ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

# COLLEGE OF SCIENCE

**Chester F. Carlson Center for Imaging Science**

**NEW COURSE**: COS-IMGS-620-The Human Visual System

**1.0 Course Designations and Approvals**

| **Required course approvals:** | **Approval request date:** | **Approval granted date:** |
|---|---|---|
| Academic Unit Curriculum Committee | 7/21/2010 | 8/17/2010 |
| College Curriculum Committee | 9/1/2010 | 9/27/2010 |

| **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**: | COS-IMGS-620-The Human Visual System |
| **Credit hours:** | 3 |
| **Prerequisite(s):** | Graduate status in Center for Imaging Science or permission of Instructor |
| **Co-requisite(s)**: | |
| **Course proposed by:** | Jeff B. Pelz |
| **Effective date:** | September, 2013 |

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

**2.a Course Conversion Designation*** (Please check which applies to this course).**
*For more information on Course Conversion Designations please see page four.

| | |
|---|---|
| X | Semester Equivalent (SE) Please indicate which quarter course it is equivalent to: 1051-720 The Human Visual System |
| | Semester Replacement (SR) Please indicate the quarter course(s) this course is replacing: |
| | New |

**2.b 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.c Student Requirements**

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| **Students required to take this course**: (by program and year, as appropriate)<br>First-year graduate students in Imaging Science Ph.D. program.<br>First-year graduate students in Color Science MS and Ph.D. programs. |
| **Students who might elect to take the course**:<br>Graduate students in Imaging Science MS program.<br>Graduate students in other programs |

*In the sections that follow, please use sub-numbering as appropriate (eg. 3.1, 3.2, etc.)*

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

The goals of this course are to provide an understanding of the primary elements of the human visual system, from the optical elements in the eye through cortical processing centers; an introduction to psychophysics (techniques used to measure visual system performance), and examples of application of this knowledge to the design and evaluation of imaging systems. Students will learn about the structure, characteristics, and limitations of the human visual system (HVS), and how those characteristics affect the design of 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:

**Course number: Name of Course**
Description as you want it to appear in the catalog. (Pre or co-requisites)
**Class X, Lab X, Credit X (Semester offered)**

**COS- IMGS-620 The Human Visual System**
This course describes the underlying structure of the human visual system, the performance of those structures and the system as a whole, and introduces psychophysical techniques used to measure them. The visual system's optical and neural systems responsible for collecting and detecting spatial, temporal, and spectral signals from the environment are described. The sources and extent of limitations in the subsystems are described and discussed in terms of the "enabling limitations" that allow practical imaging systems. **Class 3, Credit 3 (F)**

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

5.1 Palmer, Stephen E., *Vision Science: Photons to Phenomenology*,

MIT Press, Cambridge.
5.2 Selected chapters from: Gescheider, *Psychophysics: The Fundamentals*, Lawrence Erlbaum Assoc., Hillsdale.
5.3 Additional book chapters
5.4 Assigned journal articles

**6.0 Topics (outline):**

6.1 Course Overview

6.2 Psychophysics
- 6.2.1 The Experiments by Hecht, Shlaer, & Pirenne
- 6.2.2 The Classical Psychophysical Methods
- 6.2.3 Signal Detection Theory

6.3 The Eye
- 6.3.1 Physical Structure
- 6.3.2 Visual Optics
  - 6.3.2.1 Image formation
  - 6.3.2.2 Limitations on image quality
- 6.3.3 Lab/Demo: (e.g., central vs. peripheral acuity)

6.4 The Retina
- 6.4.1 Photoreceptors
- 6.4.2 Retinal Processing

6.5 The Lateral Geniculate Nucleus
- 6.5.1 LGN Structure
- 6.5.2 Processing

6.6 Cortical Processing
- 6.6.1 Primary Visual Cortex (V1)
- 6.6.2 Dorsal & Ventral Streams
- 6.6.3 Other Cortical Areas

6.7 Spatial Vision
- 6.7.1 Contrast Sensitivity Functions
- 6.7.2 Acuity, resolution, and display requirements
- 6.7.3 Eye movements

6.8 Temporal Vision and Motion Perception
- 6.8.1 Spatiotemporal CSF
- 6.8.2 Temporal/motion processing and display requirements
- 6.8.3 Lab/Demo: (e.g., Spatial and temporal aliasing)

6.9 Color Vision
- 6.9.1 Theories of color vision

6.9.2 Color vision and capture & display requirements
6.9.3 Additive and subtractive color reproduction
6.9.4 Lab/Demo: (e.g., Color vision screening)

6.10 Depth Perception
6.10.1 Depth cues; 2D, 3D-spatial, & 3D-motion, binocular disparity

**7.0 Intended course learning outcomes and associated assessment methods of those outcomes** (please include as many Course Learning Outcomes as appropriate, one outcome and assessment method per row).

| Course Learning Outcome | Assessment Method |
|---|---|
| 7.1 Describe the fundamental properties and inherent limitations of the human visual system | In-Class Discussions/Evaluations, Homework |
| 7.2 Explain performance metrics of the human visual system. | In-Class Discussions/Evaluations, Homework |
| 7.3 Evaluate the spatial, temporal, and spectral response of the human visual system and how those responses inform the design of imaging systems | In-Class Discussions/Evaluations, Homework |
| 7.4 Describe fundamental psychophysical techniques | In-Class Discussions/Evaluations, Homework |
| 7.5 Evaluate spatial and temporal aliasing of image capture/display systems | In-Class Discussions/Evaluations, Homework |
| 7.6 Evaluate color deficiencies | In-Class Discussions/Evaluations, Homework |

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

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|---|
| Provides understanding of the human visual system |

**9.0**

| | General Education Learning Outcome Supported by the Course, if appropriate | 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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| Classroom with computer-projection system and access to laboratory for lab/demos |

***Optional course designation; approval request date:** This is the date that the college curriculum committee forwards this course to the appropriate optional course designation curriculum committee for review. The chair of the college curriculum committee is responsible to fill in this date.

****Optional course designation; approval granted date:** This is the date the optional course designation curriculum committee approves a course for the requested optional course designation. The chair of the appropriate optional course designation curriculum committee is responsible to fill in this date.

*****Course Conversion Designations**
Please use the following definitions to complete table 2.a on page one.

- **Semester Equivalent (SE)** – Closely corresponds to an existing quarter course (e.g., a 4 quarter credit hour (qch) course which becomes a 3 semester credit hour (sch) course.) The semester course may develop material in greater depth or length.
- **Semester Replacement (SR) –** A semester course (or courses) taking the place of a previous quarter course(s) by rearranging or combining material from a previous quarter course(s) (e.g. a two semester sequence that replaces a three quarter sequence).
- **New (N)** - No corresponding quarter course(s).