AE1353 – EXPERIMENTAL STRESS ANALYSIS

A 1013

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Sixth Semester

Aeronautical Engineering

AE 345 — EXPERIMENT STRESS ANALYSIS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Accuracy and Sensitivity.

2. Explain precision of an instrument.

3. Give the working principle of acoustical extensometer.

4. Why extensometers are preferred for obtaining mechanical properties of materials?

5. What is meant by temperature compensation?

6. What are the requirements of strain gauge materials? Give examples.

7. Define plane polarized light and circularly polarized light.

8. What is fringe sharpening?

9. What are the advantages of holographic technique?

10. Explain master grating.

PART B — (5 × 16 = 80 marks)

11. (a) Explain in detail with neat sketches the working of a mechanical and optical extensometers. (16)

Or

(b) (i) List down the types of extensometer. (4)

(ii) Explain with neat sketch the working of extensometer in each type. (12)

12. (a) (i) Explain how the modulus of elasticity and Poisson's ratio of an engineering material are determined with the help of electrical resistance type gage. (6)

(ii) Determine principal stresses and principal strains with the help of a delta rosette mounted on an aluminium specimen with values of $\varepsilon_A = 400\,\mu$, $\varepsilon_B = 200\,\mu$, $\varepsilon_C = 100\,\mu$, $E_{al} = 70$ GPa, $\gamma = 0.3$. (10)

Or

(b) (i) Derive an expression for output voltage of Wheatstone bridge circuit for strain measurements. (10)

(ii) Calculate circuit sensitivity when all the gages are active. Given Rg = 120 ohms, Ig = 50 mA, Sg = 2. (6)

13. (a) (i) What is meant by compensation in photoelasticity? (6)

(ii) Explain any one compensation method in detail with its advantages over other methods. (10)

Or

(b) (i) Explain separation technique in photoelasticity and name the various methods. (6)

(ii) Explain two separation techniques used in photoelasticity. (10)

14. (a) Explain Fringe sharpening and Fringe multiplication techniques used in photoelasticity. (16)

Or

(b) Explain in detail : (16)

(i) Ultrasonic testing

(ii) Eddy current technique

(iii) Brittle coating technique.

15. (a) Write short notes on :

(i) Acoustic emission technique (8)

(ii) Moire technique. (8)

Or

(b) Explain Holography and ultrasonic C-scan non-destructive testing methods with its application. (16)

R 365

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2005.

Sixth Semester

Aeronautical Engineering

AE 345 — EXPERIMENTAL STRESS ANALYSIS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the precisions of an instrument.

2. Define the accuracy of an instrument.

3. Explain with example whole field technique and point by point technique.

4. Explain the principle of electrical resistance strain age.

5. Define the strain gage factor and indicate its normal value.

6. Explain the need for rosette analysis.

7. State the stress optical law.

8. Define isochromatics and isoclinics.

9. Show the arrangement of optical elements in a circular polariscope setup.

10. What are the materials used for photo elastic method.

PART B — (5 × 16 = 80 marks)

11. (i) Explain the working principle of mechanical and optical strain gages. (6)

(ii) With neat sketch describe the working of any one of the above two strain gages. (10)

12. (a) (i) Derive the expression for the strain experience by electrical resistance type strain gage. (6)

(ii) Draw the figure showing various forms of strain gages. (2)

(iii) Explain how the electrical resistance type gage can be used to determine the modulus of elasticity and Poisson's ratio of an engineering materials. (8)

Or

(b) (i) Show how the change in out put voltage is related to change in resistance of Wheatstone bridge used for strain measurement. (6)

(ii) Explain the need for temperature compensation. (2)

(iii) A beam of uniform circular section is fixed at one end and free at the other end. It is subjected to a shear force P at free end and torque T at the free end. Explain the arrangement regarding the position of strain gages such that the stress at the fixed end due to bending and torsion can be found. (8)

13. (a) (i) Derive the expression for principal strains and its direction in terms of strain measured in a three element rectangular rosette (gage A along x–axis, gage B along 45° to the x–axis and gage C along y–axis) (8)

(ii) Express the principal stress in terms of the rosette strain measurements. (3)

(iii) Compute the principal stresses using the following strain measurement from rectangular rosette. $\varepsilon_A = 400 \times 10^{-6}$ $\varepsilon_B = -200 \times 10^{-6}$ $\varepsilon_C = 200 \times 10^{6}$ E = 200 GPa and $\upsilon = 0.25$. (5)

Or

(b) (i) Derive the relation between stresses, relative retardation, material fringe value and thickness of photo elastic model (8)

(ii) Write the above relation interms of strain. (4)

(iii) Explain what is meant by place ploarizer and wave plate. (4)

14. (a) (i) Show that the intensity of light emerging from circular polariscope is a function of principal stress difference. (10)

(ii) Explain any one of the compensation techniques used for getting accuracy in fringe order determination. (6)

Or

(b) (i) Explain what is meant by separation technique. List down the various method used. (6)

(ii) Explain the separation technique based on the equilibrium equation. (10)

15. (a) (i) What are the methods used in three dimensional photo elasticity. (4)

(ii) Explain in detail any two methods used for three dimensional photo elasticity analysis. (12)

Or

(b) (i) Derive the expression for state of stress in brittle coating in terms of the stresses in the specimen and the properties of material. (8)

(ii) Write short notes on any one of the following :

Moire Technique, Acoustic Emission Technique. (8)

C 3013

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Sixth Semester

Aeronautical Engineering

AE 1353 — EXPERIMENTAL STRESS ANALYSIS

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by experimental stress analysis?

2. What is a proving ring?

3. What do you mean by strain rosette?

4. Classify strain gauges based on the principle of magnification.

5. What is a pressure transducer?

6. State stress optic law.

7. What is a half cell?

8. What is holography?

9. How is sound level measured? Define the unit.

10. What is the principle of stress coat analysis?

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the different measurements that can be used to estimate the stress in material. (8)

(ii) What is a load cell? How is it used to measure load? Explain. (8)

Or

(b) Explain the principle of operation of linear variable differential transformer with a neat sketch. Also discuss its performance characteristics.

12. (a) Explain the principle, construction and working of any one mechanical strain gauge and one optical strain gauge with neat sketches. (16)

Or

(b) The observations noted from a rectangular rosette are given below. Determine the principal strains, principal stresses and the principal angles. Find also the maximum shear stress .

$\epsilon_0 = -200\ \mu$ mm/mm

$\epsilon_{45} = +400\ \mu$mm/mm

$\epsilon_{90} = +100\ \mu$ mm/mm

$E = 210$ GPa

Poisson's ratio = 0.3

13. (a) (i) Explain : Compensation and Separation techniques. (8)

(ii) Describe the application of photo elastic technique in the analysis and design of structures. (8)

Or

(b) (i) Explain the term moire fringes. (4)

(ii) Explain in detail the principles and procedure involved in the determination of stress values.

14. (a) (i) Explain the principle of ultrasonic testing of structures. (8)

(ii) Write briefly about acoustic emission technique. (8)

Or

(b) Write briefly about

(i) Eddy current testing. (8)

(ii) Fiber-Optic sensors. (8)

15. (a) (i) What are the basic elements of a dynamic strain measuring system? Discuss the function of each briefly. (10)

(ii) What are strain rosettes? How is it used to measure state of strain at a point? (6)

Or

(b) (i) Describe any one method used for the calibration of the material used for photo elasticity investigation. (8)

(ii) How will you use the laser in testing of structures? Explain in detail. (8)