Intelligent Systems and Control

Course Code:	46332
Course Type:	Theoretical
Credits:	3
Course Status:	Elective Specialized Course
Prerequisite:	Automatic Control (BSc.), Advance Control (MSc) or Supervisor Approval

Aim/Scope/Objectives: This course intends to give the required knowledge to MSc. & Ph.D. students for simulation, prediction, identification, control, and optimization of different complex nonlinear systems using intelligent systems. This course also covers training in python programming to implements the different projects.

Course Outline:

1- **Part one: Artificial Neural Networks**
   - 1-1- Comparison the learning methods in man and machine
   - 1-2- Pattern recognition
   - 1-3- Basic neuron
   - 1-4- Multi-Layered Perceptron (MLP)
   - 1-5- Recurrent Multilayer Perceptron (RMLP)
   - 1-6- Systems identification and modeling
   - 1-7- Intelligent control systems
     - 1-7-1- Classical intelligent controllers
     - 1-7-2- Emotional Learning Based Intelligent Controllers (ELIC)
   - 1-8- Deep Neural Networks (DNN)

2- **Part two: Nature Inspired Optimization Algorithms**
   - 2-1- Introduction to optimization
   - 2-2- Simulated Annealing (SA)
   - 2-3- Genetic Algorithms (GA)
     - 2-3-1- Binary genetic algorithms
     - 2-3-2- Continuous genetic algorithms
     - 2-3-3- Applications of genetic algorithms in engineering
   - 2-4- Ant Colony Optimization (ACO)
   - 2-5- Particle Swarm Optimization (PSO)

Grading: 40% Final exam, 20% Homework by Python, 40% Research Project

References:

- S. Haykin, "Neural Networks a Comprehensive Foundation", Prentice-Hall, 2009.
- I. Goodfellow, Y. Bengio, A. Courville “Deep Learning”, MIT press, 2016.
- Oliver Nelles, “Nonlinear System Identifications, from classical approach to neural networks, fuzzy models, and Gaussian process”, Springer, second edition, 2021.
- R. L. Haupt, S. E. Haupt, “Practical Genetic Algorithms”, John Wily & Sons, 2004.
- Andreas Antoniou, Wu-Sheng Lu, “Practical Optimization: Algorithms and Engineering Applications”, Springer, 2007
- IEEE papers about applications of intelligent systems in identification, control, and optimization of complex MIMO plants.