Philadelphia University
Faculty of IT
Department of Computer Science
Second semester, 2011/2012

	Course Syllabus
Course Title: Digital Image Processing	**Course code:** 750474
Course Level: 4th	**Course prerequisite (s) : 750322** **Corequisite (s): ----------**
Lecture Time: 09:45-11:15 (M-W)	**Credit hours:** 3

Academic Staff Specifics

Name	Rank	Office Number and Location	Office Hours	E-mail Address
Dr. Qadri Hamarsheh	Assistant professor	**E712**	**10:00-11:00 (Sun-Tue-Thu)** **11 :15-12:15 (Mon-Wed)**	qhamarsheh@philadelphia.edu.jo

Prerequisite: Students are expected to have knowledge in linear signals and systems, 1-D Fourier Transform, basic linear algebra, basic probability theory and basic programming techniques; knowledge of Digital Signal Processing is desirable and working knowledge of Matlab.

Course module description:

This course is designed to give undergraduate students all the fundamentals in 2-D digital image processing with emphasis in image processing techniques, image filtering design and applications.

Course module objectives:

This module aims to:

- Develop a theoretical foundation of fundamental Digital Image Processing concepts.
- Provide mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
- Gain experience and practical techniques to write programs using MATLAB language for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.

Course/ module components

- **Books (title , author (s), publisher, year of publication)**

Title: "Digital Image Processing".
Author(s)/Editor(s): R. C. Gonzalez and R. E. Woods.
Publisher: Pearson-Prentice-Hall, 2008
ISBN: 0-13-168728-x, 978-0-13-168728-8
Edition: third.
Title: "Digital Image Processing using Matlab".
Author(s)/Editor(s): R. C. Gonzalez, R. E. Woods, S. L. Eddins.
Publisher: Pearson-Prentice-Hall, 2004
ISBN: 0-13-008519-7
Edition: 2nd .

Teaching methods:

Duration: 16 weeks, 48 hours in total
Lectures: 34 hours, 2 per week + two exams (two hours)
Tutorial in the Lab.: 11 hours,
Seminar: 3 hours, (last week)
Assignments: 4 Assignments
Project: One Digital Image Processing Application.

Learning outcomes:

- **Knowledge and understanding**
  1. Have a clear understanding of the principals the Digital Image Processing terminology used to describe features of images.
  2. Have a good understanding of the mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing, compression and analysis.
  3. Be able to write programs using Matlab language for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
  4. Have knowledge of the Digital Image Processing Systems.
  5. Be able to understand the documentation for, and make use of, the MATLAB library and MATLAB Digital Image Processing Toolbox (IPT).
  6. Learn and understand the Image Enhancement in the Spatial Domain.
  7. Learn and understand the Image Enhancement in the Frequency Domain.
  8. Understand the Image Restoration, Compression, Segmentation, Recognition, Representation and Description.
- **Cognitive skills (thinking and analysis).**
  1. Be able to use different digital image processing algorithms.
  2. Be able to design, code and test digital image processing applications using MATLAB language.
  3. Be able to use the documentation for, and make use of, MATLAB library and MATLAB Digital Image Processing Toolbox (IPT).
  4. Analyze a wide range of problems and provide solutions related to the design of image processing systems through suitable algorithms, structures, diagrams, and other appropriate methods.
  5. Practice self-learning by using the e-courses and web materials.
- **Communication skills (personal and academic).**
  1. Display personal responsibility by working to multiple deadlines in complex activities.
  2. Be able to work effectively alone or as a member of a small group working on some programming tasks.
- **Practical and subject specific skills (Transferable Skills).**
  1. Plan and undertake a major individual image processing project.

2. Be able to work effectively alone or as a member of a small group working on some programming tasks.
3. Be able to write programs in Matlab language for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
4. Prepare and deliver coherent and structured verbal and written technical reports
5. Use laboratory equipment effectively.
6. Use the scientific literature effectively.

Course Intended Learning Outcomes								
A - Knowledge and Understanding								
A1.	A2.	A3.	A4.	A5.	A6.	A7.	A8.	
B - Intellectual Skills								
B1.	B2.	B3.	B4.	B5.	B6.	B7.	B8.	B9.
C - Practical Skills								
C1.	C2.	C3.	C4.	C5.	C6.	C7.	C8.	C9.	C10.
D - Transferable Skills								
D1.	D2.	D3.	D4.	D5.	D6.	D7.		

Assessment instruments

Allocation of Marks	
Assessment Instruments	**Mark**
First examination	20%
Second examination	20%
Final examination: 50 marks	40%
Reports, research projects, Quizzes, Home works, Projects	20%
Total	100%

** Make-up exams will be offered for valid reasons only with consent of the Dean. Make-up exams may be different from regular exams in content and format.*

Documentation and academic honesty

Practical Submissions

The assignments that have work to be assessed will be given to the students in separate documents including the due date and appropriate reading material.

