

**Course specification**  
**(4105 Computer Vision)**

<b>Faculty:</b>	<i>HICIT- Higher Institute for Computers &amp; Information Technology-El Shorouk Academy</i>
<b>Programme(s) on which the course is given:</b>	Undergraduate program in Computer Science
<b>Major or minor element of programme:</b>	Compulsory
<b>Department offering the programme</b>	Department of Computer Science
<b>Department offering the course:</b>	Department of Computer Science
<b>Year / Class</b>	4 <sup>th</sup> Year – 1 <sup>st</sup> semester
<b>Date of specification approval</b>	1/8/2022

**A- Basic Information**

<b>Title: Computer Vision</b>	<b>Code: 4105</b>		
<b>Weekly Hours:</b>			
<b>Lecture: 3</b>	<b>Exercise: -</b>	<b>Practical :3</b>	<b>Total: 6</b>

**B- Professional Information**

**1- Course Aims:**

This course (CS4105) introduces the student to computer Vision principles. During the study of this course, the student understands the fundamentals of Digital Images processing and earn skills in dealing with images as well as the image processing-based systems. The Course begins with the overall picture (understanding what digital Image is, image processing-based systems, and the applications areas of the field. Then, explaining the image acquisition, sampling, quantization, related problems, and basics of image processing (neighbouring, statistics, and labelling). The image enhancement techniques in the spatial domains: average, contrast stretching, histogram equalization, and many others. Image transformations to the frequency domain using the Fourier transformation and discrete cosine transformation. Then, The use of frequency domain in image enhancement. The image segmentation techniques using vector quantization, high pass and edges detection, and labelling of connected areas explored with practical applications. Image morphology, boundary description, features extractions, and recognition techniques.

**2- Program ILOs Covered by Course**

<i>Program Intended Learning Outcomes</i>			
<b>Knowledge and understanding</b>	<b>Intellectual Skills</b>	<b>Professional and practical skills</b>	<b>General and Transferable skills</b>
<b>A6, A12, A21</b>	<b>B2</b>	<b>C5</b>	<b>D5</b>

### 3- Intended learning outcomes of course (ILOs)

#### a. Knowledge and Under-Standing:

- a1. Define Digital image and main phases of a digital image processing-based computer system. [A6]
- a2. Clarify various methods and techniques to enhance an image. [A6, A12]
- a3. Explain techniques to find out an object to segment an image. [A12]
- a4. Explain Image transformations using discrete Fourier transform and discrete cosine transform.[A12]
- a5. Explain Boundary representation and distance metrics. [A6]
- a6. Describe Morphology and features extraction techniques. [A12, A21]
- a7. Mention classifications and recognition methodologies. [A12, A21]

#### b. Intellectual Skills:

- b1. Propose a system that includes software and hardware. [B2]
- b2. Analyse the problem and decompose it. [B2]
- b3. Solve the problem using transformers to suitable domain. [B2]

#### c- Professional and practical skills

- c1. Design and realize application software's to read and enhancement images of different formats. [C5]
- c2. Develop Image, compression and transformation programs. [C5]
- c3. Practice Open CV to implement Image Segmentations applications and familiarization. [C5]
- c4. Apply Object segmentation and feature extraction concept in software design and develop. [C5]

#### d- General and transferable skills

- d1. Communicate with others, work in a team and involvement in group discussion and seminars. [D5]
- d2. Write technical report. [D5]

### 4- Contents

Topic	Hours	Lecture	Practical
Image, Digital image and image processing-based systems	6	3	3
Understanding image matrix and Neighbouring	6	3	3
Images enhancement: Contrast stretching and histogram equalization.	6	3	3
Spatial domain filters	12	6	6
Frequency domain and frequency domain filters	6	3	3
Image segmentation techniques	6	3	3
Morphology	6	3	3
Boundary description, and distance metrics	6	3	3
Features extraction.	6	3	3
Recognition and classification techniques	6	3	3
Selected Topics	3	3	-
Course Project	6	3	3

