ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

REVISED COURSE: COS-IMGS-616- Fourier Methods for Imaging

1.0 Course Approvals

Required course approvals:	**Approval Requested Date:**	**Approval Granted Date:**
Academic Unit Curriculum Committee	9/1/2010	9/27/2010
College Curriculum Committee	9/28/2010	10/14/2010
Optional course designation approvals:		
General Education Committee		
Writing Intensive Committee		
Honors		

2.0 Course information:

Course title:	Fourier Methods for Imaging
Credit hours:	3
Prerequisite(s):	Graduate standing or permission of instructor
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: 1051-716 Fourier Methods for Imaging
	Semester Replacement (SR) Please indicate the quarter course(s) this course is replacing:
	New

2.2 Semester(s) offered (check)

Fall X	Spring	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) M.S. and Ph.D. students in Imaging Science.
Students who might elect to take the course: Graduate students in the College of Science or College of Engineering, advanced undergraduates in Imaging Science (with permission)

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

To introduce the concepts of Fourier synthesis and analysis that are essential for understanding imaging systems

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

COS-IMGS-616 **Fourier Methods for Imaging** This course develops the mathematical methods required to describe continuous and discrete linear systems, with special emphasis on tasks required in the analysis or synthesis of imaging systems. The classification of systems as linear/nonlinear and shift variant/invariant, development and use of the convolution integral, Fourier methods as applied to the analysis of linear systems. The physical meaning and interpretation of transform methods are emphasized. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

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

5.1	*Fourier Methods in Imaging*, Roger L. Easton, Jr., Wiley, Chichester, UK.
5.2	*Fourier Analysis and Imaging*, Ronald N. Bracewell, Springer, New York

6.0 Topics (outline):

- 6.1 Signals, Operators, and Imaging Systems
  - 6.1.1 Imaging "chain"
  - 6.1.2 Three imaging "tasks:" forward, inverse, analysis
  - 6.1.3 Examples of the imaging chain and tasks
- 6.2 Operators and Functions
- 6.3 Representations of systems, inputs, and outputs by functions
  - 6.3.1 Symmetry properties of functions
  - 6.3.2 Projections of functions onto "reference" functions, orthogonality
  - 6.3.3 Complex functions
  - 6.3.4 Special functions
    - 6.3.4.1 Definitions of deterministic special functions
    - 6.3.4.2 Dirac delta function
    - 6.3.4.3 Stochastic functions
- 6.4 Classes of Imaging Operators
  - 6.4.1 Linearity
  - 6.4.2 Shift-invariance
  - 6.4.3 Crosscorrelation
  - 6.4.4 Convolution
- 6.5 Fourier analysis and synthesis
  - 6.5.1 Projection of functions onto sinusoidal "reference" functions
  - 6.5.2 Projections onto combinations of "reference" functions
    - 6.5.2.1 Hartley transform
    - 6.5.2.2 Fourier transform
  - 6.5.3 Fourier synthesis, Inverse Fourier transform
- 6.6 Theorems of the Fourier transform
  - 6.6.1 Transform of transform
  - 6.6.2 Scaling theorem
  - 6.6.3 Shift theorem
  - 6.6.4 Filter theorem
  - 6.6.5 Modulation theorem
  - 6.6.6 Derivative theorem
  - 6.6.7 Fourier transform of complex conjugate
  - 6.6.8 Fourier transform of crosscorrelation
  - 6.6.9 Fourier transform of autocorrelation
  - 6.6.10 Rayleigh's and Parseval's theorems
  - 6.6.11 Fourier transform of periodic function
  - 6.6.12 Fourier transform of sampled function
  - 6.6.13 Fourier transform of discrete periodic function
  - 6.6.14 Fourier transforms of stochastic signals
  - 6.6.15 Effect of nonlinear operations on spectra
- 6.7 Fourier transforms of multidimensional functions
  - 6.7.1 Separable 2-D functions
  - 6.7.2 Circularly symmetric 2-D functions, Hankel transform
  - 6.7.3 Radon transform
- 6.8 Approximations to the Fourier transform

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

Learning Outcome	**Homework**	**Examinations**
Demonstrate principles of Fourier transforms of continuous and discrete functions	X	X
Demonstrate the application of linear filtering to characterize the action of imaging systems	X	X
Differentiate between actions of linear systems acting on continuous and discrete functions	X	X

8.0 Program outcomes and/or goals supported by this course

This course provides a working knowledge of imaging techniques used to solve problems 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.)

Classroom with projector, internet access, and online learning capability

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