Undergraduate Program

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- M.Eng. Nguyen Tran Minh Nguyet
- 2- M.Eng. Tran Duc Thien
- 3- M.Eng. Vu Van Phong

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 :)	
G1	Basic knowledge of neural networks and fuzzy systems.	
G2	An ability to use textbooks, books, powerpoint slides and do homeworks and exams in English.	
G3	An ability to use software for programming and simulating intelligent control systems.	
G4	An ability to calculate and design intelligent control systems	

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

8. Course Learning Outcomes (CLOs)

CLOs		CLOs <i>Description</i> (After studying this course, the student will be able to :)	
C1	G1.1	Apply the single layer and multi- layer perceptron	
G1	G1.2	Apply the fuzzy logic systems.	1.1, 1.2
G2	G2.1	Read the documents and lectures about neural networks and fuzzy systems in English.	
C2	G3.1	Use Matlab for training neural networks	4.4
G3	G3.2	Use Matlab for simulation fuzzy systems	4.4

G4	G4.1	Design and calculate for training neural networks	2.2
G4	G4.2	Design and calculate for output of fuzzy systems	2.2

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:

Туре	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	1.1 Motivation	G1.1
	1.2 Neural network	G1.2
	1.3 Fuzzy logic control	
	Teaching methods:	

4 Transitional technic soling powerpoint of review data. Knowledges and demonstrate large applications in reality. A series of diagnostic questions will be also used to estimate students knowledges. 4 5 4 5 4 4		+ Traditional lectures using powerpoint to review basic knowledges and	
will be also used to estimate students knowledges. - 4 Questions G1.1 H > Self-study contents: (1) + Applicability to various industrial processes. G1.2 + The use of Matlab software G3.1 Chapter 2: < FUNDAMENTALS OF NEURAL NETWORKS > (2/0/4) G1.1 A/ Contents and teaching methods: (2) G1.1 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 B/ Self-study contents: (1) B/ Self-study contents: (1) + + Read the references to understand clearly the lectures. + + Search on the Internet for the applications of neural networks G1.1 G2.1 Contents: 3.1 Introduction 3.2 Single layer perceptron Teaching methods: + + Theoretical lectures + + Questions + - Discussion G1.1			
B/ Self-study contents: (4) G1.1 + Applicability to various industrial processes. G1.2 + The use of Matlab software G3.1 Chapter 2: < FUNDAMENTALS OF NEURAL NETWORKS > (2/0/4) G1.1 A/ Contents and teaching methods: (2) G1.1 Contents: 2.1 Introduction 2.1 Basic structure of a neuron 2.3 Neural network architectures 2.3 Neural network architectures G1.1 2.4 Supervised and unsupervised learning networks G1.1 2.5 Examples Teaching methods: + Theoretical lectures G1.1 + Questions G1.1 B/ Self-study contents: (4) He contents + Search on the Internet for the applications of neural networks G1.1 G1.1 G1.1 3.1 Introduction 3.2 Single layer perceptron 3.1 Introduction G1.1 3.1 Sindu contents: (4) G1.1 + Discussion B/ Self-study contents: (4) + Discussion G1.1 B/ Self-study contents: (4) G1.1 G1.1 G2.1 Chapter 3: < NEURAL NETWORK ARCHITECTURES > (8/0/16) G1.1 A/ Contents			
+ Applicability to various industrial processes. G1.2 + The use of Matlab software G1.2 G3.1 G1.2 Chapter 2: < FUNDAMENTALS OF NEURAL NETWORKS > (20/4) G1.1 A/ Contents and teaching methods: (2) Contents: 2.1 Introduction 2.2 Basic structure of a neuron 2.3 Neural network architectures G1.1 2.4 Supervised and unsupervised learning networks G1.1 2.5 Examples Teaching methods: + Ouestions G1.1 B/ Self-study contents: (4) G1.1 + Read the references to understand clearly the lectures. G1.1 + Search on the Internet for the applications of neural networks G1.1 G1.1 G1.1 G1.1 G1.1 A/Contents and teaching methods:(2) G1.1 G1.1 G1.1 G1.1		+ Questions	
+ The use of Matlab software G1.2 G3.1 Chapter 2: < FUNDAMENTALS OF NEURAL NETWORKS > (2/0/4) G1.1 A/ Contents and teaching methods: (2) Contents: 2.1 Introduction 2.2 Basic structure of a neuron 2.3 Neural network architectures G1.1 2.4 Supervised and unsupervised learning networks G1.1 2.5 Examples Teaching methods: + Theoretical lectures + Questions 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 Contents: 3.1 Introduction 3.2 Single layer perceptron Teaching methods: + Theoretical lectures + Questions G1.1 3.1 Introduction 3.1 Introduction 3.2 Single layer perceptron G1.1 Teaching methods: + Theoretical lectures + Questions + Discussion B/ Self-study contents: (4) (4) + Linear seperability G1.1 + Perceptron convergence theorem G2.1 + Exercises + Search on the Internet for the applications of single layer perceptron		<i>B</i> / Self-study contents: (4)	G1.1
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3 + Questions + Discussion B/ Self- study contents: (4) + Linear seperability G1.1 + Perceptron convergence theorem G2.1 + Exercises + Search on the Internet for the applications of single layer perceptron Chapter 3: < NEURAL NETWORK ARCHITECTURES (cont.) > (8/0/16) A/ Contents and teaching methods: (2) 4 G1.1 3.3 Adaline G1.1		Teaching methods:	
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B/ Self- study contents: (4) + Linear seperability + Perceptron convergence theorem + Exercises + Search on the Internet for the applications of single layer perceptronG1.1 G2.1Chapter 3: < NEURAL NETWORK ARCHITECTURES (cont.) > (8/0/16)A/ Contents and teaching methods: (2) Contents: 3.3 AdalineG1.1 G1.1 G1.1 G1.1 G1.1	3	+ Questions	
+ Linear seperability G1.1 + Perceptron convergence theorem G2.1 + Exercises + + Search on the Internet for the applications of single layer perceptron (6/2) Chapter 3: < NEURAL NETWORK ARCHITECTURES (cont.) > (8/0/16) A/ Contents and teaching methods: (2) G1.1 Contents: 3.3 Adaline G1.1		+ Discussion	
4 G1.1 G2.1 G1.1 G3.3 Adaline		<i>B</i> /Self-study contents: (4)	
+ Perceptron convergence theorem G2.1 + Exercises + Exercises + Search on the Internet for the applications of single layer perceptron (4) Chapter 3: < NEURAL NETWORK ARCHITECTURES (cont.) > (8/0/16) A/ Contents and teaching methods: (2) (2) Contents: (3.3 Adaline		+ Linear seperability	C1 1
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4 (8/0/16) 4 A/ Contents and teaching methods: (2) Contents: G1.1 3.3 Adaline G5.1		+ Search on the Internet for the applications of single layer perceptron	
4 A/ Contents and teaching methods: (2) Contents: G1.1 3.3 Adaline G5.1		-	
4 Contents: G1.1 3.3 Adaline G5.1			
3.3 Adaline G5.1	Λ		
65.1	4		
3.4 Perceptron with a sigmoid activation function			G5.1
		3.4 Perceptron with a sigmoid activation function	

