DeCAIR Course Syllabus Form

Author(s)	Murad Alaqtash		
Author Organization Name(s)	Tafila Technical University		
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Activity Number & Title	Activity 2.2: Designing and developing syllabi and content for the agreed upon courses in the new programs		
Work Package Leader	Francesco Masulli, University of Genoa		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	27/11/2021	Murad Alaqtash	Original (base) document	C	1-6
2	10/12/2021	Murad Alaqtash	Revised version	U	2-4
3	16/01/2022	Murad Alaqtash	Revised based on a peer review	U	2-4
4	2/2/2022	Murad Alaqtash	Revised based on a expert review	U	2-4

(*) 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	Computational Intelligence
Course number	0112545
Credit hours (lecture and lab)	3 (3 + 0)
ECTS (weekly contact and self-study load)	6 (3 + 3)
Prerequisites/co-requisites by course number and name	Mathematical Foundation of Computing (0107313) (Discrete Math)
Prerequisites by topic (other than the formal prerequisites above)	Students should have good programming skills, preferably, using Python.
Level and type (compulsory, elective)	Elective
Year of study and semester	4th year, 1st or 2nd semester
Catalogue description	The course presents the fundamentals and applications of computational intelligence. It emphasizes on CI techniques such as fuzzy logic, evolutionary computing and swarm intelligence. Moreover, it explores the applications of CI techniques such as intelligent control, nonlinear system modeling, decision-support systems, optimization, and autonomous robotics. It is a project-based course comprises the implementation of CI techniques to solve a real-world problem.
Objectives	1. Describe in-depth about theories, methods, and algorithms in computation Intelligence. 2. Compare and contrast traditional algorithms with nature-inspired algorithms. 3. Examine the nature of a problem at hand and determine whether a computation intelligent technique/algorithm can solve it efficiently enough. 4. Design and implement Computation Intelligence algorithms and approaches for solving real-world problems.
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 techniques and algorithms in computational intelligence.	1
2	Solve real-world problems using computational intelligence techniques.	1, 2

	3 | Communicate the development of a solution using computational intelligence through a detailed technical report and a short presentation. | 3 4 | Use appropriate and common computational tools and libraries for computational intelligence. | 6, 7 (*) The PLOs are listed in the appendix
Teaching and learning methods	Development of ILOs is promoted through the following teaching and learning methods: • The student attends the class and participates in the discussions. • The student joins the related online team/group and participates in the discussions. • The student studies the reference material. • The student solves the programming assignments and homework. • The student carries out a term project for solving a real-world problem using CI techniques. • The student develops a professional report for the term report. • The student presents the term project in class. • The AI lab is open for the students to practice the practical aspects and solve the programming homework assignments.
Learning material type	Textbook, class handouts, some instructor keynotes, and access to a personal computer and the internet.
Resources and references	A- Required book(s): 1. Andries P. Engelbrecht, **Computational Intelligence: An Introduction**, 2nd edition, John Wiley & Sons, 2007. 2. Timothy J. Ross, **Fuzzy Logic with Engineering Applications**, 4th edition, Wiley, 2016. B- Recommended book(s), material and media: 3. Christian Blum and Daniel Merkle, Swarm Intelligence: Introduction and Applications, Springer, 2008. 4. S.N. Sivanandam and S.N. Deepa, Principles of Soft Computing, 3rd Edition, Wiley, 2018. 5. S. Sumathi and S. Paneerselvam, Computational Intelligence Paradigms: Theory & Applications using MATLAB, 1st Edition, CRC Press, 2010. 6. M. Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition Pearson/Addison Wesley, 2011.
Topic outline and schedule	**Week** | **Topic** | **ILO** | **Resources** 1 | **Introduction to Computational Intelligence** | 1 | 1 2-6 | **Fuzzy Logic** • Fuzzy Sets • Fuzzy Relations | 1,2,4 | 2

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>• Membership Functions
• Fuzzification and Defuzzification
• Fuzzy Systems
• Applications of Fuzzy Systems</td><td></td><td></td></tr>
<tr><td>7-11</td><td>Evolutionary Computation
• Introduction to Evolutionary Computation
• Genetic Algorithm
• Genetic Programming
• Evolutionary Programming
• Evolution Strategies
• Applications of Evolutionary Computation</td><td>1,2,4</td><td>1,4</td></tr>
<tr><td>12-14</td><td>Swarm Intelligence
• Particle Swarm Optimization
• Ant Colony Optimization
• Applications of Swarm Intelligence</td><td>1,2,4</td><td>1,3</td></tr>
<tr><td>15</td><td>Term project presentations</td><td>2,4</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>Homework assignments</td><td>20%</td><td>All topics</td><td>W2-W14</td></tr>
<tr><td>Midterm exam</td><td>20%</td><td>Introduction and Fuzzy Logic</td><td>W8</td></tr>
<tr><td>Term project</td><td>20%</td><td>Practical real-world problem</td><td>W15</td></tr>
<tr><td>Final exam</td><td>40%</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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<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 not 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:</td></tr>
</table>

	• 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 and Moodle course page • AI Lab for practicing the practical aspects and solving the programming assignments. • Emails for communications
Additional information	None

Appendix

Learning Outcomes for the BSc in Computer Engineering

Students who successfully complete the BSc in Computer Engineering will be have:

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.