bar is given by (a) $\Delta L = P \times L / E \times A$ (b) $\Delta L = P / L \times E \times A$ (c) $\Delta L = P \times A / L \times E$ (d) $\Delta L = P \times E / L \times A$	1	K1	CO1
4.	The thermal stress induced in a bar due to temperature change is given by (a) $\sigma = \alpha \times E \times \Delta T$ (b) $\sigma = E / (\alpha \times \Delta T)$ (c) $\sigma = E \times L \times \Delta T$ (d) $\sigma = \alpha \times L / \Delta T$	1	K1	CO2
5.	The orientation of principal planes can be determined using: (a) Shear force diagram (b) Principal stress equations or Mohr's circle (c) Deflection equations (d) Euler's buckling formula	1	K1	CO2
6.	Maximum shear stress occurs when: (a) The angle between the principal planes is 45° (b) The normal stress is maximum (c) The difference between the principal stresses is maximum (d) The normal stress is zero	1	K1	CO2
7.	What is the relationship between shear force and bending moment? (a) The derivative of the shear force is equal to the load intensity (b) The derivative of the bending moment is equal to the shear force (c) The second derivative of the shear force is equal to the moment (d) Shear force is the integral of the moment	1	K1	CO3
8.	For a uniformly distributed load (UDL) acting on a simply supported beam, the shear force diagram will be: (a) A constant line (b) A straight line sloping downwards (c) A parabolic curve (d) A step function	1	K1	CO3
9.	A flitched beam is designed to: (a) Reduce bending stress (b) Increase the load-carrying capacity (c) Minimize deflection (d) Increase shear strength	1	K1	CO3
10.	In the double integration method, the first integration of the moment equation provides (a) Deflection of the beam (b) Slope of the beam (c) Shear force (d) Reaction at supports	1	K1	CO4
11.	Which of the following methods is used when the loading condition changes at certain points along the beam? (a) Double integration method (b) Macaulay's method (c) Conjugate beam method (d) Area moment method	1	K1	CO4

12. In the conjugate beam method, the bending moment in the conjugate beam is equivalent to — *1 K1 CO4*
    (a) Slope in the real beam (b) Deflection in the real beam
    (c) Load on the real beam (d) Shear force in the real beam
13. Intheory of torsion for solid circular shafts, which of the following assumptions is made? — *1 K1 CO5*
    (a) Shear stress varies linearly along the radius
    (b) Plane sections before twisting remain plane after twisting
    (c) The material is non-homogeneous
    (d) Maximum shear stress occurs at the center of the shaft
14. In combined bending and torsion of a shaft, resultant stress at any point is determined by — *1 K1 CO5*
    (a) Superimposing the bending stress and torsional stress
    (b) Taking the difference between bending and torsional stress
    (c) Using von Mises stress formula
    (d) Dividing the bending stress by the torsional stress
15. For a closed-coiled helical spring subjected to axial loading, the major type of stress induced in the wire is — *1 K1 CO5*
    (a) Tensile stress (b) Shear stress (c) Bending stress (d) Compressive stress
16. In the design of buffer springs, which of the following factors is most critical to prevent permanent deformation? — *1 K1 CO5*
    (a) Material yield strength (b) Spring index (c) Factor of safety (d) Modulus of rigidity
17. Which of the following is a key characteristic of a statically determinate truss? — *1 K1 CO6*
    (a) The number of unknowns exceeds the number of available equilibrium equations
    (b) The truss is unstable
    (c) The forces in all members can be determined using only the equilibrium equations
    (d) Additional supports or members are required to maintain stability
18. For a truss to be statically determinate and stable, what should be the relationship between the number of joints (J), members (M), and reactions (R)? — *1 K1 CO6*
    (a) M = 2J – 3 (b) M = 2J – R (c) M = 2J + 3 (d) M = 2J + R
19. Which of the following methods is generally used to analyze space trusses? — *1 K1 CO6*
    (a) Method of joints (b) Method of sections
    (c) Tension coefficient method (d) Moment distribution method
20. In analyzing a pin-jointed plane truss using the method of sections, which of the following steps is performed first? — *1 K1 CO6*
    (a) Isolating the section of interest by "cutting" the truss through the members to be analyzed
    (b) Drawing a free-body diagram of the entire truss
    (c) Applying the moment equilibrium equation to each joint
    (d) Calculating the internal forces at the joints

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. How is the deformation of an axially loaded member determined, and which factors influence this deformation? — *2 K2 CO1*
22. Define ultimate yield stress. — *2 K1 CO1*
23. Define the principal stresses and explain how the Mohr's Circle method is used to determine the maximum shear stress on an inclined plane. — *2 K2 CO2*
24. Draw the mohr's circle for pure shear stresses of 50N/mm^2 at a point A. — *2 K2 CO2*
25. What is the stress distribution across a beam section subjected to simple bending? — *2 K2 CO3*
26. What is the relationship between the intensity of a load, shear force, and bending moment in a beam? — *2 K2 CO3*
27. How does Macaulay's method simplify the calculation of beam deflection? — *2 K2 CO4*
28. Write the governing differential equation for the elastic curve of a beam subjected to bending. — *2 K2 CO4*

29. What is the expression for the deflection of a closed-coiled helical spring subjected to an axial load? *2 K2 CO5*

30. What is the difference between determinate and indeterminate trusses in structural analysis? *2 K2 CO6*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Determine the total change in length of a uniform cross section bar subjected to axial forces as shown in Figure:1. The cross section of bar is 600mm^2.Also determine the stresses developed in each portion. Take E = 2.1 x 10^{11}N/m^2. *10 K3 CO1*