	Teaching methods:	
	+ Theoretical lectures	
	+ Questions	
	+ Discussion	
	<i>B</i> /Self-study contents: (4)	01.1
	+ Delta training rule.	G1.1
	+ Exercises	G2.1 G5.1
	+ Search on the Internet the applications of the adaline and perceptron with a sigmoid activation function	65.1
	<i>Chapter 3: <</i> NEURAL NETWORK ARCHITECTURES (cont.) <i>></i> (8/0/16)	
	A/ Contents and teaching methods: (2)	
	Contents:	
	3.5 Multi-layer perceptron	G1.1
	Teaching methods:	
	+ Theoretical lectures	G5.1
5	+ Questions	
	+ Discussion	
	<i>B</i> /Self-study contents: (4)	01.1
	+ Practical training issues	G1.1
	+ Examples using the multi-layer perceptron to approximate nonlinear function, solve the forward kinematic of a robot manipulator	G2.1 G5.1
	+ Exercises	
	Chapter 3: < NEURAL NETWORK ARCHITECTURES (cont.) > (8/0/16)	
	A/ Contents and teaching methods: (2)	
	Contents:	
	3.6 Radial basis function network (RBF)	G1.1
	3.7 Adaptive neuro-fuzzy inference system (ANFIS)	G1.1 G5.1
6	Teaching methods:	03.1
	+ Theoretical lectures	
	+ Questions	
	+ Discussion	
	<i>B</i> /Self-study contents: (4)	C1 1
	+ Exercises	G1.1
	+The method for training ANFIS	G5.1
	Chapter 4: < APPLICATIONS OF NEURAL NETWORKS > (2/0/4)	
	A/ Contents and teaching methods: (3)	
-	Contents:	
7	4.1 Pattern recognition	G1.1
	4.2 Direct control	G5.1
		0011
	4.3 Nonlinear predictive control	

