جامعة الزيتونة الأردنية

Al-Zaytoonah University of Jordan

Course Syllabus

According to JORDAN National Qualification Framework (JNQF)

Course Name: Embedded Systems

Course Number: 0130418

General Course Information:

Course Title	Embedded Systems
Course Number	0130418
Credit Hours	3 credit hours
Education Type	Blended learning
Prerequisites/Co-requisites	Operating Systems (0130313)
Academic Program	Computer Science
Program Code	130
Faculty	Faculty of Science and Information Technology
Department	Computer Science
Level of Course	3
Academic Year /Semester	2024/2025 2nd Semester
Awarded Qualification	BS'c
Other Department(s) Involved in Teaching the Course	-
Language of Instruction	English
Date of Production/Revision	2024-2025 / 10/3/2025

Course Coordinator:

Coordinator's Name	Dr. Maher Nabulsi
Office No.	9316
Office Phone Extension Number	-
Office Hours	11-12:30 Sunday-Wednesday
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Other Instructors:

Instructor Name	
Office No.	
Office Phone Extension Number	
Office Hours	
Email	

Course Description *(English/Arabic)*:

English	**Embedded systems is concerned with computer architecture, design, organization, operating systems, microcontrollers, and many other materials. By the end of the course, students should be able to understand the embedded systems and their components. Also, the architecture of microcontrollers and how they interact with external devices. Besides that, students will learn principles of embedded system design, emphasizing simplicity and efficiency. Upon completion of the course, students should realize the basics and significant of Real-Time Operating Systems (RTOS) and Programming Tools Proficiency. They should possess the skills to apply the learned concepts through a project and tackle the security challenges in embedded systems.**
Arabic	تُعنى الأنظمة المُدمجة بهندسة الحاسوب، وتصميمه، وتنظيمه، وأنظمة التشغيل، والمتحكمات الدقيقة، والعديد من المواد الأخرى. بنهاية هذه المادة ، يُفترض أن يكون الطلاب قادرين على فهم الأنظمة المُدمجة ومكوناتها، بالإضافة إلى بنية المتحكمات الدقيقة وكيفية تفاعلها مع الأجهزة الخارجية. إضافةً إلى ذلك، سيتعلم الطلاب مبادئ تصميم الأنظمة المُدمجة، مع التركيز على البساطة والكفاءة. عند إكمال الدورة، يُفترض أن يُدرك الطلاب

	أساسيات وأهمية أنظمة التشغيل في الوقت الفعلي (RTOS) وإتقان أدوات البرمجة. كما يجب أن يمتلكوا المهارات اللازمة لتطبيق المفاهيم التي تعلموها من خلال مشروع، ومعالجة تحديات الأمن في الأنظمة المُدمجة.

Textbook: *Author(s), Title, Publisher, Edition, Year, Book website.*

1- Jacob Beningo, "Embedded Software Design: A Practical Approach to Architecture, Processes, and Coding Techniques", 1st ed. Edition, Apress, 2022.

References: *Author(s), Title, Publisher, Edition, Year, Book website.*

1- Perry Xiao, "Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things", Fourth ed., Springer, 2021.
2- Marilyn Wolf, "Computers as Components: Principles of Embedded Computing System Design (Kindle Edition): Principles and applications", Morgan Kaufmann, 2022.
3- Adam Taylor, Dan Binnun, Saket Srivastava, "A Hands-On Guide to Designing Embedded Systems (Artech House Integrated Microsystems Library)", Artech House, 2021.
4- Real-Time Systems: Design Principles for Distributed Embedded Applications 3rd Edition, Kindle Edition, Springer, 2022.

