# MODULE DESCRIPTION FORM

# نموذج وصف المادة الدراسية

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Digital Image Processing** | | | **Module Delivery** | |
| **Module Type** | **Elective** | | | ☒**Theory**<br>☐**Lecture**<br>☒**Lab**<br>☐**Tutorial**<br>☐**Practical**<br>☐**Seminar** | |
| **Module Code** | **UOMU0202065** | | | | |
| **ECTS Credits** | **5** | | | | |
| **SWL (hr/sem)** | **125** | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 6 | |
| **Administering Department** | CET | | **College** | EETC | |
| **Module Leader** | **fanaralijoda@uomus.edu.iq** | | **e-mail** | **fanaralijoda@uomus.edu.iq** | |
| **Module Leader's Acad. Title** | | | **Module Leader's Qualification** | | |
| **Module Tutor** | | | **e-mail** | | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | 29/10/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
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| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
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| **Module Aims**<br>أهداف المادة الدراسية | 1. To become familiar with digital image fundamentals<br>2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain.<br>3. To learn concepts of degradation function and restoration techniques.<br>4. To study the image segmentation and representation techniques.<br>5. To become familiar with image compression and recognition methods |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.<br>2. describe features of images.<br>3. Have a good understanding of the mathematical foundations for digital manipulation of images.<br>4. Operate on images using the techniques of smoothing, sharpening and enhancement.<br>5. image acquisition; preprocessing; segmentation; Fourier domain processing, compression and<br>6. analysis.<br>7. Be able to write programs using Matlab language for digital manipulation of images; image<br>8. Understand the restoration concepts and filtering techniques.<br>9. Be able to understand the documentation for, and make use of, the MATLAB library and MATLAB.<br>10. Acquisition; preprocessing; segmentation; Fourier domain processing; and compression.<br>11. Learn and understand the Image Enhancement in the Spatial Domain.<br>12. Learn and understand the Image Enhancement in the Frequency Domain.<br>13. Learn the basics of segmentation, features extraction, compression and recognition methods for color models. |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br><br><u>Fundamentals</u><br>Need for DIP- Fundamental steps in DIP – Elements of visual perception -Image sensing and Acquisition – Image Sampling and Quantization – Imaging geometry, discrete image mathematical characterization. [15 hrs]<br><u>Image Transforms</u> |

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| | Two dimensional Fourier Transform- Properties – Fast Fourier Transform – Inverse FFT, Discrete cosine transform and KL transform.-Discrete Short time Fourier Transform- and its application in Compression. [10 hrs]<br><br>Image Enhancement<br>Spatial Domain: Basic relationship between pixels- Basic Gray level Transformations – Histogram Processing – Smoothing spatial filters- Sharpening spatial filters. Frequency Domain: Smoothing frequency domain filters- sharpening frequency domain filters Homomorphic filtering. [15 hrs]<br><br>Image Restoration:<br>Overview of Degradation models –Unconstrained and constrained restorations- Inverse Filtering , Wiener-Filter. [10 hrs]<br><br>Feature Extraction:<br>Detection of discontinuities – Edge linking and Boundary detection- Thresholding- - Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors. [10 hrs]<br><br>Image Reconstruction from Projections:<br>Need- Radon Transform – Back projection operator- Projection Theorem- Inverse Radon Transform. [10 hrs] |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
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| **Strategies** | The assessment strategy for this module is designed to provide students with the opportunity to demonstrate the skills and knowledge as described in the learning outcomes. The written examination will assess the knowledge of terminology, concepts and theory of Digital Image Processing, as well as the ability to analyze problems and apply mathematical models of signal processing to solve and predict effects. The laboratory experiments will evaluate the acquired technical skills and expertise required to apply these methods to practical Digital Image Processing tasks. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب موزع على (15) اسبوع | | | |
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| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 64 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 4.26 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 61 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 4.06 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 125 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
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| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 10 | LO #1-4, LO#5-8 |
| | **Assignments** | 2 | 10% (10) | 3, 12 | LO # 1,2, LO# 3-11 |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | Continuous | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | LO # 1-6 |
| | **Final Exam** | 4hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
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| | **Material Covered** |
| **Week 1** | **• Introduction and Digital Image Fundamentals:**<br>• The origins of Digital Image Processing<br>• Examples of Fields that Use Digital Image Processing<br>• Fundamentals Steps in Image Processing |
| **Week 2** | **Introduction and Digital Image Fundamentals (cont.):**<br>• Image Sampling and Quantization,<br>• Some basic relationships like Neighbors, Connectivity, Distance<br>• Measures between pixels<br>• Translation, Scaling, Rotation and Perspective Projection of image |
| **Week 3** | **Introduction and Digital Image Fundamentals (cont.):**<br>• Linear and Non Linear Operations |
| **Week 4** | **Image Enhancement in the Spatial Domain:**<br>• Some basic Gray Level Transformations<br>• Histogram Processing |
| **Week 5** | **Image Enhancement in the Spatial Domain (cont.):**<br>• Enhancement Using Arithmetic and Logic operations |
| **Week 6** | **Image Enhancement in the Spatial Domain (cont.):**<br>• Combining Spatial Enhancement Methods<br>• Basics of Spatial Filters |
| **Week 7** | Mid-term Exam |
| **Week 8** | **Image Enhancement in the Spatial Domain (cont.):**<br>• Smoothening and Sharpening Spatial Filters |
| **Week 9** | **Image Enhancement in the Spatial Domain (cont.):**<br>• Histogram Processing |
| **Week 10** | **Image Enhancement in the Frequency Domain:**<br>• Introduction to Fourier Transform and the frequency Domain<br>• Computing and Visualizing |
| **Week 11** | **Image Enhancement in the Frequency Domain (cont.):**<br>• Smoothing Frequency Domain Filters |
| **Week 12** | **Image Restoration:**<br>• A model of The Image Degradation / Restoration Process |
| **Week 13** | **Image Restoration (cont.):**<br>• Inverse filtering<br>• Wiener filtering |

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| **Week 14** | **Image Segmentation:**<br>• Detection of Discontinuities<br>• Edge linking and boundary detection<br>• Thresholding |
| **Week 15** | **Object Recognition:**<br>• Patterns and Pattern Classes<br>• Decision-Theoretic Methods |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
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| | **Material Covered** |
| **Week 1** | Lab 1: Digital image Representation<br>• Reading, Displaying, Writing Images using MATLAB<br>• Data Classes, Image Types using MATLAB |
| **Week 2** | Lab 2: Digital image Representation (cont.)<br>• Introduction to M Function Programming using MATLAB |
| **Week 3** | Lab 3: Image Enhancement in the Spatial Domain:<br>• Intensity Transformation Function (MATLAB) |
| **Week 4** | Lab 4: Image Enhancement in the Spatial Domain (cont.):<br>• Histogram Processing and Function Plotting (MATLAB) |
| **Week 5** | Lab 5: Image Restoration |
| **Week 6** | Lab 6: Image Segmentation. |
| **Week 7** | Lab 7: Object Recognition: |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
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| | **Text** | **Available in the Library?** |
| **Required Texts** | Fundamentals of Digital Image Processing, Anil.K.Jain – ,Pearson Education-2003. | No |
| **Recommended Texts** | Rafael C. Gonzalez, Richard E. Woods, _Digital Image Processing', Pearson, Third Edition, 2010. | No |
| **Websites** | https://www.youtube.com/watch?v=6dFnpz_AEyA&list=PL9567DFCA3A66F299 | |

| Grading Scheme<br>مخطط الدرجات | | | | |
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| **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 |
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**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.