Course Syllabus
1051-711 Basic Principles of Imaging Science I

I. Course:

SIMG-711 Basic Principles of Imaging Science I

1.1 Four (4) credit hours

1.2 Four (4) lecture hours per week

1.3 Prerequisites: Calculus, Differential Equations, College Chemistry, University Physics

1.4 Corequisites: Coregistration in Linear Math I, if not already successfully completed

II. Course Description:

This course is the first of a two-quarter sequence that provides the student with a basic understanding of the scientific principles associated with electromagnetic radiation propagation, image capture and formation, and image processing used to reproduce or display images. The first part of this course focusses on the image capture stage of the image chain. The fundamentals of the interaction between light and matter are covered. These concepts are then used to understand the operation and limitation of detectors, including charge-coupled devices, and conventional film. The latter part of the course focusses on the image display stage of the image chain. Both mean level and spatial properties are discussed. The final part of the course ties together the basic principles covered and uses these to understand system design optimization.

III. Course Objectives:

The student will be able to:

- Demonstrate a basic knowledge foundation that enables him/her to describe simple imaging systems
- Apply a basic knowledge of imaging science to the optimization of simple imaging systems
- Describe a simple imaging process from a systems perspective, characterizing its relevant quality metrics and predicting performance characteristics

IV. Course Outline:

4.1 Interaction Between Light & Matter (4 weeks)

- atomic structure
- molecular structure
- interaction between light & matter
- crystalline solids

4.2 Measurement of EM Radiation (2 weeks)

- radiometry
- detectors
- sensitometry
- digital imaging

- film imaging

4.3 Mean Value Properties of Images (2 weeks)

- optical properties of images
- densitometry
- tone reproduction analysis

4.4 Spatial Properties of Images (1.5 weeks)

- microstructure
- noise

4.5 Systems Metrics (0.5 week)

- system optimization & comparison

V. Instructional Techniques:

5.1 There is no formal textbook, but an extensive set of course notes is available. These are contained in the .pdf file “basic principles I book” in the *course info* folder in the **Files** section of myCourses. Alternatively, you may purchase them from the bookstore printed double sided on three-hole punch paper. These notes will form the basis for your self-instruction. They are written as a textbook with 16 chapters plus an initial course overview.

5.2 Online lectures will be on Tuesday and Thursday at times to be arranged. They will consist of slides and a discussion via two-way audio using meeting place. These will be archived for those who are unable to attend a lecture. The slides can be found in the **Outline** section of myCourses.

5.3 There are problem sets at the end of each chapter in the course notes and their solutions are included with the course notes. These problems give you an opportunity to apply your basic knowledge of imaging science to real world problems. You are expected to make a reasonable effort at a solution before looking at the answer. Use these problem sets to test your understanding of course material and to highlight areas needing further study. You can expect to see similar problems on the exams (see next section).

5.4 There will be a weekly discussion topic posted in the **Discussions** section of myCourses. You are expected to participate in this discussion on a regular basis.

5.5 Weekly quizzes are for your learning self assessment. They are in the *quizzes* folder in the **Files** section of myCourses. Take them in closed-book mode, and then correct your answers by referring to the *quiz_solutions* folder in the **Files** section.

5.6 Questions for the instructor related to course content **must** be posted in the **Discussions** section of myCourses under the appropriate weekly heading. This is so the entire class can benefit from the answer. It is also designed to foster both instructor-student interaction, as well as student-student interaction, and thereby emulate to some extent the interactive processes that occur in a normal classroom setting.

VI . Learning Assessment:

6.1 The assessment of your degree of mastery of the course material and achievement of the course objectives is based on your performance on three exams — one at the end of week 4 (Chpts 1 - 4), one at the end of week 8 (Chpts 5 - 13), and a final exam during exam week. The final exam is comprehensive, but weighted toward

the final three chapters (50% Chpts 1 - 13; 50% Chpts 14 - 16). Each exam is worth 100 points, but points missed on the first two exams carry over to the final exam. For example, if you earned 50 points on exam # 1 and 75 points on exam # 2, you may earn up to 175 points on the final exam.

6.2 All exams are proctored, closed-book, essay-type exams consuming a maximum of one hour 50 minutes (two hours for the final exam). Each exam is designed to test your basic understanding of imaging science and your ability to apply it in solving problems. You will be given an example exam and directions on where to find the desired answers before the first exam.

6.3 The final grade will be based on the total number of points earned in the three exams (300 points maximum) (80%) and your participation in the weekly discussion sessions (20%). The conversion of the final numerical grade into a course letter grade is based on a curve. Note that a grade of D is not considered a passing grade in the graduate program.

VII. Texts:

7.1 Required text: Basic Principles Imaging Science I Course Notes, available in the bookstore.

7.2 Reference texts: See individual chapters in Course Notes.

VIII. Contact Information:

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Online Office Hours: 7 - 8 am Eastern, Monday thru Friday
Email Response Time: within one business day maximum, often faster

IX. Course Calendar:

See separate .pdf file