DeCAIR Course Syllabus Form

Author(s)	Clovis Francis and Hassan Shraim		
Organization Name(s)	Lebanese University		
WP Number & Title	Work Package 5: Improving Existing M.Sc. Programs in Jordan and Lebanon by Implementing or Including AI and Robotics Courses		
Activity Number & Title	Task 5.1: Developing syllabi and content for added/modified courses in existing master programs in universities of partner countries		
WP Leader	Peter Eberhard, University of Stuttgart		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	1/8/2021	Clovis Francis	Master RSI Updated Courses Syllabus	C	1-6
2	22/10/2021	Clovis Francis	Version 2	C	
3	15/11/2021	~~Clovis Francis~~	Version 3	C	
4	8/02/2022	~~Clovis Francis~~	Version 4	C	

(*) 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	Advanced Robotics and Motion Planning
Course number	RSI04
Credit hours (lecture and lab)	
ECTS (weekly contact and self-study load)	4 (a total of 24 contact hours)
Prerequisites/co-requisites	Automatic Control, Robotics
Prerequisites by topic	Students are assumed to have good background in kinematics and dynamics modelling of Robots. Students should have basic knowledge in control of robotic manipulators. Additionally, the students should have good programming skills, preferably, using Matlab Simulink and Python.
Level and type (compulsory, elective)	Masters' compulsory course
Year of study and semester	Year 2, first semester
Description	After having presented the fundamental notions of the mathematical modeling, forward and inverse kinematics, sensors and actuators of robotic systems, this course presents the concepts of mobile robot's trajectory path planning. This course presents also the different control strategies used in the field of Robotics. Articulated robots and telerobotic concepts will be introduced as new trends in the robotic field.
Objectives	1. Introduce students to the techniques used in mobile robot's trajectory path planning 2. Introduce students to the techniques to control mobile robots. 3. Introduce students to reading and analyzing of scientific papers in the field of robotics.
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 areas of AIR including industrial and service robots, and intelligent autonomous robots	1
2	Solve an AIR problem by developing an appropriate Control system.	3
3	Communicate the development of a Control system through a detailed technical report and a short presentation.	4

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<tr><td></td><td>
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<tr><td>4</td><td>Use Matlab and its specialized libraries to develop programs for solving control problems in the robotics field</td><td>3</td></tr>
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(*) 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/ZOOM and will be recorded for later access. If the local circumstances allow, lectures could be in class also.
• The Control 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 carries out a term project for solving a problem using identification and control 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. Lecture notes prepared by the Instructor
2. Hassan Khalil, Nonlinear Systems, 3rd Edition, Prentice Hall, 2001.
3. Motion and Operation Planning of Robotic Systems, Guiscepe Carbone and Fernando Gomez-Bravo</td></tr>
<tr><td>Topic outline and schedule</td><td>
<table>
<tr><th>Lecture</th><th>Topic</th><th>Hours</th><th>ILO</th><th>Resources</th></tr>
<tr><td>1</td><td>Generalities on the Mathematical modeling, Forward and inverse kinematics, System Modeling applied to robotics</td><td>2</td><td>1</td><td>1,3</td></tr>
<tr><td>2</td><td>Instrumentations for robotics: sensors, actuators, processor, cameras.</td><td>2</td><td>2,3</td><td>1</td></tr>
<tr><td>3</td><td>Introduction to Path Planning, Notation and Terminology</td><td>2</td><td>2,3</td><td>1,3</td></tr>
<tr><td>4</td><td>Different approaches for motion planning algorithms: Roadmap based method</td><td>3</td><td>2,3</td><td>1,3</td></tr>
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</td></tr>
</table>

	5	Different approaches for motion planning algorithms: Discretization into grid based	3	2,3	1,3
	6	Different approaches for motion planning algorithms: Randomized sampling-based methods	2	2,3	1,3
	6	Control strategies used in the field of mobile Robotics.	3	2,3	1,2,3
	7	Control strategies used in the field of Robotics.	3	2,3	1,2,3
	8	Assembling and control of an articulated robots	2	2,3	1
	9	Telerobotic	2	2,3	1
	10	Applications and case studies	2	4,5	1

Evaluation tools

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment tools:

Assessment tool	Mark	Topic(s)	Time
Term project report and presentation	100%	Modelling and control of mobile robots	W12
Total	**100%**		

Student requirements

The student should have a computer and internet connection.

Course policies for students and Instructors

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 • Control Lab for practicing the practical aspects and solving the programming assignments. - Faculty member's obligations are provided by the University Bylaws: • 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.