ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

NEW COURSE: COS-IMGS-732 - Advanced Environmental Applications of Remote Sensing X

1.0 Course Designations and Approvals

Required course approvals:	**Approval request date:**	**Approval granted date:**
Academic Unit Curriculum Committee	7/30/2010	3/15/2011
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:	Advanced Environmental Applications of Remote Sensing X
Credit hours:	3
Prerequisite(s):	IMGS-431, PHYS-112, or permission of instructor
Co-requisite(s):	None
Course proposed by:	Jan van Aardt
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: 1051-753 Advanced Environmental Applications of Remote Sensing
	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: None
Students who might elect to take the course: Imaging Science, Environmental Science, Math, Physics, Computer Science, Engineering

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

3.1 To advance understanding of the potential applications of remote sensing to natural resource assessment, as presented in the first course on this topic (COS-IMGS-431).
3.2 To develop advanced remote sensing analysis concepts, beyond sensors and image pre-processing, as these apply to natural resource assessment.
3.3 To better comprehend context-specific electromagnetic radiation and target responses, advanced classifiers, and remote sensing for structural assessment.
3.4 To reinforce concepts with state-of-the-art remote sensing hardware (field instrumentation and airborne imaging systems (commercial, research, and RIT-developed)) and software, as well as real-world examples of applications.

4.0 Course description

IMGS-732 Advanced Environmental Applications of Remote Sensing X

This course will focus on a broader selection of analytical techniques with an application-centric presentation. These techniques include narrow-band indices, filtering in the spatial and frequency domains, principal component analysis, textural analysis, hybrid and object-oriented classifiers, change detection methods, and structural analysis. All of these techniques are applied to assessment of natural resources. Sensing modalities include imaging spectroscopy (hyperspectral), multispectral, and light detection and ranging (lidar) sensors. Applications such as vegetation stress assessment, foliar biochemistry, advanced image classification for land use purposes, detecting change between image scenes, and assessing topography and structure in forestry and grassland ecosystems (volume, biomass, biodiversity) and built environments will be examined. Real-world remote sensing and field data from international, US, and local sources are used throughout this course. Students will be expected to perform a more comprehensive final project and homework assignments, including literature review and discussion and interpretation of results. (IMGS-431, PHYS-112, or permission of instructor) **Class 2, Lab 3, Credit 3 (F)**

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

5.1 Jensen, *Remote Sensing of the Environment – An Earth Resource Perspective*, Prentice-Hall, Upper Saddle River, NJ.
5.2 Lillesand, Kiefer, and Chipman, *Remote Sensing and Image Interpretation*, Wiley, Hoboken, NJ
5.3 Environment for Visualizing Images (ENVI) software package.

6.0 Topics (outline):

6.1 Energy-Matter Interactions

- 6.1.1 Water
  - 6.1.1.1 Spectral properties of water bodies
  - 6.1.1.2 Implications for applications
- 6.1.2 Geology
  - 6.1.2.1 Spectral properties of soil
  - 6.1.2.2 Reflectance properties of minerals
  - 6.1.2.3 Reflectance properties of rocks
- 6.1.3 Vegetation
  - 6.1.3.1 Spectral properties of vegetation
  - 6.1.3.2 Implications for applications
- 6.1.4 Spectral profiles and libraries

6.2 Applications of spectral image analysis

- 6.2.1 Band ratioing and vegetation indices (*foliar/canopy biochemistry*)
  - 6.2.1.1 Standard vegetation indices
  - 6.2.1.2 Narrow-band indices
- 6.2.2 Frequency and spatial domain filtering (*noise removal/texture*)
- 6.2.3 Principal components analysis (*species classification*)
- 6.2.4 Hybrid *classifiers* (guided clustering and IGSCR)
- 6.2.5 Object-oriented *classification*
- 6.2.6 *Change detection*
  - 6.2.6.1 Image differencing methods
  - 6.2.6.2 Image normalization

6.3 Lidar analysis for applications

- 6.3.1 Textural analysis
- 6.3.2 Lidar data types
  - 6.3.2.1 Discrete return lidar
  - 6.3.2.2 Waveform lidar
- 6.3.3 Lidar data processing
  - 6.3.3.1 Error checking
  - 6.3.3.2 Point classification
  - 6.3.3.3 Surface derivation (interpolation)
  - 6.3.3.4 Structural analysis
- 6.3.4 Lidar applications
  - 6.3.4.1 Topography (*hydrology/surface characterization*)
  - 6.3.4.2 Built environments (*building modeling*)
  - 6.3.4.3 Forestry and ecosystems (*biomass assessment*)

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

Course Learning Outcome	Quizzes	Homework	Project
7.1 Recognize the fundamental background to natural resource remote sensing in terms of light-matter interactions	X		X
7.2 Apply spatial and spectral remote sensing analysis using ENVI software	X	X	
7.3 Apply advanced classification, change detection, vegetation condition assessment, and structural analysis approaches	X	X	
7.4 Demonstrate graduate-level, independent analysis on a project topic of choice			X
7.5 Perform advanced literature review and result discussion/interpretation for assignments		X	X

8.0 Program outcomes and/or goals supported by this course

8.1 To provide students with a depth and breadth of imaging science.
8.2 To develop the student's capacity for critical thinking.
8.3 To apply advanced imaging analysis approaches, introduced as part of the prerequisite courses or covered in program core courses, to environmental applications.

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.)

10.1 A computer lab with ArcGIS/ERDAS Imagine/ENVI installations.
10.2 Student access to licensing for ENVI software.