SYLLABUS

1. **Course name:** Bio-Signal and -Image Processing
2. **Course code:** BISI331863
3. **Credits:** 2 (2/0/4)
   Duration: 15 weeks (3 theories + 0 laboratories + 6 self-studying/week)
4. **Instructors:**
   1- Nguyen Thanh Hai, PhD
   2- Ha Hoang Kha, PhD
   3- Ngo Quoc Cuong, MEng
5. **Course conditions**
   Prerequisites: None
   Corequisites: Digital Signal Processing, Digital Image Processing, Programming Languages, Circuit Simulation and System.
6. **Course description**

This course provides for students the knowledge of bio-signal and –image processing, such as EEG, EMG, fNIRS, CT-Scanner and MRI. This course also instructs students from the basic knowledge about bio-signals and bio-images to the operators related to the processing of bio-signals and bio-images. These operators include transformations, filtering, feature extractions, and neuron networks.

7. **Course Goals**

Goals	***Goal description*** *(This course provides students:)*	**ELOs**
G1	Professional knowledge about the bio-signal and –image processing such as: transformations, filtering, feature extraction, and neuron networks in processing the bio-images and signals such as: EEG, EMG, fNIRs, CT-Scanner and MRI.	01(H)
G2	An ability to analyze, explain, and solve the problems related to bio-signal and –image processing.	02(H)
G3	An ability to work and communicate in groups.	06(L)
G4	An ability to calculate, design, and use the software systems in the field of bio-signal and –image processing.	03(M)

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

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

CLOs		***Description*** *(After completing this course, students can have:)*	**Outcome**
	G1.1	The ability to describe the basic definitions about bio-signal and –image processing such as EEG, EMG, fNIRs, CT-Scanner, and MRI.	01

	G1.2	The ability to initialize and use the simulation software in bio-signal and –image processing.	01
	G1.3	The ability to present the operators in bio-signal and image processing.	01
	G1.4	The ability to present the Fourier and Wavelet transformations in bio-signal and –image processing.	01
	G1.5	The ability to present the filter applied to bio-signals and bio-image in the timing and frequency domains.	01
	G1.6	The ability to present the methods of processing the bio-signals.	01
	G1.7	The ability to present the methods of processing the bio-images.	01
	G1.8	The ability to present the methods of PCA feature extraction.	01
	G1.9	The ability to present the neuron network structures and the methods of training the neuron networks.	01
	G2.1	The ability to evaluate the filters when there are different noises acted to the bio signals and images.	02
	G2.2	The ability to analyze and evaluate the output signals after processed.	02
	G2.3	The ability to evaluate the advantages and disadvantages of various bio-signal and –image processing methods.	02
	G2.4	The ability to calculate and choose the main features within feature extractions and neuron networks.	02
	G3.1	The ability to work in groups.	06
	G3.2	The ability to explain the processional definitions.	06
	G4.1	The ability to design the filtering system for bio-signals and bio-images.	03
	G4.2	The ability to design the system for bio-signal and –image processing.	03

9. Study materials

- Textbooks:

1. Nguyen Thanh Hai, Digital Image Processing, HCM City University of Technology and Education, 2014.
2. John L. Semmlow, Biosignal and Biomedical Image Processing, Marcel Dekker, 2004.

- References:

3. Nguyen Quan Hoan, *Xử Lý Ảnh,* Lưu Hành Nội Bộ, Học Viện Công Nghệ Bưu Chính Viễn Thông, 2006.
4. Do Nang Toan, Pham Viet Binh, *Xử Lý Ảnh,* Giáo Trình Môn Học, Đại Học Thái Nguyên, Khoa Công Nghệ Thông Tin, 2007.
5. Maria Petrou, Panagiota Bosdogianni, *Image Processing: The Fundamentals*, John Wiley & Sons Ltd, 1999.
6. William K. Pratt, *Digital Image Processing,* John Wiley & Sons, Inc., 2001.

7. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing,* The Third Edition, Prentice Hall, 2008.
8. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing Using MATLAB,* Prentice Hall, 2004.
9. Kayvan N., Robert S., *Biomedical Signal and Image Processing*, Taylor and Francis Group, 2006.

10. Student Assessments

- Grading points: 10

- Planning for students assessment is followed:

Type	Contents	Linetime	Assessment techniques	CLOs	Rates (%)
In-class questions					**20**
Q.1	Present the commands and tools in MATLAB used for biosignal and biomedical image processing such as EEG, EMG, fNIRs, CT-Scanner, and MRI.	Week 3	Individual paper assessment in class	G1.1 G1.2 G1.3	5
Q.2	Present the Fourier Transformation Operator used for biosignal and biomedical image processing.	Week 7	Individual paper assessment in class	G1.4	5
Q.3	Compare the methods used for biosignal processing.	Week 11	Individual paper assessment in class	G2.1 G2.2 G2.3	5
Q.4	Compare the methods used for bioimage processing.	Week 14	Individual paper assessment in class	G2.1 G2.2 G2.3	5
Mid-term test					**30**
Test 1	The contents are related to the simluation of using toolboxes.	Week 6	Individual paper assessment in class	G4.1 G4.2	10
Test 2	The contents are related to the filtering methods used for biosignals and biomedical images.	Week 10	Individual paper assessment in class	G2.1 G2.2 G2.3 G2.4	10
Test 3	The contents are related to the biomedical image enhancement methods.	Week 13	Individual paper assessment in class	G2.1 G2.2 G2.3 G2.4	10
Final examination					**50**
E	The contents covers all the learning outcomes of the course.		Individual paper	All CLOs	50

