Course Specification

(Postgraduate Programs)

Course Title: Embedded Systems
Course Code: CE6004
Program: Master of Science in Computer Engineering
Department: Computer and Network Engineering
College: College of Computing
Institution: Umm Al-Qura University
Version: 2.0
Last Revision Date: 12/4/2025

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 2)					
4. Course General Description:					
Embedded system is a computer system with a dedicated task or set of tasks. This course presents essential knowledge on embedded systems technology and techniques. It includes but not limited to computer internal architecture, interfacing with memory and other I/Os, multiprocessing, system design and system on chip concepts. .					
5. Pre-requirements for this course (if any)**:**					
No Pre-requirements for this course is needed.					
6. Pre-requirements for this course (if any)**:**					
The fundamental knowledgeof the following is needed: • Fundamentals of Computer Architecture • Knowledge in any programming language (preferably C) • Fundamentals of Digital System Design					
7. Course Main Objective(s):					
This course covers the hardware design issues and techniques as well as embedded software design issues and techniques. Moreover, hardware/software co-design through real world examples of embedded systems is another main objective of this course.					

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Identify challenges in the design of embedded systems	K1	Lectures, and reading assignments	Written exams, assignments, projects and oral presentations
1.2	Explain fundamentals of embedde system deign concepts, terminologies and characteristics	K2		
2.0	**Skills**			
2.1	Design and implement modern embedded systems	S1	Lectures, project, discussions, tutorials	Written exams, assignments, projects and oral presentations
2.2	Apply principles of embedded systems to solve complex problems	S2		
2.3	Communicate effectively through a written report embodying the design, implementation, evaluation of embedded systems	S3		
2.4	Evaluate the performance of embedded systems	S4		
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate commitment to ethical and professional responsibilities in embedded systems	V1	Lectures, project, discussions, assignments and projects	Group assignments and projects

Code	Course Learning Outcomes	Code of PLOs	Teaching Strategies	Assessment Methods
3.2	Work in a team to implement a project in embedded systems	V2	Group assignments and projects	Group assignments and projects

C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction to Modern Embedded Systems and Embedded Computing	3
2.	Characteristics of Modern Embedded Systems	3
3.	System Design and Analysis Techniues / Methodologies	6
4.	Specifications and Modeling Languages	3
5.	Embedded Systems Hardware: Sensors	3
6.	Embedded Systems Hardware: Actuators	3
7.	Processing/Computing Platforms for Embedded Systems	6
8.	Memory Design for Embedded Systems	3
9.	Communication for Embedded Systems	3
10.	Energy Efficiency for Embedded Systems (Low Power Design)	3
11.	Security of Embedded Systems Hardware	3
12.	Embedded Operating Systems	3
13.	Embedded Multiprocessors	3
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-Term	9	20
2.	Assessment through assignment	4 and 9	20
3.	Assessment through projects	11	15
4.	Presentation of scientific article	13	15
5.	Final	15	30

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things by Peter Marwedel, 2nd Edition, Springer, 2021, ISBN-10: 303060909X, ISBN-13: 978-3030609092
Supportive References	Embedded System Design Paperback, Third Edition, Santanu Chattopadhyay, 2023, ISBN-10: 8120340248, ISBN-13: 978-8120340244 Computer Architecture - A Quantitative Approach, 7th Edition, John L. Hennessy, and David A. Patterson, Christos Kozyrakis, Elsevier Science, 2025, ISBN 9780443154065 Introduction to Embedded Systems, Second Edition: A Cyber-Physical Systems Approach, Edward A. Lee and Sanjit A. Seshia, MIT Press, 2017, ISBN-10 : 0262533812, ISBN-13 : 978-0262533812
Electronic Materials	The instructor may provide as per requirements.
Other Learning Materials	The instructor may provide as per requirements.

2. Educational and Research Facilities and Equipment Required:

Items	Resources
Facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (Projector, smart board, software)	Projector
Other equipment (Depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Program Leaders	Indirect
Effectiveness of students' assessment	Program Leaders	Direct
Quality of learning resources	Students, Faculty	Indirect
The extent to which CLOs have been achieved	Students, Faculty, Program Leaders	Direct and Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Computer and Network Engineering Department Council
REFERENCE NO.	The 18th Session Of The Academic Year 1446
DATE	15/4/2025