Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), FEBRUARY 2022

(MACHINE DESIGN)

(2021 Scheme)

Course Code : **21MD103**

Course Name: **Advanced Mechanics of Solids**

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

PART A

(Answer all questions. Each question carries 3 marks)

1. State and explain Stress Invarients. Why are they called so?
2. Explain Fictitious Load Method.
3. Write down the general equations of radial and tangential stress in a thick cylinder.
4. What are the fundamental assumptions in determining contact analysis
5. Explain crack initiation and propagation
6. What do you mean by J-Inegral?
7. Draw stress-strain curve for a perfectly elastic, perfectly plastic and elastoplastic material.
8. Explain Kelvin-Voigt Model

PART B

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

MODULE I

9. Determine the principal stresses and their axes for the state of stress characterized by the following stress matrix (All values in MPa) (6)

$$[\tau_{ij}] = \begin{bmatrix} 18 & 0 & 24 \\ 0 & -50 & 0 \\ 24 & 0 & 32 \end{bmatrix}$$

OR

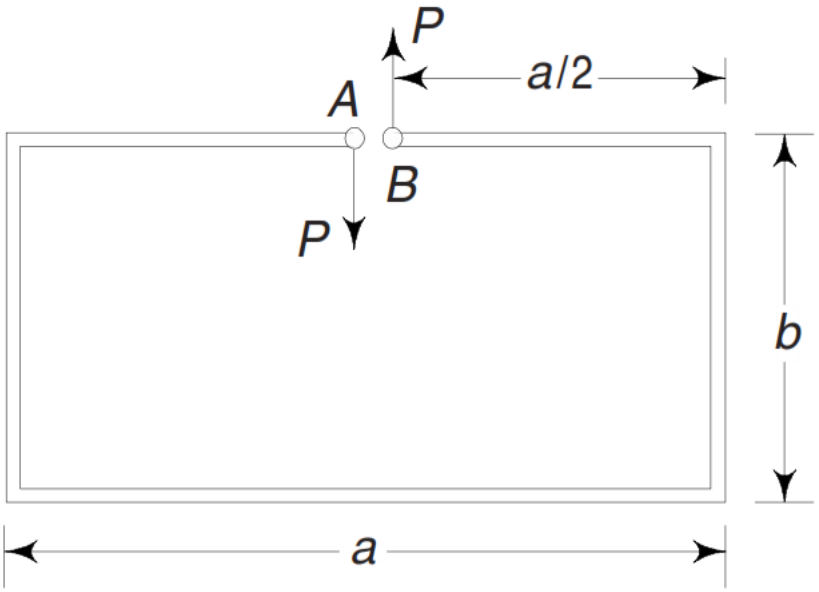
10. Prove that the Airy's function $\Phi = A(x^4 - 3x^2y^2)$ is a possible stress function for a two-dimensional elasticity problem. Find the stress distribution due to this function. (6)

MODULE II

11. a) Explain the principle of minimum potential energy. (3)
    b) What is the principle of virtual work and its application in finding load and displacements at a point (3)

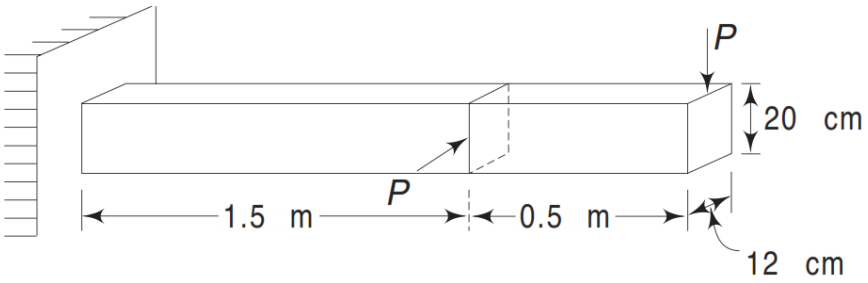
OR

12. What is the relative displacement of points ***A*** and ***B*** in the framework shown? Consider only bending energy. (6)



MODULE III

13. For the cantilever shown , determine the maximum absolute value of the flexural stress and locate the neutral axis at the section where this maximum stress occurs. ***P=1960N*** (6)



OR

14. A thick-walled tube is subjected to an external pressure p_2. Its internal and external radii are ***10cm*** and ***15cm*** respectively. Poison ratio $\nu=0.3$ and $E=200000MPa$. If the maximum shear stress is limited to ***200000kPa***, determine the value of p_2 and the change in the external radius. (6)

MODULE IV

15. A feed roll consists of two cylindrical steel rollers, each 200mm in diameter and arranged so that their longitudinal axes are parallel. A cylindrical steel shaft 60 mm in diameter is fed between the rollers in such a manner that its longitudinal axis is perpendicular to that of the rollers. The total load P between the shaft and rollers is 4.5kN. Determine the values of the maximum principal stress and maximum shear stress in the shaft. Determine the distance from the plane of contact to the point of maximum shear stress. Use $E = 200GPa$ and $\nu=0.29$ for the shaft. (6)

OR

16. A fatigue testing machine has two identical steel disks ($E=200GPa$, $\nu=0.29$) rolling together. The identical disks have a radius of curvature of ***40mm*** and width $h=20mm$. (6)

For rolling without friction a load ***P=24.1kN*** produces the following stresses: σ_{max}***=1445MPa***, τ_{max}***=433MPa*** and $\tau_{oct(max)}$***=361MPa***. Let the cylinders be subjected to a load ***P=24.1kN*** and be rotated at slightly different speeds so that the roller surfaces slides across each other. If the coefficient of sliding friction is 0.111 determine σ_{max}*(tension)*, σ_{max}*(compression)*, τ_{max} and $\tau_{oct(max)}$.

[For friction coefficient 0.111: Maximum tensile principal stress = 2b/9Δ, maximum compressive principal stress = -1.13b/Δ, maximum shear stress = 0.310b/Δ and maximum octahedral shear stress = 0.255b/Δ]

MODULE V

17. Explain with figures, the crack resistance curve. (6)

OR

18. Obtain the expression for stress at crack tip (6)

MODULE VI

19. Explain in detail Von-Mises and Tresca Yield conditions (6)

OR

20. Explain any two testing methods for viscoelastic material (6)

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