Course Specification

(Postgraduate Programs)

Course Title:	Advanced Electronics
Course Code:	2202-570
Program:	Master in Electrical Engineering
Department:	Electrical Engineering
College:	College of Engineering
Institution:	King Faisal University
Version:	V2
Last Revision Date:	17 April 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 1/1st year				
4. Course General Description:				
This course is an introduction to digital integrated circuits. The material will cover CMOS devices and manufacturing technology along with CMOS inverters and gates. Other topics include propagation delay, noise margins, power dissipation, and regenerative logic circuits. We will look at various design styles and architectures as well as the issues that designers must face, such as technology scaling and the impact of interconnect. Examples presented in class include arithmetic circuits, semiconductor memories, and other novel circuits. CAD Tools for layout, extraction, and simulation will be used for assignments and projects.				
5. Pre-requirements for this course (if any)**:**				
(2202-243) Electronics I (2202-231) Digital Logic Design				
6. Co-requisites for this course (if any)**:**				
None				
7. Course Main Objective(s):				
Students will be able to analyze and design modern digital integrated circuits. The students will learn to 1. Analyze the electrical characteristics of logical gates, 2. Design digital combinational, sequential, and memory circuits according to specifications using computer-aided design tools, and 3. Discuss the tradeoffs involved in the design of semiconductor integrated circuits and the evolution of technology. 4. Recognize the design flow of CMOS digital ICs.				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

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

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Assignments**	20
3.	**Library**	10
4.	**Projects/Research Essays/Theses**	30
5.	**Others (specify)……**	
	Total	90 Hours

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.	K1	Lectures	Final Exam M.T. Exam HW, QZ

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2	Understand the fundamentals of IC technology components, scaling trends, and limitations.	K1	Lectures	Final Exam M.T. Exam HW, QZ
1.3	Recognize tradeoffs to optimize power, delay, and area.	K1	Lectures	Final Exam M.T. Exam HW, QZ
1.4	Study realization and layout of various arithmetic and logic digital circuits and systems using the CMOS technology.	K1	Lectures	Final Exam M.T. Exam HW, QZ
2.0	**Skills**			
2.1	Apply mathematical methods and circuit analysis models in the analysis of CMOS digital electronics circuits, including logic components and their interconnection.	S1	Lectures	Exams, HWs, Project
2.2	Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and verify the functionality, timing, power, and parasitic effects.	S1	Lectures	Exams, HWs, Project
2.3	Utilize modern CAD tools for IC design, simulation, verification, and	S2	Lectures	HWs, Project

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	automated logic synthesis and layout.			
2.4	Design a custom IC chip to satisfy a set of design criteria and constraints utilizing modern IC design methodologies and design automation tools in a team project.	S2	Lectures	Project
3.0	**Values, autonomy, and responsibility**			
3.1	Communicate the design experience through a detailed report and a short presentation.	V1	Lectures	Project Presentation
3.2	Design a custom IC chip to satisfy a set of design criteria and constraints utilizing modern IC design methodologies and design automation tools in a team project.	V2, V3	Lectures	Project
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C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction to VLSI; design metrics	1.5
2.	MOS Devices, CMOS Inverter	1.5
3.	Combinational logic, layout, design rules	3
4.	Manufacturing process	3
5.	Simulation; CAD tools	3
6.	Low Power design strategies	3
7.	CMOS inverter - the dynamic view	3
8.	Logic Styles; Dynamic CMOS logic	3

9.	Timing and clock synchronization, pipelining	3
10.	Static, Dynamic sequential circuits	3
11.	Deep sub-micron designs; design for performance	3
12.	Wires; Coping with Interconnects	3
13.	Adders, Multipliers, data paths; timing issues	3
14.	Memory structures	3
15.	Emerging topics; Variability and Design for Manufacturing	3
16.	CMOS system design, Floor plan, Placement and routing, Project design	3
Total		**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HW 1	Week 2	2%
2.	Quiz 1	Week 3	5%
3.	HW 2	Week 4	2%
4.	Quiz 2	Week 5	5%
5.	HW 3	Week 6	2%
6.	Exam1	Week 8	25%
7.	HW 4	Week 10	2%
8.	Quiz 3	Week 12	5%
9.	HW 5	Week 13	2%
10.	Project or research paper	Week 15	20%
11.	Final comprehensive exam	Week 16	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	Rabaey, Jan M., Anantha P. Chandrakasan, and Borivoje Nikolic. Digital integrated circuits. Vol. 2. Englewood Cliffs: Prentice hall, 2002.
Supportive References	1. CMOS VLSI design: a circuits and systems perspective, Pearson Education India, 2015, Weste, Neil HE, and David Harris. 2. CMOS digital integrated circuits: analysis and design, New York: McGraw-Hill, 1996, Leblebici, Yusuf, and Sung-Mo Kang. 3. Digital integrated circuit design, Oxford University Press (New York), 2000, Martin, Kenneth W.

	4. CMOS logic circuit design, Springer Science & Business Media, 1999, Uyemura, John P.
Electronic Materials	IEEE Xplore
Other Learning Materials	IC design and Layout Tools: Pspice, Magic, LASI, Tanner L-Edit

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom meeting twice a week (1 hour and half each lecture)
Technology equipment (Projector, smart board, software)	Blackboard and BPM software, other simulation software
Other equipment (Depending on the nature of the specialty)	semiconductors demonstration tools

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect- Online Survey
Effectiveness of students' assessment	Students and Faculty	Direct and Indirect Assessment
Quality of learning resources	Students and Faculty	Indirect- Online Survey
The extent to which CLOs have been achieved	Students and Faculty	Direct and Indirect Assessment
Other	None	None

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**EE DEPARTMENT QUALITY COMMITTEE**
REFERENCE NO.	**MEETING # 10**
DATE	**APRIL 19, 2025**