

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 ($E = 207 \text{ GPa}$, $\nu = 0.30$) machine part are
 $\sigma_{xx} = 220 \text{ MPa}$, $\sigma_{yy} = 77 \text{ MPa}$, $\sigma_{zz} = 154 \text{ MPa}$,
 $\tau_{xy} = 110 \text{ MPa}$, $\tau_{yz} = 55 \text{ MPa}$, $\tau_{xz} = 66 \text{ MPa}$.
 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 $E = 200 \text{ GPa}$ 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)
 $\hat{\epsilon}_A = 850 \mu \text{ strain}$, $\hat{\epsilon}_B = -50 \mu \text{ strain}$, $\hat{\epsilon}_C = -850 \mu \text{ strain}$,
 - 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. (1)
- (b) Four 600Ω 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 $P_d = 0.0004 \text{ W/mm}^2$. (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)