Intelligent Control

Course Description

H. Bevrani and B. Baigzadeh

Fall 2023

Contents

Instructors

Hassan Bevrani
حسن بیورانی

Barmak Baigzadeh
برمک بیگ زاده

Hassan Bevrani

- PhD degree in electrical engineering from Osaka University, Osaka, Japan, in 2004
- Post-doctoral fellow, senior research fellow, visiting professor, and professor in several universities in Japan, Australia, France, and Germany
- Program leader of SMGRC at the University of Kurdistan.
- Fellow member of IEEE
- Research interest: smart grids and microgrids control; applications of robust and intelligent control techniques
- Author and coauthor of 9 international books and 15 book chapters
- Author and coauthor of over 450 papers

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Barmak Baigzadehnoe

- PhD degree in electrical engineering from Babol Noshirvani University of Technology , Iran, in 2018
- Lecturer in several universities such as Chabahar Maritime University, Babol Noshirvani University of Technology
- Research interest: large-scale systems; robotics; nonlinear and intelligent control techniques

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Education

- PhD. in Electrical Engineering, Control System , Babol Noshirvani University of Technology , Iran (2013 - 2018)
  Thesis title: Design of Decentralized Control Scheme for Networked Control Systems with Time Delays
- MSc. in Electrical Engineering, Control System , K.N. Toosi University of Technology , Iran (2004 - 2007)
  Thesis title: Solution of Finite Horizon Nonlinear Optimal Control Problem
- BSc. in Electrical Engineering, Control System , University of Tehran , Iran (1998 - 2004)
  Thesis title: Design and Construction of Calculator Using Microprocessor

Course Description

What Does it Cover?

- Some ways to design expert, smart, and intelligent controllers.
- Most important issues in intelligent control systems.

What will you learn?

- Fundamentals of intelligent control, relevant topics, as well as some methodologies for design intelligent controllers.
- Conduct new research in the relevant areas and present a research results.

Course Outline

Part I: Fundamentals

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

Course Outline

Part II: Fuzzy Logic Systems

1. **Concepts/Mathematics of Fuzzy Logic Systems** (Baigzadeh)
2. **Fuzzy Rules and Fuzzy Inference Systems** (Baigzadeh)
3. **Fuzzifications and Defuzzification Methods** (Baigzadeh)
4. **On Design of Fuzzy Logic Systems** (Baigzadeh)
5. **Fuzzy Control of Linear Systems** (Baigzadeh)
6. **Fuzzy Supervisory Control** (Baigzadeh)
7. **Design Example** (Baigzadeh)

Course Outline

Part III: Artificial Neural Network (ANN)

1. ANNs: Concepts, Structures, and Developments (Bevrani)

1. ANN Training Algorithms (Bevrani)

2. Multilayer Perceptron and Backpropagation Learning (Bevrani)

3. ANN-based Optimization (Bevrani)

4. ANN-based Control Systems (Bevrani)

5. Design Example (Bevrani)

Course Outline

Part IV: Special Issues

1. Neuro-Fuzzy Systems (Bevrani)

2. Fuzzy Systems and ANNs as Approximators (Baigzadeh)

3. Takagi-Sugeno-Kang Fuzzy modeling (Baigzadeh)

4. Evolutionary Algorithms in Control Systems (Bevrani)

Grading

1. **Attending/HWs** **20%**
2. **Final Exam** **30%**
3. **Project and Presentation** **50%**

Course Project

❖ **Select a dynamic system**;

1- Design an intelligent controller using a method learned in Part II **(Report 1)**;

2- Design an intelligent controller using a method learned in Part III **(Report 2)**;

3- Design an intelligent controller using a method learned in Part IV **(Report 3)**;

Course Project

4- Do a comparison study **(Report 4)**.

