

**Faculty of Engineering & Technology**  
**Design of Real-Time Embedded Systems**

**Information :**

**Course Code :** CMP 456                      **Level :** Undergraduate                      **Course Hours :** 2.00- Hours

**Department :** Specialization of Mechatronics Engineering

**Instructor Information :**

Title	Name	Office hours
Associate Professor	Mohamed Hassan Mohamed Elmahlawy	
Teaching Assistant	Shahd Ahmad Samir Ibrahim	

**Area Of Study :**

- 1) Demonstrate knowledge of the disciplinary foundation of embedded systems as well as insight into current research and development work.
- 2) Demonstrate the ability to identify, formulate and deal with issues independently and creatively.
- 3) Attain the ability to model, simulate, and integrate technological solutions to design an embedded system.
- 4) Identify the need for further knowledge and development of skills. This is shown in laboratory and project assignments which require gathering of information and critical evaluation.

**Description :**

Introduction to bus architectures and programming; Device and system firmware; Arduino and I/O architectures; Memory architectures; Interrupt service routines; Real-time clocks/timers; Real-time debugging techniques and tools; Development and testing techniques; Students will be introduced to the full embedded system design process including: analysis, design (using extended finite state machine specification), interfacing, programming, hardware assembly, integration and system testing.

**Course outcomes :**

**a.Knowledge and Understanding: :**

1 -	Apply basic applied and engineering science.
2 -	Identify principles of microcontroller implementation and programming for various fields of mechanical engineering and, in particular, mechatronics engineering discipline.
3 -	Develop conceptual and design details of microcontroller-controlled projects for mechatronics applications.

**b.Intellectual Skills: :**

1 -	Develop and implement computer programs for engineering applications including programming of microprocessor based units.
2 -	Analyze and design electrical and electronics including logic circuits, and microprocessor based mechatronics systems
3 -	Define microcontroller design problems in mechanical engineering and evaluate designs, processes, and performance and propose improvements.

**c. Professional and Practical Skills :**

1 -	Write programs for the Arduino microcontroller platform and use measuring instruments and laboratory equipment to design experiments, collect, analyze and interpret results.
2 -	Apply gained hardware and software skills to create and design embedded applications in mechatronics and its applications.
3 -	Use the basic organizational and project management skills.

**d. General and Transferable Skills :**

1 -	Collaborate effectively within multidisciplinary team
2 -	Search for information and engage in life-long self-learning discipline through self-learning assignments.
3 -	Refer to relevant literatures in project report.

**Course Topic And Contents :**

Topic	No. of hours	Lecture	Tutorial / Practical
Introduction to embedded processors and C programming.	3	2	1
Arduino embedded system design platform, Arduino basic circuit diagrams	6	4	2
Timers, debugging, and pulse width modulation (PWM), analog input	6	4	2
Communication protocols (UART, SPI, I2C), interrupts, and power management.	6	4	2
Embedded algorithms and feedback control	6	4	2
Peripherals and sensors	6	4	2
Embedded systems applications.	4	4	0
Final design project.	6	4	2
Midterm Exams	2	0	2

**Teaching And Learning Methodologies :**

Interactive Lecturing
Problem solving
Discussion
Experiential Learning
Project
Research

**Course Assessment :**

Methods of assessment	Relative weight %	Week No	Assess What
Final Exam	40.00	16	
First Midterm	15.00	6	
Participation and Assessments	10.00	0	
Project	10.00	15	
Project Proposal	10.00	5	

**Recommended books :**

Massimo Banzi, Getting Started with Arduino, O'Reilly books, 2011.  
Edward Lee and Sanjit Seshia, Introduction to Embedded Systems, A  
Cyber-Physical Systems Approach, LeeSeshia.org, 2011