COLLEGE OF ENGINEERING
MECHANICAL ELECTRICAL DEPARTMENT

Course Name: Microcontrollers
Course ID: 5670
Faculty I.D.:
U.A.S.L.P. I.D.: **Clave CACEI I.D.:** CI
Study Plan Level: IMT, IEA:VII **Credits:** 7
Hours/Class/Week: 3
Total hours/Semester: 48
Hours/Practice (and/or Laboratory): 1
Complementary practices:
Extra-class work-hours/Week: 3
Bachelors'/course type: IMT, IEA:/Mandatory own area
Approved credits needed:
Curricular last revision date: 2013
Prerequisite course: Design of digital machines (5673)

COURSE JUSTIFICATION

Microcontrollers are digital devices widely used in mechatronic systems. This course is designed such that the student learns de operating fundamentals of each one of the elements that conforms the microcontroller integrated circuit, besides of acquiring the basic tools to program microcontrollers that allow him solving specific tasks.

COURSE OBJECTIVE

The objective of the course is to present, as clearest as possible, the fundamental principles of microcontrollers, as well as the specific functions of its internal elements.

To teach the instruction set of the microcontroller in order to solve specific tasks, in addition to the programming languages of the microcontroller.

COURSE TOPICS

1.- ARCHITECTURE OF A MICROCONTROLLER 6 H.

Objective: To know the basic architecture of a microcontroller.

1.1 Basic structure
1.2 Registers
1.3 Buses
1.4 Time base
1.5 Port system
1.6 Memory
1.7 Timers
1.8 Analog to digital converters
1.9 Communication systems
1.10 System of interrupts
1.11 Pulse width modulation channels (PWM)

2.- ASSEMBLY LANGUAGE AND INSTRUCTION SET 7 H.

Objective: To learn the instruction set of the microcontroller.

2.1 Logic instructions
2.2 Arithmetic instructions
2.3 Instructions for program control
2.4 Program structures

3.- PERIPHERALS 6 H.

Objective: To learn the structure of the input/output ports of the microcontroller and their interconnection with diverse peripherals.

3.1 Fundamentals
3.2 Oscillators
3.3 Structure of the input/output ports
3.4 Basic peripheral devices
3.5 Interconnection of peripherals with the microcontroller.
3.6 Programming examples

4.- INTERRUPTS 7 H.

Objective: To learn the set of interrupts of the microcontroller in order to design a real-time data acquisition system.

4.1 Introduction
4.2 Function of an interrupt
4.3 Interrupt service routine
4.4 External interrupts
4.5 Timer overflow interrupt
4.6 Analog to digital converter interrupt
4.7 Data acquisition systems
4.8 Programming examples

5.- TIMERS 7H.

Objective: To know the timer system of the microcontroller for time-based tasks, counting, and generation of PWM patterns.

5.1 Fundamentals
5.2 System of timers
5.3 Counting
5.4 Timing
5.5 Pulse width modulation (PWM)
5.6 Programming examples

6.- SERIAL COMMUNICATION 6 H.

Objective: To understand the serial communication protocol using the microcontroller.

6.1. Serial communication fundamentals
6.2. Terminology
6.3. The USART
6.4. Serial interface TWI
6.5. Programming example

7.- ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERSIONS 9 H.

Objective: To know the digital to analog and analog to digital conversions and their applications.

7.1 Fundamentals
7.2 Analog to digital conversion
7.3 Digital to analog conversion
7.4 Design examples

METHODOLOGY

All the theoretical concepts are presented.

Application exercises are developed using computer tools.

EVALUATION CRITERIA

The rating of the course is the average of four midterms and a final exam standard. Each assessment is weighted with the guidelines and requirements of the professor who teaches the course. To pass the course is necessary to approve the corresponding laboratory.

BIBLIOGRAPHY

TEXT BOOK:

1. Dhananjay Grade, Programming and Customizing the AVR Microcontroller, McGraw Hill, 1st Edition, 2000.

2. Muhamad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Prentice Hall, 1st Edition, 2010.

3. Richard H. Barnet, Sarah Cox, Larry O'Cull, Embedded C Programming and the Atmel AVR, Delmar Cengage Learning, 2nd Edition, 2006.

4. ATMEL, ATmega48/88/168 Complete, Data Sheet.

5. ATMEL, 8 Bit AVR Microcontroller Instruction Set.