

Information Sheet

Instructor : Prof. Essam A. Marouf
Office : E353
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Office Hours : M&W 2:30-3:30 & 5:30-6:30 pm

Format : Lectures M&W 4:00-5:15 pm

Prerequisite : Basic knowledge of Signals and Systems (EE112/210 or equivalent)

Description : Fundamentals of the two-dimensional Fourier transform and its relatives. Application to selected problems in image enhancement, image restoration, image compression, imaging transducer arrays, ultrasonic medical imaging, synthetic-aperture radar imaging, computed tomography, and planetary exploration.

Texts: 1- R. Bracewell, Fourier Analysis and Imaging, Kluwer 2004 (required).
2- R. Gonzalez and R. Woods, Digital Image Processing, 2nd Ed, Prentice-Hall, 2002 (required)
3- The Matlab Student Version + Signal Processing Toolbox + Image Processing Toolbox (recommended)

Grading:	Homework	10%
	Midterm Exam #1 (Time TBD)	30%
	Midterm Exam #2 (Time TBD)	30%
	Optional Term Project (Optional)	30%
	Final Exam (Wednesday December 15, 02:45-05:00 pm)	30%

Exams & Term Project:

All exams are in-class, open book and notes. No make up exams are given. A term project is optional. A term project is an in depth study of a relevant application, and must include computer simulations or hardware implementation. A Project grade replaces the worst of the two midterm exams, if better. More details regarding potential areas for the term project will be handed out later in class later. You must take ALL three exams regardless of whether you're doing a project or not.

Homework:

Homework is critical for understanding the course material. Homework will be assigned regularly and, if a grader is found, will be partially graded. Solutions will be provided (except for some Matlab problems). Please try to solve the homework problems on your own. This is critical if you are to understand the course material and to do well in the exams. Part of the homework will require using Matlab. A 10% homework grade can move one across grade boundaries.

Matlab:

Matlab is used as the computational platform for class examples and some homework problems. Matlab and many of its Toolboxes are available on the PCs in ENG 387. The lab operates on an open door policy. Check availability times posted on the lab door.

You may also want to consider purchasing the Student Version of Matlab (Release 14) to use it at home (~\$100). This is a convenient way to do the computational assignments and Project at your own convenience. It's available at the Spartan Bookstore (check the shelf of EE264, or check the Software shelf of the Bookstore Computers section). You can also order it from the Mathworks website. You will also need to purchase the Signal Processing Toolbox (~\$30) through an electronic download from the Mathworks website: http://www.mathworks.com/products/education/student_version/sc/index.shtml. The Image Processing Toolbox is optional (~\$70). Again, you need not buy any of these products since they are available to use in the lab room (ENG 387).

If you are not familiar with Matlab, you should go through the introductory chapters of the Student Version Manual. Several Matlab introductions are also available on various websites, including one by the Mathworks at:

<http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.shtml>. Electronic versions of all Matlab and toolboxes manuals can be accessed at that website. The manuals are also available as pdf files as html and pdf files on the website and on the Student Version CD. Matlab has a good help facility that you should invoke to learn more about specific commands and functions.

Textbook Website

The Gonzalez and Woods textbook has a good supporting website that posts images in the text, PowerPoint presentation slides, tutorial material, computational (laboratory) problems, few Matlab programs, useful links, and solutions to a subset of problems. The URL is: <http://www.imageprocessingbook.com/default.htm>. There is also a Matlab based version of the textbook by Gonzalez, Woods, and Eddins that includes Matlab example implementation of topics in the G&W textbook. Its website may be accessed at: http://www.imageprocessingbook.com/index_dipum.htm.

EE264 Website: A website for this class hosted by WEBCT is being established at this time. The URL will be provided in class.

IMPORTANT NOTE: FRIDAY LECTURES

In addition to teaching duties, I'm also involved in research projects related to planetary exploration using unmanned spacecraft. To be able to attend related technical meetings during the semester some re-scheduling of class time will be necessary. During two or so weeks of the semester the class will be taught M & F, W & F, or M, W, & F so as to compensate for sessions missed during travel. Please make sure that you are available to attend lectures on Friday, 4:00-5:15pm, in addition to the regular times on M & W. Any Friday lectures will be announced in class ahead of time.

Tentative Topics Covered: may not be covered in the order listed

	Reading Assignment	
	Bracewell Ch(s).	Gonzalez&Woods Ch(s).
1- Overview		1 and 2
2- 2-D Impulse Functions	2	
3- The 2-D Fourier Transform and its properties	4	4.2
4- 2-D Convolution & Correlation	5 and 6	
5- Sampling in 2-D	7	
6- 2-D FFT		4.6
7- Image enhancement in the spatial domain	8	3
8- Image enhancement in the frequency domain	8	4.3, 4.4
9- Image Restoration	13	5
10- Intro to Image Compression		8
11- Diffraction Theory of Sensors and Radiators	11	
12- Intro to Ultrasonic Medical Imaging	lecture notes + handout	
11- Radio Imaging of Saturn's Rings	lecture notes	
12- Synthetic-Aperture Radar Imaging	16 + handout	
13- Radar Imaging of the Surface of Earth and Venus	lecture notes + handout	
14- The Hankel and Abel Transforms	9	
15- Image Reconstruction from Projections; X-ray Computed Tomography	14, 15	