**Registration no:**

### 1st Semester Regular / Back Examination – 2016-17
### ADVANCED MECHANICS OF SOLIDS
### BRANCH(S): MECHANICAL SYSTEM DESIGN
### Time: 3 Hours
### Max Marks: 70
### Q.CODE:Y854
### Answer Question No.1 which is compulsory and any five from the rest.
### The figures in the right hand margin indicate marks.

Q1     Answer the following questions:     (2 x 10)

a) state and explain the conditions for generalized plane stress and plane strain

b) Explain what one understands by hydrostatic state of stress in 3-D elasticity problem.

c) Write the equations of equilibrium and compatibility conditions in 2-D problem of elasticity in polar co-ordinates.

d) Write the equations for shear stress components in terms of warping function for a prismatic solid bar under torsion and mention the terms used.

e) Establish that $\psi = A\left(y^3 - 3x^2 y\right)$ satisfies the Laplace equation.

f) Write down the boundary conditions of a rectangular plate with one edge elastically supported and other edge simply supported.

g) State the equation for determination of deflection of surface of a rectangular plate loaded by distributed load of intensity load of intensity $q$ in the transverse direction.

h) State the limitations of the membrane theory of shell for strength analysis of pressure vessels.

i) Establish that stress matrix is symmetric i.e. $T_{ij} = T_{ji}$, i, j=1,2,3

j) What is stress invariant?

Q2 a) State and explain the significance of shear center.     (5)

    b) Determine shear center of the unsymmetrical section shown in the figure. Take same thickness throughout the cross section.     (5)
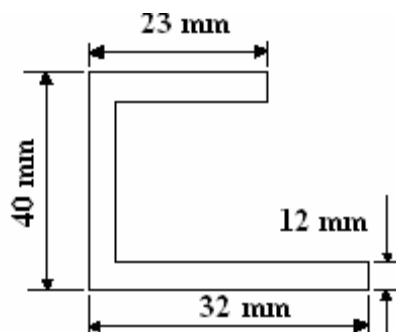
Q3 a) A simply supported beam of length 2.5 m carries a central load of 10 kN inclined at an angle 350 to the vertical and passing through the Centroid of the section. Determine i) Maximum tensile stress ii) Maximum compressive stress iii) Deflection due to load and Direction of the neutral axis. Take E = 2 x $10^5$ N/mm$^2$. (10)

Q4 a) Explain membrane analogy for torsion of non-circular shafts. (5)
   b) A shaft of hollow square section of outer side 60 mm and inner side 45 mm is subjected to twisting such that the maximum shear stress developed is 350 N/mm2. What is the torque acting on the shaft and angular twist if the shaft is 1.2m long? Take G = 8.1 x $10^5$ N/mm$^2$. (5)

Q5 a) Derive an expression for torsion of bars with rectangular cross section (5)
   b) Deduce from the first principle the equation for deflection of a plate under the combined effect of bending and tension assuming that the body forces are present in both the directions. (5)

Q6 a) Explain the phenomenon of finding deflection of straight beams due to non – Symmetrical bending (5)
   b) A ring made of 35 mm diameter steel bar carries a pull of 40 kN. Calculate the maximum tensile and compressive stresses in the ring. The mean radius of the ring is 240 mm. (5)

Q7 A square plate is simply supported on all edges and is loaded by sand such that (10)

$$P(x,y) = P_0 \sin\left(\frac{2\pi x}{a}\right)\sin\left(\frac{2\pi x}{b}\right), \ a = b$$

a) Determine the maximum deflection and its location.
b) Determine the maximum values of the moments

Q8 Write short notes on any (5 x 2)
   a) Contact stresses
   b) Compatibility equation
   c) Lami's stress ellipsoid
   d) Generalized hook's law