Rochester Institute of Technology
Rochester, New York

COLLEGE of SCIENCE
Department of Imaging Science

REVISED COURSE: 1051-2xx

1.0 **Title**: Imaging in the Physical Sciences **Date**: 10/28/03
Credit Hours: 4
Prerequisite(s): none
Corequisite(s): 1016-214, 241, or 251
Course proposed by: CIS Undergraduate Curriculum Committee

2.0 Course information:

	Contact hours	**Maximum students/section**
Classroom	3	48
Lab	3	12
Studio	-	-
Other (specify _____)	-	-

Quarter(s) offered (check)
X Fall X Winter _ Spring Summer

Students required to take this course: (by program and year, as appropriate)

First-year declared Imaging Science majors.

Students who might elect to take the course:

First-year College of Science, Engineering, or Computer Science students who seek an elective or need to complete a sequence of science courses with lab; GLAT students who meet entry requirements for Imaging Science program.

3.0 Goals of the course

Imaging in the Physical Sciences is designed to provide an introduction to the theory and applications of Imaging Science in a range of scientific disciplines.

4.0 Course description (as it will appear in the RIT Catalog, including pre- and co-requisites, quarters offered)

1056-2xx Imaging in the Physical Sciences

This course presents a survey of the field of imaging science and its applications, by examining representative imaging systems from the *imaging chain* perspective. Fundamental properties and characteristics of light, optics, and sensors, as well as fundamental principles of image processing, are presented and explored through lab experiments and through analysis of familiar imaging systems (e.g., traditional film and digital cameras, telescopes, medical X-ray systems, consumer video systems, copy machines, laser and ink-jet printers, and fax machines). Students explore how imaging techniques are applied to representative scientific problems from fields such as Medical Science, Remote Sensing, and Astronomy. (Corequisite: 1016-214, 241, or 251) **Class 3, Lab 3, Credit 4**

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

5.1 Falk, Brill, & Stork . Seeing the Light. Optics in Nature, Photography, Color Vision and Holography. ISBN: 0471603856.
5.2 Course notes

6.0 Lecture Topics (outline)

6.1 The Imaging Chain

6.1.1 Energy sources
6.1.2 Collection: image formation
6.1.3 Detectors: capturing and sensing imagewise energy distributions (spatial and spectral characteristics)
6.1.4 Processing: computational, chemical, and neural
6.1.5 Storage/retrieval/transmission/reception; bandwidth
6.1 6 Display: hardcopy and softcopy output (spatial and spectral characteristics)
6.1.7 Perception: the human visual system (spatial and spectral characteristics)

6.2 The Science of Imaging: Fundamentals

6.2.1 Light sources; wave and particle nature of light, color and energy
6.2.2 Interaction between light and matter; capturing the energy
6.2.3 Imaging mathematics
6.2.4 Image processing algorithms

6.2.5 Physiology of the human visual system
6.2.6 Color Science

6.3 The Engineering of Imaging: Applications

6.3.1 Medical Imaging (X-Rays, CT, MRI, Ultrasound)
6.3.2 Display (e.g. Softcopy; CRT, LCD, Hardcopy; ink-jet, lithography, xerography)
6.3.3 Photographic Systems (Film-based (silver-halide) and digital)
6.3.4 Optical Systems (e.g. Human eye, Microscopes, Telescopes, Loupes, Glasses, Contact lenses)
6.3.5 Video Systems (analog raster and digital)

Laboratories (examples)

- Exploring Photocopiers: what imaging properties lead to a superior photocopying machine?
- Shadowgrams: shadow geometry and image quality metrics
- Digital Pinhole Camera: characterization and optimization
- Lenses and Aberrations
- Human Visual System
- Display Systems

7.0 Intended learning outcomes and associated assessment methods of those outcomes

7.1 Understanding of the image chain and ability to analyze imaging systems via image chain model (LABS/HOMEWORK)
7.2 Basic knowledge of properties of light, interaction between light & matter, and optics (EXAMS/LABS/HOMEWORK)
7.3 Ability to perform basic image processing and analysis tasks (LABS)
7.4 Understanding of basic functionality of human visual system and fundamentals of color science (EXAMS/LABS/HOMEWORK)
7.5 Introductory knowledge of how imaging is applied in certain, specific scientific disciplines (EXAMS/HOMEWORK)

8.0 Program or general education goals supported by this course

This course addresses the first three goals for the Imaging Science curriculum, as defined under its Program Educational Objectives statement; namely:
1. provide a broad education in both the physics, mathematics, and digital characteristics of images and imaging systems;
2.provide practical laboratory experiences in characterizing optical, electronic, electro-mechanical, and digital imaging systems;

3. provide practical laboratory experiences in the application of optical, electronic, electromechanical, and digital imaging systems to technical and

scientific problem solving.

9.0 Other relevant information

Required: a classroom with a projector and Internet connection; laboratory spaces equipped with optical benches, digital cameras, and standard optics lab equipment and accessories such as lenses, oscilloscopes, and stand microscopes

10.0 Supplemental Information

None.