Course Educational Objectives (CEOs):

1.	**Understand the Fundamentals: By the end of the course, students should be able to understand the embedded systems and their components. And understand the architecture of microcontrollers and how they interact with external devices. Besides that, students will learn principles of embedded system design, emphasizing simplicity and efficiency.**
2.	Practical Interfacing and Communication Protocols Mastery: Students will Acquire skills in interfacing with various sensors, actuators, and external devices. And master the use of communication protocols essential for embedded systems.
3.	Real-Time Operating Systems (RTOS) and Programming Tools Proficiency: Upon completion of the course, students should realize the basics and significant of RTOS in embedded systems. Besides task scheduling, synchronization and communication. In addition, students will have skills in the use of integrated development environments (IDEs) and debugging techniques for embedded systems.
4.	Embedded System Project and security basics: After taking this course, students should possess the skills to apply the learned concepts through a project. They should be able to introduce the security challenges in embedded systems.

Intended Learning Outcomes (ILO's):

Intended learning outcomes (ILOs)		Relationship to CEOs	Contribution to PLOs	Bloom Taxonomy Levels*	JNQF Descriptors**
1.	K- Knowledge and Understanding				
2. **3.** **ILO1-K1**	Providing knowledge about embedded system's (ES) components, applications, and architecture.	CEO1	PlO1-k	Remembering	K
4. **5.** **ILO2-K2**	Learning about microcontrollers and I / O programming of ES.	CEO2	PlO2-k	understanding	K
	S- Intellectual skills				
6. **7.** **ILO3-S1**	Define the structure and components of ES. Get to know the applications of	CEO3	PlO3-s	Applying	S

	ES. Understand the differences between architecture types of ES.				
8. **9. ILO4-S2**	Recognize the features and block diagram of 8051 microcontroller. Understand I / O ports, their functions and how to program.	CEO4	PlO4-s	Applying	S
10. **11. ILO5-S3**	Recognize registers bank in 8051, flags and PSW register. Understand Timer/counter and TMOD register, ISR, and how to program.	CEO1	PlO7-s	Understanding	S
	C- Competencies				
12. **13. ILO6-C1**	The ability to define the structure and components of ES.	CEO3	PlO5-c	Understanding	C
14. **15. ILO7-C2**	The ability to understand I / O ports, their functions and how to program.	CEO4	PlO6-c	Evaluating	C
	D- Transferable skills				
16. D1					

***Bloom Taxonomy Levels:**

Level #	1	2	3	4	5	6
Level Name	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating

**** Descriptor (National Qualification Framework Descriptors): K: Knowledge, S: Skill, C: Competency.**

Program Learning Outcome (PLOs):

(PLOs)	JNQF Descriptors**		
	K	**S**	**C**

PLO1-K	Knowledge of professional ethics, social responsibility, and the regulations governing them.	√		
PLO2-K	Understanding various programming techniques, the stages of software development, and the fundamental principles of security.	√		
PLO3-S	Skill in applying mathematical concepts to analyze and design algorithms and verify their correctness		√	
PLO4-S	Skill in using different programming languages and applying them to develop software and computer applications.		√	
PLO5-C	The ability to analyze, design, and develop effective and reliable computer programs that meet user requirements and adhere to professional ethics.			√
PLO6-C	The ability to keep up with continuous advancements in computer science, innovate, and work independently or as part of a team.			√
PLO7-T	The ability to work collaboratively, communicate effectively, and demonstrate teamwork spirit.		√	

**** Descriptors according to the national qualifications framework (K: knowledge, S: skill, C: Competency)**

Weekly Schedule *(please choose the type of teaching)*

- ☒ **Face to Face (F2F)**
- ☐ **Hybrid** *(One – To - One)*
- ☐ **Online**

Schedule of Simultaneous and their Topics:

Week	First Lecture (F2F)	Second Lecture (Activity)	ILOs	PLOs	JNQF Descriptors*
1	PC- Design, Organization, and Architecture Digital circuits Execution components	PC- Design, Organization, and Architecture Digital circuits Execution components, video	ILO1-k	Plo1-k	K
2	Storage systems Instruction set completeness I / O operations- HW	Storage systems Instruction set completeness I / O operations,video	ILO2-k	Plo1-k	K
3	Stack and subroutines Instruction code I / O Fundamentals- HW	Stack and subroutines Instruction code I / O Fundamentals -QUIZ	ILO5-s	Plo2-k	K
4	Parallel processing and Pipelining	Parallel processing and Pipelining	ILO1-k	Plo2-k	K
5	ES- Real time operating system (RTOS) Basic structure of ES (sensor, CPU, mem., actuator)	ES- Real time operating system (RTOS) Basic structure of ES (sensor, CPU, mem., actuator)	ILO5-s	Plo5-c	C

