Roll No. .....

22231

M. Tech. 2nd Sem. Mechanical Engg.

(Machine Design)

Examination – December, 2014

THEORY OF ELASTICITY

Paper : M-802-A

Time : Three hours] *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt any *five* questions. All questions carry equal marks.

1. The stress (in N/m^2) acting on an element of a loaded body figure. Apply Mohr's circle to determine the normal and shear stresses acting on a plane defined by $\theta = 30°$. 20

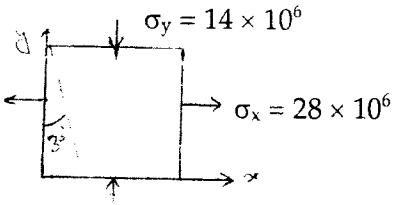

Fig. 1

2. At a point in a given material, the three dimensional state of stress is given by $\sigma_x = \sigma_y = \sigma_z = 10N/mm^2$, $\tau_{xy} = 20\ N/mm^2$ and $\tau_{yz} = \tau_{zx} = 10N/mm^2$ Compute the principal planes if the corresponding principal stresses are $\sigma_1 = 37.2\ N/mm^2$, $\sigma_2 = -10N/mm^2$ and $\sigma_3 = 2.7N/mm^2$. 20

3. Investigate what problem is solved by $\phi = \frac{F}{d^3} xy^2(3d - 2y)$ applied to the region included y = 0, y = d, x = 0 on the side x positive. 20

4. The stress function

$$\phi = S\left(\frac{1}{4}xy - \frac{xy^2}{4c} - \frac{xy^3}{4c^2} + \frac{ly^2}{4c} + \frac{ly^3}{4c^2}\right)$$ is proposed as giving the solution for a cantilever $y = \pm c$, $(0<x<l)$ loaded by uniform shear along the lower edge, the upper edge and the end $x = l$ being free from load. In what respect is this solution is imperfect ? Compare the expression for the stress with those obtained from elementary tension and bending formula. 20

5. A rectangular plate is subjected to uniform shearing force of intensity q on it edges. If there is a small circular hole in the plate not near the boundary, what will be the maximum and minimum normal stress around the hole ? 20

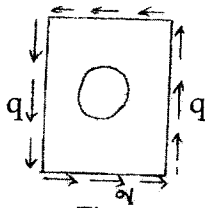

Fig. 2

6. Drive the expression for torsion of thin rectangular sections. 20

7. (a) Determine the real functions of x and y which are the real and imaginary parts of the complex functions z^2, z^3, tanh z. 10

   (b) What are the benefits of using complex stress functions ? 10

8. (a) Brifely explain Edge dislocation. 10

   (b) Drive the following equation for coordinate transformation of displacement component. 10

$$u_r = u \cos\theta + v \sin\theta, \quad u_\theta = -u \sin\theta + v \sin\theta,$$

$$u = u_r \cos\theta - u_\theta \sin\theta, \quad v = u_r \sin\theta + u_\theta \cos\theta,$$