	Teaching methods:	
	+ Theoretical lectures	
	+ Questions	
	+ Discussion	
	<i>B</i> /Self-study contents: (6)	
	+ Direct inverse control	G1.1
	+ Internal model control	G2.1
	+ Model reference control	02.1
	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	
8.9	5.5 Training multi-layer perceptron	G1.1
8,9	5.6 Training RBF	G3.1
	Teaching methods:	
	+ Theoretical lectures	
	+ Question	
	+ Programming, simulation	
	i rogramming, simulation	C1 1
	<i>B</i> / Self- study contents: (8)	G1.1 G3.1
	+ Training neural networks learning the practical problems.	03.1
	+ Training neural networks learning the practical problems. <i>Chapter 6: </i> INTRODUCTION TO FUZZY SETS> (2/0/4)	05.1
	Chapter 6: <introduction fuzzy="" sets="" to=""> (2/0/4)</introduction>	
	Chapter 6: <introduction fuzzy="" sets="" to=""> (2/0/4) A/ Contents and teaching methods: (2)</introduction>	
	Chapter 6: <introduction fuzzy="" sets="" to=""> (2/0/4) A/ Contents and teaching methods: (2) Contents:</introduction>	
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10	Chapter 6: <introduction fuzzy="" sets="" to=""> (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 + Questions</introduction>	G1.2
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10	Chapter 6: <introduction fuzzy="" sets="" to=""> (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 + Questions + Discussion</introduction>	G1.2 G5.2

	Chapter 7: <introduction fuzzy="" logic="" to=""> (4/0/8)</introduction>	
	A/ Contents and teaching methods: (2)	
	Contents:	
	7.1 Linguistic variables and linguistic values	
	7.2 Fuzzy logic	
	7.3 Fuzzy rules	G1.2
11	7.4 Approximate reasoning	G5.2
	Teaching methods:	
	+ Theoretical lectures	
	+ Questions	
	<i>B</i> / Self- study contents: (4)	
	+ Exercises	G1.2
	+ Exercises + Mamdani rules and Takagai- Sugeno rules	G5.2
	<i>Chapter 7: </i> <introduction (cont.)="" fuzzy="" logic="" to=""> (4/0/8)</introduction>	
	A/ Contents and teaching methods: (2)	
	Contents:	
	7.5 Fuzzy system	
	7.6 Examples	G1 0
	Teaching methods:	G1.2
12	+ Theoretical lectures	G5.2
	+ Questions	
	+ Discussion	
	<i>B</i> / Self- study contents: (4)	G1.2
	+ Exercises	G3.2
	+ The use of Fuzzy logic toolbox of Matlab	G5.2
	Chapter 8: <application for<br="" fuzzy="" logic="" of="">CONTROL> (2/0/4)</application>	
	A/ Contents and teaching methods: (2)	
	Contents:	
	8.1 Fuzzy direct control	C1 0
	8.2 Fuzzy PID control	G1.2
13	Teaching methods:	G5.2
	+ Theoretical lectures	
	+ Questions	
	B / Self- study contents: (4)	G1.2
	+ Exercises	G2.1
	+ Object recognition by fuzzy combination	G5.2
	Chapter 9: <design, by<br="" fuzzy="" simulation="" systems="">MATLAB> (4/0/8)</design,>	
	A/ Contents and teaching methods: (3)	G1.2
14, 15	Contents:	G2.1
	9.1 Introduction to Fuzzy Logic Toolbox and Simulink.	G3.2
	9.2 Design fuzzy direct controller and simulation by Simulink	G5.2

9.3 Design fuzzy PID controller and simulation by Simulink	
Teaching methods:	
+ Theoretical lectures	
+ Programming, simulation	
+ Discussion	
<i>B</i> / Self- study contents: (6)	G1.
+ Design, programming, simulation the fuzzy controller for practical	G3.
issues.	G5.

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
Assoc. Prof. PhD.	Assoc. Prof. PhD. Truong	M.Eng. Nguyen Tran
Nguyen Minh Tam	Dinh Nhon	Minh Nguyet

15. Syllabus updated process

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