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**BIMEE-005**

# B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

## Term-End Examination

## December, 2015

## BIMEE-005 : EXPERIMENTAL STRESS ANALYSIS

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Attempt any **seven** questions. All questions carry equal marks. Assume any missing data suitably. Use of scientific calculator is permitted.*

**1.** The stress components at a point are given by

$$\sigma_x = 20, \sigma_y = 10, \sigma_z = 15$$

$$T_{xy} = 5, T_{yz} = 4, T_{xz} = 3 \text{ kg/cm}^2$$

with reference to x, y, z co-ordinate system. If this coordinate system is rotated about the z-axis in the anticlockwise direction through 45°, determine the new stress components. *10*

**2.** If $\phi = (Ar^3 + \frac{B}{r} + Cr + Dr\ ln\ r) \sin\theta$ is suitable as a stress function for the bending of a curved bar by a force at the end, determine the values of A, B, C and D. *10*

3. Discuss the advantages and limitations of an optical strain gauge. How do you define the magnification of an optical gauge ? *10*

4. At a certain point A of an aluminium specimen, cracks in one direction begin to appear when the external load is 500 kg. At the same point A, cracks perpendicular to the above mentioned cracks begin to appear when the load reaches 1000 kg. The strain sensitivity $\varepsilon_s^d$ of the coating as obtained from the aluminium cantilever calibration strip is 600 μcm/cm, $\nu_a = \nu_s = 0{\cdot}32$, $\nu_c = 0{\cdot}42$, $E_s = 0{\cdot}7 \times 10^6$ kg/cm$^2$, k = 0·5. Find the principal stresses when the external load is 400 kg. Assume maximum tensile stress law of failure. *10*

5. A thin walled steel cylinder is subjected to an internal pressure of 21 bar (1 bar = 0·1 MN/m$^2$). The cylinder is 1 m in diameter and 30 mm thick. Two gauges of identical type with cross-sensitivity factor of 0·03 are mounted along the axial and circumferential directions respectively. Determine what strain reading will be shown by these gauges, if E = 200 GN/m$^2$ and $\nu = 0{\cdot}3$. *10*

6. A rectangular rosette is cemented on the surface such that gauge A is along the x-axis while gauge C is along the y-axis gauge. B makes an angle of 45° with both x- and y-axes. Following readings were recorded : $\varepsilon_A = 45 \times 10^{-6}$ mm/mm, $\varepsilon_B = 200 \times 10^{-6}$ mm/mm, $\varepsilon_C = -200 \times 10^{-6}$ mm/mm.

Determine

(a) the state of stress with reference to x- and y-axes,

(b) the state of principal stresses, maximum shearing stress and their orientation. *10*

7. If a particular point in a photoelastic model is examined using a mercury light source ($\lambda$ = 5481 Å) and a fringe order of 3 is obtained, what fringe order would be observed if sodium light ($\lambda$ = 5893 Å) is used ? *10*

8. Describe the concept of photoelastic photography. How can fractional fringe order be determined by Post's methods for fringe sharpening and fringe multiplication ? *10*

9. A 3 mm thick PS-1A sheet having $f_\sigma$ = 1·22 kg/mm is applied upon a steel surface which is 10 mm thick. From reflection polariscope at a point on the surface, fringe order of 2·3 was observed. Calculate the corrected difference of principal strains at the given point. $E_s = 2{\cdot}06 \times 10^4$ kg/mm$^2$, $E_c = 2{\cdot}8 \times 10^3$ kg/mm$^2$, $\nu_s = 0{\cdot}29$, $\nu_c = 0{\cdot}34$. *10*

**10.** If in an oblique incidence experiment the following observations are made at a point with model rotation of 45° each about axes ox and oy, determine $\sigma_{p1}$ and $\sigma_{p2}$.

$N = 4,\ N_{\theta x} = 2{\cdot}1,\ N_{\theta y} = 3{\cdot}5,\ h = 5$ mm,

$f_\sigma = 1{\cdot}5$ kg/mm. *10*

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