ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

NEW COURSE: COS-IMGS-361 Image Processing and Computer Vision I

1.0 Course Designations and Approvals

Required course approvals:	**Approval request date:**	**Approval granted date:**
Academic Unit Curriculum Committee	9/1/10	9/15/10
College Curriculum Committee	10/19/10	12/7/2010

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:	Image Processing and Computer Vision I
Credit hours:	3
Prerequisite(s):	COS-IMGS-261, COS-IMGS-180 or equivalent programming experience
Co-requisite(s):	None
Course proposed by:	Carl Salvaggio
Effective date:	Fall 2013

	Contact hours	**Maximum students/section**
Classroom	3	30
Lab		
Studio		
Other (specify)		

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

√	Semester Equivalent (SE) Please indicate which quarter course it is equivalent to: 1051-361 Digital Image Processing I
	Semester Replacement (SR) Please indicate the quarter course(s) this course is replacing:
	New

2.2 Semester(s) offered (check)

Fall √	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: This course will be offered every year

2.3 Student Requirements

Students required to take this course: (by program and year, as appropriate) Imaging Science/3rd year, Digital Cinema 3rd year
Students who might elect to take the course: Imaging and Photographic Technology, Computer Science, Computer Engineering, Environmental Science, Applied Mathematics, Physics

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

3.1 To provide an understanding of basic digital image processing concepts
3.2 To develop programming skills to enable implementation these concepts to facilitate application to real imagery.

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-361 Image Processing and Computer Vision I
This course is an introduction to the basic concepts of digital image processing. The student will be exposed to image capture and image formation methodologies, sampling and quantization concepts, statistical descriptors and enhancement techniques based upon the image histogram, point processing, neighborhood processing, and global processing techniques based upon kernel operations and discrete convolution as well as the frequency domain equivalents, treatment of noise, geometrical operations for scale and rotation, and grey-level resampling techniques. Emphasis is placed on applications and efficient algorithmic implementation using the student's programming language of choice. (P: COS-IMGS-261, COS-IMGS-180 or equivalent programming experience)
Class 3, Credit 3 (F)

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

5.1 Gonzalez, Rafael C. and Richard E. Woods, *Digital Image Processing*, Prentice-Hall, Upper Saddle River NJ
5.2 IDL from ITT Visual Information Solutions, Boulder CO
5.3 MATLAB from Mathworks, Natick MA

6.0 Topics (outline):

6.1 Image processing concepts and steps
- 6.1.1 Image acquisition
- 6.1.2 Image enhancement
- 6.1.3 Image restoration
- 6.1.4 Color image processing
- 6.1.5 Compression
- 6.1.6 Morphological processing
- 6.1.7 Segmentation

6.2 Image acquisition systems

- 6.2.1 Point detectors
- 6.2.2 Linear arrays
- 6.2.3 CCD arrays
- 6.2.4 Line scanners
- 6.2.5 Whiskbroom scanners
- 6.2.6 Fourier-transform spectrometers

6.3 Geometric manipulations
- 6.3.1 Scale
- 6.3.2 Rotation
- 6.3.3 Grey-level resampling
  - 6.3.3.1 Nearest-neighbor
  - 6.3.3.2 Bilinear interpolation
  - 6.3.3.3 Cubic convolution
- 6.3.4 Mapping via control point selection
  - 6.3.4.1 Control point selection
  - 6.3.4.2 Multiple least squares regression
  - 6.3.4.3 Assessment of the quality of mapping transform
- 6.3.5 Feature detection
  - 6.3.4.1 Harris corner detector
  - 6.3.4.2 Scale-invariant feature transform (SIFT)

6.4 Image enhancement
- 6.4.1 Grey-level manipulations
- 6.4.2 Lookup tables
- 6.4.3 Histogram equalization
- 6.4.4 Histogram specification
- 6.4.5 Arithmetic operators

6.5 Linear spatial filtering
- 6.5.1 Smoothing and averaging
- 6.5.2 Sharpening
- 6.5.3 Unsharp masking
- 6.5.4 First and second derivative-based operators
- 6.5.5 Gradient operators

6.6 Frequency domain processing
- 6.6.1 Description of frequency domain representation of imagery
- 6.6.2 Fourier transform
- 6.6.3 Fourier series
- 6.6.4 Discrete Fourier transform (DFT)
  - 6.6.4.1 One-dimensional DFT
  - 6.6.4.2 Two-dimensional DFT
- 6.6.5 Phase and it physical meaning
- 6.6.6 Fast Fourier transform (FFT)
- 6.6.7 Windowing functions

6.7 Frequency-domain filtering
- 6.7.1 Lowpass
- 6.7.2 Highpass
- 6.7.3 Filter types

6.7.3.1 Ideal 6.7.3.2 Butterworth 6.7.3.3 Gaussian 6.7.3.4 Laplacian

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

Course Learning Outcome	Assessment 1	Assessment 2
7.1 Ability to use basic digital image processing concepts to perform enhancements to grey-level data	Homework Assignments	Exams
7.2 Ability to use a modern computer programming environment (e.g. IDL or Matlab) as an interactive problem solving tool and visualization system	Programming Projects	

8.0 Program outcomes and/or goals supported by this course

8.1 To develop a set of tools with which to perform grey-level image enhancements, spatial and frequency domain operations, and geometric manipulation of image data 8.2 To enhance proficiency in using a modern programming environment as an image manipulation/enhancement tool and further readiness to become active algorithm developers in industry 8.3 To apply mathematics to applied image processing problems

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.)

Course needs to be conducted in a classroom equipped with a high-resolution projector (1280 × 1024) for classroom instruction