



Syllabus

MET 232 Optical Mounting Design

General Information

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Author

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Department

Science and Technology

Course Prefix

MET

Course Number

232

Course Title

Optical Mounting Design

Course Information

Credit Hours

3

Lecture Contact Hours

1

Lab Contact Hours

4

Other Contact Hours

0

Catalog Description

This course explores principles of optical elements such as lens, prisms and mirrors, the manufacturing processes involved in producing the optical elements and the design criteria and constraints in mounting and testing single optical elements and optical systems.

Key Assessment

This course does not contain a Key Assessment for any programs

Prerequisites

None

Co-requisites

None

Grading Scheme

Letter

First Year Experience/Capstone Designation

This course DOES NOT satisfy the outcomes applicable for status as a FYE or Capstone.

SUNY General Education

This course is designated as satisfying a requirement in the following SUNY Gen Ed category

None

FLCC Values

Institutional Learning Outcomes Addressed by the Course

Vitality

Inquiry

Perseverance

Interconnectedness

Course Learning Outcomes

Course Learning Outcomes

1. Explain the processes used to manufacture and test optical elements
2. Demonstrate the proper practices use to mount and support optical elements
3. Demonstrate optical ray analysis.

Program Affiliation

This course is not required as a core course in a program

Outline of Topics Covered

I. Optical Principal

- o Nature of Light

II. Environments and Their Impacts

- o Temperature
- o Pressure
- o Vibration
- o Shock
- o Moisture
- o Radiation
- o Contaminates
- o Materials
- o Refractive Elements
- o Reflective Elements
- o Mechanical Components
- o Adhesives

III. Basic Optical Principals

- o Refraction
- o Reflection
- o Scattering
- o Interference
- o Diffraction

- o Dispersion

IV. Materials

- o Optical Elements
- o Optical Crown Glass
- o Borosilicate Crown Glass
- o Barium Crown Glass
- o Flint Glass
- o Zerodur
- o Aluminum
- o Beryllium
- o Structural Material
- o Aluminum
- o Invar
- o Beryllium
- o Composites
- o Other Materials

V. Manufacturing Optical Elements

- o Tolerances on Optical Elements and Mechanical Components
- o Tradeoff Between Tight Tolerances and Cost
- o Dimensional Instability
- o Manufacturing Operations on Optical and Mechanical components

VI. The Optic-to-Mount Interface

- o Mechanical Constraints
- o General Considerations
- o Centering a Lens Element
- o Lens Interfaces
- o Prism Interfaces
- o Mirror Interfaces
- o Interfaces With Other Optical Components
- o Consequences of Mounting Forces
- o Sealing Considerations

VII. Mounting Individual Lenses

- o Preload Requirements

- o Weight and Center of Gravity Calculations
- o Spring Mountings for Lenses and Filters
- o Burnished Cell Mountings
- o Snap and "Interference Fit" Rings
- o Retaining Ring Constraints
- o Constraining the Lens With Multiple Spring Clips
- o Geometry of the Lens-to-Mount Interface
- o Elastomeric Mountings
- o Flexure Mountings for Lenses
- o Mounting Plastic Lenses.

VIII. Multiple-Component Lens Assemblies

- o Spacer Design and Manufacture
- o Drop-in Assembly
- o Lathe Assembly
- o Elastomeric Mountings
- o Poker-Chip Assembly
- o Assemblies Designed for High-Shock Environments
- o Photographic Objective Lenses
- o Modular Construction and Assembly
- o Catoptric and Catadioptric Assemblies
- o Assemblies With Plastic Housings and Lenses
- o Internal Mechanisms
- o Sealing and Purging Lens Assemblies

IX. Mounting Optical Windows, Filters, Shells, and Domes

- o Simple Window Mountings
- o "Special" Windows
- o Conformal Windows
- o Windows Subject to Pressure Differential
- o Filter Mountings
- o Mounting Shells and Domes.

X. Prism Design

- o Principal Functions
- o Geometric Considerations
- o Aberration Contributions of Prisms

- o Typical Prism Configurations

XI. Techniques for Mounting Prisms

- o Kinematic Mountings
- o Semikinematic Mountings
- o The Use of Pad On Cantilevered and Straddling Springs
- o Mechanically Clamped Nonkinematic Mountings
- o Bonded Prism Mountings
- o Flexure Mountings for Prisms

XII. Mirror Design

- o General Considerations
- o Image Orientation
- o First and Second-Surface Mirrors
- o Ghost Image Formation with Second-Surface Mirrors
- o Approximation of Mirror Aperture
- o Weight Reduction Techniques
- o Thin Facesheet Configuration
- o Metallic Mirrors
- o Metallic Foam Core Mirrors
- o Pellicles

XIII. Techniques for Mounting Smaller Nonmetallic Mirrors

- o Mechanically Clamped Mirror Mountings
- o Bonded Mirror Mountings
- o Compound Mirror Mountings
- o Flexure Mountings for Smaller Mirrors
- o Central and Zonal Mountings
- o Gravitational Effects on Smaller Mirrors

XIV. Techniques for Mounting Metallic Mirrors

- o Single Point Diamond Turning of Metallic Mirrors
- o Integral Mounting Provisions
- o Flexure Mountings for Metallic Mirrors
- o Plating of Metallic Mirrors
- o Interfacing Metallic Mirrors For Assembly and Alignment

XV. Techniques For Mounting Larger Nonmetallic Mirrors

- o Mounts for Axis-Horizontal Applications
- o Mounts for Axis-Vertical Applications
- o Mounts for Axis Variable Applications
- o Supports for Large, Space-home Mirrors

The Hubble Space Telescope

The Chandra X-Ray Telescope

XVI. Aligning Refracting, Reflecting and Catadioptric Systems

- o Aligning the Individual Lens
- o Aligning Multiple Lens Assemblies
- o Aligning Reflecting Systems

XVII. Estimation of Mounting Stresses

- o General Considerations
- o Rule-of-Thumb Stress Tolerances
- o Stress Generation at Point, Line, and Area Contacts
- o Bending Effects in Asymmetrically Clamped Optics

XVIII. Effects of Temperature Changes

- o Effects; of Temperature Change On Axial Preload
- o Radial Effects in Rim Contact Mountings
- o Effects of Temperature Gradients
- o Temperature Change-Induced Stresses in Bonded Optics