Reg.No. _____

**Karunya UNIVERSITY**

(Karunya Institute of Technology & Sciences)
(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

## End Semester Examination – Nov/Dec – 2016

**Code : 14CE3001**
**Sub. Name : Applied Elasticity and Plasticity**

**Semester : 2016-17 ODD**
**Duration : 3hrs**
**Max. marks : 100**

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**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

| Q. No. | Sub Div. | Questions | Course Outcome | Marks |
|---|---|---|---|---|
| 1. | A | Develop the strain displacement relations in rectangular coordinates. | 1 | 5 |
| | B | Explain displacement formulation of elasticity problems | 1 | 5 |
| | C | The displacement field components at a point are given by<br>$U = -0.0001\,y^2 + 0.0015\,xyz$; $V = 0.0002\,x^2y + 0.0003\,x^2z$ ;<br>$W = 0.0015\,xyz + 0.0002\,x^2yz$.<br>(i) Determine the strain tensor at a point P ( 2,-3,-1)<br>(ii) Find the principal strains and their directions<br>(iii) If E = 210 GPa and $\gamma = 0.28$, find the Lame's constants | 1 | 10 |
| | | (OR) | | |
| 2. | A | Explain Generalized Hook's law for an isotropic materials. | 1 | 5 |
| | B | Develop St.Venant compatibility conditions. | 1 | 5 |
| | C | The state of stress at a particular point relative to the xyz coordinate system is given by the stress matrix<br>$\begin{bmatrix} 5 & 10 & -10 \\ 10 & 10 & 0 \\ -10 & 0 & 40 \end{bmatrix}$ MPa<br>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.<br>$2x - y + 3z = 9$ | 1 | 10 |
| 3. | A | Distinguish between plane stress and plane strain problems | 1 | 5 |
| | B | Develop the bi-harmonic equation for Airy's stress function for plane stress problem | 1 | 5 |
| | C | A beam of narrow rectangular cross section is subjected to uniformly distributed load of q over the entire span. Assuming suitable stress function, derive expressions for stresses if the beam is simply supported. | 1 | 10 |
| | | (OR) | | |

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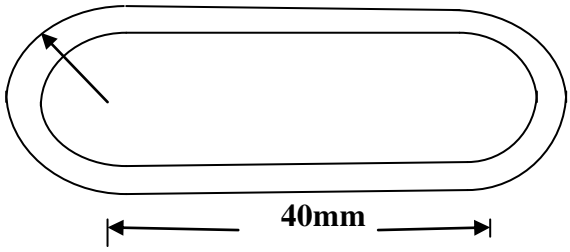
|---|---|---|---|---|
| **4.** | **A** | **Develop the St.Venant Compatiblity equation** | **1** | **5** |
| | **B** | **Explain the Principle of superposition** | **1** | **5** |
| | **C** | **Investigate what problem of plane stress is solved by the stress function applied to the region bounded in y = 0, y = ± c, x = 0 on the side $x + ve$.**<br>$$\phi = \frac{3F}{4C}\left( xy - \frac{xy^3}{3C^2} \right) + \frac{\rho}{2} y^2 .$$ | **1** | **10** |
| **5.** | **A** | **Develop the strain-displacement relations in polar coordinates** | **1** | **5** |
| | **B** | **Prove that the stress concentration factor is 2 for the rotating disc with a pin hole at the centre** | **1** | **15** |
| | | **(OR)** | | |
| **6.** | **A** | **Determine the stress distribution in circular disc subjected to diametric compression.** | **1** | **5** |
| | **B** | **Explain what is an axisymmetric problem and develop the expressions for the stress distributions in an axi-symmetric problem** | **1** | **15** |
| **7.** | **A** | **Explain Laplace Equation and the associated boundary conditions for torsion of non-circular section** | **1** | **5** |
| | **B** | **A thin walled circular cylinder of outside diameter 125mm and 4 mm wall thickness is subjected to a torque of 100 N.m. estimate the shear stress and total angle of twist. Assume E = $2X10^5$ N/ $mm^2$ . and Poisson's ratio = 0.3.** | **1** | **5** |
| | **C** | **An elliptical bar is subjected to a twisting moment T. Derive the expressions for shear stresses and angle of twist at any point in the bar and hence the maximum shear stress** | **1** | **10** |
| | | **(OR)** | | |
| **8.** | **A** | **Develop the equations for stress and unit angle of twist for torsion of thin walled open section** | **1** | **5** |
| | **B** | **A thin-walled member 1.2 m long has the cross-section wth uniform thickness 1mm shown in Fig. Determine the maximum torque which can be carried by the section if the angle of twist is limited to 10''. What will be the maximum shear stress when this maximum torque is applied? For the material of the $G$ = 80 GN/m2.**<br>**Radius 10 mm**<br>  <br>**40mm** | **1** | **7** |

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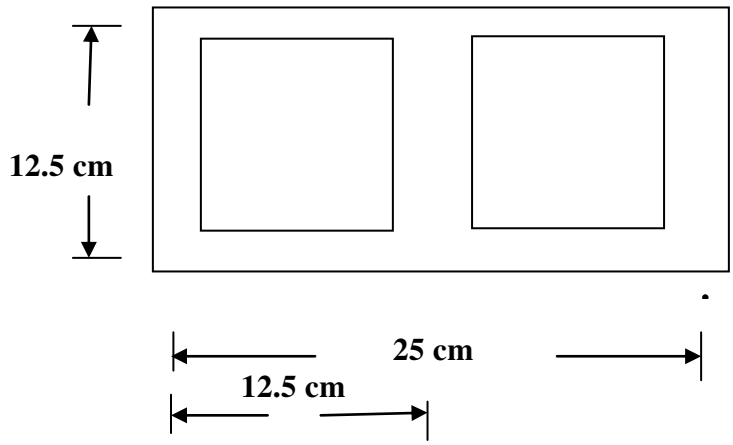
|---|---|---|---|---|
| | C | **A steel girder has cross section shown below. Wall thickness in uniformly 1.2 cm. The stress due to twisting should not exceed 350 N/mm$^2$. Neglect stress concentration. G=75 GPA.**<br>  <br><br>**i. What is the maximum allowable torque?**<br>**ii. What is the twist per unit length under the torque?**<br>**iii. What is the shear stress in the middle web?** | **1** | **8** |
| | | **Compulsory:** | | |
| **9.** | **A** | **The State of stress at a point is given by $\sigma_x$ = 70 MPa, $\sigma_y$ = 120 MPa, $\tau_{xy}$ = 35 MPa and the yield strength for the material is 125 MPa, obtained from uniaxial tensile test. Determine whether yielding will occur according to Tresca's or Von Mises yield conditions or not.** | **1** | **10** |
| | **B** | **Develop the elastic, plastic and elasto-plastic stress – strain relationship equations for a thick cylinder subjected to internal pressure of p1 .** | **1** | **10** |