4/4 B.Tech. EIGHTH SEMESTER

ME8T3D EXPERIMENTAL STRESS ANALYSIS Credits: 4

Lecture:- 4 periods/week **Internal assessment: 30marks**
Tutorial: -- **Semester end examination: 70 marks**

Objectives:

1. Focus on the Fundamentals of the theory of elasticity principles.
2. Recognize the various techniques available to measure the stress and strains using different sources.
3. Distinguish the principles of photo elasticity including two dimensional and three dimensional concepts.

Learning outcomes:

At the end of course the students will be able to:

1. Employ elementary elasticity theory to cover the equilibrium, Compatibility, and three-dimensional relationships commonly used in experimental stress analysis.
2. Attentive of the overall concepts of stress/strain analysis by experimental means.
3. Familiar with the theory and practice of common experimental stress analysis methods including moiré methods, photo elasticity, moiré analysis, Brittle and bi-refrigent and strain gauges.
4. Implement the concepts of the theory of elasticity including: stress, strain, stress equilibrium, strain compatibility, constitutive relations, and three-dimensional stress states.

Prerequisites:

Strength of materials

UNIT – I
INTRODUCTION:
Theory of elasticity, plane stress and plane strain conditions, Compatibility conditions, problems using plane stress and plane strain conditions.

UNIT – II
STRAIN MEASUREMENT METHODS:
Various types of strain gauges, Electrical Resistance strain gauges, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor Semiconductor strain gauges, Temperature compensation, strain gauge circuits,

ANALYSIS OF STRAIN GAGE DATA: Three Element Rectangular Rosette, Delta Rosette, strain gauge rosette.

UNIT-III

RECORDING INSTRUMENTS:

Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies.

UNIT – IV

BRITTLE COATINGS:

Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

UNIT – V

MOIRE METHODS:

Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

UNIT – VI

PHOTO ELASTICITY:–

Introduction Polariscope – Plane and circularly polarized light, Bright and dark field setups**, ,** Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Materials for Two-Dimensional Photo elasticity

UNIT-VII

THREE DIMENSIONAL PHOTO ELASTICITY:

Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, Stress Optic Law.

UNIT-VIII

BIREFRINGENT COATINGS:

Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation method Undercoating.

Learning resources

Text books :

1. Experimental stress analysis, (Third Edition), by James Dally and Riley, Mc Graw-Hill International, , New Delhi.1978.
2. Experimental stress analysis, (6^{th} edition), by Dr. Sadhu Singh, Khanna Publishers, , New Delhi, 1996.
3. Theory of Elasticity, (Third Edition), S.Timoshenke and JN. Goodier “” McGraw-Hill, New York ,1970.

Reference books:

1. A treatise on Mathematical theory of Elasticity, by Augustus Edward Hough Love, University Press, fourth edition, 1906.
2. Experimental stress analysis principles and methods, by G.S. Holister, Cambridge university press, 1967.