Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (R), DECEMBER 2023

MACHINE DESIGN

(2021 Scheme)

Course Code: **21MD103**

Course Name: **Advanced Mechanics of Solids**

Max. Marks: **60** **Duration: 3 Hours**

Students are permitted the use of faculty approved data sheets

PART A

(Answer all questions. Each question carries 3 marks)

1. Discuss Airy's stress function. Express the stresses in terms of Airy's function.
2. Describe briefly the principle of virtual work with an example.
3. Obtain the strain energy expression for a bar subjected to axial load.
4. Write the expressions for determining radial and tangential stresses in thick cylinders.
5. List the assumptions in solving contact stress problems.
6. Discuss the mechanism of crack formation and crack propagation.
7. List the assumptions in the Plasticity theory.
8. Explain the Kelvin-Voigt rheological model.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Derive the strain compatibility equations. (6)

OR

10. Evaluate the principal stresses and the principal plane corresponding to the maximum principal stress for the given stress matrix. All values are in MPa. (6)

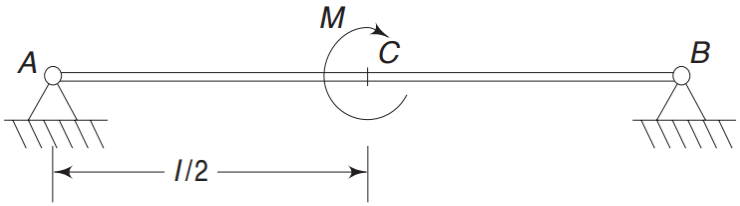
$$\begin{bmatrix} 23 & 20 & 12 \\ 20 & 15 & 21 \\ 12 & 21 & 19 \end{bmatrix}$$

MODULE II

11. a) State and derive Castigliano's first theorem. (4)
    b) State Maxwell's Reciprocal theorem. (2)

OR

12. Determine the rotation of point C of the beam under the action of a couple M applied at its center. (6)

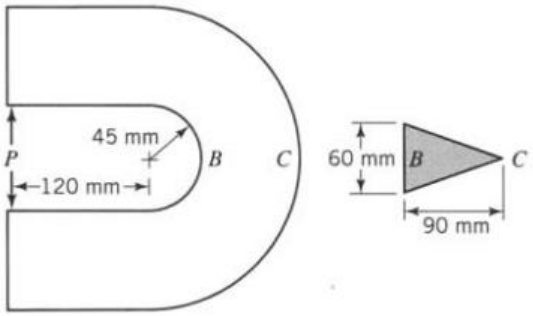


MODULE III

13. A long, closed cylinder has an internal radius a = 100 mm and an external radius b = 250 mm. It is subjected to an internal pressure p_1 = 80.0 MPa (External pressure p_2 = 0). Determine the maximum radial, circumferential, and axial stresses in the cylinder. (6)

OR

14. The curved beam shown has a triangular cross section with the dimensions shown. If P = 40 kN, determine the circumferential stresses at B and C. (6)



MODULE IV

15. Two cylindrical steel rollers (E = 200 MPa and poisson's ratio, ν = 0.29), each 80 mm in diameter and 150 mm long, are mounted on parallel shafts and loaded by a force P = 80 kN. The two cylinders are rotated at slightly different speeds so that the roller surfaces slide across each other. If the coefficient of sliding friction is β = 0.333, determine the maximum compressive principal stress, maximum shear stress, and maximum octahedral shear stress. (6)

OR

16. In terms of P compute the maximum principal stress, maximum shear stress, and maximum octahedral shear stress in two steel balls (E = 200 GPa and poisson's ratio, ν = 0.29), 200 mm in diameter pressed together by a force P. (6)

MODULE V

17. Explain Griffith criterion in fracture mechanics (6)

OR

18. Discuss the J-Integral for crack energy release rate. (6)

MODULE VI

19. Explain the von Mises and Tresca yield conditions (6)

OR

20. Discuss the applications of viscoelastic materials. (6)

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