6	Harvard, Von Neumann architecture CISC and RISC architecture	Harvard, Von Neumann architecture CISC and RISC architecture	ILO4-s	Plo3-s	S
7	ES-Tools and Peripherals Compiler, assembler, I / O devices ES-Microcontrollers (8051 and PIC)	ES-Tools and Peripherals Compiler, assembler, I / O devices ES-Microcontrollers (8051 and PIC)	ILO5-S	Plo4-s	S
Midterm Exam (30%)					
9	Features and block diagram of 8051 microcontroller ES-I/O Programming Pin diagram (PDIP)	Features and block diagram of 8051 microcontroller ES-I/O Programming Pin diagram (PDIP)	ILO5-S	Plo4-s	S
10	I / O ports and their functions ES-Assembly Language Instructions and directives	I / O ports and their functions ES-Assembly Language Instructions and directives, video	ILO7-c	Plo5-c	C
11	ES-Registers Bank / Stack AC, R-registers, DPTR, PC, SP	ES-Registers Bank / Stack AC, R-registers, DPTR, PC, SP	ILO7-c	Plo6-c	C
12	Stack and call instructions in 8051 ES-Addressing Modes	Stack and call instructions in 8051 ES-Addressing Modes, Quiz	ILO6-c	Plo6-c	C
13	Types of addressing modes ES-Timer / Counter Timer / counter and TMOD register	Types of addressing modes ES-Timer / Counter Timer / counter and TMOD register	ILO6-c	Plo5 -c	C
14	Interrupt service routine (ISR) IE (interrupt enable) register Control programs and applications	Interrupt service routine (ISR) IE (interrupt enable) register Control programs and applications, video.	ILO6-c	Plo6-c	C
15	**Projects Discussion**				
16	**Final Exam**				

* **K: Knowledge, S: Skills, C: Competency**

Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

- Lecture.
- flipped learning.
- learning through projects.
- learning through problem solving.
- participatory learning

Course Policies:

A- Attendance policies:
The maximum allowed absences is 15% of the lectures.
B- Absences from exams and handing in assignments on time:
Midterm exam can be retaken based on approval of excuse by the instructor's discretion.
Not handing assignment on time will incur penalties.
C- Academic Health and safety procedures
D- Honesty policy regarding cheating, plagiarism, and misbehaviour:
Cheating, plagiarism, misbehaviour will result in zero grade and further disciplinary actions may be taken.
E- Grading policy:

- All homework is to be posted online through the e-learning system.
- Exams will be marked within 72 hours and the marked exam papers will be handed to the students.
- Online Activities (Course Videos, Practice labs, Discussion Forums, Quizzes) **20%**
- Midterm 30**%**
- Final Exam 50**%**

F- Available university services that support achievement in the course: **E-Learning Platform, Labs, Library.**

Required Equipment:

- PC / Laptop with webcam and mic
- Internet Connection
- Access to the ZUJ E-Learning Platform at https://exams.zuj.edu.jo/
- E-learning plan
- Satisfaction questionnaires for online and face-to-face learning
- Software for e-learning
- Training

Assessment Tools Implemented in the Course:

- Final Exam
- Midterm Exam
- Quizzes
- Homework
- Practice Labs
- Discussion Forums
- Periodic reports for learning assessment
- Improvement plans for online or face-to-face teaching.
- Others…

Responsible Persons and their Signatures:

Course Coordinator	**Dr. Maher Nabulsi**	**Completed Date**	**3 / 5 / 2025**
		Signature	

Received by (Department Head)		**Received Date**	/ /
		Signature	