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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*A Constituent Institution of Manipal University*

## I SEMESTER M.TECH. (CIVIL ENGINEERING)

## END SEMESTER EXAMINATIONS, NOV/DEC 2016

## SUBJECT: ADVANCED MECHANICS OF SOLIDS [CIE 5151]

**REVISED CREDIT SYSTEM**
**( /11/2016)**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

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| **1A.** | The general displacement fields in a body in Cartesian coordinate system is given by $u = 3x^2y + y^2$; $v = 3yz + xy$; $w = 4xz^2 + 5xy^2$. Find strain tensor and the linear strain at the point (1, -3, 2) in the direction (0.6, 0.53, -0.6). | **5** |
| **1B.** | Derive the stress compatibility conditions for plane stress condition (2D). | **5** |
| **2.** | State of stress at a point in a strained body is given: $\sigma = \begin{bmatrix} 30 & -45 & -65 \\ -45 & 45 & 30 \\ -65 & 30 & -25 \end{bmatrix} MPa$<br>Determine the three principal stresses and associated principal planes. | **10** |
| **3A.** | Analyze for stress in a cantilever beam of span 'L', unit width and depth '2C', subjected to point load at free end, considering Airy's stress function $\phi = Bxy + Dxy^3$. Take origin at fixed end. | **5** |
| **3B.** | Derive the strain displacement relations in 2D polar co-ordinate system. | **5** |
| **4A.** | For a thin rectangular plate subjected to uniformly distributed load, obtain the expressions for Kirchhoff's shear forces in terms of vertical displacement 'w'. | **5** |
| **4B.** | For a simply supported plate subjected to uniform constant lateral load '$q_o$' using Navier's solution, obtain the expressions for deflection and moments. | **5** |
| **5A.** | Obtain the expressions for deflection and moment of an annular plate simply supported at outer edges, and loaded by edge moments $M_1$ at the inner edge (r = b) & $M_2$ at outer edge (r = a). | **5** |
| **5B.** | With usual notations for a shell element, obtain the stress resultants in terms of strains and curvature. | **5** |