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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M-TECH DEGREE EXAMINATION, MAY 2016

Mechanical Engineering

(Machine Design)

01ME6106 EXPERIMENTAL STRESS ANALYSIS

Max marks : 60 Duration : 3 hours

Answer any two full questions from each PART.

PART A

1. (a) Derive the equations of compatibility. (3)

   (b) The Cartesian components of stress at a point in a steel (E= 207 GPa, $\nu = 0.30$) machine part are
   $\sigma_{xx} = 220$ MPa, $\sigma_{yy} = 77$ MPa, $\sigma_{zz} = 154$ MPa,
   $\tau_{xy} = 110$ MPa, $\tau_{yz} = 55$ MPa, $\tau_{xz} = 66$ MPa.
   Determine the principal strains at that point. (5)

   (c) Explain cubical dilatation. (1)

2. (a) Describe about any one mechanical strain gauge. (3)

   (b) A three element rectangular rosette is mounted on a steel component with E= 200 GPa and $\nu = 0.3$. The manufacturer's gauge factor F and the cross sensitivity K_t of this type of gauge is known to be 2.8 and 0.06 respectively. The readings correspond to three gauges as indicated on a strain meter are (6)
   $\hat{\epsilon}_A = 850\ \mu$ strain, $\hat{\epsilon}_B = -50\ \mu$ strain, $\hat{\epsilon}_C = -850\ \mu$ strain,

   i. Find the actual strains ϵ_A, ϵ_B, ϵ_C.

   ii. Find the magnitude of corrected principal stresses.

   iii. What is the error, if indicated strains $\hat{\epsilon}_A$, $\hat{\epsilon}_B$ and $\hat{\epsilon}_C$ are used to calculate the principal strains.

3. (a) Explain the in-plane displacement Moire fringe analysis of strain measurement. (4)

   (b) What is residual stress? Brief about the residual stress measurement? (5)

PART B

4. (a) Explain the use of circular polariscope in photoelasticity. Derive the equations for light passing through a stressed model in a circular polariscope. (6)

   (b) Discuss about isochromatic and isoclinic fringe patterns. (3)

5. (a) Describe the fixed voltage Wheatstone bridge method of strain measurements. How calibration can be done on strain gauge circuits.

   (b) Four 600 Ω strain gauges are connected to each arm of a Wheatstone bridge. Each gauge has a grid area of 50 mm^2. Calculate the permissible gauge current I_g, voltage V and bridge sensitivity when the power density is $P_d = 0.0004\ W/mm^2$. (3)

6. (a) Obtain the sensitivity of constant current potentiometer circuitry for strain measurement. (3)

   (b) Explain about any one dynamic recording device. (4)

   (c) Describe the stress-optic law. (2)

PART C

7. (a) Describe the use of isostatics and isoentatics in brittle coating test? (4)

   (b) Explain about magnetic particle inspection. Mention its merits and demerits. (8)

8. (a) Which are the steps in brittle coating test? (4)

   (b) Discuss about the failure theories of brittle coating. (6)

   (c) Name the variables influencing the accuracy of brittle coating application. (2)

9. (a) How defect detection can be achieved by liquid penetrant test, discuss in detail? (5)

   (b) What are ultrasonic waves and how they are classified? With suitable figures describe about ultrasonic flaw detection technique. (7)