Course E-Syllabus

1	**Course title**	Digital Image Processing
2	**Course number**	1902454
3	**Credit hours**	3
	Contact hours (theory, practical)	3
4	**Prerequisites/corequisites**	Computer Graphics (1901359)
5	**Program title**	Computer Information Systems
6	**Program code**	2
7	**Awarding institution**	The university of Jordan
8	**School**	King Abdullah II School for Information Technology
9	**Department**	Computer Information Systems Department
10	**Level of course**	3
11	**Year of study and semester (s)**	Each semester
12	**Final Qualification**	Bs
13	**Other department (s) involved in teaching the course**	Computer Science
14	**Language of Instruction**	English
15	**Teaching methodology**	☒In-Class ☐ Blended ☐Online
16	**Electronic platform(s)**	☒Moodle ☐Microsoft Teams ☐Skype ☐Zoom ☐Others……
17	**Date of production/revision**	Fall semester 2022/2023 (9/10/2022)

18 Course Coordinator:

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19 Other instructors:

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20 Course Description:

This course aims to provide an introduction to the basic concepts, techniques, and algorithms of digital image processing. It explains the fundamental techniques of the following: acquisition of the digital images (equipment, sampling, quantization, and color representation), enhancement of digital images in spatial and in frequency domains (smoothing, sharpening, edge detection, thresholding, histogram equalization, morphological operations, etc.), conversion the digital image into Fourier and other transforms, feature identification, image compression, application to models of human and machine vision. In addition, students will be able to apply the image processing techniques to solve real-world problems in any domain. Specifically, students are required to work through a case study in the healthcare domain and show how to deploy the image processing techniques to perform enhancement, segmentation, analysis, diagnosis, etc. into the medical images. The course will also include practical demonstrations on using the state-of-the-art Matlab-Image processing software package.

21 Course aims and outcomes:

A- Aims:

The aim of this course is to equip students with knowledge and skills on how to manipulate, process, and enhance digital images. The course will also include practical demonstrations on using the state-of-the art Matlab-Image processing software package.

B- Intended Learning Outcomes (ILOs):

Upon successful completion of this course, students will be able to:

A – knowledge and Understanding:
A1) Have an idea on the importance and applications of digital image processing. A2) Learn the basics, concepts and methodologies of digital image processing. A3) learn image sampling and quantization A4) learn filtering in the spatial domain A5) learn filtering in the frequency domain A6) Understanding color models A7) Learn image compression A8) learn different methods of feature extraction using morphological operators. A9) Understand image representation and description A10) learn Matlab software to implement all of the above
B – Intellectual Skills: with the ability to …
B1) Compare and analyze algorithms used to solve a problem. B2) Compare between different image filtering methods. B3) Apply mathematical tools to algorithm verification and analysis. B4) Compare between different color models
C – Subject specific skills – with ability to …
C1) Work on case studies in health care domain to show how all the tools are used together to build a real project. C2) Apply different enhancement methods C3) Apply Fourier transform. C4) Perform image representations and descriptions C5) Translate abstract ideas into practice C6) Implement and handle projects that use medical image database.
D- Transferable skills – with ability to
D1) Possess good image analysis concept in healthcare domain. D2) Develop the basic image algorithms into complete project in healthcare domain. D3) Choose the appropriate image algorithms for a certain problem in healthcare domain.

D4)	Design and implement image processing techniques in Matlab such as histogram equalization, enhancement, filtering, segmentation, etc. to prepare better medical images for better diagnosis in healthcare domain.

22. Topic Outline and Schedule:

Topic	Week	Achieved ILOs	Program SOs	Teaching/Learning and Assessment Methods
The importance and applications of digital image processing	1	A1	1,2	Reading lecture notes and Ch 1 In Class questions
Basics, concepts and methodologies of digital image processing.	2	A2, A3	1	Reading lecture notes and Ch 2 In Class questions Practical on Matlab
Image enhancement in the spatial domain	3-7	A4, B1, B2, C1,D1, D2,D3,D4	1,2	Reading lecture notes and Ch 3 In Class questions Practical on Matlab
Mid Term Exam	7	A1-A6	1	
Image enhancement in the frequency domain	8-9	A5,B1,B2, C1, D1, D2,D3,D4	1,2	Reading lecture notes and Ch 4 In Class questions Practical on Matlab
Color image enhancement	10-11	A6, B1, B3, B4, C2, D3	1,2	lecture notes and Chap 5 In Class questions Practical on Matlab
Image compressions	12	A7, B2, C4, D4	1,2	Reading lecture notes and Ch 6 In Class questions Practical on Matlab
Image Morphology	13-14	A8, B3, C4, D4	1,2	Reading lecture notes and Ch 8 In Class questions Practical on Matlab
Image representation and descriptions	14	A9, C4, D3	2	Reading lecture notes and Ch 10 In Class questions Practical on Matlab
Project (case study: Digital Image Processing in Health care System)	15	A10, B1, B2, C1, C2, C5, C6, D1-D4	2	Practical on Matlab and reading reference no. 5

