# *B.Tech Degree IV Semester Examination, April 2010*

**ME 403 ADVANCED MECHANICS OF SOLIDS**

*(2006 Scheme)*

Time: 3 Hours Maximum Marks: 100

## PART – A

(Answer ***ALL*** questions) (8 x 5 = 40)

I. (a) Explain Saint Venant's principle.
(b) Explain the concept of principal stresses. Mention its significance in practical problems.
(c) Obtain the stress distribution of the solid disk in rotation with uniform thickness.
(d) Draw the stress diagrams in composite tubes.
(e) Explain Lame's stress ellipsoid.
(f) Explain Castigliano's first theorem.
(g) Explain concept of shear center.
(h) Explain membrance analogy.

## PART – B

(4 x 15 = 60)

II. (a) Derive equations of equilibrium in 3-D in most general form. (8)
(b) Draw the Mohr's circle for the following stresses and graphically find out principal stresses and maximum shear stress.

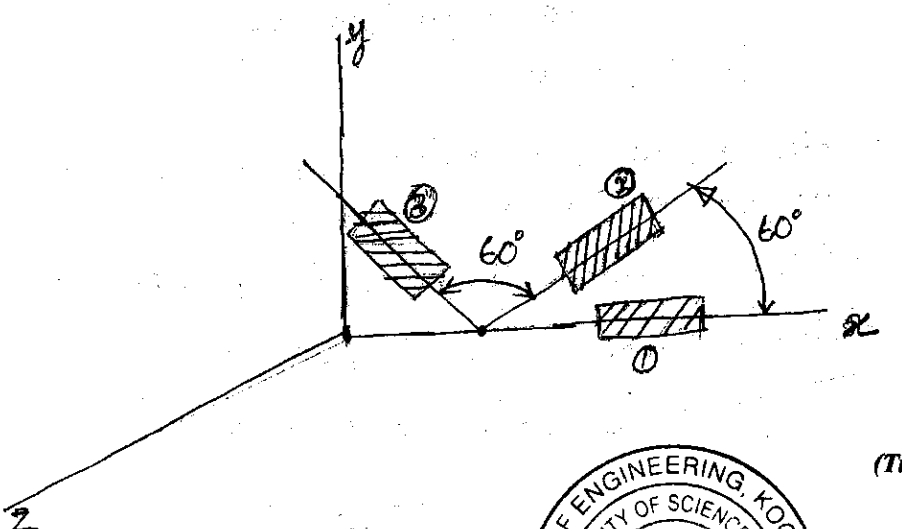
$$\tau_{xx} = 4000KPa \quad \tau_{yy}1000KPa \quad \tau_{xy} = -500KPa \qquad (7)$$

**OR**

III. (a) Explain compatibility conditions. From this concept obtain compatibility equations in strain terms. (8)
(b) Using a $60^0$ strain rosette the following strains have been determined at a point on the surface of a steel of a machine base.

$$E_1 = 40\mu \qquad E_2 = 980\mu \qquad E_3 = 330\mu$$

Determine strain components in 3 rectangular co-ordinates and principal strains and maximum shearing strain. (7)



IV. Derive an equation for the contact pressure for a shrink fitted composite tubes in terms of shrink fit allowance. (15)

**OR**

V. A steel turbine rotor of 750mm outer diameter, 150mm inner diameter and 50mm thickness has 100 blades 150mm long each weighing 4N. It is shrink fitted on a rigid shaft. Calculate the initial shrinkage allowance on the inner diameter of the rotor so that it just loosens on the shaft at 3000 revolutions per minute. Assume E=200 GPa and Poisson's ratio 0.3. The density of the shaft and rotor is 7500 kg/m$^2$. (15)

VI. (a) Derive displacement equations of equilibrium. (7)

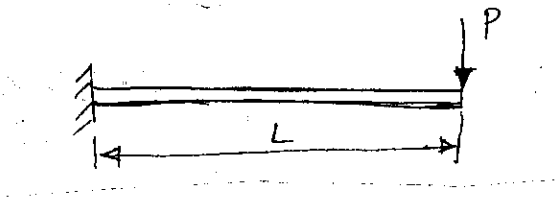
(b) The following is the stress matrix at a point P. Determine the principal stresses and their associated directions.

$$[\tau_{ij}] = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$ (8)

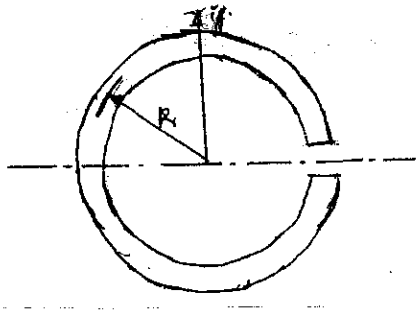
**OR**

VII. (a) Derive the relation for the strain energy due to shear and bending. (9)

(b) Determine the deflection at end A of cantilever beam shown in figure. (6)




VIII. Determine the shear stress distribution for a circular open section under bending caused by a shear force. Also locate the shear center. (15)




**OR**

IX. (a) Obtain the stresses acting on a bar of elliptical cross section. Also find the maximum stress, angle of twist and torsional rigidity for the same. (10)

(b) An elliptical shaft of semi axes a = 0.05m, b=0.025m and G=80GPa is subjected to a twisting moment of 1200 $\pi$ N.m. Determine the maximum shear stress and the angle of twist per unit length. (5)

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