Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **18CE3011** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ADVANCED SOLID MECHANICS** | **Max. marks :** | **100** |

**ANSWER ANY FIVE QUESTIONS (5 x 16 = 80 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Define state of stress at a point. | CO1 | 2 |
| b. | Calculate the body forces for the given state of stresses at a point P having coordinates P ( 1,2,3)  σx = 20x3 + y3 τxy = z  σy = 30x3 + 200 τyz = x3  σz = 30y2 + 30z3 τzx = y2 | CO2 | 6 |
| c. | The state of stress at a particular point relative to the xyz coordinate system is given by the stress matrix.    Determine the normal stress and the magnitude and direction of the shear stress on a surface intersecting the point and parallel to the plane given by the equation. 2x – y + 3z = 9. | CO3 | 8 |
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| 2. | a. | Define plane strain problem with examples. | CO1 | 2 |
| b. | For a plane stress problem, develop the equation    and a companion equation. | CO3 | 6 |
| c. | Investigate what problem of plane stress is solved by the stress function,  applied to the region bounded in y = 0, y = d, x = 0 on the side . | CO3 | 8 |
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| 3. | a. | Using the general solution satisfying the biharmonic equation for axisymmetric problem in polar coordinates∇4φ = 0 , determine the stresses. | CO2 | 2 |
| b. | Develop the equilibrium equations in polar coordinates. | CO3 | 6 |
| c. | For a thin hollow disc of external radius “b” and internal radius “a” and for solid disc of radius “b” find the maximum stress in rotating disc. | CO6 | 8 |
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| 4. | a. | Develop the Governing equation and boundary conditions by St.Venant method for torsion of noncircular section. | CO6 | 6 |
| b. | Develop the expression for torsional stress of thin narrow rectangle section. | CO6 | 4 |
| c. | Develop the expression for torsional stress and unit angle of twist for torsion of thin walled single celled tubular section. | CO6 | 6 |
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| 5. | a. | Define beam on elastic foundation with examples. | CO1 | 2 |
| b. | Develop the expressions for maximum bending moment, deflection and shear force for a simply supported finite beam carrying udl. | CO5 | 8 |
| c. | An infinite beam on a Winkler foundation has the following properties. K = 0.3 kN/mm/mm. E=200GPa. A concentrated load of intensity 25 kN is applied to the beam. Compute the maximum deflection, shear force, bending moment and slope in the beam. The beam cross section is I shaped with flanges 100 X 10 mm and web 150 X 8mm. | CO5 | 6 |
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| 6. | a. | Define Generalized Hook’s law. | CO1 | 2 |
| b. | Develop the strain displacement relations in 3D rectangular coordinates. | CO2 | 6 |
| c. | For the state of engineering strain at a point given below, determine the principal strains and their associated directions.  0.02 -0.04 0.00  -0.04 0.06 -0.02  0.00 -0.02 0.00 | CO3 | 8 |
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| 7. | a. | Develop the constitutive law for plane strain problem. | CO4 | 4 |
| b. | Explain the principle of superposition. | CO4 | 4 |
| c. | Explain Airy’s stress function and its application. | CO4 | 4 |
| d. | Determine the stress distribution in a Boussinesq problem. | CO4 | 4 |
| **COMPULSORY QUESTION (1 x 20 = 20 Marks)** | | | | |
| 8. | a. | Define Westergaard’s Stress Space, π – Plane and Image result for symbol for lambda line. | CO1 | 4 |
| b. | A rectangular beam having linear stress strain behavior is 6cm wide and 8cm deep. It is 3m long, simply supported at the ends and carries a uniformly distributed load over the whole span. The load is increased so that the outer 2cm depth of the beam yields plastically. If the yield stress for the beam material is 240 MPa, plot the stress distribution in the beam. | CO4 | 8 |
| c. | A circular shaft of inner radius 4cm and outer radius 10cm is subjected to a twisting couple so that the outer 2cm deep shell yields plastically. Determine the twisting couple applied to the shaft. Yield stress in shear for the shaft materials is 425MPa. Also determine the couple for full plastic yielding. | CO4 | 8 |