			assessment in class		

11. Course details:

Weeks	Contents	CLOs
	Chapter 1: **<BASIC DEFINITIONS>** *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 1.1 Overviews of biostatistics 1.2 Introduction to biosignals 1.3 Biosignal processing 1.4 Models of biosignal processing **Teaching methods**: + Presentation + Lecturing	G1.1; G2.2
	B/ **Self-study contents**: (6) 1.5 The factor of biosignal processing 1.6 Homework	G2.2; G3.1; G3.2
	Chapter 2: **<RANDOM VARIABLES AND RANDOM PROCESSES>** *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 2.1 Random variables 2.2 Moment 2.3 Distribution 2.4 The independent statistic processes and random processes **Teaching methods**: + Lecturing + Presentation	G1.2
	B/ **Self-study contents**: (6) 2.5 Researching and simulating the distribution formulas 2.6 Homework	G1.2; G3.1
	Chapter 3: **<STATISTIC AND VERIFYING THE THEORIES>** *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 3.1 The methods of statistic 3.2 The methods for theoretical verifying 3.3 The applications in biosignal processing **Teaching methods**: + Lecturing + Presentation + Discussion	G1.3; G2.6; G3.1

	***B/* Self- study contents**: (6) 3.4 Homework	G1.3; G2.6
	***Chapter 4:* < PROCESSING THE ECG SIGNALS >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 4.1 The methods of measuring the ECG signals 4.2 The features of the ECG signals 4.3 The processing of ECG signals **Teaching methods**: + Presentation + Discussion + Lecturing	G1.3; G2.1; G2.2; G3.1
	***B/* Self- study contents**: (6) 4.4 Simulating the ECG signal using MATLAB 4.5 Homework	G1.3; G2.1; G2.2
	***Chapter 5:* < PROCESSING THE EEG SIGNALS >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 5.1 The methods of measuring the EEG signals 5.2 The features of the EEG signals 5.3 The processing of EEG signals **Teaching methods**: + Presentation + Lecturing	G1.3; G2.1; G2.2; G2.6;
	***B/* Self- study contents**: (6) 5.4 Simulating the EEG signal using MATLAB 5.5 Homework	G1.3; G2.1; G2.2; G2.6
	***Chapter 6:* < PROCESSING THE fNIRS SIGNALS >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 6.1 The methods of measuring the fNIRS signals 6.2 The features of the fNIRS signals 6.3 The processing of fNIRS signals **Teaching methods**: + Presentation + Lecturing	G1.4; G2.5; G2.6; G3.1; G4.1

	***B/* Self- study contents**: (6) 6.4 Simulating the fNIRS signal using MATLAB 6.5 Applications of fNIRs signals 6.6 Homework	G3.1; G3.2
	***Chapter 7:* < MEASURING THE X-RAY, CT, AND MRI IMAGES >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 7.1 The X-Ray images 7.2 The CT images 7.3 The MRI images **Teaching methods**: + Presentation + Lecturing	G1.4; G2.5; G3.1; G4.1
	***B/* Self- study contents**: (6) 7.4 Image toolboxes in MATLAB 7.5 Reading more in referencing documents	G1.4; G2.5; G3.1; G4.1
	***Chapter 8:* < DEFINTION OF DIGITAL IMAGES AND IMAGE TRANSFORMATIONS >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 8.1 Pixels in digital images 8.2 Image classifications 8.3 Image operators 8.4 Fourier transformation 8.5 Wavelet transformation **Teaching methods**: + Presentation + Lecturing	G1.4; G3.1; G4.1
	***B/* Self- study contents**: (6) 8.6 Homework	G1.4; G3.1; G4.1
	***Chapter 9:* < IMAGE FILTERING AND ENHANCEMENT >** *(3/0/6)*	
	A/* Contents and teaching methods: (3)* **Contents:** 9.1 Filtering in space domains 9.2 Filtering in frequency domains 9.3 Pixel processing 9.4 Mask processing	G1.4; G2.5; G2.6; G4.1

	Teaching methods: + Presentation + Lecturing	
	B/ **Self- study contents**: (6) 9.5 Distance measurement 9.6 Homework	G1.4; G2.5; G2.6; G4.1
	Chapter 10: **<BORDERING AND SEGMENTATION>** *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 10.1 Segmentation 10.2 Bodering **Teaching methods**: + Presentation + Lecturing	G1.4; G4.1
	B/ **Self- study contents**: (6) 10.3 Homework	G1.4; G4.1

12. Learning ethics:

- If there are any tricks in homework and reports, the midterm scores will be eliminated to 0. In case of more critically where there are more than 3 students who have the same reports or homework, they are not allowed to take part in the final examinaltion for both copiers and supporters.
- If there is anyone who helps his/her friends in their final examination, both he and his friends are not allow to continue to study in the next semester.

13. First approved date:

14. Approval level:

Dean **Department** **Instructor**

15. Syllabus updated process

1st time: Updated content dated	Instructors Nguyen Thanh Hai
2st time: Updated content dated	Head of department