ELEC4610 Engineering Optics

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, aberration, aperture and field stops; Basic wave theory, diffraction, interference, polarization, dispersion; fundamentals of optical instrumentation. *Exclusion(s):* PHYS 3038 *Prerequisite(s):* ELEC 2400

List of Topics

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

Statement of Objectives/Outcomes:

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

CO1 - Explain key theoretical concepts relating to optics and applications of optical technology, including the nature and propagation of light, and optical instrumentation.

CO2 - Observe key optical phenomena experimentally and build a variety of optical instruments.

CO3 - 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.

CO4 - Analyze and design systems for measurement of polarization, precision measurement based on interference, optical thin film, interferometer, etc.

CO5 - 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, 4th 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:

Labs	15%
Homework	15%
Midterm Examination	20%
Final Examination	50%