## 5- Teaching and learning methods

Teaching and learning methods	Used
<b>Active Learning</b>	
Lectures (blending learning – online learning using virtual classroom)	√
Tutorial Exercises (hybrid learning – online learning)	√
Practical Lab (blending learning– online learning)	√
Exercises	-
Discussions.	-
<b>Self – Learning strategy</b>	
Reading material	√
Websites search	√
Research and reporting	√
Self-studies	√
<b>Experimental strategy</b>	
Group work	√
Presentation	-
<b>Problem solving strategy</b>	
Problem solving/problem solving learning based	-
Case study	-
<b>Synchronous E-Learning</b>	
Virtual lab	-
Virtual class	-
Chat Room	√
Video lectures	√
<b>Asynchronous E-Learning</b>	
E-Learning	√

## 6- Student assessment methods

Methods	Assessment	Used
Electronic Midterm Exam	To assess the knowledge and understanding achieved by the student during the previous weeks. (Online on e-learning hub)	√
Pencil-to-Paper Final Exam	To evaluate what the student gain at the end of the course, and to assess: the knowledge and understanding, general skills, and intellectual skills.	√
Course Project	To allow students work in team, and to evaluate knowledge, understanding, intellectual, and transferable skills. (Online on e-learning hub, FTF)	√

Electronic Course Work & Quizzes	To keep the student always in the course, and to evaluate knowledge, understanding, intellectual, and transferable skills. (Online on e-learning hub)	√
Practical Exam	To measure the ability of students to design and implement a software program (FTF).	--
Participation	To assess the knowledge and understanding achieved by the student during the previous weeks.	√

### Assessment Schedule

Assessment	Week #
Mid Term Exam	8
Final Exam	16
Course Project	3-14
Course Work & Quizzes	2-14

### Assessment Weight

Assessment	Weight %
Mid Term Exam	5%
Final Exam	80%
Course Project	10%
Course Work & Quizzes	5%
<b>Total</b>	<b>100</b>

- Course Work & Quizzes:
  - o Short Exams, Assignments, Researchs, Reports, Presentations on e-learning hub
  - o Class/Project discussion

### 7- List of references

<b>Essential books (textbooks)</b>	<ul style="list-style-type: none"> <li>• Gonzalez, R., &amp; Woods, R. (2017, March 20). <i>Digital Image Processing</i>.</li> <li>• Minichino, J., &amp; Howse, J. (2015, September 29). <i>Learning OpenCV 3 Computer Vision with Python - Second Edition</i>.</li> <li>• Villán, A. F. (2019, March 29). <i>Mastering OpenCV 4 with Python: A Practical Guide Covering Topics from Image Processing, Augmented Reality to Deep Learning with OpenCV 4 and Python 3. 7</i>.</li> </ul>
<b>Course notes</b>	<ul style="list-style-type: none"> <li>• <a href="https://learn.sha.edu.eg/course/view.php?id=1372">https://learn.sha.edu.eg/course/view.php?id=1372</a></li> <li>• <a href="https://www.academia.edu/23394861/DIGITAL_IMAGE_PROCESSING_APPLICATIONS_LECTURE_NOTES">https://www.academia.edu/23394861/DIGITAL_IMAGE_PROCESSING_APPLICATIONS_LECTURE_NOTES</a></li> <li>• <a href="https://www.studocu.com/de/document/technische-universitat-munchen/computer-aided-medical-procedures-1-camp/edge-detect-other-slides/15321104">https://www.studocu.com/de/document/technische-universitat-munchen/computer-aided-medical-procedures-1-camp/edge-detect-other-slides/15321104</a></li> </ul>

<b>Recommended books</b>	<ul style="list-style-type: none"> <li>• Nixon, M., &amp; Aguado, A. (2019, October 18). <i>Feature Extraction and Image Processing for Computer Vision</i>. Academic Press.</li> <li>• Klette, R. (2019, June 13). <i>Concise Computer Vision: An Introduction into Theory and Algorithms</i>.  <a href="https://learn.sha.edu.eg/pluginfile.php/185040/mod_resource/content/1/Feature.Extraction..Image.Processing.pdf">[https://learn.sha.edu.eg/pluginfile.php/185040/mod_resource/content/1/Feature.Extraction..Image.Processing.pdf]</a></li> </ul>
<b>Periodicals, website</b>	<ul style="list-style-type: none"> <li>• PowerPoint presentations of all course materials</li> <li>• All labs material</li> <li>• [https://learn.sha.edu.eg/course/view.php?id=1372]</li> </ul>

