



**University/Academy:** Arab Academy for Science, Technology & Maritime Transport  
**Faculty/Institute:** College of Engineering & Technology  
**Program:** B.Sc Computer Engineering

### Form no. (12): Course Specification

#### 1- Course Data

Course Code: <b>CC516</b>	Course Title: <b>Pattern Recognition</b>	Academic Year/Level: <b>4<sup>th</sup> year / 7<sup>th</sup> semester</b>
Specialization: <b>Computer Engineering</b>	No. of Instructional Units <b>3</b>	Lecture <b>2</b>
		Practical <b>2</b>

#### 2- Course Aim

In the field of pattern recognition the aim is to teach a computer to recognize patterns in data sets (e.g. input-output relations). Real data is often noisy, and therefore probabilistic methods are used. Using the Bayesian perspective is the starting point for a treatment of both classical methods (least mean squares methods, discriminant analysis) and modern methods (neural networks, Bayesian learning).

#### 3- Intended Learning Outcomes

<b>a- Knowledge and Understanding</b>	<p><b>Through knowledge and understanding, students will be able to:</b>  <b>a1. Concepts and theories of mathematics and sciences, appropriate to the computer engineering.</b></p> <ul style="list-style-type: none"> <li>• List applications of pattern recognition.</li> <li>• Know what Image Processing is.</li> <li>• Define Gray level scaling transformations.</li> <li>• List different transformations.</li> <li>• Define smoothing transformations.</li> <li>• Show effect of smoothing transformations.</li> <li>• Show the importance of edge detection in different applications.</li> <li>• Identify the challenges faced by different edge detecting algorithms.</li> <li>• Define image segmentation.</li> <li>• Define shape detection.</li> <li>• Define the different morphological operations such as dilation and erosion.</li> <li>• Know what statistical decision making is.</li> <li>• Define Bayes' Theory.</li> <li>• Define statistical priors and posteriors, probability of error, and error rate of a classifier.</li> <li>• Define what clustering is and class discovery.</li> <li>• List different clustering techniques.</li> <li>• Show what partitional clustering is.</li> <li>• Define what neural networks are.</li> <li>• List the different applications for neural networks.</li> <li>• Know the learning algorithm used in training the ff-net.</li> <li>• Define HopField Networks.</li> </ul>
<b>b- Intellectual Skills</b>	<p><b>Through intellectual skills, students will be able to:</b>  <b>b1. Select/Apply appropriate mathematical and computer-based methods for modeling and analyzing problems and select appropriate solutions for engineering problems based on analytical thinking..</b></p> <ul style="list-style-type: none"> <li>• Compare different transformations.</li> <li>• Show effect of smoothing transformations.</li> <li>• Differentiate between Prewitt's and Sobel's edge detecting algorithms.</li> </ul>

