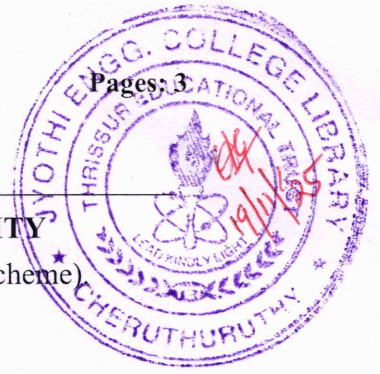


Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (R,S) Examination November 2025 (2019 Scheme)

**Course Code: RAT433****Course Name: THEORY OF ELASTICITY****Max. Marks: 100****Duration: 3 Hours****PART A***Answer all questions, each carries 3 marks.*

Marks

- | | | |
|----|---|-----|
| 1 | Define state of stress at a point. | (3) |
| 2 | Explain compatibility conditions. What is its significance in solving problems on elasticity? | (3) |
| 3 | Write the stress strain relations for isotropic material. | (3) |
| 4 | Write a short note on the use of polynomials in the solution of rectangular beam problems. | (3) |
| 5 | Explain the principle of photo elasticity. | (3) |
| 6 | What are principal stresses? How is it related to maximum shear stress? | (3) |
| 7 | Detail the phenomenon of warping in torsion. | (3) |
| 8 | Define torsional rigidity and give its units. | (3) |
| 9 | Explain P-waves and S-waves in an elastic solid. | (3) |
| 10 | State the maximum shear stress theory and give its condition for yielding. | (3) |

PART B*Answer any one full question from each module, each carries 14 marks.***Module I**

- 11 a) At a point P in a body $\sigma_x = 10000 \text{ N/cm}^2$, $\tau_{xy} = \tau_{yz} = \tau_{zx} = 10000 \text{ N/cm}^2$, $\sigma_y = -5000 \text{ N/cm}^2$, $\sigma_z = -5000 \text{ N/cm}^2$. Determine the normal and shearing stresses on a plane that is equally inclined to all the three axes (7)
- b) The state of stress at a point is given by
- | | | |
|-----|-----|-----|
| 70 | -40 | 20 |
| -40 | 10 | 20 |
| 20 | 20 | -20 |
- (7)
- All units are in MPa.

Determine the principal stresses and maximum shear stress.

OR

- 12 a) The displacement field for a body is given by $U = (x^2+y)i + (3+z)j + (x^2+2y)k$. Write down the displacement gradient matrix at point (3,1,-2). (9)
- b) Explain the differential strain displacement relations. (5)

Module II

- 13 Given the stress function $\Phi = - (F/h^3)xy^2(3h-2y)$. Determine the stress components and sketch their variations in a region included in $y = 0$, $y=h$, $x=0$ on the side x positive. (14)

OR

- 14 a) Explain what problem of plane stress can be solved using 3rd degree polynomial (7)
- b) What is meant by stress concentration? List the boundary conditions applied to solve the problem of a plate with a hole. (7)

Module III

- 15 a) A body is subjected to two mutually perpendicular principal stresses which are unequal and unlike. Write the steps for drawing Mohr's circle of stresses and explain how will you obtain normal stress, shear stress and resultant stress on an oblique plane which is inclined at an angle of θ with the axis of minor axis (7)
- b) The stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (Compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of major stress. Also determine the maximum intensity of shear stress in the stress in the material at the point using analytical method. (7)

OR

- 16 a) At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of magnitude 10 N/mm^2 . Find graphically or otherwise, the location of principal planes and evaluate the principal stresses. (7)
- b) Show that the angle between planes of maximum shear stress and maximum normal stress is 45° (7)

Module IV

- 17 a) State Castigliano's Second Theorem. Represent it mathematically. What is its main use? (6)
- b) For a simply supported beam span L with central load P , find deflection using energy method. (8)

OR

- 18 a) Explain membrane analogy for torsion and outline how it helps find torque for complex sections. (6)
- b) Derive bending equation. State assumptions involved in deriving the same. (8)

Module V

- 19 a) Derive the differential equation governing longitudinal vibrations of a uniform prismatic bar and obtain an expression for the speed of wave propagation along the bar. (14)

OR

- 20 a) Write short notes on: (12)
- (i) Distortion energy
 - (ii) Plane waves
 - (iii) Longitudinal impact of bars.
- b) What is the physical significance of distortion energy in a material? (2)
