ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

NEW COURSE: COS-IMGS-737 - Physical Optics

1.0 Course Approvals

Required course approvals:	**Approval request date:**	**Approval granted date:**
Academic Unit Curriculum Committee	9/10/2010	9/15/2011
College Curriculum Committee	9/28/2011	10/11/2011

Optional designations:	**Is designation desired?**		***Approval request date:**	****Approval granted date:**
General Education:		No		
Writing Intensive:		No		
Honors		No		

2.0 Course information:

Course title:	Physical Optics
Credit hours:	3
Prerequisite(s):	None
Co-requisite(s):	IMGS-633 or permission of instructor
Course proposed by:	Roger Dube
Effective date:	Fall 2013

	Contact hours	**Maximum students/section**
Classroom	2	20
Lab	3	20
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: 1051-737 Physical Optics
	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: Graduate Students in Imaging Science in the Optics specialty track
Students who might elect to take the course: 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 provide a foundation that enables a classical and quantum mechanical understanding of the possible interactions of electromagnetic waves, charged particles, and neutrons with matter.

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:

IMGS-737 Physical Optics

This course covers the wave properties of light, its interaction with matter, and the application of these principles to imaging systems. Topics include polarization of light, birefringence, interference and interferometers, spatial and temporal coherence, and scalar diffraction theory. (IMGS-633 or permission of instructor) **Class 2, Lab 3, Credit 3 (S)**

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

5.1 Easton, *Fourier Methods in Imaging*, Wiley, Hoboken, NJ
5.2 Hecht, *Optics*, Addison-Wesley, Boston, MA

6.0 Topics (outline):

- 6.1. Complex representation of waves and the wave equations
  - 6.1.1. Classical electricity and magnetism (EM)
    - 6.1.1.1. Maxwell's equations
  - 6.1.2. Propagation of EM waves in a conductor
- 6.2. Vector representation
  - 6.2.1. Vector and scalar fields
  - 6.2.2. Gradients, divergence and fields
  - 6.2.3. Curl
  - 6.2.4. Laplacian of scalar and vector fields
- 6.3. Polarization
  - 6.3.1. Jones calculus
- 6.4. Propagation of light in dielectric media
  - 6.4.1. Refractive index and dispersion
  - 6.4.2. Lorentz model for refractive index
  - 6.4.3. Fresnel equations

- 6.4.3.1. Boundary conditions at an optical interface
- 6.4.3.2. Polarization
- 6.4.3.3. Reflection and transmission, impact on polarization
- 6.4.4. Crystals
- 6.4.5. Metals
- 6.4.6. Electro-optic and magneto-optic effects and devices

6.5. Coherence
- 6.5.1. Spatial coherence
- 6.5.2. Temporal coherence
- 6.5.3. Young's experiment

6.6. Interferometry devices
- 6.6.1. Michelson
- 6.6.2. Twyman-Green
- 6.6.3. Fizeau, others
- 6.6.4. Multiple beam interferometers

6.7. Spherical waves
- 6.7.1. Huygens-Fresnel principle and integral
- 6.7.2. Spherical waves and diffraction

6.8. Diffraction
- 6.8.1. Fraunhofer diffraction
  - 6.8.1.1. Fraunhofer diffraction and Fourier transforms
- 6.8.2. Fresnel diffraction
- 6.8.3. Applications of diffraction to devices

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

Course Learning Outcome	Homework	Exams	Labs
7.1 Explain Maxwell's equations and the relationships between the terms		X	X
7.2 Describe polarization in a reflection problem using Jones calculus		X	X
7.3 Explain the difference between Fraunhofer and Fresnel diffraction		X	X
7.4 Identify the appropriate interferometer for a given measurement	X	X	X
7.5 Analyze the diffraction effects at different points in an optical system	X	X	X

8.0 Program outcomes and/or goals supported by this course

8.1 To provide a working knowledge of the interaction of light with matter, the effects of coherence on a system, and an understanding of diffraction effects.
8.2 To apply knowledge of the science and technology of imaging.

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.