Jordan University of Science and Technology
Faculty of Engineering
Biomedical Engineering Department

BME 521 Digital Image Processing

Course Catalog
3 Credit hours (3 h lectures, Department Elective). Two-dimensional discrete systems, design of two-dimensional filters, digital image processing, human perception of images, color models, picture processing, sampling and data compression, picture enhancement, restoration and analysis, hardware and software implementation.

Text Book(s)	
Title	Digital Image Processing
Author(s)	Gonzales R and Woods R.,
Publisher	Prentice Hall
Year	2008
Edition	3rd edition

References	
Books	• Class Notes • Gonzales R, Woods R., and Eddins S., Digital image processing using Matlab, 3nd edition, Prentice Hall 2008 • Bernd Jahne, Digital image processing, 5th edition 2002, Springer, ISBN 3-540-67754-2
Software	• Matlab7.0 +: http://www.mathworks.com

Objectives and Outcomes	
Objectives	**Outcomes**
Develop experience in using computers to process images.	Learn how to use computers to read, print, and display and process images. Understand the basic principle and properties of images.
Understand basic principles of medical imaging	Understand the role of image processing in various imaging modalities such as MRI and CT, and its role in biomedical field and image diagnosis.
Learn how to enhance images in the spatial domain	Understand the basic filtering techniques in the spatial domain including: histogram equalization, point operators, filter masks, low pass and band pass filters, …etc.
Learn how to enhance images in	Understand the Fourier Transform for images and its properties.

Objectives and Outcomes	
Objectives	**Outcomes**
the frequency domain	Understand the basic filtering techniques in the frequency domain including: Gaussian, ideal, and Butterworth filters, as well as homomorphic filtering.
Understand how to restore images after degradation and adding noise	Learn different techniques restore image and removing noise from images
Develop experience in interpreting images and extracting features and objects from an image	Understand different techniques in image segmentation and edge detection
Understand the basic principles and techniques for image compression	Students will learn how to compress images using techniques like: Fourier transform; wavelet transform and Hough transform.
Writing and Developing image processing codes	Students will have the ability to write their own Matlab code for image processing.
Encourage Long Life Learning, foster team work and enhance students communication skills	Write technical report and give oral presentation on team work project

Topics Covered		
Week	**Topics**	**Chepters in Text**
1	**Introduction** Origin of DIP, Fields of DIP and components of DIP frequency response	Chapter 1
1-2	**Digital Image Fundamentals** Elements of Visual Perception, EM spectrum, Image sensing and Acquisition, Image Sampling and quantization, relation between pixels, and linear and nonlinear operations	Chapter 2
3-4	**Image enhancement in the spatial domain** Gray level transformations, Histogram processing, A/L operations, spatial filtering, and spatial enhancement methods.	Chapter 3
5-6	**Image enhancement in the frequency domain** 2D Fourier transform and properties, frequency domain filters and homomorphic filtering.	Chapter 4
7-8	**Image restoration and reconstruction** Modeling of degradation and restoration process, noise models, restoration in the presence of noise, LPI degradation, Inverse filtering and Weiner filtering.	Chapter 5
9-11	**Image compression** Fundamentals, models, information theory and lossless compression	Chapter 8
12-14	**Image segmentation**	Chapter 10

Topics Covered		
Week	**Topics**	**Chepters in Text**
	Detection of discontinuities, edge linking and boundary detection, thresholding, Morphological segmentation.	

Evaluation		
Assessment Tool	**Expected Due Date**	**Weight**
Homework, Quizzes, Project	One week after homework problems are assigned	20%
First Exam	According to BME dept. schedule	20 %
Second Exam	According to BME dept. schedule	20 %
Final Exam	According to the University final examination schedule	40 %

Teaching & Learning Methods

- Active learning, where students should be active and involved in the learning process inside the classroom, will be emphasized in the delivery of this course.
- Different active learning methods/approaches such as: Engaged Learning, Project-Based Learning, Cooperative Learning, Problem-based Learning, Structured Problem-solving, will be used.
- The teaching method that will be used in this course will be composed of a series of mini lectures interrupted with frequent discussions and brainstorming exercises. PowerPoint presentations will be prepared for the course materials.
- A typical lecture would start with a short review (~ 5 minutes) using both PowerPoint presentations and the blackboard. This review will also depend on discussions which will gauge the students' digestion of the previous material. Then, the students would have a lecture on new materials using PowerPoint presentations and blackboard. The lecture presentation will be paused every 15 – 20 minutes with brainstorming questions and discussions that will allow the students to reflect and think in more depth about what they learned in that presentation. Then, some example problems will be presented and discussed with the students to illustrate the appropriate problem solving skills that the students should learn. The lecture will be continued for another 15 – 20 minutes, followed by examples and/or a quiz covering the materials taught in the previous two weeks.