DeCAIR Course Syllabus Form

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Organization Name(s)	Lebanese University		
WP Number & Title	Work Package 6: Improving curricula of current BSc programs in JO and LB		
Activity Number & Title	Activity 6.1: Developing syllabi and content for added/modified courses in existing bachelor programs in universities of partner countries.		
WP Leader	Jorge Casillas, UGR		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	20/9/2021	Clovis Francis and Hassan Shraim	Updated Syllabus of BE courses in Electrical Eng'g	U	1-6
2	22/10/2021	Clovis Francis and Hassan Shraim	Version 2	U	
3	15/11/2021	Clovis Francis and Hassan Shraim	Version3	U	
4	8/02/2022	Clovis Francis and Hassan Shraim	Version 4	U	

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

Disclaimer

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<table>
<tr><td>Course title</td><td>Robotics</td></tr>
<tr><td>Course number</td><td>ELEC529</td></tr>
<tr><td>Credit hours (lecture and lab)</td><td>3</td></tr>
<tr><td>ECTS (weekly contact and self-study load)</td><td>3 (3 contact hours per week)</td></tr>
<tr><td>Prerequisites/co-requisites</td><td>Linear Control: continuous and discrete</td></tr>
<tr><td>Prerequisites by topic</td><td>Students are assumed to have good background in Linear continuous and discrete control techniques. Additionally, the students should have good programming skills, preferably, using Python, MatLab and ROS.</td></tr>
<tr><td>Level and type (compulsory, elective)</td><td>BE compulsory course</td></tr>
<tr><td>Year of study and semester</td><td>Fifth year, first semester</td></tr>
<tr><td>Description</td><td>This BE course concentrates on the modelling and design of mobile robots. The course concentrates on the mobile robots control and path planning.</td></tr>
<tr><td>Objectives</td><td>1. Introduce students to the different types of robots
2. Introduce students to the methods and techniques for robots modelling
3. Introduce students to modern control techniques applied to robots.
4. Develop a robots complete perception system</td></tr>
<tr><td>Intended learning outcomes</td><td>Upon successful completion of this course, students will be able to:
<table>
<tr><th>No</th><th>Intended learning Outcome (ILO)</th><th>Program learning outcome (PLO)*</th></tr>
<tr><td>1</td><td>Demonstrate a sound understanding of the main techniques for robots modelling</td><td>1</td></tr>
<tr><td>2</td><td>Develop an appropriate perception and sensing system for mobile robots</td><td>3</td></tr>
<tr><td>3</td><td>Communicate the development of modern control techniques applied to robots system through a detailed technical report and a short presentation.</td><td>4</td></tr>
<tr><td>4</td><td>Use Python and MatLab and their specialized libraries to develop programs for solving robots control problems.</td><td>3</td></tr>
</table>
(*) 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 through Microsoft Teams and will be recorded for later access. Lectures could be delivered also in class depending on the local situation.</td></tr>
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The Robotics 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 system design.
The student carries out a term project for solving a problem using data acquisition techniques.
The student develops a professional report for the term report.
The student presents the term project in class.

</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>Recommended book(s), material and media:

1. Introduction to Robotics: Mechanics and Control, John Craig

2. B. Siciliano et. al., Robotics – Modeling, Planning and Control, Springer</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>General overview on robots : History, technology, geometry, industrial classification</td><td>1</td><td>1,2</td></tr>
<tr><td>2</td><td>Actuators for robots: electrical, hydraulic and pneumatic</td><td>1</td><td>1,2</td></tr>
<tr><td>3</td><td>Actuators for robots: electrical, hydraulic and pneumatic</td><td>1</td><td>1,2</td></tr>
<tr><td>4</td><td>Kinematics sensors for robots</td><td>1, 2, 4</td><td>1,2</td></tr>
<tr><td>5</td><td>Kinematic modelling: direct methods</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>6</td><td>Kinematic modelling: inverse methods</td><td>1</td><td>1,2</td></tr>
<tr><td>7</td><td>Kinematic modelling: incremental methods</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>8</td><td>Dynamic modelling of robots: derivation of equations of motion with Euler Lagrange theory</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>9</td><td>Programming of robots: MATLAB Simulink and ROS environments</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>10</td><td>Off Line programming and path planning</td><td>1</td><td>1,2</td></tr>
<tr><td>11</td><td>Path planning and trajectory tracking: e.g. feedforward control</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>12</td><td>AI techniques for robots control</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>13</td><td>Control by feedback from images</td><td>1, 2</td><td>1,2</td></tr>
<tr><td>14</td><td>Verification and correction of a planned scenario with an infographic simulator</td><td>1, 2</td><td>1,2</td></tr>
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<tr><td>15</td><td>Case study: simulation in ROS environment.</td><td>3, 4</td><td>1,2</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>10%</td><td>Robots modelling and control aspects</td><td>W2-W14</td></tr>
<tr><td>Midterm exam</td><td>30%</td><td>Robots modelling</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 for students and Instructors</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
AI Lab for practicing the practical aspects and solving the programming assignments.
Program announcements Facebook group
F- Faculty member’s obligations are provided by the University Bylaws:</td></tr>
</table>

	• Office hours (4 hours per week) are dedicated to the students support and must be announced on the Faculty member's office door • Continuous support to the students within their projects and activities related to the course
Additional information	None

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.