Course Definition
Digital Image Processing

Information

Technology

Engineering

Syrian Arab Republic	الجمهورية العربية السورية
Ministry of Higher Education	وزارة التعليم العالــــي
Syrian Virtual University	الجامعة الافتراضية السورية

1. Basic Information:

Course Name	Digital Image Processing
Course Code	AIP601
Number of Presentational Sessions*	10 – 12
Number of Synchronous Sessions**	10 – 12
Number of Shorter Tests***	No Tests
Number of Exams***	1
Theoretical Sessions Work Load (hrs.)	36
Practical Sessions Work Load (hrs.)	36
Credit Hours	5

*Each presentational session comprises both recorded lecture (1.5 hrs.) and interactive learning content (1.5 hrs.).

**Each synchronous session comprises the interactive lecture carried out in real time in a virtual class (1.5 hrs.).

***Each shorter test is 0.5 hr. long. The final exam is 2 hrs. long.

N.B.

Generally, each chapter requires two presentational sessions: one for the recorded content and one for the interactive content (unless the chapter is too long, in which case it may require more sessions (. This note applies to synchronous sessions as well, where each chapter requires one synchronous session generally.

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2. Prerequisites courses:

Course	Code
Computer Graphics	BCG601
English Language (5)	GEN601
Intelligent Algorithms	BIA601

3. Course Objectives:

The course aims to employ the basic concepts of image processing in the development of student's informational and mathematical ability, so that:

1. The student can contribute to solving problems related to digital image processing

2. The student has the skills to analyze problems related to digital image processing and solve them using computers

3. The student has the ability to use the programming languages (MATLAB) in the application of image processing algorithms

4. Be able to analyze issues related to image processing applications and find appropriate solutions using a computer

5. Be able to visualize the skills required of the engineer to keep pace with modern technologies and methods in the field of digital image processing

6. The student applies mathematical techniques to solve problems related to image processing

7. The student employs what he teaches from techniques and software tools to visualize solutions to image processing issues

8. Be able to continuously learn and develop skills and knowledge through self-learning

9. Be able to use technical information from multiple sources

4. Learning Outcomes (LO):

By the end of this course, the learner is expected to be capable of:

- Learn the basics of digital photos
- Learn about digital image processing algorithms
- Understand the principles of pattern recognition
- The ability to analyze issues related to image processing applications and find appropriate solutions using a computer
- The ability to visualize the skills required of the engineer to keep pace with modern technologies and methods in the field of digital image processing
- The student applies mathematical techniques to solve problems related to image processing
- The student employs what he has taught techniques and software tools to visualize solutions to image processing issues
- The student can contribute to solving problems related to digital image processing
- The student has the skills to analyze problems related to digital image processing and solve them using the computer
- The student has the ability to use the programming languages (MATLAB) in applying image processing algorithms
- The ability to continuously learn and develop skills and knowledge through self-learning

- The ability to use technical information from multiple sources
- The ability to participate in a team work

5. Assessment Results:

Chapter Number	Chapter Title	General Objectives	Assessment Type				
			Interactive Content & Recorded Sessions	Applied Activities (Synch. Sessions)	Final Exam*/ Shorter Tests**	Presentations and Interviews***	Reports****
CH1	Basics of Digital Image	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH2	Point Operations	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH3	Image Histogram Processing	Comprehension –Analytical Thinking –	√	√	√	√	√

		Tools and Application Hands– On					
CH4	Spatial Domain Filtering	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH5	Edge Detection	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH6	Frequency Domain Filtering	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√

CH7	Morphological Operations	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√
CH8	Multi–spectral Images	Comprehension –Analytical Thinking – Tools and Application Hands– On	√	√	√	√	√

*The final exam is two hours long and is given at the end of the course.

**Shorter tests are about 30 minutes long and are given after three or four lectures throughout the semester during synchronous sessions.

***Presentations, interviews, and reports are submitted once after each three or four lectures throughout the semester during synchronous sessions.

6. Course Syllabus:

Chapter	Subject	Content	Number of Theoretical Learning Units	Number of Practical Learning Units (synchronous)
CH1	Basics of Digital Image	1. Light and the electromagnetic spectrum 2. Sensing and Acquiring images 3. Image sampling and quantization 4. digital image representation 5. Some basic relationships between pixels 1. Introduction to the mathematical tools used in digital image processing	4	1.5
CH2	Point Operations	1. Arithmetic operations 2. Boolean operations 3. Operations on gray levels	4	1.5
CH3	Image Histogram Processing	1. Appropriate selection of threshold value using histogram 2. Histogram Equalization 3. Histogram matching 4. Local histogram Equalization 5. Adaptive histogram Equalization 6. Contrast-limited adaptive histogram Equalization	4	1.5

		7. Using histogram statistical values to enhance images		
CH4	Spatial Domain Filtering	1. Basic definitions: a. pixel neighbors b. Filter kernel and linear filter application mechanism 2. Filters used to reduce noise: a. value filter b. Gaussian filter c. Non-linear filters	**6**	**1.5**
CH5	Edge Detection	1. Edge detection based on gradient 2. Edge detection filters 3. Edge detection based on the second derivative 4. Gaussian Difference (DoG) 5. Edge sharpening	**4**	**1.5**
CH6	Frequency Domain Filtering	1. . Fourier transform 2. Two-dimensional discrete Fourier transform 3. Frequencies and direction in two-dimensional space 4. Properties of the two-dimensional discrete Fourier transform	**6**	**1.5**

		5. Discrete Fourier transform applications		
CH7	Morphological Operations	1. Dilation and Erosion 2. basic morphological processes 3. Compound morphological processes	**4**	**1.5**

CH8	Multispectral Images	1. Multispectral image analysis
		2. color image processing
		   a. Images based on color scheme
		   b. Color spaces and conversion between them
		   c. Pseudo colors
		   d. histogram of color pictures
			4	**1.5**

7. Practical Activity:

- **Tools and Labs:**

Tool Name	Description
Matlab	Programming environment
Word, power point, excel	Microsoft office

- **Practical Activities per Chapters**:

Chapter	Activities Type	Remarks
CH1	☑ Exercises ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH2	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH3	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH4	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☐ Other	
CH5	☑ Exercises	

	☑ Homework	
	☐ Webinars	
	☐ Project	
	☐ Experiment	
	☐ Other	
CH6	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☑ Other	
CH7	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☑ Other	
CH8	☑ Exercises ☑ Homework ☐ Webinars ☐ Project ☐ Experiment ☑ Other	

8. References:

- Gonzalez, R.C. and Woods, R.E., 2008. Digital Image Processing-3rd ed. Pearson Prentice Hall, Upper Saddle River, NJ
- Russ, J.C., The Image Processing Handbook-4th ed. CRC Press, Boca Raton, FL.