University of Tehran
School of Electrical and Computer Engineering

Course:	**8101365 – Advanced VLSI Design**
Course type:	

	EE*						CE*			Credit:
	Com	E	P	B	Con	D	SW	HW	IT	
Required	☐	☐	☐	☐	☐	☐	☐	☐	☐	3
Elective	☐	☒	☐	☐	☐	☐	☐	☐	☐	

Level:	Undergraduate ☐ Graduate ■
Co-requisite(s):	-
Prerequisite(s):	-
Prerequisite by topic:	Familiarity with Basic Digital Electronics
Textbook(s):	[1] "CMOS VLSI Design: A Circuits and Systems Perspective", Fourth Edition, by Neil H.E. Weste and D. Harris, Published by Addison Wesley, 2011. ISBN: 978-0-321-54774-3. [2] "Digital Integrated Circuits: A Design Perspective", Second Edition, by J.M. Rabaey, [3] Class lecture notes
Coordinator:	Nasser Masoumi, Professor, Electrical and Computer Engineering
Goals:	Develop understanding of new design methodologies and implementation strategies of digital Very Large Scale ICs. b) Develop understanding of new issues that impact the reliability, robustness, cost, performance, and power dissipation of chips now reaching the 18-nm realm. c) Develop understanding of design considerations to maximize chip success and overall performance
Outcome:	Upon successful completion of the course, students will be able 1. A: UNDESTADN, DESIGN, and OPIMIZE (static and dynamic): 1. A comprehensive variety of all logic families 2.Sequential logic circuits, 3. Arithmetic building blocks, 4. Memories and array structure 5. Crossbar array based architectures All static and dynamic circuits B: To understand, model and apply 1. Design metrics 2. Interconnects caused issues 3. Timing and signal integrity issues 4. Test and testability

Topics:	**1.INTRODUCTION** Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design. Perspective: New Technologies, Nano Electronics, FinFET,Technology Scaling. **2.THE MANUFACTURING PROCESS** Manufacturing CMOS Integrated Circuits, Design Rules, Perspective — Trends in Process Technology. **3. THE DEVICES (A brief Overview)** The MOS(FET) Transistor, A Word on Process Variations, **4. The Wire** Interconnect Parameters Capacitance, Resistance, and Inductance, Electrical Wire Models, Perspective: A Look into the Future. **5. THE CMOS INVERTER** The Static CMOS Inverter An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter: The Static Behavior, Performance of CMOS Inverter: The Dynamic Behavior, Power, Energy, and Energy-Delay, Perspective: Technology Scaling and its Impact on the Inverter Metrics. **6. DESIGNING COMBINATIONAL LOGIC GATES IN CMOS** Static CMOS Design, Dynamic CMOS Design. **7. DESIGNING SEQUENTIAL LOGIC CIRCUITS** Static Latches and Registers, Dynamic Latches and Registers, Alternative Register Styles, Pipelining: An approach to optimize sequential circuits, Perspective: Choosing a Clocking Strategy. **8. DESIGNING SEQUENTIAL LOGIC CIRCUITS** Static Latches and Registers, Dynamic Latches and Registers, Alternative Register Styles, Pipelining: An approach to optimize sequential circuits, Perspective: Choosing a Clocking Strategy. **9. Designing Arithmetic Building Blocks** Datapaths in Digital Processor Architectures, The Adder, The Multiplier, The Shifter, Other Arithmetic Operators, Power and Speed Trade-Offs in Datapath Structures, Perspective: Design as a Trade-Off. **10. Designing Memory and Array Structures** The Memory Core, Memory Peripheral Circuitry, Memory Reliability and Yield, Power Dissipation in Memories, Case Studies in Memory Design, Perspective: Semiconductor Memory Trends and Evolutions. **11. Timing issues** 12. **Crossbar array based architectures** **13. Test and Testability**
Computer usage:	Hspice, L-Edit, S-Edit, ISE Xilinx
Assignments:	8 homework and Computer assignments
Projects:	One final project is given
Grading:	Assignments: 20 % Quizzes 5% Final Project 15% Midterm 30%

	Final 40%
Further readings:	[1] "Low-Power Digital VLSI Design: Circuits and Systems", First Edition, by A. Bellaouar, M.I. Elmasry, Published by Kluwer Academic. ISBN: 978-0-792-39587-4. [2] "Modern VLSI Design: System-on-Chip Design", Second Edition, by W. Wolf, Published by Prentice-Hall. ISBN: 978-0-130-61970-9.
Prepared by:	Nasser Masoumi, Professor of Electrical and Computer Engineering
Date:	September 2017

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		
D	Digital System		