MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Image Processing**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☐ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**UOMU0302052**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	3		**Semester of Delivery**	5	
Administering Department	الأنظمة الطبية الذكية		**College**	العلوم	
Module Leader	م.م. قصي منير دياب		**e-mail**	qusai.muneer.deyab@uomus.edu.iq	
Module Leader's Acad. Title	Assistant Lecturer		**Module Leader's Qualification**	M.Sc.	
Module Tutor	م.م. قصي منير دياب		**e-mail**	qusai.muneer.deyab@uomus.edu.iq	
Peer Reviewer Name	ا.د مهدي عبادي مانع		**e-mail**	mahdi.ebadi@uomus.edu.iq	
Scientific Committee Approval Date	1/10/2024		**Version Number**	2.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	UOMU0302014	**Semester**	1
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims أهداف المادة الدراسية	1. Introducing the basics about digital signals and their types and the most important processes that can be applied to digital signals, and then choosing one of these digital signals such as the digital images 2. Introducing the basics used in processing digital images by identifying digital images and their types and how to analyze them 3. The processes that can be applied to images, such as improving the damaged image as a result of operations carried out on it, such as exposure to attacks, for example 4. converting the image from the spatial domain to the frequency domain. 5. How to compress images using different methods , and other processes that are applied to images so that the student can know digital images and deal with them, 6. How to analyze the image and extract the information to be obtained to achieve the desired goal.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Helping the student to become familiar with digital signals and digital images and the processes that can be applied to these images 2. Learn about images, their types, how to analyze them, and extract the most important information from them. 3. How to process and retrieve damaged images. 4. How to improve the image that is not clear to the human eye and the most important methods used in the improvement. 5. The most important methods used to compress images and how to compress images so that you do not lose the most important information in them. 6. The most important methods used to convert images from the spatial domain to the frequency domain. 7. Learn about the most important types of noise that images are exposed to and how to use the most important methods to treat this noise and obtain clear and understandable images for the human eye. 8. Learn about the most important quality metrics and how to use them in measuring image quality after processing. 9. Teaching students how to build algorithms in creating watermarks used to preserve ownership and rights.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. <u>partA- Digital Signal Processing</u> Signals – Definition, Continuous-Time Signals, Discrete-Time signals, Basic DT Signals, Unit Impulse Sequence, Unit Step Signal, Unit Ramp Function, Parabolic Function, Classification of DT Signals, Even and Odd Signals, Periodic and Non-Periodic Signals, Energy and Power Signals Operations on Signals, Shifting ,Scaling, Reversal, convolution

	partB- Computer Vision and Image Processing Computer Imaging Systems ,Computer Vision , Image Processing , The Major Topics Within The Field of Image Processing , Image restoration, Image enhancement, Image compression, Examples of Fields that Use Digital Image Processing (DIP). Mathematical Representation of the Image, Image Types, Binary Image, Gray Scale Image, Color Image, Multispectral Images, Thresholding, Digital Image File Format, Spatial Domain and Frequency Domain,Linear Algebra and Image Processing, Matrix Decomposition Methods in Image Processing, Image Analysis. Part C - Arithmetic Operations Image Algebraic Operations and Noises with Spatial Filters, Calculus and Image Processing –Discrete Transformations, Edge Line Detection, Histogram, Histogram features, Image compression.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The strategy that will be adopted in this unit is to Helping the student to become familiar with digital signals and digital images and the processes that can be applied to these images, what are images and types of images, and how to perform preliminary operations on them and convert them from color images to grayscale or binary as well as how to compress images and remove noise from them using filters and other methods, in addition to teaching the student how to deal with images In the spatial domin or frequency domin and train the student to conduct these strategies in a practical way

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	62	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation

تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5, 10	LO #1, 2, 10 and 11
	Assignments	2	10% (10)	2, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	1	10% (10)	Continuous	
	Report	1	10% (10)	13	LO # 5, 8 and 10
Summative assessment	Midterm Exam	3 hr	10% (10)	7	LO # 1-7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Digital Signal Processing: Signals – Definition a- Continuous-Time Signals b- Discrete-Time signals Basic DT Signals a- Unit Impulse Sequence b- Unit Step Signal c- Unit Ramp Function d- Parabolic Function Classification of DT Signals a- Even and Odd Signals b- Periodic and Non-Periodic Signals c- Energy and Power Signals
Week 2	Operations on Signals a- Shifting b- Scaling c- Reversal convlution
Week 3	Computer Vision and Image Processing 1- Computer Imaging Systems 2- Computer Vision 3- Image Processing 4- The Major Topics Within The Field of Image Processing Include a. Image restoration. b. Image enhancement. c. Image compression. 5- Examples of Fields that Use Digital Image Processing (DIP)
Week 4	Mathematical Representation of the Image:

