Experimental Stress Analysis

By

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Module -1. Overview of Experimental Stress Analysis

Lecture	Key words
1 Overview of Experimental Stress Analysis	Experimental Stress Analysis, Analytical Approach, Numerical Approach Experimental Approach.
2 Optical Methods Work as Optical Computers	Experimental Stress Analysis, Optical methods work as optical computers, Direct information provided by various experimental methods, Visual appreciation of field information.
3 Stress, Strain and Displacement Fields	Experimental Stress Analysis, Stress field, Strain field, Displacement field, Fringe contours, Beam under pure bending, Disc under diametral compression, Clamped circular plate under a central load.
4 Physical Principle of Strain Gauges, Photoelasticity and Moiré	Experimental Stress Analysis, Completeness of a numerical solution, Physical principle of experimental techniques, Strain Gauges, Photoelasticity, Grids, Geometric moiré.
5 Introduction to Moiré, Brittle Coatings and Holography	Experimental Stress Analysis, Moiré, Brittle coatings, Holography, Photography, Rainbow hologram.
6 Hologram Interferometry, Speckle Methods	Experimental Stress Analysis, Hologram interferometry, Speckle methods, Objective speckles, Subjective speckles.
7 Introduction to Shearography, TSA, DIC and Caustics	Experimental Stress Analysis, Speckle interferometry, Shearography, Thermoelastic Stress Analysis (TSA), Digital Image Correlation (DIC), Caustics.
8 Fringe Patterns – Richness of Qualitative Information	Experimental Stress Analysis, Coherent gradient sensor, Quality inspection, Streamline fillet, Technologies for Experimental Mechanics.

9 Multi-Scale Analysis in Experimental Mechanics	Experimental Stress Analysis, Multi-scale analysis, Trends in experimental mechanics, Selection of an experimental technique,
10 Selection of an Experimental Technique	Experimental Stress Analysis, Selection of an experimental technique Books, References, Review of solid mechanics, Free surface, Ambiguity, Principal stress direction.

Module -2. Transmission Photoelasticity

Lecture	Key words
11 Introduction to Transmission Photoelasticity	Experimental Stress Analysis, Birefringence, Nature of light, Polarisation, Polarized light, Understanding polarization, Isotropic media.
12 Ordinary and Extraordinary Rays	Experimental Stress Analysis, Snell's laws, Crystalline media, Calcite prism, Optical axis, Light ellipse.
13 Light Ellipse, Passage of Light Through a Crystal Plate	Experimental Stress Analysis, Light ellipse, Retardation plates, Wave plates, Dichroism, Sheet polarisers.
14 Retardation Plates, Stress-optic Law	Experimental Stress Analysis, Retardation plates, Wave plates, Quarter wave plate, Half wave plate, Full wave plate, Stress-optic law.
15 Plane Polariscope	Experimental Stress Analysis, Plane polariscope, Fringes, Isochromatics, Isoclinics. Trigonometric resolution.
16 Jones Calculus	Experimental Stress Analysis, Jones calculus, Rotation matrix, Retardation matrix, Retarder, Plane polariscope, Circular polariscope, Dark field, Bright field.
17 Circular Polariscope	Experimental Stress Analysis, Circular polariscope, Jones calculus, Commercial polariscope, White light, Colour code, Tint of passage, Time-edge effect.
18 Determination of Photoelastic Parameters at an Arbitrary Point	Experimental Stress Analysis, Colour code, Compensation techniques, Babinet–Soleil compensator, Tardy's Method of compensation.
19	Experimental Stress Analysis, Tardy's method of compensation, Digital

Tardy's Method of Compensation	photoelasticity, Calibration, Photoelastic materials, Circular disk.
20 Calibration of Photo elastic Materials	Experimental Stress Analysis, Calibration, Conventional approach, Linear least squares analysis, Sampled least squares, Image processing, Image sampling, Quantization.
21 Fringe Thinning Methodologies	Experimental Stress Analysis, Fringe thinning, Fringe skeletonisation, Global fringe thinning, Reconstruction of fringe pattern, Fringe ordering.
22 Fringe Ordering in Photoelasticity	Experimental Stress Analysis, Fringe ordering, Features of Isochromatics, Isoclinics, Isotropic points, zeroth fringe order.
23 Miscellaneous Topics in Transmission Photoelasticity	Experimental Stress Analysis, Ambiguity, Principal stress direction, Sign of the boundary stress, Compatibility conditions, Model to prototype relations, Properties of photoelastic model materials.

