DeCAIR Course Syllabus Form

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Organization Name(s)	The University of Jordan		
WP Number & Title	Work Package 6: Improving Existing B.Sc. Programs in Jordan and Lebanon by Implementing or Including AI and Robotics Courses		
Activity Number & Title	Task 6.1: Developing syllabi and content for added/modified courses in existing BSc programs in universities of partner countries		
WP Leader	Jorge Casillas, University of Granada		
Due Date of Delivery	30/10/2020	Project Month	M10
Submission Date	8/11/2021	Project Month	M11

Revision History

Version	Date	Author	Description	Action *	Page(s)
1	8/11/2021	Adham Alsharkawi	Original (base) document	C	1-5
2	18/12/2021	Adham Alsharkawi	Original (base) document	U	1-5
3					
4					

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

Disclaimer

This project has been co-funded by the Erasmus+ Programme of the European Union.

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<table>
<tr><td>Course title</td><td>Intelligent Control</td></tr>
<tr><td>Course number</td><td>0908485</td></tr>
<tr><td>Credit hours (lecture and lab)</td><td>3 (3 + 0)</td></tr>
<tr><td>ECTS (weekly contact and self-study load)</td><td>6 (3 + 3)</td></tr>
<tr><td>Prerequisites/co-requisites</td><td>0908483 (Digital Control)</td></tr>
<tr><td>Prerequisites by topic</td><td>Basics of analog and digital control</td></tr>
<tr><td>Level and type (compulsory, elective)</td><td>BSc obligatory course</td></tr>
<tr><td>Year of study and semester</td><td>Fourth year, second semester</td></tr>
<tr><td>Description</td><td>This course focuses on various approaches based on different soft computing techniques to modeling of nonlinear systems, optimization, and control of various engineering problems.</td></tr>
<tr><td>Objectives</td><td>1. To expose the students to intelligent systems.
2. To provide adequate knowledge about modeling of nonlinear systems.
3. To provide adequate knowledge about fuzzy inverse model development.
4. To provide comprehensive knowledge about neural and fuzzy control.
5. To provide adequate knowledge of intelligent control of SISO nonlinear systems.</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>Acquire the basic knowledge of soft computing.</td><td>1</td></tr>
<tr><td>2</td><td>Develop a nonlinear model using a neural network, fuzzy, and neuro-fuzzy scheme</td><td>2</td></tr>
<tr><td>3</td><td>Design stable, intelligent controllers</td><td>3</td></tr>
<tr><td>4</td><td>Assess the stability of an intelligent controller</td><td>4</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 face to face and through Microsoft Teams and will be recorded for later access.
• The control lab is open for the students to practice the practical aspects.
• The student attends the class presentations and participates in the discussions.
• The student joins the related online team/group and participates in its discussions.</td></tr>
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- The student studies the reference material, including books and videos.
- The student solves the control assignments using appropriate tools.
- The student carries out a term project for solving a control problem.
- 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>

A- Required book(s), assigned reading and audio-visuals:

1. Y. Sin and C. Xu. *Intelligent Systems: Modeling, Optimization, and Control*. 1st Edition. 2008.

B- Recommended book(s), material and media:

1. J-S. R. Jang, C-T. Sun, and E. Mizutani. *Neuro-Fuzzy and Soft Computing*. 1st Edition. 1997.

</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>1-2</td><td>Intelligent Systems</td><td>1</td><td>A-1, B-1</td></tr>
<tr><td></td><td>Introduction</td><td></td><td></td></tr>
<tr><td></td><td>Introduction of Soft Computing Techniques</td><td></td><td></td></tr>
<tr><td>3-5</td><td>Modeling of Nonlinear Systems: Fuzzy Logic, Neural Networks, and Neuro-Fuzzy Systems</td><td>2</td><td>A-1, B-1</td></tr>
<tr><td></td><td>Fuzzy Systems</td><td></td><td></td></tr>
<tr><td></td><td>Artificial Neural Networks</td><td></td><td></td></tr>
<tr><td></td><td>Neuro-Fuzzy Systems</td><td></td><td></td></tr>
<tr><td></td><td>Modeling of Dynamic Systems</td><td></td><td></td></tr>
<tr><td>6-7</td><td>Fuzzy Inverse Model Development</td><td>2</td><td>A-1</td></tr>
<tr><td></td><td>Fuzzy Inverse Model Development</td><td></td><td></td></tr>
<tr><td></td><td>Simulation Examples</td><td></td><td></td></tr>
<tr><td>8-10</td><td>Neural Control</td><td>3</td><td>A-1</td></tr>
<tr><td></td><td>Supervised Control</td><td></td><td></td></tr>
<tr><td></td><td>Direct Inverse Control</td><td></td><td></td></tr>
<tr><td>11-13</td><td>Fuzzy Control</td><td>3</td><td>A-1</td></tr>
<tr><td></td><td>Knowledge-Based Fuzzy Control</td><td></td><td></td></tr>
<tr><td></td><td>Model –Based Fuzzy Control</td><td></td><td></td></tr>
<tr><td>14-15</td><td>Intelligent Control for SISO Nonlinear Systems</td><td>4</td><td>A-1</td></tr>
<tr><td></td><td>Fuzzy Control System Design</td><td></td><td></td></tr>
<tr><td></td><td>Stability Analysis</td><td></td><td></td></tr>
<tr><td></td><td>Simulation and Implementation</td><td></td><td></td></tr>
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<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>Assignments</td><td>5%</td><td>Stability Analysis Method</td><td>W14</td></tr>
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<tr><td>Midterm exam</td><td>30%</td><td>Intelligent Systems, Modeling of Nonlinear Systems: Fuzzy Logic, Neural Networks, and Neuro-Fuzzy Systems, Fuzzy Inverse Model Development</td><td>W8</td></tr>
<tr><td>Term project report and presentation</td><td>15%</td><td>Neural Control, Fuzzy Control</td><td>W15</td></tr>
<tr><td>Final exam</td><td>50%</td><td>All Topics</td><td>W16</td></tr>
<tr><td>Total</td><td>100%</td><td></td><td></td></tr>
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</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
AI Lab 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 Mechatronics Engineering

Students who successfully complete the BSc in Mechatronics Engineering will be able to:

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.