DeCAIR Course Syllabus Form

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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		
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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	Robotic Systems
Course number	0908721
Credit hours (lecture and lab)	3 (3 + 0)
ECTS (weekly contact and self-study load)	6 (3 + 3)
Prerequisites/co-requisites	-
Prerequisites by topic	Students are assumed to have sufficient knowledge pertaining to the following: Numerical methods, Linear Algebra, Systems dynamics, Machinery and Matlab computer language.
Level and type (compulsory, elective)	Masters' obligatory course
Year of study and semester	First year, 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. Learn the fundamental concepts of robotics manipulation such as transformation mathematics in 3D space, forward kinematics, inverse kinematics, Jacobian and singularities, manipulator dynamics, and trajectory planning. 2. Use computer languages such as MATLAB to solve course topics in a generalized procedure using symbolic manipulation and numerical techniques. 3. Introduce students to the techniques used in mobile robot's trajectory path planning 4. Introduce students to the techniques to control mobile robots. 5. 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 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

	<table><tr><td>4</td><td>Apply the knowledge learned for the design and development of simple robotic systems.</td><td>4</td></tr><tr><td>5</td><td>Use MATLAB and its specialized toolboxes to develop simulations for different robotic manipulator arms.</td><td>5</td></tr></table> (*) 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 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.
Learning material	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. 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 4. B. Siciliano et. al., Robotics – Modeling, Planning and Control, Springer, 2009. 5. Introduction to Robotics: Mechanics and Control by John J. Craig. 2th Edition. Prentice Hall. 6. Introduction to Robotics: Analysis, Control, Applications, 3rd Edition by Saeed B. Niku. 7. Robot Modeling and Control: 1st Edition by Mark W. Spong, Seth Andrew Hutchinson, M. Vidyasagar.
Topic outline and schedule	<table><tr><th>Week</th><th>Topic</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></tr><tr><td>2-3</td><td>Instrumentations for robotics: sensors, actuators, processor, cameras.</td><td>2</td><td>2,3</td></tr></table>

	4	Introduction to Path Planning, Notation and Terminology	2	2,3
	5	Different approaches for motion planning algorithms: Roadmap based method	3	2,3
	6	Different approaches for motion planning algorithms: Discretization into grid based	3	2,3
	7	Different approaches for motion planning algorithms: Randomized sampling-based methods	2	2,3
	8	Control strategies used in the field of mobile Robotics.	3	2,3
	9	Control strategies used in the field of Robotics.	3	2,3
	10	Assembling and control of an articulated robots	2	2,3
	11-12	Telerobotic	2	2,3
	13-14	Applications and case studies	2	4,5

Evaluation tools

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

Assessment tool	Mark	Topic(s)	Time
Homework assignments	10%	Programming aspects	W2-W14
Midterm exam	30%	Robotic System Components through trajectory generation	W8
Term project report and presentation	20%	Practical and presentation aspects	W15
Final exam	40%	All material	W16
Total	**100%**		

Student requirements

The student should have a computer and internet connection.

Course policies

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
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.