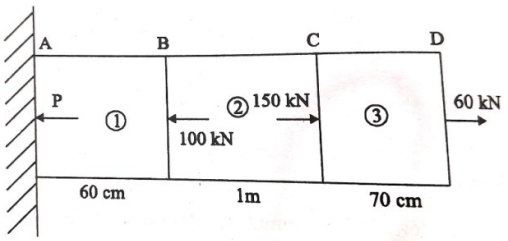

Figure: 1

OR

b) A composite member made up of aluminum and brass rigidly connected as shown in Figure:2 at 85°C. The temperature is lowered to 22°C.Determine the stresses developed in the members. Take E_{Al}=0.7x10^5N/mm^2, E_{Br} = 0.86 x 10^5N/mm^2, α_{Al} = 2.28 x 10^{-5}/°C, α_{Br} = 1.65 x 10^{-5}/°C. *10 K3 CO1*

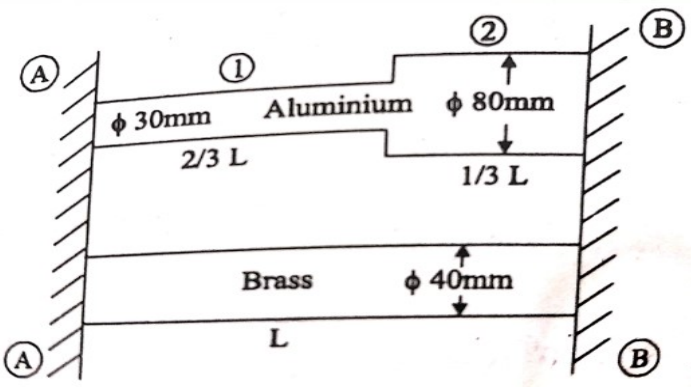

Figure:2

32. a) A member is subjected to normal stresses of 50mpa and 30mpa both tensile. It is also subjected to a complementary shear stress of 15mpa. Determine the major and minor principal stresses and their plane of inclination. *10 K3 CO2*

OR

b) A plane of subjected to a complementary shear of 50mpa along with normal stresses acting on a perpendicular planes of magnitude 200mpa (T) and 150mpa (C) respectively. Determine major and minor principal normal and shear stresses using Mohr's circle method. Also find out their inclination. *10 K3 CO2*

33. a) A simply supported beam of span 6m is carrying a uniformly distributed load of 2kN/m over the entire span. Calculate the magnitude of shear force and bending moment at every section, 2m from the left support. Also draw shear force and bending moment diagram. *10 K3 CO3*

OR

b) A steel plate of width120mm and of thickness 20mm is bent into a circular arc of radius 10m.determine the maximum stress induced and the bending moment which will produce the maximum stress. Take G = 2 x 10^5 N/mm^2. *10 K3 CO3*

34. a) i) A cantilever beam of span 2m is loaded with 10kN at free end. The moment of inertia of the beam is $1.2x10^6mm^4$ and E = 1.8 x 10^5 N/mm^2.Determine the slope and deflection at free end using double integration method. *5 K3 CO4*

ii) Determine the slope and deflection at the free end of the cantilever beam of 5m span with 6kN point load at the free end using moment area method *5 K3 CO4*

OR

b) A beam of 6m long, simply supported at its ends, is carrying a point load of 50kN at its center. The moment of inertia of the beam is given as equal to $78x10^6mm^4$. If E for the material of the beam = $2.1x10^5N/mm^2$. Calculate i) deflection at the center of the beam ii) slope at the supports. *10 K3 CO4*

35. a) The internal and external diameter of a hollow shaft is in the ratio of 2:3. The hollow shaft is to transmit a 400kW power at 120rpm. The maximum expected torque is 15% greater than the mean value. If the shear stress is not to exceed 50mpa.Find the section of the shaft which would the shear stress and twist conditions. Take G = 0.85 x 10^5 Mpa. *10 K3 CO5*

OR

b) A closely coiled helical spring absorbs 85Nm energy and produces a deflection of 70mm. Determine the mean coil diameter as well as the wire diameter of the spring. The spring index is 8 and number of turns is 11. Take G = 78Gpa. *10 K3 CO5*

36. a) Using the method of joint, determine the axial force in each member of the truss shown in Figure:3 *10 K3 CO6*

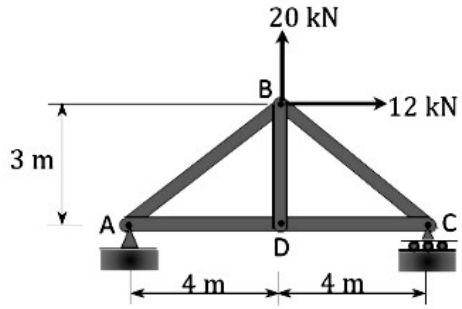

Figure : 3

OR

b) Using the method of section, determine the axial forces in members CDCD, CGCG, and HGHG of the truss shown in Figure 4 *10 K3 CO6*

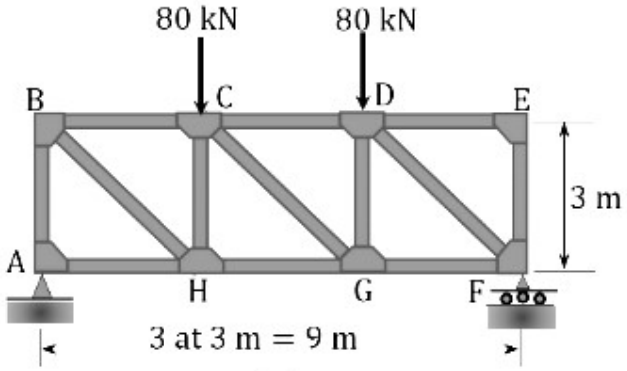

Figure: 4