ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

NEW COURSE: COS-IMGS-261 Linear and Fourier Methods for Imaging

1.0 Course Designations and Approvals

Required course approvals:	**Approval request date:**	**Approval granted date:**
Academic Unit Curriculum Committee	7/23/10	8/17/10
College Curriculum Committee	10/19/10	11/4/2010

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

2.0 Course information:

Course title:	Linear and Fourier Methods for Imaging
Credit hours:	4
Prerequisite(s):	COS-MATH-182
Co-requisite(s):	
Course proposed by:	Roger L. Easton, Jr.
Effective date:	Fall 2013

	Contact hours	**Maximum students/section**
Classroom	4	30
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: 1051-320 Linear Mathematics 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: Imaging Science-2, Digital Cinema-2
Students who might elect to take the course: Physics-2, Electrical Engineering-2

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

This course introduces and develops the concepts of complex numbers, vectors, and matrices for use as representations of discrete models of linear imaging systems. The alternative representations of discrete imaging systems are obtained via the discrete Fourier transform and extended to the continuous case by deriving and applying the Fourier integral for analysis and synthesis. The concepts introduced in this course will be applied in the subsequent courses in the imaging science curriculum.

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-261 Linear and Fourier Methods for Imaging
This course develops the concepts of complex numbers and linear algebra for describing imaging systems in the frequency domain via the discrete and continuous Fourier transforms. (COS-MATH-182) **Class 4, Lab 0, Credit 4 (S)**

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

5.1 *Fourier Methods in Imagin*g, Roger L. Easton, Jr., John Wiley & Sons, Chichester, UK.
5.2 *Linear Algebra and its Applications*, Gilbert Strang, Cengage, Florence KY..

6.0 Topics (outline):

6.1 The Imaging "Chain"
6.2 Mathematical expressions for describing imaging systems
6.3 The three imaging "tasks:"
  6.3.1 Direct problem
  6.3.2 Inverse problem
  6.3.3 System analysis and synthesis
6.4 Operators that describe imaging systems
  6.4.1 Linearity
  6.4.2 Shift invariance
  6.4.3 Examples of imaging systems and mathematical models
6.5 Functions as objects and images
  6.5.1 Continuous functions
  6.5.2 Discrete functions, sampling
6.6 Scalars and vectors with real-valued components
6.7 Vector algebra
  6.7.1 Scalar products
  6.7.2 Projection of one vector onto a reference vector
  6.7.3 Projections of one vector onto multiple reference vectors, matrices
  6.7.4 Matrix-vector products
  6.7.5 Imaging systems as matrices
  6.7.6 Shift-invariant imaging systems as circulant matrices
6.8 Complex numbers
6.9 Vectors with complex-valued components
6.10 Eigenvectors and Eigenvalues
  6.10.1 Eigenvectors of circulant matrices
  6.10.2 Discrete Fourier transform (DFT) to diagonalize circulant matrices
6.11 Continuous-domain analogues of vector operations
6.12 Fourier transforms of 1-D continuous functions
6.13 Sampling
6.14 Fourier transforms of discrete functions
6.15 Discrete Fourier transforms of two-dimensional functions

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

Course Learning Outcome	Assessment 1	Assessment 2
7.1 Demonstrate representations of images as vectors and of imaging systems as matrices	Homework Assignments	Examinations
7.2 Apply the discrete Fourier transform to solve inverse problems in imaging	Homework Assignments	
7.3 Apply the one-dimensional continuous Fourier transform to common functions used in imaging	Homework Assignments	Examinations
7.4 Apply the 2-D discrete Fourier transform to images	Homework Assignments	

8.0 Program outcomes and/or goals supported by this course

8.1 Apply knowledge of imaging systems, physics, mathematics, and digital processing to formulate, analyze, and solve practical problems in imaging science.

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	
X	Comprehend and evaluate mathematical and statistical information	Homework, examinations
	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