Philadelphia University

Faculty of Engineering - Department of Mechatronics Engineering

First Semester 2020/2021

Course Details:

Title:	**Machine Intelligence** (0640424)
Course Type:	Compulsory
Class Time:	11:15 – 12:45 Monday/Wednesday
Prerequisite:	Automatic Control Systems
Credit Hours:	Three credit hours (15 weeks per semester, approximately 44 contact hours)
Textbook:	"Computational Intelligence: Synergies of Fuzzy Logic, Neural Networks, and Evolutionary Computing" by N. Siddique and H. Adeli. Wiley Publication 2013
Course Description:	This course introduces the student to intelligent control theory. The course material is divided in two main parts: Artificial Neural Networks and Fuzzy Logic Control techniques. Emphasize is provided for intelligent control applications of mechatronic systems.
Website:	www.philadelphia.edu.jo/academics/amahasneh
Instructor:	**Dr. Ahmad Jobran Al-Mahasneh** Email: amahasneh@philadelphia.edu.jo Office: Engineering building, room E06406 Office hours: Sun, Tus, and Thu: 10:00-11:00. Mon and Wed 10:15-11:15.

Course Learning Outcomes:

Upon successful completion of this course, the student should be able to:

	Course Learning Outcomes	ABET L.O.	Taxonomy
1.	Recognize the difference between classical and intelligent control.	1	Knowledge and Understanding
2.	Know the basics of machine intelligence.	1	
3.	Understand the theory and mathematical models of fuzzy systems and neural networks	1	
4.	Derive mathematical equations for fuzzy and neural network systems.	1	Thinking and Analysis
5.	Apply solutions to mathematical problems as they relate to intelligent systems.	6	
6.	Analyze control problems and develop solutions using intelligent algorithms.	6	
7.	Design intelligent controllers for mechatronic plants	2	
8.	Apply MATLAB, Simulink, Fuzzy toolbox, and Neural Network toolbox.	2, 7	Practical and Specific Skills
9.	Simulate intelligent controller designs and analyze the results.	1, 6	
10.	Work in teams and write homework reports	3, 5	Communication Skills

Week	Subject
1	**Introduction to Artificial Intelligence:** Definition, History, and Applications
2	**Part I Neural Networks** Perceptron; Activation Functions; XOR Problem
3	Feed-Forward Architecture: Single and Multi-Layers Radial Basis Function Network Probabilistic Network
4	Learning Algorithms: Gradient Descent / Delta-Rule
5	Learning Algorithms: Backpropagation
6	Unsupervised Learning: Classification and Competitive Network
7	Recurrent Neural Networks: Hopefield Network; Jordan Network **Mid EXAM**
8	Neural Network Application: System Identification and Control
9	Introduction to Deep Learning
10	**Part II Fuzzy Logic** Fuzzy Logic; Fuzzy Sets; Membership Functions; Fuzzy Operations
11	Fuzzy If-Then Rules; Fuzzification; Defuzzification
12	Inference Mechanism: Mamdani and Sugeno
13	Fuzzy Modeling
14	Fuzzy Control; Design of Fuzzy Controllers
15	Review **FINAL EXAM**

Assessment Guidance: Evaluation of the student performance will be based on the following:

Exams. One in-class exam will be given. It will cover the first 7 weeks of lectures**.**
Quizzes. Two 10-minute quizzes will be given to the students throughout the semester. The quizzes will be used as bonus points to help the students with their grade.
Homework. Students are expected to program learning algorithms for Neural Network structures, simulate the models, analyze the results, and write a technical report.
Final Exam. The final exam will cover all the class material.

Grading policy:

Mid Exam	30%
Quizzes, homework and participation.	20%
Final Exam	50%
Total	100%

References:

1. Neural Network and Deep Leaning by Charu Aggarwal. Springer 2018
2. Intelligent Controller Systems using Soft Computing Methodologies. Edited by Ali Zilouchin and Mo Jamshidi. CRC Press 2001
3. A First Course in Fuzzy and Neural Control by Nguyen, Prasad, Walker, and Walker. CRC 2003
4. Neural Networks and Learning Machine by Simon Haykin 3rd Edition. Pearson 2009
5. Data-Driven Science and Engineering: Machine Learning, Synamic Systems, and Control by Brunton and Kutz. Campridge University Press. 2019
6. MATLAB Fuzzy Logic Toolbox: user's guide
7. MATLAB Neural Network Toolbox: user's guide.

Attendance policy:

Absence from classes and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse, acceptable to and approved by the Dean of the relevant college/faculty, shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

October,2020