GAU, Faculty of Engineering

Course Unit Title	Digital Integrated Circuit Design
Course Unit Code	EEN419
Type of Course Unit	Technical Elective, Electrical and Electronics Engineering students
Level of Course Unit	4th Year BSc
National Credits	3
Number of ECTS Credits Allocated	6 ECTS
Theoretical (hour/week)	3
Practice (hour/week)	-
Laboratory (hour/week)	-
Year of Study	4
Semester when the course unit is delivered	7
Course Coordinator	Prof. Dr. Ali Zeki
Name of Lecturer (s)	Prof. Dr. Ali Zeki
Name of Assistant (s)	
Mode of Delivery	Face to Face, E-learning activities
Language of Instruction	English
Prerequisities and co-requisities	EEN301 Electronic Circuits I
Recommended Optional Programme Components	Basic background of Logic Circuit Design

Objectives of the Course:

- Teaching transistor-level realization of basic MOS digital circuits
- Teaching analysis of static behavior of basic MOS digital circuits
- Teaching analysis of dynamic behavior of basic MOS digital circuits

Learning Outcomes

When this course has been completed the student should be able to		Assessment
1	explain the need for and advantages of digital signals and circuits	1,2
2	plot the voltage transfer curve and extract the static parameters and noise margins of a given MOS inverter	1,2
3	build the transistor-level logic gate realizing a given Boolean function	1,2
4	calculate the propagation delays and rise/fall times of a given MOS inverter or gate	1,2
5	design transistor-level combinational and sequential digital circuits using classical (standard CMOS) as well as alternative approaches (transmission gates, dynamic logic)	1,2
6	determine the static and dynamic power consumption of a given MOS inverter or gate	1,2
7	analyze and design MOS memory cells (ROM, SRAM, DRAM)	1,2

Assessment Methods: 1. Written Exam, 2. Assignment, 3. Project/Report, 4. Presentation, 5 Lab. Work

Course's Contribution to Program		CL
1	Ability to understand and apply knowledge of mathematics, science, and engineering	5
2	Ability to design and conduct experiments as well as to analyze and interpret data	3
3	Ability to work in multidisciplinary teams while exhibiting professional responsibility and ethical conduct	2
4	Ability to apply systems thinking in problem solving and system design	5
5	Knowledge of contemporary issues while continuing to engage in lifelong learning	4
6	Ability to use the techniques, skills and modern engineering tools necessary for engineering practice	3
7	Ability to express their ideas and findings, in written and oral form	3
8	Ability to design and integrate systems, components or processes to meet desired needs within realistic constraints	5
9	Ability to approach engineering problems and effects of their possible solutions within a well structured, ethically responsible and professional manner	4
11	Strong foundation on the fundamentals of Electrical and Electronics Engineering such as Circuit Theory, Signals, Systems, Control and Communications, which are necessary for successful practice in the field	4
12	Awareness on the contemporary requirements, methods and applications of the Electrical and Electronics Engineering	5

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5:Very High)

Course Contents

Week	Theory	Application	Exams
1	Why Digital Circuits? Why Integrated Circuits? Physical and Electrical Properties of the MOS Transistor		
2	Ideal inverter, practical inverter and characteristics, resistive-load inverter		
3	Various types of NMOS inverters, CMOS inverter		
4	Static analysis and design of CMOS inverter		pop quiz #1
5	Dynamic analysis and design of CMOS inverter		
6	NAND, NOR gates, complex gates		
7	Static analysis and design of CMOS complex gates		pop quiz #2
8			Midterm
9	Dynamic analysis and design of CMOS complex gates		
10	Transmission gates		
11	Various flip-flop circuits		
12	Dynamic logic		Quiz
13	Read-only memories (ROM)		
14	static and dynamic random-access memories (SRAM and DRAM)		pop quiz #3
15			Final

Recommended Sources

Textbook: R. Boylestad & L. Nashelsky, "Electronic Devices and Circuit Theory", 10th edition, Prentice Hall, 2008.

Supplementary Material(s): A. Sedra & K.C. Smith, "Microelectronic Circuits", 6th edition, Oxford University Press, 2010.

Assessment

Attendance	5%	
Assignments	10%	
Midterm Exam	20%	
Quiz	15%	
Pop quizzes	10%	
Final Exam	40%	
Total	100%	

ECTS Allocated Based on the Student Workload

Activities	Number	Duration (hour)	Total Workload(hour)
Hours per week (Theoretical)	14	3	42
The preparation of the homeworks	5	8	40
Pop Quizzes	3	7	21
Quiz	1	16	16
Midterm Examination	1	22	22
Final Exam	1	27	27
Total Workload			168
ECTS Credit of the Course			6