DeCAIR Course Syllabus Form

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Organization Name(s)	The University of Jordan		
WP 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		
WP Leader	Francesco Masulli, University of Genoa		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	8/11/2021	Musa Al-Yaman	Original (base) document	C	1-5
2	Dec 19, 2021	Mohammad Mashagbeh	Original (base) document	U	1-5
3					
4					

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

Disclaimer

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Course title	Industrial and Applied Robotics
Course number	0908722
Credit hours (lecture and lab)	3 (3 + 0)
ECTS (weekly contact and self-study load)	6 (3 + 3)
Prerequisites/co-requisites	0908721 (Introductory Robotics: Sensing, Controlling and Actuating)
Prerequisites by topic	Students are assumed to have good background in sensors types and principle of operation, different actuator types, basic control theory. Additionally, the students should have good programming skills, preferably, using Matlab and Python.
Level and type (compulsory, elective)	Masters' elective course
Year of study and semester	Second year, first semester
Description	Introduction to robotic manipulator arms; types of joints; number of degrees of freedom; the concept of a workspace; review of forward, inverse, and differential kinematics; dynamics; trajectory generation, motion control systems, actuators and drive systems, sensors, simulation of robotic manipulator arms using robotics toolbox; examination of real robots from commercial companies; applications in the industry (e.g., palletizing, welding, spraying, and picking fruits). Term project.
Objectives	1. Introduce students to basic manipulator robot concepts. 2. Introduce students to the forward, inverse, and differential kinematics for manipulator arms. 3. Introduce students to the programming techniques and toolboxes used in robotic manipulator simulation. 4. Enable the students to gain practical skills in practicing a wide range of robotic manipulator arms using lab facilities.
Intended learning outcomes	Upon successful completion of this course, students will be able to:

No	Intended learning Outcome (ILO)	Program learning outcome (PLO)*
1	Demonstrate a sound understanding of the main concepts and components of industrial manipulators.	1
2	Formulate solutions to solve problems related to robot kinematics, dynamics, and trajectory and motion control.	2
3	Classify sensors and drive systems used in robotics.	3
4	Apply the knowledge learned for the design and development of simple robotic systems.	4
5	Use MATLAB and its specialized toolboxes to develop simulations for different robotic manipulator arms.	5

<table>
<tr><td></td><td>(*) The PLOs are listed in the appendix</td></tr>
<tr><td>Teaching and learning methods</td><td>Development of ILOs is promoted through the following teaching and learning methods:
Lectures will be delivered in person and through Microsoft Teams and will be recorded for later access.
The robotics lab is open for the students to practice the practical aspects and solve the 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 assignments in robotics field.
Student will carry out a term project in groups. Deliverables includes a professional report and a presentation for the project in class towards end of the semester.</td></tr>
<tr><td>Learning material</td><td>Textbook, class handouts, some instructor keynotes, selected YouTube videos, and access to a personal computer and the internet.</td></tr>
<tr><td>Resources and references</td><td>A- Required book(s), assigned reading and audio-visuals:
B. Siciliano et. al., Robotics – Modeling, Planning and Control, Springer, 2009.
Introduction to Robotics: Mechanics and Control by John J. Craig. 2th Edition. Prentice Hall.
Introduction to Robotics: Analysis, Control, Applications, 3rd Edition by Saeed B. Niku.
Robot Modeling and Control: 1st Edition by Mark W. Spong, Seth Andrew Hutchinson, M. Vidyasagar.</td></tr>
<tr><td>Topic outline and schedule</td><td>
<table>
<tr><th>Week</th><th>Topic</th><th>ILO</th><th>Resources</th></tr>
<tr><td>1</td><td>Robotic system components</td><td>1</td><td>1, 2</td></tr>
<tr><td>2</td><td>Manipulator configurations and homogenous transformation</td><td>1</td><td>1,2</td></tr>
<tr><td>3-4</td><td>Forward and inverse kinematics review</td><td>1, 2</td><td>1,4</td></tr>
<tr><td>5-6</td><td>Differential motion</td><td>1, 2</td><td>1,4</td></tr>
<tr><td>7</td><td>Robot dynamics</td><td>1, 2</td><td>1,4</td></tr>
<tr><td>8</td><td>Trajectory generation</td><td>1,2</td><td>1,3</td></tr>
<tr><td>9</td><td>Motion control</td><td>1, 2</td><td>1,3</td></tr>
<tr><td>10-11</td><td>Sensors and drive systems</td><td>3</td><td>1,3</td></tr>
<tr><td>12</td><td>Manipulator design</td><td>1-4</td><td>1-4</td></tr>
<tr><td>13-14</td><td>Robot programming</td><td>1-5</td><td>1-4</td></tr>
<tr><td>15</td><td>Term Project Presentations</td><td>1-5</td><td>1-4</td></tr>
</table>
</td></tr>
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<table>
<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>10%</td><td>Programming aspects</td><td>W2-W14</td></tr>
<tr><td>Midterm exam</td><td>30%</td><td>Robotic System Components through trajectory generation</td><td>W8</td></tr>
<tr><td>Term project report and presentation</td><td>20%</td><td>Practical and presentation aspects</td><td>W15</td></tr>
<tr><td>Final exam</td><td>40%</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 submitting assignments on time:
A makeup exam 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 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:
Open-book exams
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
Robotics Lab for practicing the practical aspects and solving the 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 MSc in Artificial Intelligence and Robotics

Students who successfully complete the MSc in Artificial Intelligence and Robotics (AIR) will be able to:

1. Demonstrate a sound understanding of the main areas of AIR including artificial neural networks, machine learning, data science, industrial and service robots, and intelligent and autonomous robots.

2. Apply a critical understanding of essential concepts, principles and practices of AIR, and critically evaluate tools, techniques and results using structured arguments based on subject knowledge.

3. Apply the methods and techniques of the AIR fields in the design, analysis and deployment of AIR solutions and solving practical problems.

4. Demonstrate the ability to produce a substantial piece of research work from problem inception to implementation, documentation and presentation.

5. Demonstrate life-long learning, independent self-learning and continuous professional development skills in the AIR fields.

6. Demonstrate a sound understanding of the ethical, safety and social impact issues of AIR solutions and products.