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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID :278203

Roll No

M. Tech. (Sem. II)

THEORY EXAMINATION, 2014-15

ADVANCED MECHANICS OF SOLIDS

Time : 3 Hours] *[Total Marks : 100*

Note: Attempt all questions

1 Attempt any four of the following 5×4=20

(a) Explain body force and surface force

(b) Define the normal and shear stress components

(c) In a triaxial stress system, the six components of the stress at a point are given below

$\sigma_x = 6MN/m^2$, $\tau_{xy} = \tau_{yx} = 1MN/m^2$

$\sigma_y = 5MN/m^2$, $\tau_{yz} = 3MN/m^2$

$\sigma_z = 4MN/m^2$, $\tau_{zx} = \tau_{xz} = 1MN/m^2$

Find the magnitude of three principal stresses.

5 Attempt any two of the following 10×2=20

(a) Derive and explain the generalized Hooke's law?

(b) Determine the diameter d of a circular shaft subjected to a bending moment M and a torque T according to the several theories of failure. Use a factor of safety N

(c) Derive stress strain relations for Isotropic material in terms of Lame's coefficient (λ and μ)

—x—

(d) What is Lame's stress ellipsoid?

(e) Derive the differential equations of equilibrium for 3D state of stress on a body

(f) A cylindrical boiler, 180 cm in diameter, is made of plates 1.8 cm thick, and is subjected to an internal pressure 1400 Kpa. Determine the maximum shearing stress in the plate at point P and the plane on which it acts.

2 Attempt any two of the following: 10×2=20

(a) Define state of strain at a point. Derive the deformation in the neighbourhood of a point.

(b) The displacement field for a body is given by $u = k(x^2 + y)i + k(y + z)j + k(x^2 + 2z^2)k$ where k=10^{-3}. At a point P (2,2,3), consider two line segments PQ and PR having the following direction cosines before deformation PQ: $n_{x1}=n_{y1}=n_{z1}=1/\sqrt{3}$, PR: $n_{x2}=n_{y2}1/\sqrt{2}$, $n_{z2}=0$. Determine the angle between the two segments before and after deformation.

i) What are the compatibility conditions? Explain in detail

ii) What do you mean by strain deviators and its invariant?

3 Attempt any two of the following 10×2=20

(a) Write short notes on isotropy, anisotropy and orthotropy

(b) Derive expression for Elastic constant G in terms of Lame's coefficients for isotropic material.

(c) What do you mean by torsion of circular and elliptical bars? What do you mean by membrane analogy in torsion?

4 Attempt any two of the following 10×2=20

(a) Define notch sensitivity? What do you mean by fracture toughness?

(b) Derive the expression for radial and circumferential stresses induced in a thick cylinder which is subjected to internal pressure alone. Draw also stress profiles.

(c) A flat steel turbine disk of 75 cm outside diagram and 15 cm inside diameter rotates at 3000 rpm. at which speed the blades and shrouding cause a tensile rim loading of 4312KPa. The maximum stress at this speed is to be 114072 KPa. Finr the maximum shrinkage allowance on the diameter when the disk and the shaft are rotating.