Total No. of Questions : 8]

SEAT No. :

P5064

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[5060]-537

M.E. (Civil - Structures)

ADVANCED MECHANICS OF SOLIDS

(2013 Credit Course) (Semester - I)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Attempt any five questions from the following.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figure to the right indicates full marks.***
4) ***Assume suitable data, if necessary and clearly state.***
5) ***Use of cell phone is prohibited in the examination hall.***
6) ***Use of electronic pocket calculator is allowed.***

Q1) a) Obtain Naviers equation of equilibrium. **[5]**

b) Define strain compatibility. In general states of stress, assuming the strain displacement relation, obtain the necessary strain compatibility relation. **[5]**

Q2) a) State and explain generalized Hook's law. Express the stress strain relations for an elastic and isotropic body in term of engineering constant E and υ. **[6]**

b) Define with an example, a plane strain problem. For such case obtain the stress equation of equilibrium, the strain relation and the strain compatibility. **[4]**

Q3) a) What is Airry stress function ϕ. Neglecting body forces, obtain governing equation for the stress functions $\phi(r,\theta)$ in plane elasticity problem $\nabla^4\phi = 0$. **[7]**

b) Write the basic equations for a plane stress 2D problem in polar coordinates. **[3]**

Q4) a) Derive component of stress due to circular hole in a stressed plate (Kirsch's problem). **[6]**

b) What is axisymmetric problem. Show that for such a problem, the stress function $\phi = A \log r + Br^2 \log r + Cr^2 + D$. **[4]**

P.T.O.

Q5) a) Determine deflection at cantilever end for a quarter circle beam of radius R. It is loaded with a concentrated load P at its free end. **[5]**

b) A semicircular beam ABC of radius 3 m, is loaded with uniformly distributed load 20kN/m. It is simply supported at A & C and continuous over B. Determine reaction at supports A, B and C. **[5]**

Q6) a) Derive expression for stress by using Winkler - Bach theory. **[5]**

b) Determine the ratio of $\sigma_{max}/\sigma_{min}$ for a curved beam in elevation of rectangular section in pure bending. The radius of curvature is 200 mm and height of cross section is 100 mm. **[5]**

Q7) a) Obtain the expression for torsion of elliptical cross section bar. **[5]**

b) Derive Poisson's equation for torsion of prismatic bars of non circular section in terms of stress function ϕ. Neglect body force. **[5]**

Q8) a) Explain briefly the classification of beams on elastic foundation. What is a Winklers foundation. **[5]**

b) A timber of length 4m and cross section 80 mm × 150 mm is attached to rubber foundation for which k = 32MPa. A clockwise couple of 6 kNm is applied at one end. Determine maximum deflection. Take E = 156 Pa. **[5]**