MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Image Processing**			**Module Delivery**	
Module Type	**Support or related learning activity**			☒ **Theory** ☐**Lecture** ☒ **Lab** ☒ **Tutorial** ☒ **Practical** ☐ **Seminar**	
Module Code	**IMPR324**				
ECTS Credits	**6.00**				
SWL (hr/sem)	150				
Module Level	2		**Semester of Delivery**	1	
Administering Department	Type Dept. Code		**College**	Type College Code	
Module Leader			**e-mail**		
Module Leader's Acad. Title	**Lecturer**		**Module Leader's Qualification**	Ph.D.	
Module Tutor	**None**		**e-mail**	**None**	
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date	**1 / 4 /2026**		**Version Number**	1.0	
Relation with other Modules العلاقة مع المواد الدراسية الأخرى					
Prerequisite module	None		**Semester**		
Co-requisites module	None		**Semester**		

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1. Understand Core Concepts: Demonstrate a solid understanding of the fundamentals of digital image processing, including image acquisition, sampling, quantization, and basic relationships between pixels. 2. Apply Image Enhancement Techniques: Utilize intensity transformations, spatial filtering, and frequency domain methods to enhance images and address common challenges like noise reduction and edge sharpening. 3. Analyze and Restore Images: Analyze degraded images and apply restoration techniques such as inverse filtering, Wiener filtering, and noise reduction to improve image quality. 4. Implement Advanced Processing Techniques: Employ advanced techniques, including wavelet transforms, color image processing, and segmentation, to extract and process meaningful information from images. 5. Explore Real-World Applications: Integrate learned concepts and modern advancements, such as convolutional neural networks and deep learning, to solve practical image processing problems in fields like medical imaging, satellite imaging, and biometrics.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Explain Fundamental Concepts: Define and explain key concepts in digital image processing, including the image processing pipeline, mathematical tools, and the role of digital image processing in various fields. 2. Perform Image Preprocessing: Apply intensity transformations, spatial filtering, and frequency domain techniques to preprocess and enhance images for better analysis. 3. Analyze and Mitigate Degradation: Identify sources of image degradation and implement appropriate restoration techniques to improve image quality in noisy or distorted environments. 4. Segment and Transform Images: Utilize segmentation techniques and image transforms, including wavelets, to isolate regions of interest and analyze image features effectively. 5. Implement Practical Applications: Develop and implement solutions to real-world problems using image processing techniques, such as object detection, color enhancement, and image reconstruction, with tools like MATLAB, Python, or deep learning frameworks. 6. Explore Advanced Topics: Demonstrate an introductory understanding of modern advancements like convolutional neural networks (CNNs) and their applications in image processing tasks. 7. Evaluate Image Processing Systems: Assess the effectiveness of different image processing techniques in solving specific problems and communicate findings through written reports and presentations.
Indicative Contents المحتويات الإرشادية	1. Introduction to Digital Image Processing 2. Digital Image Fundamentals 3. Intensity Transformations and Spatial Filtering (Part 1) 4. Intensity Transformations and Spatial Filtering (Part 2)

	5. Filtering in the Frequency Domain (Part 1) 6. Filtering in the Frequency Domain (Part 2) 7. Image Restoration and Reconstruction (Part 1) 8. Image Restoration and Reconstruction (Part 2) 9. Color Image Processing 10. Wavelet and Other Image Transforms 11. Image Segmentation (Part 1) 12. Image Segmentation (Part 2) 13. Applications of Digital Image Processing 14. Modern Advancements in Image Processing

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures (Theory-Based Learning)** - Objective: Provide a solid foundation of theoretical knowledge in digital image processing. - Approach: Weekly lectures introducing key concepts, supported by visual aids, case studies, and real-world examples from medical imaging, biometrics, and remote sensing. **2. Practical Lab Sessions (Hands-On Learning)** - Objective: Enhance students' practical skills in applying image processing techniques. - Approach: Weekly lab sessions using tools like MATLAB, Python (OpenCV, NumPy, scikit-image), and image datasets. Labs will emphasize solving real-world challenges through exercises on filtering, segmentation, and restoration. **3. Project-Based Learning** - Objective: Encourage integration of learned concepts to solve real-world problems. - Approach: Assign a midterm project and final project focusing on real-world applications, such as designing a pipeline for medical image enhancement or segmentation of satellite images. **4. Collaborative Learning** - Objective: Foster teamwork and knowledge sharing. - Approach: Group assignments, discussions, and peer reviews to promote collaborative problem-solving and critical thinking. **5. Blended Learning** - Objective: Leverage technology to enhance learning flexibility and

	engagement. - Approach: Provide supplementary materials, recorded tutorials, and online resources through a learning management system (e.g., lecture slides, video tutorials, and datasets for practice). **6. Assessment-Driven Learning** - Objective: Reinforce learning through regular feedback and assessments. - Approach: Conduct bi-weekly quizzes, regular lab assignments, and in-class discussions to assess understanding and encourage active participation. **7. Self-Directed Learning** - Objective: Encourage independent exploration of topics beyond the classroom. - Approach: Provide reading lists (e.g., Digital Image Processing by Rafael C. Gonzalez) and encourage exploration of modern topics like deep learning applications in image processing.

