DeCAIR Course Syllabus Form

Author(s)	Jafar AbuKhait		
Author Organization Name(s)	Tafila Technical University		
Work Package Number & Title	Work Package 2: Development of new MSc and BSc programs in AIR		
Activity Number & Title	Activity 2.2: Designing and developing syllabi and content for the agreed upon courses in the new programs		
Work Package Leader	Francesco Masulli, University of Genoa		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	13/11/2021	Jafar AbuKhait	Original (base) document	C	1-5
2	11/12/2021	Jafar AbuKhait	Revised version	U	1-5
3	16/01/2022	Jafar AbuKhait	Revised based on a peer review	U	1-5
4	2/2/2022	Jafar AbuKhait	Revised based on an expert review	U	1-5

(*) Action: C = Creation, I = Insert, U = Update, R = Replace, D = Delete

Disclaimer

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Email: DeCAIR@ju.edu.jo

Project Website: http://DeCAIR.ju.edu.jo/

Course title	Computer Vision
Course number	0112551
Credit hours (lecture and lab)	3
ECTS (weekly contact and self-study load)	6 (3 + 3)
Prerequisites/co-requisites by course number and name	Digital Signal Processing (0110333)
Prerequisites by topic (other than the formal prerequisites above)	Students are assumed to have good background in data structures, linear system analysis, knowledge of matrix algebra, and fundamentals of 2-D signal processing. Additionally, the students should have good programming skills, preferably, using Python.
Level and type (mandatory, elective)	Undergraduate mandatory course
Year of study and semester	Fourth year; first semester
Catalogue description	This course introduces the concepts, algorithms, and techniques of digital image processing and computer vision. It covers a range of topics including: fundamentals of image formation, camera imaging geometry, camera calibration, image segmentation, feature extraction and matching in spatial and frequency domains, stereo imaging, motion estimation and tracking, image classification and scene understanding, in addition to classification models in digital images.
Objectives	1. Introduce both the theoretical and practical aspects of computing with images. 2. Describe the foundation of image formation, measurement, and analysis. 3. Introduce image-based feature extraction methods and algorithms. 4. Introduce common methods for robust image matching and alignment. 5. Introduce object and scene recognition and categorization from images. 6. Develop the practical skills necessary to build computer vision applications.
Intended learning outcomes	Upon successful completion of this course, students will be able to:

No	Intended learning Outcome (ILO)	Program learning outcome (PLO)*
1	Acquire the concepts of digital image processing and computer vision.	1
2	Work with different digital camera models and color spaces.	1,7
3	Demonstrate the main methods and algorithms in feature extraction, object detection and classification.	1
4	Apply different computer vision techniques on real image datasets.	2

	5 | Implement a vision model to solve real life problem. | 2, 6 (*) The PLOs are listed in the appendix
Teaching and learning methods	Development of ILOs is promoted through the following teaching and learning methods: • Lectures will be delivered through Microsoft Teams and will be recorded for later access. • The Intelligent Systems Lab. is open for the students to practice the practical aspects and solve the programming homework assignments. • The student attends the class presentations and participates in the discussions. • The student joins the related online team/group and participates in its discussions. • The student studies the reference material, including books and videos. • The student solves the programming assignments in Computer Vision. • The student carries out a term project for solving a problem using Computer Vision techniques. • The student presents the term project in class.
Learning material type	Textbook, class handouts, some instructor keynotes, selected YouTube videos, and access to a personal computer and the internet.
Resources and references	A- Required book(s), assigned reading and audio-visuals: 1. Computer Vision: Algorithms and Applications, by Richard Szeliski, 2022. 2. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce, 2020. B- Recommended book(s), material and media: 3. Digital Image Processing, by Rafael Gonzalez and Richard Woods, 2017. 4. Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman, 2004.
Topic outline and schedule	

Week	Topic	ILO	Resources
1	Introduction to computer vision	1	1, 2
2	Digital camera and image formation	2	2
3	Image filtering and Image pyramids	1, 2, 3	1, 2
4	Frequency domain filtering	3	2
5	Color segmentation	3	1, 2
6	Morphological, point, and geometric features	3	1, 2
7	Texture Analysis	3	1, 2
8	Boundary and corner detection	3	1
9	Image segmentation	3	2
10, 11	Deep learning	3	1
12	Object detection and matching	3	1
13	Object recognition and classification	3, 4, 5	1

<table>
<tr><td></td><td>
<table>
<tr><td>14
15</td><td>Motion estimation and tracking</td><td>3, 4, 5</td><td>1</td></tr>
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</td></tr>
<tr><td>Evaluation tools</td><td>Opportunities to demonstrate achievement of the ILOs are provided through the following assessment tools:
<table>
<tr><th>Assessment tool</th><th>Mark</th><th>Topic(s)</th><th>Time</th></tr>
<tr><td>Homework assignments</td><td>20%</td><td>Programming aspects</td><td>W2-W14</td></tr>
<tr><td>Midterm exam</td><td>30%</td><td>Feature extraction classical techniques</td><td>W8</td></tr>
<tr><td>Term Project report and presentation</td><td>20%</td><td>Practical and presentation aspects</td><td>W14</td></tr>
<tr><td>Final exam</td><td>30%</td><td>All material</td><td>W16</td></tr>
<tr><td>Total</td><td>100%</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Student requirements</td><td>The student should have a computer and internet connection.</td></tr>
<tr><td>Course policies</td><td>A- Attendance policies:
• Attendance is required. Class attendance will be taken every class and the university polices will be enforced in this regard.
B- Absences from exams and not submitting assignments on time:
• A makeup exam for finals only can be arranged for students with acceptable absence causes.
• Assignments submitted late, but before announcing or discussing, the solution can be accepted with 25% penalty.
• The project report must be handed in time.
C- Health and safety procedures:
• All health and safety procedures of the university and the school should be followed.
D- Honesty policy regarding cheating, plagiarism, misbehavior:
• All submitted work must be of the submitting student.
• Other text or code must be properly quoted with clear source specification.
• Cheating will not be tolerated.
E- Available university services that support achievement in the course:
• Microsoft Teams team and Moodle course page
• Computer labs are available for practicing the practical aspects and solving the programming assignments.
• Program announcements Facebook group</td></tr>
<tr><td>Additional information</td><td>None</td></tr>
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Appendix

Learning Outcomes for the BSc in Computer Engineering

Students who successfully complete the BSc in Computer Engineering will be have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3. An ability to communicate effectively with a range of audiences.

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.