23. Topic Outline and Schedule:

Week	Lecture	Topic	Teaching Methods*/platform	Evaluation Methods**	References
1	1.1 (9/10)	Discussion about course outline	Face to Face In-Class	None	ELearning platform
	1.2 (11/10)	Chapter 1 (Introduction into digital images processing)	Face to Face In-Class	None	Reading from Text Book

	1.3 (13/10)	Chapter 1 (Energy sources for images)	Face to Face In-Class	None	/ Reading from lecture notes
2	2.1 (16/10)	Chapter 2 (Sampling and Quantization + Image Types)	Face to Face In-Class	None	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	2.2 (18/10)	Chapter 2 (Introduction into Matlab + how to create different Image Types in Matlab)	Face to Face In-Class	Assignment 1 on ELearning + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	2. 3 (20/10)	Chapter 2 (Spatial and Intensity Resolution)	Face to Face In-Class	Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
3	3.1 (23/10)	Chapter 2 (Image Interpolation)	Face to Face In-Class	Assignment 1 on ELearning platform	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	3.2 (25/10)	Chapter 2 (Pixel's Relationships+ Regions)	Face to Face In-Class	Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	3.3 (27/10)	Chapter 2 (Distance Measures + Matlab)	Face to Face In-Class	Assignment 1 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
4	4.1 (30/10)	Chapter 3 (Basic Intensity Transformation Function 1)	Face to Face In-Class	Midterm Exam on juexams.com	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	4.2 (1/11)	Chapter 3 (Basic Intensity	Face to Face In-Class	Midterm Exam	Reading from Text Book / Watching

		Transformation Function 2)			recorded lecture from Moodle/ Reading from lecture notes
	4.3 (3/11)	Chapter 3 (Contrast Stretching and Thresholding)	Face to Face In-Class	Assignment 2 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
5	5.1 (6/11)	Chapter 3 (Gray-level slicing and bit-plane slicing)	Face to Face In-Class	Assignment 2 on ELearning platform + Midterm Exam	Reading from Text Book /Watching recorded lecture from Moodle/ Reading from lecture notes
	5.2 (8/11)	Chapter 3 (Arithmetic and logical image operation + histogram equalization)	Face to Face In-Class	Assignment 2 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	5.3 (10/11)	Chapter 3 (Smoothing filters-1)	Face to Face In-Class	Assignment 3 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
6	6.1 (13/11)	Chapter 3 (Smoothing filters-2)	Face to Face In-Class	Assignment 3 on ELearning platform + Midterm Exam	Reading from Text Book/ Watching recorded lecture from Moodle/ Reading from lecture notes
	6.2 (15/11)	Chapter 3 (Sharpening filters: Laplacian)	Face to Face In-Class	Assignment 3 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	6.3 (17/11)	Chapter 3 (Sharpening filters: Laplacian)	Face to Face In-Class	Assignment 3 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
7	7.1 (20/11)	Chapter 3 (Sharpening filters:	Face to Face In-Class	Assignment 3 on ELearning	Reading from Text Book /

		Unsharp and Sobel operators)		platform + Midterm Exam	Watching recorded lecture from Moodle/ Reading from lecture notes
	7.2 (22/11)	Matlab: Smoothing filter + sharpening filters	Face to Face In-Class	Assignment 3 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	7.3 (24/11)	Midterm Exam			
8	8.1 (27/11)	Chapter 4 (Introduction Frequency Transform)	Face to Face In-Class	Assignment 3 on ELearning platform + Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	8.2 (29/11)	Chapter 4 (Frequency Transform: polar coordinates)	Face to Face In-Class	Midterm Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	8.3 (1/12)	Chapter 4 (Frequency Transform: Characteristics of Fourier Transform)	Face to Face In-Class	Assignment 3 on ELearning platform + Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
9	9.1 (4/12)	Chapter 4 (Frequency Transform Filters; Low-pass filters)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	9.2 (6/12)	Chapter 4 (Frequency Transform Filters: High-pass filters + Matlab)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	9.3 (8/12)	Chapter 6 (introduction into color image processing)	Face to Face In-Class	Assignment 3 on ELearning platform + Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes

