



Lahore University of Management Sciences

EE 523: VLSI Design

Spring 2024 - 25

Instructor	Dr. Shahid Masud
Room No.	9-323A
Office Hours	Mon / Wed 11:00 am to 11:30 am
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TA	
TA Office Hours	TBA
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

Course Basics			
Credit Hours	3		
Lecture(s)/week	2	Duration	75 min
Total Labs / Assignments	8	Duration	75 min + EDA Tool usage in own time

Course Distribution	
Core	MS Digital Embedded Systems / MS Electrical Engineering Electronics and Embedded Systems Stream
Elective	Elective course for BS / MS in Electrical Engineering / Physics / Computer Science etc.
Open for Student Category	All Senior / MS / PhD students in SBASSE
Close for Student Category	Freshman and Sophomore

COURSE DESCRIPTION
<p>This course provides the necessary background to design digital integrated circuits and systems for VLSI. These integrated circuits are required to provide very high performance while working under size, area, and power constraints. The design of such electronic circuits is also complex owing to the high clock speeds, high logic density and problems in layout, simulation, and fabrication. The course covers different design and architecture approaches for CMOS digital VLSI while also giving hands-on experience of design, verification and simulation of an integrated circuit using state-of-the-art CAD tools. The course will cover some of the advanced topics such as Data Converters, Memories, and some Mixed-Signal circuits.</p>

COURSE PREREQUISITE(S)
Electronics Course at undergraduate level (EE 340 or equivalent)

COURSE LEARNING OUTCOMES
<p>The students should be able to:</p> <p>CLO 1: Derive and apply knowledge of CMOS transistor theory to understand the operation of integrated circuits</p> <p>CLO 2: Make use of CMOS transistor circuit analysis in performance and operation characterization of digital integrated circuits</p> <p>CLO 3: Investigate the effects of parasitic capacitance in the speed and power profiling of digital integrated circuits</p> <p>CLO 4: Explore the use of modern simulation and layout tools in the design of digital integrated circuits</p>



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RELATION TO PROGRAM LEARNING OUTCOMES (PLO)

EE 523 CLO	RELATED PLO	LEVELS OF LEARNING	TEACHING METHODS	CLO ASSESSMENT
CLO 1	PLO 1	COG 4	INSTRUCTION, LABS	MIDTERM, FINAL
CLO 2	PLO 2	COG 4	INSTRUCTION, LABS	MIDTERM, FINAL
CLO 3	PLO 4	COG 5	INSTRUCTION, LABS	MIDTERM, FINAL
CLO 4	PLO 5	COG 5	INSTRUCTION, LABS	LABS / PROJECTS

MODULE TITLES:

1.Introduction and Background to VLSI	1 week
2.MOS Transistor Theory	1 week
3.CMOS Processing Technology and Design rules	1 week
4.VLSI Circuit Characterization and Performance	2 weeks
5.Design of Combinational CMOS Circuits	1 week
6.Design of Sequential CMOS Circuits	2 weeks
7.Design of Complex VLSI Circuits and Systems (advanced topics)	2 weeks
9. VLSI Design Laboratories and EDA tools-based assignments	4 weeks

Grading Breakup and Policy

Quizzes (5 to 6): 15%
VLSI Design Labs (7 to 8): 15%
Assignments / Design Projects (2 or 3): 10%
Midterm Exam: 30%
Final Exam: 30%

Examination Detail

Midterm Exam	In-class midterm examination
Final Exam	Comprehensive final examination

COURSE OVERVIEW

Lecture No.	Course Topics	Readings	Objectives/Application
1	Introduction – Microelectronics background	Chap 1	
2	Introduction to VLSI Design, tools, technology	Chap 1	
3	<i>Lab – 1- Introduction to Simulation and Layout tools</i>		
4	MOS Transistors – characteristics, capacitance	Chap 2	
5	<i>Lab – 2 – Design, simulation, layout of Inverter</i>		
6	Advance properties in MOS Transistors, pass transistors	Chap 2	
7	CMOS Processing Technology	Chap 3	
8	CMOS Design rules, circuit extraction and layout	Chap 3	
9	<i>Lab – 3 – Delay of gates as a function of design parameters</i>		
10	Circuit characterization – delay estimation	Chap 4	
11	Power estimation, transistor sizing	Chap 4	
12	Interconnect resistance and capacitance	Chap 4	
13	<i>Lab – 4 – Power dissipation in CMOS circuits</i>		
14	Reliability and scaling issues	Chap 4	
15	Midterm Exam		



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16	Combinational Logic CMOS families	Chap 6	
17	Bi-CMOS and low-power logic circuits	Chap 6	
18	<i>Lab – 5 – Interconnect analysis</i>		
19	Other topics in Combinational VLSI Circuits	Chap 6	
20	Design of Latches and Flip-flops	Chap 7	
21	Sequencing and Dynamic circuits	Chap 7	
22	<i>Lab – 6- Issues in Dynamic logic circuits</i>		
23	Synchronizer circuits for clock-domain conversion	Chap 7	
24	VLSI Circuits for SRAM and CAM	Chap 9	
25	<i>Lab – 7 – SRAM Design issues</i>	Chap 9	
26	I/O Pads for VLSI Chips	Chap 11	
27	Design case studies (advanced topics)		
28	<i>Student Projects / Lab - 8</i>		

Textbook

CMOS VLSI Design: A Circuits and Systems Perspective by Neil H.E. Weste, David Harris, Third Edition, Pearson Education, 2005.

Supplementary Readings

1. Digital Integrated Circuits, A Design Perspective, Second ed., Jan Rabaey, A. Chandrakasan, B. Nikolic, Prentice Hall (PHI), 2003.
2. Analysis and Design of Digital Integrated Circuits, David A. Hodges, Horace G. Jackson, Resve Saleh, Third Edition, McGraw Hill.

Campus supports & Key university policies

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, [online resources](https://advising.lums.edu.pk/advising-resources) (<https://advising.lums.edu.pk/advising-resources>), etc. To view all support services, their specific role as well as contact information [click here](https://advising.lums.edu.pk/#supportservices) (<https://advising.lums.edu.pk/#supportservices>).

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) [Academic and Intellectual Integrity](http://surl.li/gpvwb) (<http://surl.li/gpvwb>), and 2) [Understanding and Avoiding Plagiarism](http://surl.li/gpvwo) (<http://surl.li/gpvwo>).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (<https://rb.gy/8sj1h>)

LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.



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To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information:* [Harassment, Bullying & Other Interpersonal Misconduct: Presentation \(http://surl.li/gpvwt \)](http://surl.li/gpvwt)