	1- Image Types a. Binary Image b. Gray Scale Image c. Color Image d. Multispectral Images 2- Thresholding 3- Digital Image File Format 4- Spatial Domain and Frequency Domain a- Spatial Domain b- Frequency Domain
Week 5	Linear Algebra and Image Processing: 1. What is the connection between Digital Image Processing (DIP) and linear algebra. 2. Basic Examples
Week 6	Matrix Decomposition Methods in Image Processing: 1. Some Types of Matrix Decomposition Methods 2. The Effect of the Matrix Decomposition Methods on Images a. The Effect of SVD Method on image b. The Effect of Hessenberg Decomposition Method on image c. The Effect of QR Decomposition Method on image d. The Effect of LU Decomposition Method on image 3. Singular Value Decomposition (SVD) and Image Processing 4. Singular Value Decomposition Method Mathematically 5. Computing the SVD by Hand 6. Theorem 7. Some Singular Value Decomposition (SVD) Properties in DIP 8. Some Applications of the Singular Value Decomposition (SVD) in DIP: a. Image Security b. Image Compression c. Image Denoising d. Image Forensic
Week 7	Mid-term Exam
Week 8	Image Analysis: 1- Why Digital Image Analysis? 2- What are Image Features? 3- System Model 4- Why Preprocessing? 5- Region of Interest in Image Geometry - Zero Order Hold - First Order Hold - Convolution A- Convolution mask for the first-order hold B- Convolution mask for Zero-order hold - Zoom Using K-factor 6- Translation and Rotation
Week 9	Image Algebraic Operations and Noises with Spatial Filters: 1- Image Algebra 1.1. Arithmetic operations a. Pixel addition b. Pixel subtraction c. Pixel Multiplication and Scaling d. Pixel Division 1.2. Logic operations

	● Truth Tables a. Logical AND/NAND b. Logical OR/NOR c. Logical XOR/XNOR 2- Noise and Spatial Filters 2.1. Noise ● Types of Noise a. Gaussian Noise b. Salt Pepper Noise c. Gamma Noise d. Exponential Noise e. Poisson Noise f. Speckle Noise 2.2 Filters a. Mean Filters b. Median Filters c. Enhancement Filters
Week 10	Calculus and Image Processing –Discrete Transformations : 1- Discrete Fourier Transform (DFT) 2- Discrete Wavelet Transform (DWT) 3- Discrete Cosine Transform (DCT) 4- Filterin
Week 11	Edge Line Detection: - Define of edge / line detection -Methods of detection edge / line
Week 12	Histogram: - Define of Histogram - Histogram Modifications -Histogram Equalization - Histogram features: mean, standard, deviation, skew, energy and entropy.
Week 13	Image compression A: -Compression System Model. -Lossless Compression Methods. Image compression B: -Run-Length Coding
Week 14	Image compression A: -Compression System Model. -Lossless Compression Methods. Image compression B: -Run-Length Coding
Week 15	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Lab 1: Introduction to the MATLAB program
Week 2	Lab 2: Types of digital images in MATLAB, opening and reading an image,convert image elements into doubles or unit8
Week 3	Lab 3 Convert the image from one color gradient to another, obtain complete information about the image
Week 4	Lab 4: Conditional statements in MATLAB for example (if – statement, switch – case) with examples, logical or relational operators
Week 5	Lab 5: Loops statements(for, while) with examples
Week 6	Lab 6: Jamping statements, view images in more than one way using MATLAB, using Threshold function on images.
Week 7	Mid-term Exam
Week 8	Lab 8: Using some algebraic methods to extract the most important features from a digital image such as(Hessenberg Decomposition Method, SVD Method)
Week 9	Lab9: Using methods of resizing images or ways to cut part of images in addition to methods of rotating images
Week 10	Lab10: Ways to add noise to images
Week 11	Lab11: Use filters to remove noise from images
Week 12	Lab 12: Methods for extracting edges from images
Week 13	Lab 13: Use some transformations on the images
Week 14	Mid-term Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	1- Digital Signal Processing Tutorial 2- Computer Vision and Image Processing: A Practical Approach Using CVIPTools (BK/CD-ROM) Hardcover – December 1, 1997 by Scott E. Umbaugh 3- Digital Image Processing, Kenneth R. Castelman, Prentice Hall 4- Digital Image Processing, Rafael C. Gonzalez and Richards E. Woods, Addison Wesley 5- Digital Image Processing, Rafael Gonzalez and Paul Wintz, Addison Wesley 6- Fundamentals of Digital Image Processing, Anil K. Jain, Prentice Hall, 1989.	Yes

	7- Mohamed Allali (2010) Linear algebra and image processing, International Journal of Mathematical Education in Science and Technology, 41:6, 725-741, DOI: 10.1080/00207391003675133 8- http://blog.kleinproject.org/?p=588 9- Rowayda A. Sadek, SVD Based Image Processing Applications: State of The Art, Contributions and Research Challenges, International Journal of Advanced Computer Science and Applications, Vol. 3, No. 7, 2012, pp: 26-34. 10- Lijie Cao, Singular Value Decomposition Applied To Digital Image Processing, Division of Computing Studies, Arizona State University Polytechnic Campus, Mesa, Arizona 85212, 2012, 2006, pp. 1 – 15.	
Recommended Texts		
Websites	https://www.tutorialspoint.com/ http:// www.lokminglui.com/CaoSVDintro.pdf (last access: 3.5.2013). https://homepages.inf.ed.ac.uk/rbf/HIPR2/hipr_top.htm https://slideplayer.com/ http://www.ritsumei.ac.jp/~gulliver/iaml/	

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks (%)	Definition
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.