ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

# COLLEGE OF SCIENCE

Chester F. Carlson Center for Imaging Science

NEW COURSE: COS-IMGS-441-Noise and System Modeling

**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 | 12/3/2010 |

| **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**: | Noise and System Modeling |
| **Credit hours:** | 3 |
| **Prerequisite(s):** | COS-MATH-251,COS-IMGS-261 |
| **Co-requisite(s)**: | None |
| **Course proposed by:** | Rich Hailstone |
| **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)**

| | |
|---|---|
| x | Semester Equivalent (SE) Please indicate which quarter course it is equivalent to:<br>1051-453 Image Systems Analysis III: Noise & Random Processes |
| | 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**

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| **Students required to take this course**: (by program and year, as appropriate) Third-year Imaging Science majors | |
| **Students who might elect to take the course**: Students with appropriate prerequisites | |

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

Provide students with practical skills in the mathematical analysis and modeling of noise in imaging systems. Students will be able to measure, characterize, and diagnose the causes of noise and imaging inefficiencies in complex imaging systems.

**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-441** **Noise & System Modeling**

This course develops the concepts of noise modeling and random processes within the context of imaging systems. After a brief review of probability theory, the concept of image noise is introduced. Random processes are considered in both the spatial and spatial frequency domains, with emphasis on the autocorrelation function and power density spectrum. Finally, the principles of random processes are applied to signal and noise transfer in multistage imaging systems. At the completion of the course the student will be able to model signal and noise transfer within a multistage imaging system. (COS-MATH-251, COS-IMGS-261) **Class 3, Credit 3 (F)**

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

5.1 Course notes: Noise and Random Processes
5.2 Frieden, B.R., *Probability, Statistical Optics, and Data Testing*, Springer, New York, NY

**6.0 Topics (outline):**

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

| Course Learning Outcome | Assessment 1 | Assessment 2 |
|---|---|---|
| 7.1 Identify and describe the factors that govern noise and signal/noise ratio in imaging systems. | Homework | Examinations |
| 7.2 Explain spatial aspects of random noise, including autocorrelation, autocovariance, and cross-correlation functions. | Homework | Examinations |
| 7.3 Describe the power density spectrum and its application to noise in imaging systems. | Homework | Examinations |
| 7.4 Describe detective quantum efficiency and its use in imaging system analysis. | Homework | Examinations |
| 7.5 Describe how signal and noise are propagated in a multistage imaging system. | Homework | Examinations |
| 7.6 Explain how the concept of signal and noise transfer must be modified for discrete imaging systems. | Homework | Examinations |

**8.0 Program outcomes and/or goals supported by this course**

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| Provides mathematical skills with which to understand and model imaging system performance |

**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.)

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| Smart classroom |