ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

REVISED COURSE: COS-IMGS-633-Optics For Imaging

1.0 Course Approvals

Required course approvals:	**Approval Requested Date:**	**Approval Granted Date:**
Academic Unit Curriculum Committee	9/1/2010	9/15/2010
College Curriculum Committee	9/30/10	10/14/10
Optional course designation approvals:		
General Education Committee		
Writing Intensive Committee		
Honors		

2.0 Course information:

Course title:	Optics for Imaging
Credit hours:	3
Prerequisite(s):	COS-IMGS-616 and COS-IMGS-619
Co-requisite(s):	
Course proposed by:	Roger L. Easton, Jr.
Effective date:	September 2013

	Contact hours	**Maximum students/section**
Classroom	3	50
Lab		
Studio		
Other (specify)		

2.1 Course Conversion Designation (Please check which applies to this course)

X	Semester Equivalent (SE) Please indicate which quarter course it is equivalent to: 1051-733 Optics for Imaging
	Semester Replacement (SR) Please indicate the quarter course(s) this course is replacing:
	New

2.2 Semester(s) offered (check)

Fall	Spring X	Summer	Other

All courses must be offered at least once every 2 years. If course will be offered on a bi-annual basis, please indicate here:

2.3 Student Requirements

Students required to take this course: (by program and year, as appropriate) Graduate students in Imaging Science PhD program
Students who might elect to take the 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, and quarters offered). Please use the following format:

COS-IMGS-633 **Optics for Imaging** This course provides the requisite knowledge in optics needed by a student in the graduate program in Imaging Science. The topics covered include the ray and wave models of light, diffraction, imaging system resolution, (COS-IMGS-616 and COS-IMGS-619) **Class 3, Credit 3 (S)**

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

5.1 *Optics*, Hecht, Addison-Wesley, New York 5.2 *Fourier Methods in Imaging*, Roger L. Easton, Jr., Wiley, Chichester, UK

6.0 Topics (outline):

6.1 Wave Optics and Imaging
- 6.1.1 Review of wave equation
- 6.1.2 Electric and magnetic fields
- 6.1.3 Review of Maxwell's equations, propagation of electromagnetic fields
- 6.1.4 Vector Calculus
  - 6.1.4.1 Vector and scalar fields
  - 6.1.4.2 Gradient of scalar field is a vector field
  - 6.1.4.3 Divergence of vector field is a scalar field
  - 6.1.4.4 Curl of three-dimensional (3-D) vector field is a 3-D vector field
  - 6.1.4.5 Laplacian of scalar and vector fields
- 6.1.5 Electromagnetic waves

6.2 Diffraction of light
- 6.2.1 Huygens' principle
- 6.2.2 Fresnel-Kirchhoff Diffraction Integral
  - 6.2.2.1 Spherical waves
  - 6.2.2.2 Linearity and shift variance of process
- 6.2.3 Fresnel Diffraction
  - 6.2.3.1 Propagation from point sources as paraboloidal waves
  - 6.2.3.2 Linearity and shift invariance
  - 6.2.3.3 quadratic-phase factors
  - 6.2.3.4 Impulse response of propagation in Fresnel diffraction
  - 6.2.3.5 Transfer function of light propagation in Fresnel diffraction
  - 6.2.3.6 Fresnel diffraction from a straight edge, Cornu spiral
  - 6.2.3.7 Fresnel diffraction from rectangular aperture
  - 6.2.3.8 Fresnel diffraction from circular aperture
  - 6.2.3.9 Fresnel zone plates
- 6.2.4 Fraunhofer Diffraction
  - 6.2.4.1 Approximation of spherical waves as plane waves, shift variance
  - 6.2.4.2 Relationship to Fourier Transform
  - 6.2.4.3 Diffraction from one slit, two slits, many slits
  - 6.2.4.4 Diffraction gratings
  - 6.2.4.5 Diffractive spreading of a beam
  - 6.2.4.6 Rectangular and circular apertures; Airy disk

6.3 Optical imaging in the diffraction model
- 6.3.1 Action of lenses with spherical surfaces
- 6.3.2 Quadratic-phase model of lenses
- 6.3.3 Action of lens: propagation+multiplication+propagation Fourier transform (Convolve + Multiply + Convolve = C-M-C)
- 6.3.4 Imaging Equation
- 6.3.5 Coherence
- 6.3.6 Diffraction limit
- 6.3.7 Criteria for resolution
  - 6.3.7.1 Dawes' limit
  - 6.3.7.2 Rayleigh criterion
  - 6.3.7.3 Sparrow criterion

7.0 Intended course learning outcomes and associated assessment methods of those outcomes

Learning Outcome	Homework Assignments	Examinations
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 outcomes and/or goals supported by this course

This course provides a working knowledge of optical imaging techniques used in the physical sciences and engineering.

9.0

	General Education Learning Outcome Supported by the Course	Assessment Method
Communication		
	Express themselves effectively in common college-level written forms using standard American English	
	Revise and improve written and visual content	
	Express themselves effectively in presentations, either in spoken standard American English or sign language (American Sign Language or English-based Signing)	
	Comprehend information accessed through reading and discussion	
Intellectual Inquiry		
	Review, assess, and draw conclusions about hypotheses and theories	
	Analyze arguments, in relation to their premises, assumptions, contexts, and conclusions	
	Construct logical and reasonable arguments that include anticipation of counterarguments	
	Use relevant evidence gathered through accepted scholarly methods and properly acknowledge sources of information	
Ethical, Social and Global Awareness		
	Analyze similarities and differences in human experiences and consequent perspectives	
	Examine connections among the world's populations	
	Identify contemporary ethical questions and relevant stakeholder positions	
Scientific, Mathematical and Technological Literacy		
	Explain basic principles and concepts of one of the natural sciences	
	Apply methods of scientific inquiry and problem solving to contemporary issues	
	Comprehend and evaluate mathematical and statistical information	
	Perform college-level mathematical operations on quantitative data	
	Describe the potential and the limitations of technology	
	Use appropriate technology to achieve desired outcomes	
Creativity, Innovation and Artistic Literacy		
	Demonstrate creative/innovative approaches to course-based assignments or projects	
	Interpret and evaluate artistic expression considering the cultural context in which it was created	

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

Smart classroom

11.0 Supplemental information for Optional Course Designations: If the course is to be considered as writing intensive or as a general education or honors course, include the sections of the course syllabus that would support this designation.

Programform.doc

NYSED Documentation Form

Audience

This document is intended for all department chairs and program directors.

Summary

This document includes the information and required forms for submission of program to NYSED for semester conversion.

Change Log

Responsible	Date	Version	Short description
<your name here>	<date>	1	Document originator