ROCHESTER INSTITUTE OF TECHNOLOGY
COURSE OUTLINE FORM

COLLEGE OF SCIENCE

Imaging Science

REVISED COURSE: COS-IMGS-351-Fundamentals of Color Science

1.0 Course Designations and Approvals

Required course approvals:	**Approval request date:**	**Approval granted date:**
Academic Unit Curriculum Committee	11/12/14	11/19/14
College Curriculum Committee	3/16/15	3/16/2015

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:	Fundamentals of Color Science
Credit hours:	3
Prerequisite(s):	COS-IMGS-180 and COS-IMGS-221, or equivalent.
Co-requisite(s):	
Course proposed by:	James Ferwerda
Effective date:	September 2015

	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.

	Semester Equivalent (SE) Please indicate which quarter course it is equivalent to:
	Semester Replacement (SR) Please indicate the quarter course(s) this course is replacing:
	New

2.b 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.c Student Requirements

Students required to take this course: (by program and year, as appropriate) Imaging Science and Motion Picture Science majors
Students who might elect to take the course: Other students with appropriate backgrounds.

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):

3.1 Understand the physical sources of color, the visual mechanisms that provide our experience of color, and the descriptive systems that have been developed for relating the physical and visual properties.
3.2 Learn practical methods for measuring, modeling, and controlling color in digital 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: COS-IMGS-351 Name of Course
Description as you want it to appear in the catalog. (Pre or co-requisites)
Class 3, Lab X, Credit 3 (Spring)

COS-IMGS-351 Fundamentals of Color Science
This course will introduce students to the field of Color Science. Students will learn about the physical sources of color, the visual mechanisms that provide our experience of color, and the descriptive systems that have been developed for relating the physical and visual properties. Through hands-on projects, students will learn practical methods for measuring, modeling, and controlling color in digital imaging systems. (COS-IMGS-180 and COS-IMGS-221, or equivalent) **Class 3, Credit 3 (Spring)**

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

5.1 Reinhard et al., *Color imaging: fundamentals and applications*, A.K. Peters, Natick, MA
5.2 Reinhard et al., *High Dynamic Range Imaging,* Elsevier/Morgan Kaufmann, Amsterdam.
5.3 Kang, *Computational Color Technology*, SPIE Press, Bellingham WA.
5.4 Readings assigned by the instructor.
5.5 MATLAB/Python programming environments

6.0 Topics (outline):

6.1. Measuring color
- 6.1.1. Radiometric concepts/units
- 6.1.2. Photometric concepts/units
- 6.1.3. Spectral measurement

6.2. Seeing color
- 6.2.1. The visual response to light
- 6.2.2. Mechanisms of visual adaptation
- 6.2.3. Color vision

6.3. Representing color
- 6.3.1. Trichromacy, metamerism, and color matching
- 6.3.2. The CIE system of colorimetry
- 6.3.3. Color spaces
- 6.3.4. Color difference metrics
- 6.3.5. Color appearance models

6.4. Imaging color
- 6.4.1. Color response properties
- 6.4.2. Measuring and modeling color
- 6.4.3. Calibrating color systems

6.5. Reproducing color
- 6.5.1. Color display
- 6.5.2. Measuring and modeling display color response
- 6.5.3. Calibrating color displays

6.6. Color management
- 6.6.1. The color management problem in the imaging chain
- 6.6.2. The ICC color management system
- 6.6.3. Examples of end-to-end color-accurate imaging

6.7. High dynamic range imaging
- 6.7.1. The tone reproduction problem
- 6.7.2. HDR image capture
- 6.7.3. HDR image processing
- 6.7.4. HDR displays

6.8. Spectral imaging
- 6.8.1. Spectral image capture
- 6.8.2. Spectral image processing
- 6.8.3. Visualization of spectral image data

6.9. Projects

- 6.9.1. Measuring the spectral reflectance properties of colored surfaces
- 6.9.2. Calculating the CIE XYZ tristimulus values of colors from their spectra
- 6.9.3. Quantifying color differences using the CIELAB system
- 6.9.4. Measuring and modeling the tone and color transfer functions of digital camera and display systems
- 6.9.5. Calibrating digital cameras and displays to have specific tone and color response properties

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 Methods
Define and apply Color Science concepts and terminology	Homeworks, Exams
Describe the physical sources of color and the visual mechanisms that provide our experience of color.	Homeworks, Exams
Calculate and interpret XYZ tristimulus values and CIELAB color differences	Homeworks, Exams
Measure the spectral reflectance properties of colored surfaces	Project reports
Model and measure the tone and color transfer functions of digital imaging systems	Project reports
Calibrate digital imaging systems to have specific tone and color response properties	Project reports

8.0 Program outcomes and/or goals supported by this course

8.1 To gain knowledge of the concepts and terminology of color science
8.2 To gain hands-on experience with imaging systems
8.3 To gain fluency in computational problem solving
8.4 To apply knowledge of physics, mathematics, computing, and vision to address practical problems in imaging science

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		
X	Explain basic principles and concepts of one of the natural sciences	Homeworks Exams
X	Apply methods of scientific inquiry and problem solving to contemporary issues	Projects
	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.)

Smart classroom. Dedicated project room for out-of-class access to measurement equipment.