- **Final Presentation**
- Date:
- Time: 10 minutes

Course Objectives

1. **A deep knowledge on the main concepts, frameworks, and components of intelligent control,**
2. **Design a fuzzy logic-based controller for a given system by programing and simulation in MATLAB environment,**
3. **Design an ANN-based controller for a given system by programing and simulation in MATLAB environment,**
4. **Application of at least one method learned in Part IV for designing of a controller.**
5. **Making an enough strong background for self-learning of other approaches and tools in intelligent control area in a short time.**

Reference

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.

Contact e-mail for this Course

- **Please submit your homework and project reports only to the following email address:**

uok.aic@gmail.com

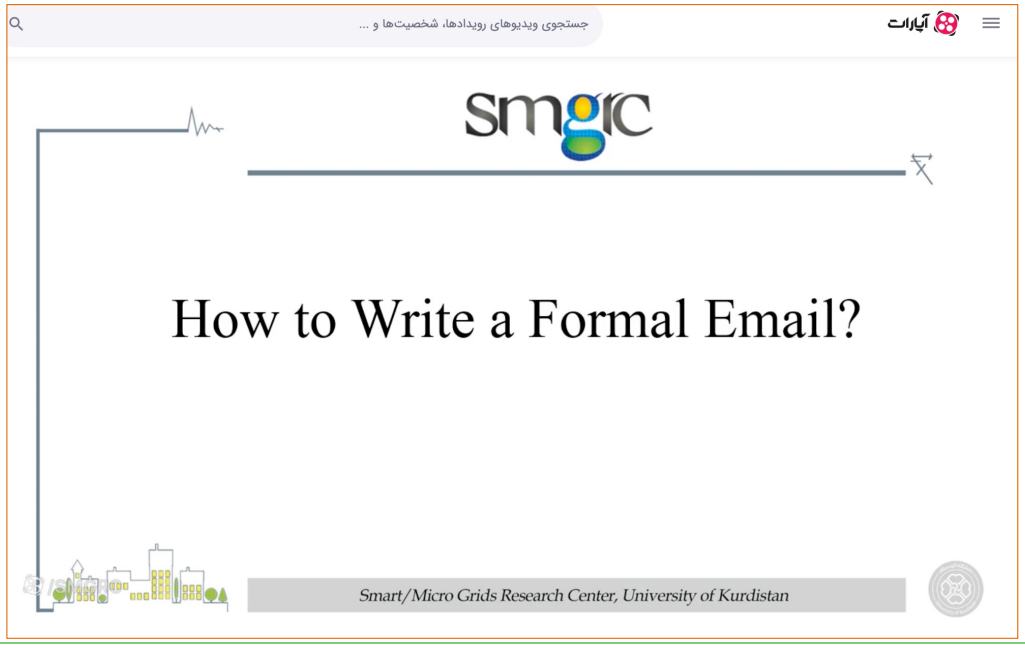
- Please use the following term as subject of your email:

  Family Name_IC_HW3 (for HWs)

  Family Name_IC_PR3 (for Project Sections)

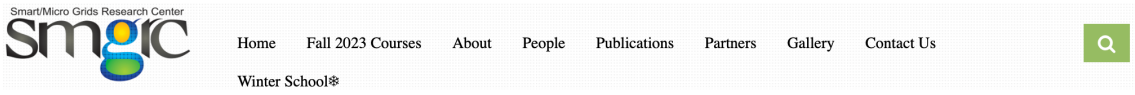
Writing a Formal Email

https://www.aparat.com/v/8iXW9



Course Website

https://smgrc.uok.ac.ir/intelligent-control-fall-2023-university-of-kurdistan/



Intelligent Control-Fall 2023 University of Kurdistan

Here, enrolled students can access relevant course materials via the provided links.
Explore and enhance your learning experience with the resources available.

Course ID: 7012291-01

Course Name: Intelligent Control
Academic Year: Fall 2023
Lecturer(s): Dr. Barmak Baigzadehnoe and Dr. Hassan Bevrani

PDF of the Lectures:

Num.	Lecture Name	Download Section
00	Sylabus and Description_Fall 2023	Click Here
01		Click Here
02		Click Here

Thank you!