Documentation and Academic Honesty

Submit your home work covered with a sheet containing your name, number, course title and number, and type and number of the home work (e.g. tutorial, assignment, and project).

Any completed homework must be handed in to my office (room E712) by 13:00 on the due date. After the deadline "zero" will be awarded. You must keep a duplicate copy of your work because it may be needed while the original is being marked.

You should hand in with your assignments:

1- A printed listing of your test programs (if any).
2- A brief report to explain your findings.
3- Your solution of questions.

For the research report, you are required to write a report similar to a research paper. It should include:

- **Abstract**: It describes the main synopsis of your paper.
- **Introduction**: It provides background information necessary to understand the research and getting readers interested in your subject. The introduction is where you put your problem in context and is likely where the bulk of your sources will appear.
- **Methods (Algorithms and Implementation)**: Describe your methods here. Summarize the algorithms generally, highlight features relevant to your project, and refer readers to your references for further details.
- **Results and Discussion (Benchmarking and Analysis)**: This section is the most important part of your paper. It is here that you demonstrate the work you have accomplished on this project and explain its significance. The quality of your analysis will impact your final grade more than any other component on the paper. You should therefore plan to spend the bulk of your project time not just gathering data, but determining what it ultimately means and deciding how best to showcase these findings.
- **Conclusion**: The conclusion should give your reader the points to "take home" from your paper. It should state clearly what your results demonstrate about the problem you were tackling in the paper. It should also generalize your findings, putting them into a useful context that can be built upon. All generalizations should be supported by your data, however; the discussion should prove these points, so that when the reader gets to the conclusion, the statements are logical and seem self-evident.
- **Bibliography:** Refer to any reference that you used in your assignment. Citations in the body of the paper should refer to a bibliography at the end of the paper.

• **Protection by Copyright**

1. Coursework, laboratory exercises, reports, and essays submitted for assessment must be your own work, unless in the case of group projects a joint effort is expected and is indicated as such.
2. Use of quotations or data from the work of others is entirely acceptable, and is often very valuable provided that the source of the quotation or data is given. Failure to provide a source or put quotation marks around material that is taken from elsewhere gives the appearance that the comments are ostensibly your own. When quoting word-for-word from the work of another person quotation marks or indenting (setting the quotation in from the margin) must be used and the source of the quoted material must be acknowledged.
3. Sources of quotations used should be listed in full in a bibliography at the end of your piece of work.

• **Avoiding Plagiarism**.

1. Unacknowledged direct copying from the work of another person, or the close paraphrasing of somebody else's work, is called plagiarism and is a serious offence, equated with cheating in examinations. This applies to copying both from other students' work and from published sources such as books, reports or journal articles.
2. Paraphrasing, when the original statement is still identifiable and has no acknowledgement, is plagiarism. A close paraphrase of another person's work must have an acknowledgement to the source. It is not acceptable for you to put together unacknowledged passages from the same or from different sources linking these together with a few words or sentences of your own and changing a few words from the original text: this is regarded as over-dependence on other sources, which is a form of plagiarism.

3. Direct quotations from an earlier piece of your own work, if not attributed, suggest that your work is original, when in fact it is not. The direct copying of one's own writings qualifies as plagiarism if the fact that the work has been or is to be presented elsewhere is not acknowledged.
4. Plagiarism is a serious offence and will always result in imposition of a penalty. In deciding upon the penalty the Department will take into account factors such as the year of study, the extent and proportion of the work that has been plagiarized, and the apparent intent of the student. The penalties that can be imposed range from a minimum of a zero mark for the work (without allowing resubmission) through caution to disciplinary measures (such as suspension or expulsion).

