

**Rochester Institute of Technology
Rochester, New York**

COLLEGE of SCIENCE
Chester F. Carlson Center for Imaging Science

New Course : Optics, 1051-733

1.0 Title: Optics

Date: October 10, 2006

Prerequisite(s): Graduate standing in a science or engineering program or permission of instructor. 1051-716, 1051-719.

Corequisite(s):

Course proposed by: Zoran Ninkov and Roger Easton

2.0 Course information:

	Contact hours	Maximum students/section
Classroom	4	30
Lab		
Studio		
Other (specify _____)		

Quarter(s) offered (check)

_____ Fall Winter _____ Spring _____ Summer

Students required to take this course: (by program and year, as appropriate)

Graduate students in Imaging Science, PhD track.

Students who might elect to take this course:

Graduate students in Imaging Science, MS track. Graduate students in the College of Science or College of Engineering.

3.0 Goals of the course (including rationale for the course, when appropriate)

To introduce students to the basic concepts of optics needed to complete a graduate program of study in Imaging Science.

4.0 Course description (as it will appear in the RIT Catalog, including pre- and co-requisites, quarters offered)

1051-733

Optics

This course will provide the requisite introductory knowledge in optics needed by a student in the graduate program in Imaging Science. The course will cover topics including geometrical optics, the Fresnel equations, diffraction, and resolution of imaging systems. (1051-716, 1051-719) **Class 4, Credit 4 (W)**

5.0 Possible resources (texts, references, computer packages, etc.)

- 5.1 Hecht, *Optics*
- 5.2 OSLO software

6.0 Topics

6.1 Geometrical Optics and Imaging

- 6.1.1 Refraction at a Spherical Surface
 - 6.1.1.1 Paraxial Approximation
 - 6.1.1.2 Nature of Objects and Images
- 6.1.2 Imaging With Lenses
 - 6.1.2.1 Transverse Magnification
 - 6.1.2.2 Longitudinal Magnification
 - 6.1.2.3 Spherical Mirrors
 - 6.1.2.4 Systems of Thin Lenses
 - 6.1.2.5 Effective Focal Length
 - 6.1.2.6 Cardinal Points
 - 6.1.2.7 Stops and Pupils
 - 6.1.2.8 System f-Number
- 6.1.3 Ray Tracing
 - 6.1.3.1 Marginal and Chief Rays

6.2 Fresnel Equations and Applications

- 6.2.1 Boundary Conditions at an Optical Interface
- 6.2.2 Derivation of Fresnel Equations for TE and TM Polarizations
- 6.2.3 Reflectance and Transmittance Curves
- 6.2.4 Polarization Angle; Brewster Windows
- 6.2.5 Total Internal Reflection (TIR)
- 6.2.6 Evanescent Wave, Frustrated TIR; Beam Splitters
- 6.2.7 Phase Change on Reflection

6.3 Diffraction

- 6.3.1 Huygens' principle
- 6.3.2 Fresnel-Kirchhoff Diffraction Integral
- 6.3.3 Diffraction Regions
- 6.3.4 Fresnel Diffraction
 - 6.3.4.1 Propagation from point sources, quadratic-phase factors
 - 6.3.4.2 Fresnel diffraction from a straight edge
 - 6.3.4.3 Fresnel diffraction from a rectangular aperture
 - 6.3.4.4 Fresnel diffraction from a circular aperture

- 6.3.4.5 Fresnel zone plates
- 6.3.5 Fraunhofer Diffraction
 - 6.3.5.1 Single-Slit Diffraction
 - 6.3.5.2 Diffractive Spreading of a Beam
 - 6.3.5.3 Relationship to Fourier Transform
 - 6.3.5.4 Rectangular and Circular Apertures; Airy Disk
 - 6.3.5.5 Rayleigh Criterion and Resolution of Images
 - 6.3.5.6 Diffraction from Multiple Apertures
- 6.4 **Resolution of Optical Imaging Systems**
 - 6.4.1 Fraunhofer diffraction in optical imaging
 - 6.4.2 Diffraction limited systems
 - 6.4.3 Criteria for resolution
 - 6.4.4 MTF

7.0 Intended learning outcomes and associated assessment methods of those outcomes

Learning Outcome	In class attendance and evaluation	Homework Assignments
7.1 Calculate reflectivity from a variety of surfaces.	X	X
7.2 Characterize geometric properties of optical imaging systems	X	X
7.3 Calculate diffraction-limited performance of optical systems	X	X

8.0 Program or general education goals supported by this course

8.1 Satisfies one element of the set of Core Course Requirements for the MS and PhD in Imaging Science.

8.2 Prepares graduate students in science and engineering for careers in optical systems.

9.0 Other relevant information (such as special classroom, studio or lab needs, special scheduling, media requirements, etc.)

9.1 Classroom with computer projection system.

10.0 Supplemental information

Laboratory exercises to include (OSLO-based):

Lab 1: Image Formation

Lab 2: System Evaluation

Lab 3: Achromatic Telescope Objectives