[ELEC 4610] [Engineering Optics] [Spring 2024] [Credits: 4]

Course Description

An introductory course in optics covering fundamentals of geometrical and physical optics. Topics include: review of geometrical optics, first order optical system and analysis, aberrations, designs of optical component and system; Basic wave theory, diffraction, interference, polarization, dispersion; fundamentals of optical instrumentation. Exclusion: PHYS3038 Prerequisite: ELEC 2400

List of Topics

Lecture Outline

1. The nature of light
2. Huygens'and Fermat's principles: reflection and refraction at an interface
3. Introduction of geometrical optics: propagation of light ray and paraxial approximation
4. Refractive surfaces, thin lenses and mirrors
5. Cardinal points/planes in paraxial optics and for thin and thick lenses
6. Matrix methods and aberrations
7. Optical systems -Cameras and the eye
8. Optical systems -Magnifier, microscope, telescope and binoculars
9. Making waves and propagation of waves
10. Electromagnetic Waves: reflection, refraction, transmission and polarization
11. Total internal reflection and reflection from metals
12. Two source Interference: thin film, Haidinger's bands, Fizeau fringes
13. Interference: Newton's Rings, Anti-reflecting coatings
14. Fraunhofer Diffraction: Single, multiple slit(s) and circular aperture
15. Limitation of optical imaging system
16. Fraunhofer Diffraction: grating and optical spectrometer

Laboratory Outline

1. characterization of optical components: Measuring the focal lengths of positive thin lenses and eyepiece
2. optical instrumentation I: Assembling a slide projector and a telescope
3. optical instrumentation II: Assembling a microscope and erect telescope
4. light is a wave, light is an electromagnetic wave
5. interference of light wave: Newton's ring and Michelson interferometer
6. diffraction of light wave: Fraunhofer diffraction of single slit and grating, reflective grating spectrometer

Intended Learning Outcomes:

On successful completion of this course, students are expected to be able to:

1. Explain key theoretical concepts relating to optics and applications of optical technology, including the nature and propagation of light, and optical instrumentation.
2. Observe key optical phenomena experimentally and build a variety of optical instruments.
3. Analyze simple optical systems consisting of lenses, stops, reflectors and prisms, determine and use principal points and focal points, and calculate and describe optical aberrations.
4. Analyze and design systems for measurement of polarization, precision measurement based on interference, optical thin film, interferometer, etc.
5. Analyze Fraunhofer diffraction patterns, determine the spatial resolution of an imaging system, design optical gratings and build an optical spectrometer.

Textbook(s):

1. Lecture notes
2. Hecht, *Optics*, Addison-Wesley, 5th Edition

Reference Books/Materials:

1. F. & L. Pedrotti, *Introduction to Optics*, Prentice Hall
2. Smith and Thomson, *Optics*, Wiley
3. R.S. Longhurst, *Geometrical and Physical Optics*, Wiley

Relationship of Course to Program Outcomes:

Please refer to the Report Section 4.3.2 (iii).

Grading Scheme:

Homework	15%
Laboratory	15%
Mid-Term Examination	20%
Final Examination	50%