## 8- Required Facilities

To assess professional and practical skills given the following facilities:

a. Tools & SW (Technologies facilities):

- **Anaconda Jupyter Notebook**
- **Python (OpenCV)**
- **Portal (MOODLE) to make electronic quizzes and electronic midterm exam**
- **Portal (MOODLE) to upload project deliverable and assignment**
- **Academy portal (MOODLE) to upload electronic material**

b. Teaching facilities:

	<i>Lecture</i>	<i>class</i>	<i>Lab</i>
Whiteboard	used	-	used
Pc/laptop	used	-	used
Data show	used	-	used
Webinars	MS TEAMS	-	MS TEAMS
Social Media	Facebook Page for 4 <sup>th</sup> year	-	Facebook Page for 4 <sup>th</sup> year
Chat Room	Chat Teams	-	Chat Teams
Videos	Stream-MOODLE	-	Stream-MOODLE
Website	MOODLE	-	MOODLE

## 9- Course Matrices

### 9.1- Course Content/ILO Matrix

Course Contents	Knowledge & understanding							Intellectual skills			Professional and practical skills				General	
	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	c3	c4	d1	d2
Image, Digital image and image processing-based systems	x															
Understanding image matrix and Neighbouring			x											x		
Images enhancement: Contrast stretching and histogram equalization.	x															
Spatial domain filters		x		x				x	x	x						
Frequency domain and frequency domain filters		x	x	x							x	x		x		
Image segmentation techniques																
Morphology												x				
Boundary description, and distance metrics					x											
Features extraction.						x										
Recognition and classification techniques							x									
Selected Topics		x	x	x							x	x		x		
Course Project															x	x

### Learning Method /ILOs Matrix

Learning Methods	Knowledge and understanding				Intellectual skills				Professional and practical skills				General			
	a1	a2	a3	a4	b1	b2	b3	b4	c1	c2	c3	c4	d1	d2	d3	d4
Lectures	x	x	x	x	x	x	x	x	x	x	x	x				
Tutorial Exercises					x	x	x	x	x	x	x	x				
Reading material	x	x	x	x	x	x	x	x	x	x	x	x				
Websites search	x	x	x	x	x	x	x	x		x			x	x	x	x
Research and reporting	x	x	x	x									x	x		
Problem solving																
Group work									x	x	x	x	x	x	x	x
Presentations																
Practical Lab																
Discussions.					x	x	x	x	x	x	x	x	x	x	x	x

### 9.3 Assessment Methods /ILOs Matrix

Assessment Methods	Knowledge & understanding				Intellectual skills				Professional & practical skills				General				
	a1	a2	a3	a4	b1	b2	b3	b4	c1	c2	c3	c4	d1	d2	d3	d4	d5
Electronic Mid Term Exam	x	x	x	x	x	x	x	x									
Final Exam	x	x	x	x	x	x	x	x									
Electronic Course Project	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

<b>Electronic Course Work &amp; Quizzes</b>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
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**10. Course ILOs Vs Program ILOs**

Prog ILOs Course ILOs		Knowledge & understanding			Intellectual skills	Professional and practical skills	General
		A6	A12	A21	B2	C5	D5
<b>K&amp;U</b>	a1	√					
	a2	√	√				
	a3		√				
	a4		√				
	a5	√					
	a6		√	√			
	a7		√	√			
<b>Int.</b>	b1				√		
	b2				√		
	b3				√		
<b>P. &amp;P.</b>	c1					√	
	c2					√	
	c3					√	
	c4					√	
<b>General</b>	d1						√
	d2						√

**Course Coordinator:** prof. Dr. Abd El-Latif Hussein ( )

**Head of Department:** Prof. Dr. Ahmed El-Abbassy ( )

**Date:** 1/8/2022