Intelligent Control

University of Kurdistan
Faculty of Engineering
Department of Power and Control Engineering

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• Course Description and Objectives

Intelligent Control presents the ways to design expert, smart, and intelligent controllers for dynamic systems. The course is designed for postgraduate students. Topics given in this course cover the most important issues in intelligent control systems. After successful completion of this course, the students will learn the fundamentals of intelligent control, relevant topics, as well as some methodologies for design intelligent controllers. They will be able to conduct new research in the relevant areas and will complete and present a research project in one of given main subjects in the contents.

• Topics Covered — Lecturer

Part I: Fundamentals

1. Course Description (*Baigzadeh-Bevrani*)
2. Fundamentals in Control Systems Theory (*Baigzadeh*)
3. An Introduction on Artificial Intelligence (*Bevrani*)
4. Intelligent Control Technologies (*Bevrani*)

Part II: Fuzzy Logic Systems

5. Concepts and Mathematics of Fuzzy Logic Systems (*Baigzadeh*)
6. Fuzzy Rules and Fuzzy Inference Systems (*Baigzadeh*)
7. Fuzzifications and Defuzzification Methods (*Baigzadeh*)
8. On Design of Fuzzy Logic Systems (*Baigzadeh*)
9. Fuzzy Control of Linear Systems (*Baigzadeh*)
10. Fuzzy Supervisory Control (*Baigzadeh*)
11. Design Example (*Baigzadeh*)

Part III: Artificial Neural Networks (ANNs)

12. An Introduction on ANNs: Concepts, Elements, Structures, and Developments (*Bevrani*)
13. ANN Training Algorithms (*Bevrani*)
14. Multilayer Perceptron and Backpropagation Learning (*Bevrani*)
15. ANN-based Optimization (*Bevrani*)
16. ANN-based Control Systems (*Bevrani*)
17. Design Example (*Bevrani*)

Part IV: Special Issues

18. Neuro-Fuzzy Systems (*Bevrani*)
19. Fuzzy Systems and ANNs as Approximators (*Baigzadeh*)
20. Takagi-Sugeno-Kang Fuzzy modeling (*Baigzadeh*)
21. Evolutionary Algorithms in Control Systems (*Bevrani*)

• Grading

- Homework: 20%
- Final Exam: 30%
- Course Project and Presentation: 50%

Homework/Short report (Assignments)

The course assignments will be performed along the semester.
Note: Students may discuss the problems with other students but are not allowed to share the solutions (MATLAB m-files, etc.).

• Course Project

The project is organized to be performed on three steps during term-time and includes many aspects of the courses. Each student must choose a benchmark plant based on his/her interest and implements taught control methods for the selected plant. Everyone should provide three detailed written reports with simulation files. At the end, the project report must be discussed in the class.

- **References**

[1] L.X. Wang, *A Course in Fuzzy Systems and Control*, Prentice-Hall, Upper Saddle River, NJ; 1996.
[2] K. M. Passino and S. Yurkovich, *Fuzzy control*, Addison Wesley Longman, Menlo Park, CA, 1998.
[3] H. Bevrani, and T. Hiyama, *Intelligent Automatic Generation Control*, CRC Press, USA, 2011.
[4] M. Fathi, and H. Bevrani, *Artificial Intelligence and Evolutionary Algorithms-based Optimization*, Chapter 7 in *Optimization in Electrical Engineering*, Switzerland, Springer, 2019.