	<ul style="list-style-type: none"> <li>• Solve a classification problem using Bayes' Theory.</li> </ul> <p><b>b3. Combine, exchange, and assess different ideas, views, and knowledge from a range of sources.</b></p> <ul style="list-style-type: none"> <li>• Show the groups generated by hierarchical methodology using agglomerative clustering algorithm.</li> <li>• Demonstrate the effect of the number classes on the classification process.</li> <li>• Show the effect of noisy data on the output groups.</li> <li>• Show how to build and use a feed forward neural network for a classification problem using Matlab</li> </ul>
<b>c- Professional Skills</b>	<p><b>Through professional and practical skills, students will be able to:</b></p> <p><b>c1. Professionally merge the engineering knowledge, understanding, and feedback to improve design, products and/or services.</b></p> <ul style="list-style-type: none"> <li>• Apply transformations to a set of images using Matlab.</li> <li>• Apply various smoothing transformations to a set of images using Matlab.</li> <li>• Experiment with different edge detectors such as Prewitt's and Sobel's.</li> <li>• Apply region labeling algorithm to different images using Matlab.</li> <li>• Apply boundary detection, gap filling, and Hough transforms to images using Matlab.</li> <li>• Apply opening and closing operations to different images using Matlab.</li> <li>• Distinguish between single linkage, complete linkage, and average linkage.</li> <li>• Apply agglomerative algorithm to different datasets using Matlab.</li> <li>• Apply k-means algorithm to different datasets using Matlab.</li> </ul> <p><b>c2. Create and/or re-design a process, component or system, and carry out specialized engineering designs with neatness and aesthetics in design and approach.</b></p> <ul style="list-style-type: none"> <li>• Design a feed forward neural network for a classification problem.</li> <li>• Distinguish between Hopfield and feed forward neural networks.</li> </ul>
<b>d- General Skills</b>	<p><b>Through general and transferable skills, students will be able to:</b></p> <p><b>d2. Work in stressful environment and within constraints, communicate effectively, lead and motivate individuals and effectively manage tasks, time, and resources.</b></p> <p><b>d4. Search for information and engage in life-long self-learning computer engineering and refer to relevant literatures.</b></p> <ul style="list-style-type: none"> <li>• Plot quadratic and linear decision boundaries for different classes using Matlab.</li> <li>• Sketch the probability of different events for different classes.</li> <li>• Sketch pdfs for different classes identifying decision boundaries.</li> <li>• Sketch different groups according to the nearest neighbor algorithm.</li> </ul>

#### 4- Course Content

<b>Week No.1</b>	Introduction to Pattern Recognition
<b>Week No.2</b>	Gray scale Transformations
<b>Week No.3</b>	Smoothing Transformations
<b>Week No.4</b>	Edge Detection
<b>Week No.5</b>	Scene Segmentation and labeling
<b>Week No.6</b>	Shape Detection
<b>Week No.7</b>	7th week exam + Revision
<b>Week No.8</b>	Morphological Operations
<b>Week No.9</b>	Statistical Decision Making
<b>Week No.10</b>	Minimization of Classification Error
<b>Week No.11</b>	Hierarchical Clustering
<b>Week No.12</b>	12th week exam + Revision
<b>Week No.13</b>	Partitioned Clustering
<b>Week No.14</b>	Feed Forward Neural Networks
<b>Week No.15</b>	Hopfield Networks
<b>Week No.16</b>	Presentation of projects and Final Exam.

## 5- Teaching and Learning Methods

- Lectures
- Tutorials
- Reports & sheets
- Laboratories
- Seminars

## 6-Teaching and Learning Methods for Students with Special Needs

- Lectures
- Tutorials
- Reports & sheets
- Laboratories
- Seminars

The academic advisors of each student, as well as dedicated department TAs monitor the students' progress and solve any problem he/she may encounter.

## 7- Student Assessment

<b>a-Procedures used</b>	1-Written Examinations to assess The Intended Learning Outcomes.	
	2-Class Activities (Reports, Discussions, -----) to assess The Intellectual Skills.	
<b>b- Schedule:</b>	Assessment 1	7 <sup>th</sup> Week Written Exam
	Assessment 2	12 <sup>th</sup> Week Written Exam
	Assessment 3	Continuous
	Assessment 4	16 <sup>th</sup> Week Final Written Exam
<b>c- Weighing of Assessment</b>	7 <sup>th</sup> Week Examination	30 %
	12 <sup>th</sup> Week Examination	20 %
	Final-term Examination	40 %
	Oral Examination	00 %
	Practical Examination	00 %
	Semester Work	10 %
	Total	100%

## 8- List of References:

<b>a- Course Notes</b>	
<b>b- Required Books (Textbooks)</b>	• E. Gose, R. Johnsonbaugh, "Pattern Recognition and Image Analysis", Prentice Hall PTR.
<b>c- Recommended Books</b>	• R. Gonzalez and R. Woods, "Digital Image Processing", Pearson Hall, Second Edition.
<b>d- Periodicals, Web Sites, etc.</b>	

**Course Instructor:**  
Prof. Dr Khaled Mahar

**Head of Department:**  
Prof. Dr. Mohamad AbouEI-Nasr

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