SYLLABUS

1. **Course name:** Intelligent Control
2. **Course code:** INCO321546
3. **Credits:** 2 (2/0/4)
   Duration: 15 weeks (30h main course and 60h self-study)
4. **Instructors:**
   1- Nguyen Tran Minh Nguyet, MEng
   2- Tran Duc Thien, MEng
   3- Vu Van Phong, MEng
5. **Course conditions**
   Prerequisites: Automatic Control Systems
   Corequisites: N/A
6. **Course description**

This course provides students the fundamentals of neural network and fuzzy logic, include: neural network architectures and algorithms for training networks; fuzzy set, fuzzy logic. In addition, students will discuss neural networks and design fuzzy systems in the applications of identification, prediction and control.

7. **Course Goals**

Goals	***Goal description*** *(This course provides students :)*	**ELOs**
G1	Basic knowledge of neural networks and fuzzy systems.	01 (H)
G2	An ability to use textbooks, books, powerpoint slides and do homeworks and exams in English.	05 (L)
G3	An ability to use software for programming and simulating intelligent control systems.	03 (M)
G4	An ability to use tools and methods for solving problems related to intelligent control systems.	07 (H)
G5	An ability to calculate and design intelligent control systems	02 (M)

** Note: High: H; Medium: M; Low: L*

8. **Course Learning Outcomes (CLOs)**

CLOs		***Description*** *(After studying this course, the student will be able to :)*	**Outcome**
	G1.1	Apply the single layer and multi- layer perceptron	01 07
	G1.2	Apply the fuzzy logic systems.	01 07

G2	G2.1	Read the documents and lectures about neural networks and fuzzy systems in English.	05
	G3.1	Use Matlab for training neural networks	03
	G3.2	Use Matlab for simulation fuzzy systems	03
	G4.1	Design and calculate for training neural networks	02
	G4.2	Design and calculate for output of fuzzy systems	02

9. Study materials

- Textbooks:

[1] Huỳnh Thái Hoàng, *Hệ thống điều khiển thông minh*, NXB Đại học Quốc gia TP.Hồ Chí Minh, 2016

- References:

[2] Nguyễn Thị Phương Hà, *Lý thuyết điều khiển hiện đại*, NXB Đại học Quốc gia TP.Hồ Chí Minh, 2016

[3] Nguyễn Doãn Phước, Phan Xuân Minh, *Lý thuyết điều khiển mờ,* NXB Khoa học và kỹ thuật, 2006.

[4] Ali Jilouchian and Mo Jamshidi, *Intelligent Control Systems Using Soft Computing Methodologies,* CRC press, 2001.

10. Student Assessments

- Grading points: 10

- Planning for students assessment is followed:

Type	Contents	Linetime	Assessment techniques	CLOs	Rates (%)
Midterms					**50**
Exam01	Calculating for training one layer perceptron	Week 6	Quiz	G1.1, G5.1	15
Exam02	Programming for training one layer perceptron	Week 9	Homework	G1.1, G3.1	10
Exam03	Calculating the output of fuzzy system	Week 12	Individual paper assessment in class	G1.2, G5.2	15
Exam04	Programming the fuzzy systems	Week 14	Homework	G1.2,G2.1, G3.2	10
Final exam					**50**
Final Exam	- The exam covers all contents related to the expected learning outcomes of the course.		Individual paper assessment in class	G1.1,G1.2, G2.1, G5.1, G5.2	50

11. Course details:

Weeks	Contents	CLOs
	Chapter 1: **< INTRODUCTION>** *(2/0/4)*	
	A/ **Contents and teaching methods***: (2)*	

	Contents: 1.1 Motivation 1.2 Neural network 1.3 Fuzzy logic control **Teaching methods**: + Traditional lectures using powerpoint to review basic knowledges and demonstrate large applications in reality. A series of diagnostic questions will be also used to estimate students knowledges. + Questions	G1.1 G1.2
	***B/* Self-study contents**: *(4)* + Applicability to various industrial processes. + The use of Matlab software	G1.1 G1.2 G3.1
	***Chapter 2:* < FUNDAMENTALS OF NEURAL NETWORKS >** *(2/0/4)*	
	A/* Contents and teaching methods: (2)* **Contents:** 2.1 Introduction 2.2 Basic structure of a neuron 2.3 Neural network architectures 2.4 Supervised and unsupervised learning networks 2.5 Examples **Teaching methods**: + Theoretical lectures + Questions	G1.1
	***B/* Self-study contents**: *(4)* + Read the references to understand clearly the lectures. + Search on the Internet for the applications of neural networks	G1.1 G2.1
	***Chapter 3:* < NEURAL NETWORK ARCHITECTURES >** *(8/0/16)*	
	A/* Contents and teaching methods:(2)* **Contents:** 3.1 Introduction 3.2 Single layer perceptron **Teaching methods**: + Theoretical lectures + Questions + Discussion	G1.1
	***B/* Self- study contents**: *(4)* + Linear seperability + Perceptron convergence theorem + Exercises + Search on the Internet for the applications of single layer perceptron	G1.1 G2.1

