



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

EXPERIMENTAL METHODS OF STRESS ANALYSIS								
II Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BAEE18	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			
Prerequisite: Aircraft structures								

### I. COURSE OVERVIEW:

This course deals with theory behind the experimental techniques and their process. The main focus is on principal of measurements and their uses on the practical problems. The students will learn about the electrical circuits, their sensitivity and effects. Broad knowledge on the two photo-elasticity concepts, techniques, materials used and their effects. A glimpse of three-dimensional photo elasticity will be given. Various applications of coatings will be discussed along with advantages. A view point on calibration photo elastic model materials is appreciated. Two element and three element rosettes and gauges are addressed.

### II. COURSE OBJECTIVES:

**The students will try to learn:**

- I. The effects of force and motion while carrying out the innovative design functions of engineering. Bring awareness on experimental method of finding the response of the structure to different types of loads.
- II. The relation between the mechanics theory, experimental stress analysis, and the mechanical, optical, pneumatic and electrical strain gauges for strain measurement.
- III. The fundamental concepts and newly experimental techniques and able to use the experimental techniques on the practical problems.
- IV. The fine presentation related to the experimental paper.

### III. COURSE OUTCOMES:

**After successful completion of the course, students will be able to:**

- CO 1 Understand the principles and range of measurements used to discover the responses of the structure
- CO 2 Apply about the various extensor meters for finding the response of the structure to different types of loads.
- CO 3 Analyse the strain sensitivity in metallic alloys and techniques for strain measurement
- CO 4 Make a use of the two- and three-dimensional photo elasticity concepts and effects
- CO 5 Apply the various photo-elastic coatings, methods and their applications to the study of stress distribution
- CO 6 Explain the effect of stress model, fringe order techniques and calibration photo elastic model materials

#### IV. COURSE CONTENT:

##### MODULE-I: BASIC CONCEPTS (09)

Stresses, Strains and Displacements - Determination of Principal Values of Stresses and Strains in 2-D & 3-D - Maximum Shear Stress - Strain Measurement Using Mechanical Extensometers -Principles of Measurements - Basic Characteristics and Requirements of a Measuring System -Sources of error - Statistical Analysis of Experimental Data - Non-Contact Measurement.

##### MODULE-II: ELECTRICAL RESISTANCE STRAIN GAGES (09)

Strain sensitivity in metallic alloys, gage construction, adhesives and mounting techniques, gage sensitivity and gage factor, performance characteristics, environmental effects, strain gage circuits; Potentiometer, wheat stone's bridges, constant current circuits.

##### MODULE-III: TWO- AND THREE-DIMENSIONAL PHOTO-ELASTICITY (09)

Two-dimensional photo elasticity; Concepts of light-photo-elastic effects, stress optic law-interpretation of fringe pattern-compensation and separation techniques; Photo elastic materials; Introduction to three-dimensional photo elasticity.

Photo elastic (Bi-refrigent) coatings, effects of coating thickness, brittle coatings, types of brittle coatings, advantages and brittle coating applications, crack detection methods and Moire methods: Applications and advantages.

##### MODULE-IV: PHOTO-ELASTICITY (09)

Nature of light, wave theory of light, optical interference, stress optic law, effect of stressed model in plane and circular polariscopes, iso clinics and iso-chromatics, fringe order determination fringe multiplication techniques, calibration photo elastic model materials.

##### MODULE-V: NON-DESTRUCTIVE TESTING (09)

Different types of NDT Techniques - Acoustic Emission Technique - Ultrasonic - Pulse-Echo - Through Transmission - Eddy Current Testing - X-Ray Radiography - Challenges in Non-Destructive Evaluation - Non-Destructive Evaluation in Composites - Concepts of Image Processing Theory.

#### V. TEXT BOOKS:

1. Albert S. Kobayashi, "Handbook on Experimental Mechanics", Prentice Hall Publishers, 1987.
2. Sadhu Singh, "Experimental Stress Analysis", Khanna Publisher, 4<sup>th</sup> edition, 2009.
3. Srinath L.S tata, "Experimental stress Analysis", McGraw-Hill, 3<sup>rd</sup> edition, 2012.

#### VI. REFERENCE BOOKS:

1. M.M.Frocht, John Wiley & sons, "Photo elasticity Vol I and Vol II", McGraw Hill, 2<sup>nd</sup> edition, 1969.
2. Perry and Lissner, "Strain Gauge Primer", McGraw Hill, 2<sup>nd</sup> edition, 1969.
3. Udpa. S.S & Patrick O. Moore, "Non-destructive Testing Handbook", Electromagnetic Testing, 3<sup>rd</sup>: Volume 5, 2004.

#### VII. ELECTRONICS RESOURCES:

1. [https://www.youtube.com/playlist?list=PLU14u3cNGP62esZEwffjMAsEMW\\_YArxYC](https://www.youtube.com/playlist?list=PLU14u3cNGP62esZEwffjMAsEMW_YArxYC)
  2. [www.nptel.ac.in/syllabus/syllabus.php?subjectId=112106068](http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=112106068)[www.textofvideo.nptel.iitm.ac.in/112106068/lec1.pdf](http://www.textofvideo.nptel.iitm.ac.in/112106068/lec1.pdf)
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## **VIII. MATERIALS ONLINE**

1. Course template.
  2. Assignments.
  3. Tutorial question bank.
  4. Model question paper – I.
  5. Model question paper – II.
  6. Lecture notes.
  7. Power point presentations.
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