10	10.1 (11/12)	Chapter 6 (CMY and HSI Model)	Face to Face In-Class	Assignment 3 on ELearning platform + Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	10.2 (13/12)	Chapter 6 (Pseudo color image processing)	Face to Face In-Class	Assignment 3 on ELearning platform + Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	10.3 (15/12)	Chapter 6 (Full Color image processing + Matlab)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
11	11.1 (18/12)	Matlab: Chapter 6	Face to Face In-Class	Assignment 4 on ELearning platform +Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	11.2 (20/12)	Chapter 8 (Introduction on Image Compression)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	11.3 (22/12)	Chapter 8 (JPEG Image Compression)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
12	12.1 (25/12)	Holiday			
	12.2 (27/12)	Chapter 9 (Erosion and Dilation)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	12.3 (29/12)	Chapter 9 (Opening and Closing)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture

					from Moodle/ Reading from lecture notes
13	13.1 (1/1)	Holiday			
	13.2 (3/1)	Chapter 9 (Examples)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	13.3 (5/1)	Chapter 9 (Matlab)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
14	14.1 (8/1)	Chapter 11 (Chain Code)	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	14.2 (10/1)	Revision	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	14.3 (12/1)	Assignments Discussion	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
15	15.1 (14/1)	Assignments Discussion	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes
	15.2 (16/1)	Assignments Discussion	Face to Face In-Class	Final Exam	Reading from Text Book / Watching recorded lecture from Moodle/ Reading from lecture notes

16	19/1- 30/1	Final Exam			

- Teaching methods include: In-Class; Synchronous lecturing/meeting; Asynchronous lecturing/meeting
- Evaluation methods include: Homework, Quiz, Exam, pre-lab quiz…etc

24 Evaluation Methods:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	Period (Week)	Platform
Assignment 1	5	Image types, image interpolation, and pixel connectivity	Week 5	ELearning
Assignment 2	5	LSB Watermarking and Histogram Equalization	Week 7	ELearning
Assignment 3	5	Filtering in spatial and frequency domain	Week 9	ELearning
Assignment 4	5	Color image Processing	Week 11	ELearning
Midterm Exam	30	Chapter 2 +3	Week 7	University
Final	50	Chapter 4 + 6 + 9 + 11	Week 14	University

25 Course Requirements (e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc):

- Laptop or desktop computers
- Internet Connection to submit the assignments on the Elearning and to watch the recorded lectures.
- Matlab

26 Course Policies:

A- Attendance policies:

- According to University regulations the maximum allowable absence 15% of number of lectures/semester

B- Absences from exams and submitting assignments on time:

- Every student is expected to completely adhere to the assignments and report strict deadlines, absolutely no exceptions will be given.

- Concerns or complaints should be expressed in the first instance to the module lecturer; if no resolution is forthcoming then the issue should be brought to the attention of the module coordinator (for multiple sections) who will take the concerns to the module representative meeting. Thereafter problems are dealt with by the Department Chair and if still unresolved the Dean and then ultimately the Vice President. For the final complaints, there will be a committee to review grading the final exam.

C- Health and safety procedures:

- University regulations.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

- The honor code applies to all work turned in for this course including exams and assignments. It is important that you understand the solutions to all problems, and the best way to gain an understanding is to work them out and write them up by yourself. Hence the policy is that you must submit your own work. You may not share your work with other students, unless it is allowed as group. Violating the policy will be taken as a no submission state for the assignment. University regulations will be preserved at all times.

E- Grading policy:

0-40	F	41-49	D-	50-55	D	56-60	D+	
61-65	C-	66-71	C	72-76	C+			
77-80	B-	81-83	B	84-86	B+	87-89	A-	90-100 A

F- Available university services that support achievement in the course:

For more details on University regulations please visit http://www.ju.edu.jo/Pages/Regulations.aspx.

27 References:

A- Required Text Book, assigned reading and audio-visuals:

Gonzalez & R. Woods, Digital Image Processing 4th Edition, 2008, Prentice Hall.

B- Recommended books, materials and media:

1. A . Jain, Fundamentals of Digital, Image Processing (1988), Prentice Hall
2. Bernd Jahne , Digital Image Processing (2001), Springer Verlag
3. IEEE Transactions on Image Processing
4. Geoff Dougherty, Medical Image Processing: Techniques and Applications(2011) , Springer-Verlag New York

28 Additional information:

Course description, Teaching materials, Assignments and Announcements are available in the course page on http://elearning.ju.edu.jo

Name of Course Coordinator: -------**Dr. Huda Karajeh**------ Signature: ---*Dr. Huda Karajeh*--
Date: -----9/10/2022-------

Head of Curriculum Committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature: ----------

Head of Curriculum Committee/Faculty: ---------- Signature: ----------

Dean: ---------- Signature: ----------