4	***Chapter 3:*** **< NEURAL NETWORK ARCHITECTURES (cont.) >** *(8/0/16)*	
	A/ **Contents and teaching methods***: (2)* **Contents:** 3.3 Adaline 3.4 Perceptron with a sigmoid activation function **Teaching methods**: + Theoretical lectures + Questions + Discussion	G1.1 G5.1
	B/ **Self- study contents**: *(4)* + Delta training rule. + Exercises + Search on the Internet the applications of the adaline and perceptron with a sigmoid activation function	G1.1 G2.1 G5.1
	Chapter 3: **< NEURAL NETWORK ARCHITECTURES (cont.) >** *(8/0/16)*	
	A/ **Contents and teaching methods***: (2)* **Contents:** 3.5 Multi-layer perceptron **Teaching methods**: + Theoretical lectures + Questions + Discussion	G1.1 G5.1
	B/ **Self- study contents**: *(4)* + Practical training issues + Examples using the multi-layer perceptron to approximate nonlinear function, solve the forward kinematic of a robot manipulator… + Exercises	G1.1 G2.1 G5.1
	Chapter 3: **< NEURAL NETWORK ARCHITECTURES (cont.) >** *(8/0/16)*	
	A/ **Contents and teaching methods***: (2)* **Contents:** 3.6 Radial basis function network (RBF) 3.7 Adaptive neuro-fuzzy inference system (ANFIS) **Teaching methods**: + Theoretical lectures + Questions + Discussion	G1.1 G5.1
	B/ **Self- study contents**: *(4)* + Exercises +The method for training ANFIS	G1.1 G5.1
	Chapter 4: **< APPLICATIONS OF NEURAL NETWORKS >** *(2/0/4)*	

	A/* Contents and teaching methods: (3)* **Contents:** 4.1 Pattern recognition 4.2 Direct control 4.3 Nonlinear predictive control 4.4 Adaptive control **Teaching methods**: + Theoretical lectures + Questions + Discussion	G1.1 G5.1
	***B/* Self- study contents**: *(6)* + Direct inverse control + Internal model control + Model reference control	G1.1 G2.1
	***Chapter 5:* < TRAINING NEURAL NETWORKS BY MATLAB>** *(4/0/8)*	
	A/* Contents and teaching methods: (4)* **Contents:** 5.1 Introduction to Matlab 5.2 Training single layer perceptron 5.3 Training adaline 5.4 Training perceptron with a sigmoid activation function 5.5 Training multi-layer perceptron 5.6 Training RBF **Teaching methods**: + Theoretical lectures + Question + Programming, simulation	G1.1 G3.1
	***B/* Self- study contents**: *(8)* + Training neural networks learning the practical problems.	G1.1 G3.1
	***Chapter 6:* <INTRODUCTION TO FUZZY SETS>** *(2/0/4)*	
	A/* Contents and teaching methods: (2)* **Contents:** 6.1 Introduction 6.2 Classical sets 6.3 Classical set operations 6.4 Properties of classical sets 6.5 Fuzzy sets 6.6 Fuzzy set operations 6.7 Properties of fuzzy sets 6.8 Classical relations vs Fuzzy relations **Teaching methods**: + Theoretical lectures	G1.2 G5.2

	+ Questions + Discussion	
	***B/* Self- study contents**: *(4)* + Fuzzy systems + Search on the Internet, references for the applications of fuzzy systems	G1.2 G2.1
	***Chapter 7:* <INTRODUCTION TO FUZZY LOGIC>** *(4/0/8)*	
	A/* Contents and teaching methods: (2)* **Contents:** 7.1 Linguistic variables and linguistic values 7.2 Fuzzy logic 7.3 Fuzzy rules 7.4 Approximate reasoning **Teaching methods**: + Theoretical lectures + Questions	G1.2 G5.2
	***B/* Self- study contents**: *(4)* + Exercises + Mamdani rules and Takagai- Sugeno rules	G1.2 G5.2
	***Chapter 7:* <INTRODUCTION TO FUZZY LOGIC (cont.)>** *(4/0/8)*	
	A/* Contents and teaching methods: (2)* **Contents:** 7.5 Fuzzy system 7.6 Examples **Teaching methods**: + Theoretical lectures + Questions + Discussion	G1.2 G5.2
	***B/* Self- study contents**: *(4)* + Exercises + The use of Fuzzy logic toolbox of Matlab	G1.2 G3.2 G5.2
	***Chapter 8:* <APPLICATION OF FUZZY LOGIC FOR CONTROL>** *(2/0/4)*	
	A/* Contents and teaching methods: (2)* **Contents:** 8.1 Fuzzy direct control 8.2 Fuzzy PID control **Teaching methods**: + Theoretical lectures + Questions	G1.2 G5.2
	***B/* Self- study contents**: *(4)* + Exercises	G1.2 G2.1

	+ Object recognition by fuzzy combination	G5.2
	Chapter 9: **<DESIGN, SIMULATION FUZZY SYSTEMS BY MATLAB>** *(4/0/8)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 9.1 Introduction to Fuzzy Logic Toolbox and Simulink. 9.2 Design fuzzy direct controller and simulation by Simulink 9.3 Design fuzzy PID controller and simulation by Simulink **Teaching methods**: + Theoretical lectures + Programming, simulation + Discussion	G1.2 G2.1 G3.2 G5.2
	B/ **Self- study contents**: *(6)* + Design, programming, simulation the fuzzy controller for practical issues.	G1.2 G3.2 G5.2

12. Learning ethics:

Home assignments and projects must be done by the students themselves. Plagiarism found in the assessments will get zero point.

13. First approved date: August 1st 2012

14. Approval level:

Dean	Department	Instructor

15. Syllabus updated process

1st time: Updated content dated, **August 1st 2014**	Instructors Head of department
2nd time: Updated content dated, **August 1st 2016**	Instructors Head of department