Module -3. Introduction to Three Dimensional Photoelasticity and Digital Photoelasticity

Lecture	Key words
24 Three Dimensional Photoelasticity	Experimental Stress Analysis, Three dimensional photoelasticity, Stress freezing, Slicing, Integrated photoelasticity, Principle of optical equivalence.
25 Overview of Digital Photoelasticity	Experimental Stress Analysis, Digital photoelasticity, Three Fringe Photoelasticity (TFP), Refined TFP (RTFP), Phase-shifting, Ten-step method, Understanding phasemaps.

Module -4. Photoelastic Coatings and Brittle Coatings

Lecture	Key words
26 Introduction to Photoelastic Coatings	Experimental Stress Analysis, Photoelastic coatings, Photoelastic strain gauges, Strain-optic relation, Coating stress, Specimen stress.
27 Correction Factors for Photoelastic Coatings	Experimental Stress Analysis, Correction factors, Bending, Torsion, Pressure vessel.

28 Coating Materials, Selection of Coating Thickness, Industrial Application of Photoelastic Coatings	Experimental Stress Analysis, Correction factors, Mismatch of Poisson's ratio, Coating materials, Coating thickness, Maximum fringe order obtainable, Practical applications.
29 Calibration of Photoelastic Coatings, Introduction to Brittle Coatings	Experimental Stress Analysis, Photoelastic coating test, Calibration, Brittle coatings, Crack patterns, Uniaxial, Biaxial and Isotropic stress fields, Surface preparation.
30 Analysis of Brittle Coatings	Experimental Stress Analysis, Brittle coatings, Undercoating, Coating stress, Crack patterns, Refrigeration, Relaxation, Stresscoat.

Module -5. Strain Gauges

Lecture	Key words
31 Introduction to Strain Gauges	Experimental Stress Analysis, Isoentatic data, Strain Gauges, SR-4 gauges, Strain sensitivity, Gauge construction, Gauge length. Strain gauge materials.
32 Strain Sensitivity of a Strain Gauge, Bridge Sensitivity, Rosettes	Experimental Stress Analysis, Strain gauges, Transverse sensitivity factor, Gauge factor, Wheatstone bridge, Linearity, Hysteresis, Zero shift, Rosette.
33 Strain Gauge Alloys, Carriers and Adhesives	Experimental Stress Analysis, Rosette, Strain gauge alloys, Advance, Isoelastic, Karma, Nichrome-D, Carriers, Cements, Cynaoacrylate.
34 Performance of Strain Gauge System	Experimental Stress Analysis, Strain Gauges, Ceramic cements, High temperature strain gauge, Stability, Heat dissipation, Power density, Bridge voltage,
35 Temperature Compensation, Two-wire and Three-wire Circuits	Experimental Stress Analysis, Strain Gauges, Temperature compensation, Two-wire circuit, Three-wire circuit.
36 Strain Gauge Selection	Experimental Stress Analysis, Strain Gauges, Selection compromises, Designation systems, Strain gauge selection.
37	Experimental Stress Analysis, Strain Gauges, Temperature effects,

Bonding of a Strain Gauge	Bonding procedure, Surface abrading, Surface conditioning, Alignment, Catalyst application.
38 Soldering, Accounting for Transverse Sensitivity Effects	Experimental Stress Analysis, Strain Gauges, Masking, Tinning, Soldering, Protective coating, Transverse sensitivity.
39 Correction Factors for Special Applications	Experimental Stress Analysis, Strain Gauges, Corrections for transverse strain effects, T–rosette, Rectangular rosette, Hydrostatic pressure, Nuclear radiation, High temperature, Cryogenic temperature, Strain cycling, Environmental effects.
40 Special Gauges	Experimental Stress Analysis, Strain Gauges, Environmental effects, Torque gauge, Stress gauge, SIF evaluation, Strip gauge,
41 Discussion Session	Experimental Stress Analysis, Questions, Answers.