SYLLABUS

1. **Course name:** Embedded Systems
2. **Course code:** EMSY435664
3. **Credits:** 3 (3/0/6)
   Duration: 15 weeks (45h main course and 90h self-study)
4. **Instructors:**
   1- Truong Ngoc Son, PhD
   2- Truong Quang Phuc, MEng
   3- Huynh Hoang Ha, MEng
5. **Course conditions**
   Prerequisites: Basic electronics
   Co-requisites: N/A
6. **Course description**

This course provides a comprehensive introduction to the embedded system. This course focuses on the basic knowledge of the embedded system, such as the design, interface, configuration, and the programming of the embedded system. In this course, students will learn how to develop an embedded system in hardware and software approaches. The practice part of this course is also conducted with a specific embedded system which is based on MCU. At the end of the course, students will be able to design and program an embedded system at the basic level, develop software, custom an application of embedded system with the use of the existing embedded systems.

7. **Course Goals**

Goals	***Goal description*** *(This course provides students:)*	**ELOs**
G1	Basic knowledge of the embedded system, MCU, sensors, executive structure, communication, programming, and interface.	01 (H)
G2	An ability to design and develop an embedded system (including hardware and software) for practical application	02 (M), 11 (M)
G3	An ability to use hardware/software development techniques and computer skills to solve problems.	07 (M), 03 (H)

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

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

CLOs		***Description*** *(After completing this course, students can have:)*	**Outcome**
G1	G1.1	The ability to identify the requirements and design constraints of the embedded system.	01
	G1.2	The ability to program a modern microprocessor using assembly language.	01

	G1.3	The ability to recognize the embedded system's components with different processors and peripheral devices.	01
G2	G2.1	The ability to design and program an embedded system based on microcontroller for specific applications	02, 11
G3	G3.1	The ability to develop the embedded system	03

9. Study materials

- Textbooks:

[1] Marilyn Wolf, Computers as Components, Third Edition: Principles of Embedded Computing System Design, 3rd ed. Morgan Kaufmann, 2012.

- References:

[2] David Russell, Introduction to Embedded Systems, 2010.

[3] Edward Lee and Sanjit Seshia, Introduction to Embedded Systems, A Cyber-Physical systems Approach, 2011

10. Student Assessments

- Grading points: 10

- Planning for students assessment is followed:

Type	Contents	Time-line	Assessment techniques	CLOs	Rates (%)
Assignments					**10**
Q.1	Assignments/LMS		quizzes	G1	10
Midterms					**40**
M.1	Program the microprocessor to control the peripheral devices	Week 6	Paper-based assessment	G1	20
M.2	Interrupt programming, communication between microprocessors using serial protocols	Week 11	Paper-based assessment	G1	20
Final exam					**50**
P	Design an embedded system based on a microprocessor		Report		50

11. Course details:

Weeks	Contents	CLOs
1	***Chapter 1.*** **Introduction of embedded system** *(3/0/6)*	
	Contents*: (3)* 1.1 Introduction of embedded system 1.2 Embedded system design flow 1.3 Characteristics of embedded systems **Teaching methods**: + Lecture + Discussion + Presentation	G1.1

	***B/* Self-study contents**: *(6)* + Digital logic and logic devices + State machine	
2	***Chapter 2.* Embedded system architecture** *(3/0/6)*	
	Contents*: (3)* 2.1 Core and memory 2.2 Sensors and inputs and outputs 2.3 Firmware 2.4 Real-time operating system 2.5 Other peripheral devices **Teaching methods**: + Lecture + Discussion + Presentation	G1.1
	Self-study contents: *(6)* + Von Neuman architecture	
3	***Chapter 3.* Characteristics of embedded system and real-time system** *(3/0/6)*	
	Contents: *(3)* 3.1 Characteristics of Embedded system 3.2 Design constraints 3.3 Real-time system **Teaching methods**: + Lecture + Discussion + Presentation	G1
	Self- study contents: *(6)* + C programming laguage	
4	***Chapter 4.* MCU** *(3/0/6)*	
	Contents: *(3)* 3.1 Single purpose processor 3.2 General purpose processor 3.3 Dedicated processor. **Teaching methods**: + Lecture + Discussion + Presentation	G1
	Self- study contents: *(6)* + MPU	
5	***Chapter 5.* I/O and Interrupt** *(3/0/6)*	

	Contents: *(3)* 5.1 I/O 5.2 Sensors 5.3 Interrupt **Teaching methods**: + Lecture + Discussion + Presentation	G1
	Self- study contents: *(6)* + Pulse width modulation	
6	***Chapter 6.*** **Embedded software** *(3/0/6)*	
	Contents: *(3)* 6.1 Interrupt programming 6.2 Debugging techniques **Teaching methods**: + Lecture + Discussion + Presentation	G1
	Self- study contents: *(6)* + Homework	
7	**MIDTERM EXAM**	
8	***Chapter 6.*** **Embedded software (cont')** *(3/0/6)*	
	Contents: *(3)* 6.3 Real-time operating system 6.4 Driver 6.5 Middleware **Teaching methods**: + Lecture + Discussion + Presentation	G1.2 G2.1
	Self- study contents: *(6)* + RTOSs	
9	***Chapter 7.*** **Communications** *(3/0/6)*	
	Contents: *(3)* 7.1 UART, SPI, I2C 7.2 Wireless **Teaching methods**: + Lecture + Discussion	G1

	+ Presentation	
	Self- study contents: *(6)* + Wifi, Zigbee, Lora	
10	***Chapter 8.*** **Algorithms and feedback control** *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 8.1 Algorithms 8.2 Feedback control **Teaching methods**: + Lecture + Discussion + Presentation	G1
	B/ **Self- study contents**: *(6)* + PID control	
11	**EXERCISE AND EXAM**	
12	***Chapter 9.*** **EMBEDDED SYSTEM DEVELOPMENT** > *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 9.1 Embedded system development with IDE 9.2 Embedded system development with development kit **Teaching methods**: + Lecture + Discussion + Presentation	G2,3
	B/ **Self- study contents**: *(6)* + Arduino kit	
13	***Chapter 10.*** **Embedded system design** *(3/0/6)*	
	A/ **Contents and teaching methods***: (3)* **Contents:** 10.1 Embedded system design **Teaching methods**: + Lecture + Discussion + Presentation	G2,3
	B/ **Self- study contents**: *(6)* + Simulate the design of an embedded system	
14	***Chapter 10.*** **EMBEDDED SYSTEM DESIGN**> *(3/0/6)*	
	Contents: *(3)* 10.2 Desing an embedded system based on microcontroller	G2,3

	Teaching methods: + Lecture + Discussion + Presentation	
	Self- study contents: *(6)* + Simulate the design of an embedded system	
15	**REVIEW**	

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: January 15, 2012

14. Approval level:

Dean	**Department**	**Instructor**

15. Syllabus updated process

1st time: Updated content dated: 15/01/2014	Instructors Truong Quang Phuc, MEng.
2nd time: Updated content dated: 15/01/2016	Head of department Vo Minh Huan, PhD Instructors Truong Ngoc Son, PhD Head of department Phan Van Ca, PhD