Course/module academic calendar

week	***Basic and support material to be covered***	***Homework, Reports and their due dates***
(1)	• **Introduction And Digital Image Fundamentals:** ❖ The origins of Digital Image Processing ❖ Examples of Fields that Use Digital Image Processing ❖ Fundamentals Steps in Image Processing ❖ Elements of Digital Image Processing Systems	
(2)	• **Introduction And Digital Image Fundamentals (cont.):** ❖ Image Sampling and Quantization, ❖ Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels ❖ Translation, Scaling, Rotation and Perspective Projection of image	
(3)	• **Introduction And Digital Image Fundamentals (cont.):** ❖ Linear and Non Linear Operations • **Digital image Representation** ❖ Reading, Displaying, Writing Images using MATLAB ❖ Data Classes, Image Types using MATLAB	
(4)	• **Digital image Representation (cont.)** ❖ Converting Between data classes and Image Types ❖ Introduction to M Function Programming using MATLAB • **Image Enhancement in the Spatial Domain:** ❖ Some basic Gray Level Transformations ❖ Histogram Processing ❖ Quiz 1	Tutorial 1 Assignment 1
(5)	• **Image Enhancement in the Spatial Domain (cont.):** ❖ Enhancement Using Arithmetic and Logic operations ❖ Combining Spatial Enhancement Methods ❖ Basics of Spatial Filters	Tutorial 2
(6) **First exam**	• **Image Enhancement in the Spatial Domain (cont.):** ❖ Smoothening and Sharpening Spatial Filters ❖ Intensity Transformation Function (MATLAB)	Tutorial 3 Project: Part 1 Digital Image Processing Application (Design) 2 weeks
(7)	• **Image Enhancement in the Spatial Domain (cont.):** ❖ Histogram Processing and Function Plotting (MATLAB) • **Image Enhancement in the Frequency Domain:** ❖ Introduction to Fourier Transform and the frequency Domain ❖ Computing and Visualizing the 2D DFT (MATLAB)	Tutorial 4 Assignment 2
(8)	• **Image Enhancement in the Frequency Domain (cont.):** ❖ Smoothing Frequency Domain Filters ❖ Sharpening Frequency Domain Filters ❖ Homomorphic Filtering	Tutorial 5
(9)	• **Image Restoration:** ❖ A model of The Image Degradation / Restoration Process	Project: Part 2 Digital Image

	❖ Noise Models ❖ Restoration in the presence of Noise Only Spatial Filtering	Processing Application (Implementation) 6 weeks
(10)	• **Image Restoration (cont.):** ❖ Periodic Noise Reduction by Frequency Domain Filtering ❖ Linear Position-Invariant Degradations ❖ Estimation of Degradation Function	Tutorial 6 Assignement 3
(11) Second exam.	• **Image Restoration (cont.):** ❖ Inverse filtering ❖ Wiener filtering	Tutorial 7
(12)	• **Image Restoration (cont.):** ❖ Geometric Mean Filter ❖ Geometric Transformations ❖ Quiz 2	Tutorial 8
(13)	• **Image Compression:** ❖ Coding ❖ Interpixel and Psychovisual Redundancy ❖ Image Compression models ❖ Compression standards	Tutorial 9 Assignment 4
(14)	• **Image Segmentation:** ❖ Detection of Discontinuities ❖ Edge linking and boundary detection ❖ Thresholding	Tutorial 10
(15)	• **Object Recognition:** ❖ Patterns and Pattern Classes ❖ Decision-Theoretic Methods ❖ Structural Methods	Tutorial 11
(16) Final Exam	**Seminars**	

Expected workload:

On average students need to spend 3 hours of study and preparation for each 50-minute lecture/tutorial.

Attendance policy:

Absence from lectures and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse acceptable to and approved by the Dean of the relevant college/faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

Module references

Students will be expected to give the same attention to these references as given to the Module textbooks.

Additional Books

1. Al Bovik (ed.), "Handbook of Image and Video Processing", Academic Press, 2000.
2. A.K. Jain, "Fundamentals of Digital Image Processing", Prentice-Hall, Addison-Wesley, 1989.
3. M. Petrou, P. Bosdogianni, "Image Processing, The Fundamentals", Wiley, 1999.
4. P.Ramesh Babu, Digital Image Processing. Scitech Publications., 2003
5. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.
6. B. Jähne, "Practical Handbook on Image Processing for Scientific Applications", CRC Press, 1997.
7. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4th edn., 2002.
8. J. S. Lim, "Two-dimensional Signal and Image Processing" Prentice-Hall, 1990.
9. Rudra Pratap, Getting Started With MATLAB 7. Oxford University Press, 2006
10. W. K. Pratt. Digital image processing, PIKS Inside. Wiley, New York, 3rd, edn., 2001.
11. Stephane Marchand-Maillet, Yazid M. Sharaiha, Binary Digital Image Processing, A Discrete Approach, Academic Press, 2000

Journals ----------

- IEEE Transactions on Pattern Analysis and Machine Intelligence
- IEEE Transactions on Computers
- Pattern Recognition
- Computer Vision, Graphics and Image Processing
- IEEE Transactions on Medical Imaging
- Computerized Medical Imaging and Graphics
- IEEE Transactions on Image Processing
- IEEE Engineering in Medicine and Biology
- IEEE Transactions on Signal Processing
- IEEE Transactions on Neural Networks
- IEEE Transactions on Geoscience and Remote Sensing
- Photogrammetric Engineering and Remote Sensing
- International Journal of Remote Sensing
- Journal of Visual Communication and Image Representation

Web Sites

- www.imageprocessingplace.com (required). Text book website)
- www.mathworks.com (MATLAB documentation)
- en.wikipedia.org/wiki/Digital image processing (General image processing concepts)
- www.mathworks.com/access/helpdesk/help/pdf_doc/matlab/getstart.pdf (MATLAB Getting Started Guide from Mathworks)