ECE 481 – Image Processing

Credits: 3, **Contact Hours:** Two 75 minute lecture sessions per week.

Coordinator: M. Wernick, Professor of ECE

Textbook: A.K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989.

2019 Catalog Data: ECE 481: Image Processing. Credits 3.
Mathematical foundations of image processing, including twodimensional discrete Fourier transforms, circulant and block circulant matrices. Digital representation of images and basic color theory. Fundamentals and applications of image enhancement, restoration, reconstruction, compression, and recognition. Lecture: 3 Lab: 0 Credits: 3 Satisfies: ECE Professional Elective (P)

Prerequisites or co-requisites by topic: ECE 308 and MATH 374 (maybe taken concurrently)

1. Signal Processing: convolution, sampling, Fourier transform.
2. Basic Probability.

Enrollment: Elective course for CPE and EE majors

Specific outcomes of instruction:
After completing this course, the student should be able to do the following:

1. Understand the basic elements of the color theory, including hue, saturation, and luminance; the basic principles of color matching, the RGB color system.
2. Process digital images using convolution, discrete Fourier Transform, linear filtering.
3. Perform digital image enhancement by intensity transformations, histogram operations, smoothing, sharpening, etc.
4. Perform digital image restoration using the Wiener and pseudoinverse filters.
5. Perform digital image reconstruction from projections (Computed tomography).
6. Analyze and report image processing algorithms performance.
7. Understand basic of "Protections for Human Subjects" in medical imaging research.
8. Recognize and design appropriate image processing methods based on the observed image degradation.
9. Understand the fundamentals of image coding and compression.

Relationship of ECE 481 and specific outcomes of instruction to student outcomes:

	Student Outcomes	**Course Goals**
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1,2,3,4,5,6,7,8, 9
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	8
3	An ability to communicate effectively with a range of audiences	
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	7
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	6,8
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

Topics:

- Introduction. Representation of images by functions/signals (1 week)
- Geometrical description of imaging (1 week)
- Signals, systems, and transforms. 1-D signals (1 week)
- Signals, systems, and transforms. 2-D signals (1 week)
- Impulse and transfer functions associated with physical imaging (1 week)
- Color and color matching (1 week)
- Image sampling with arrays (1 week)
- Halftoning (1 week)
- The human eye as an image sampling system (1 week)
- Introduction to image processing (1 week)
- Linear and circular convolution (1 week)
- Aberrations and image degradation (1 week)
- Image coding and the JPEG standard (1 week)
- Exams (1.5 weeks)

Prepared by: I. Brown **Date:** February 26, 2020