Student Workload (SWL)

الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	**170**	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	**2**
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	**77**	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	**2**
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation

تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	LO #1- #5 and #6 - #11
	Assignments	2	10% (10)	3 and 12	LO #2 and #5, #7, #11

	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5 - #12
Summative assessment	**Midterm Exam**	2hr	10% (10)	8	LO #1 - #10
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	- What is Digital Image Processing - Examples of Fields that Use Digital Image Processing - Fundamental Steps in Digital Image Processing - Components of an Image Processing System
Week 2	- Image Sensing and Acquisition - Image Sampling and Quantization - Basic Relationships Between Pixels - Introduction to Basic Mathematical Tools
Week 3	- Basic Intensity Transformation Functions - Histogram Processing - Fundamentals of Spatial Filtering
Week 4	- Smoothing (Lowpass) Spatial Filters - Sharpening (Highpass) Spatial Filters
Week 5	- Basics of Filtering in the Frequency Domain - Fourier Transform and Its Importance in Image Processing
Week 6	- Image Smoothing Using Lowpass Frequency Domain Filters - Image Sharpening Using Highpass Filters - Selective Filtering
Week 7	- A Model of the Image Degradation/Restoration Process - Noise Models - Restoration in the Presence of Noise Only (Spatial Filtering)
Week 8	- Periodic Noise Reduction Using Frequency Domain Filtering - Inverse Filtering and Wiener Filtering - Geometric Mean Filtering
Week 9	- Color Fundamentals - Color Models (RGB, CMY, HSI) - Basics of Full-Color Image Processing - Color Transformations
Week 10	- Fourier-Related Transforms - Walsh-Hadamard, Slant, Haar, and Wavelet Transforms

	- Applications of Wavelet Transforms
Week 11	- Fundamentals of Image Segmentation - Point, Line, and Edge Detection - Thresholding Techniques
Week 12	- Region Growing, Splitting, and Merging - Region Segmentation Using Clustering and Superpixels - Morphological Watersheds
Week 13	- Medical Imaging - Satellite Imaging and Remote Sensing
Week 14	- Introduction to Convolutional Neural Networks (CNNs) - Role of Deep Learning in Image Processing - Overview of Tools like TensorFlow and PyTorch
Week 15	Exam
Week 16	**Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	- Explore and visualize sample images using MATLAB or Python (e.g., OpenCV). - Analyze image components such as intensity, resolution, and color.
Week 2	- Perform image sampling and quantization with different resolutions. - Visualize pixel relationships (e.g., neighborhoods, connectivity).
Week 3	- Implement intensity transformations like contrast stretching and thresholding. - Perform histogram equalization and visualize results.
Week 4	- Apply smoothing filters (e.g., averaging, Gaussian) to reduce noise. - Use sharpening filters (e.g., Laplacian, Sobel) to enhance image edges.
Week 5	- Implement the 2D Fast Fourier Transform (FFT) to visualize an image in the frequency domain. - Analyze low-frequency and high-frequency components.
Week 6	- Apply frequency domain filters for smoothing and sharpening. - Design selective filters to target specific image features.
Week 7	- Simulate noise models (e.g., Gaussian, salt-and-pepper). - Apply spatial filtering techniques to remove noise.
Week 8	- Implement Wiener filtering and analyze its performance on noisy images. - Use frequency domain filtering to reduce periodic noise.
Week 9	- Convert images between different color spaces. - Perform simple operations like color enhancement or color-based segmentation.
Week 10	- Perform discrete wavelet transforms (DWT) for image compression. - Compare DWT with FFT for specific applications.
Week 11	- Implement edge detection algorithms (e.g., Sobel, Canny). - Apply thresholding methods to segment objects in grayscale images.

Week 12	- Use region-growing methods to extract regions of interest. - Perform segmentation with clustering techniques (e.g., k-means).
Week 13	- Analyze real-world datasets (e.g., medical images or satellite data). - Apply learned techniques to solve a specific problem, such as detecting anomalies in medical scans.
Week 14	- Train a basic CNN for image classification using a small dataset. - Discuss results and challenges of modern techniques.
Week 15	**Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	- Digital Image Processing, 4th edition, Rafael C. Gonzalez and Richard E. Woods	
Recommended Texts	- Digital Image Processing using Matlab, Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins	Yes
Websites	-	

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.