| Reg. No. | | | | | | | | | | | | |
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| Question Paper Code | 12034 |
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**B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023**

Fourth Semester

**Civil Engineering**

**20CEPC402 - STRENGTH OF MATERIALS – II**

(Regulations 2020)

Duration: 3 Hours | Max. Marks: 100

**PART - A (10 × 2 = 20 Marks)**

Answer ALL Questions

| | | *Marks, K-Level, CO* |
|---|---|---|
| 1. | State Maxwell's reciprocal theorem. | *2,K1,CO1* |
| 2. | Write the formula to calculate the strain energy due to bending under Point load. | *2,K2,CO1* |
| 3. | What are the advantages and limitations of theorem of three moments? | *2,K2,CO3* |
| 4. | What is shear force and bending moment? | *2,K2,CO3* |
| 5. | What is slenderness ratio (buckling factor)? | *2,K1,CO4* |
| 6. | State the assumptions made in Lame's theory. | *2,K1,CO4* |
| 7. | Give the expressions for Maximum and Minimum Principal stresses on a plane. | *2,K1,CO5* |
| 8. | What are the three stress invariants? | *2,K2,CO5* |
| 9. | Differentiate between symmetrical and unsymmetrical bending. | *2,K2,CO6* |
| 10. | When is Winkler-Bach theory used? | *2,K2,CO6* |

**PART - B (5 × 13 = 65 Marks)**

Answer ALL Questions

| | | | | |
|---|---|---|---|---|
| 11. | a) | 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. | *13,K2,CO1* |
| | | **OR** | |
| | b) | An axial pull of 40 KN is suddenly applied to steel rod 2m long and 1000 $mm^2$ in cross section .Calculate the strain energy that can be absorbed if E = 200 $GN/m^2$. | *13,K2,CO1* |
| 12. | a) | A cantilever of length L carries a concentrated load W at the end span if the free end is supported on a rigid prop, find the reaction at the prop. Also draw shear force and bending moment diagrams. | *13,K2,CO3* |
| | | **OR** | |

b) A beam ABCD 16 m long is continuous over three spans; AB = 6 m, BC = 6m and CD = 6 m, the supports being at the same level. There is a uniformly distributed load of 20 kN/m over BC. On AB, there is a point load of 80 kN at 2 m from A. On CD there is a point load of 60 kN at 3m from D. Calculate the moments and reactions at the supports using theorem of three moments. *13,K2,CO3*

13. a) (i) What are the assumptions made in Euler"s Column theory? *3,K2,CO4*

(ii) Derive the Euler"s crippling load for a column with one end fixed and the other end free. *10,K2,CO4*

**OR**

b) Determine the maximum and minimum hoop stress across the section of pipe of 400 mm internal diameter and 100 mm thick, the pipe contains a fluid at a pressure of 8 $N/mm^2$. Also sketch the radial pressure distribution and hoop stress distribution across the section. *13,K2,CO4*

14. a) In a steel member, at a point the major principal stress is 200 $MN/m^2$ and the minor principal stress is compressive. If the tensile yield point of the steel is 235 $MN/m^2$, find the value of the minor principal stress at which yielding will commence, according to each of the following criteria of failure *13,K2,CO5*

i) Maximum shearing stress.
ii) Maximum total strain energy and
iii) Maximum shear strain energy.

Take Poisson Ratio = 0.26.

**OR**

b) Determine the principal stresses and direction cosines of principal stresses and maximum shear stress for the following 3D- stress field. *13,K2,CO5*

$$\sigma = \begin{bmatrix} 110 & 60 & 0 \\ 60 & -86 & 0 \\ 0 & 0 & 55 \end{bmatrix} \text{MPa}$$

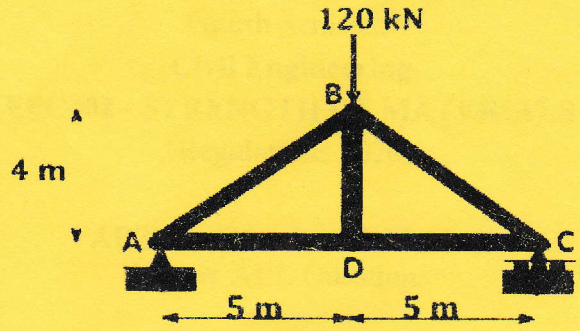
15. a) A curved beam of rectangular cross section is subjected to pure bending with a moment of 400 N-m. The beam has width of 20 mm, depth of 40 mm and is curved in plane to the depth. The mean radius of curvature is 5 mm. Determine the position of neutral axis and the ratio of maximum to the minimum stress. Also, plot the variation of the bending stress across the section. *13,K2,CO6*

**OR**

b) Determine the principal moments of inertia for an unequal section 60 mm x 60 mm x 8 mm. *13,K2,CO6*

## PART - C (1 × 15 = 15 Marks)

16. a) Using the virtual work method, determine the vertical deflection at joint D of the truss shown in Figure below. Take E=200GPa and A=5 $cm^2$. *15,K2,CO2*




**OR**

b) A beam of length 8m is loaded with a single concentrated load of 100 kN at a distance of 4m from the left end. Using Castigliano's theorem, obtain the deflection under the concentrated load. EI =2.2MN$m^2$. *15,K2,CO2*