澳門大學
UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU

Major Programme:	Master of Science in Microelectronics & Master of Philosophy in Microelectronics		
Course Type:	☐ CM – Compulsory Major ☑ RE – Required Elective ☐ L&S – Languages and Skills ☐ CPE – Community and Peer Education ☐ * GE – General Education ☐ MI – Minor ☐ FE – Free Elective		
Course Title: (in Chinese and English)	Digital Integrated Circuits 數字集成電路	Suggested Year of Study:	Year 1
Duration:	☑ Semester Course ☐ Yearly Course	Credit Units:	3
Grading System:	☑ Letter Grade ☐ P/NP	Pre-requisite: (if any)	None
Medium of Instruction:	English		
Course Description:	This is an introductory course in digital integrated circuits. It covers topics from MOS inverters and different logic family. The student will learn how to model interconnect wires and design optimization with respect to a number of metrics: cost, reliability, speed and power. This course also cover sequential and dynamic logic circuit design, timing considerations, and clocking approaches, as well as design of large system blocks, including memories, such as D-flip-flop and SRAM. This customized course from bottom-up based, which starts from the fundamental techniques for the design and analysis of digital circuits. Then, it provides a detailed understanding of basic logic synthesis and analysis algorithms, and to enable students to apply this knowledge in the design of digital systems and EDA tools. The course aims to give a basic idea of the digital integrated circuit design. The students will have a hands-on experience on combinational circuit optimization (two-level and multi-level synthesis), sequential circuit optimization (state encoding, retiming), timing analysis, testing, and logic verification through the lab work.		
Intended Learning Outcomes (ILO):	This course enables students to have: • To introduce the essential knowledge in digital circuits design both for custom and auto-genration schemes • To introduce common digital circuit building blocks, such as logic gates, adder and SRAM, with practical considerations. • To teach students with hands on experience on designing and simulating digital circuits using industrial simulation tools with real world CMOS process. • To teach students with hands on experience on the digital standard cell design with real physical layout consideration using industrial layout tools in CMOS process		

Major Assessment Methods:	Case Study	Role Playing	Student Presentation	Individual project / paper	Group project / paper	Group discussions	Writing Assignment	Exercises & problems	Service learning	Internship	Field study	Company visits	Reading & Writing Assessments / tests	Listening & Oral Assessments / tests	Others (please specify)
Class Participation / Discussion 10 %								√							
Assignment(s) 10 %								√							
Test(s) 20 %								√							
Examination 20 %								√							
Others: Project 40 %			√	√											

Course Content: (topic outline)	- Introduction: basic CMOS device physic and technology scaling. - Basic combinational logic overview: CMOS inverters, Nand gate, OR gate, X OR gate, Full and Half Adder design and layout - Modeling of interconnect wires and optimization of design: Elmore delay theory and logical effort. - Other logic families: pass gate logic, dynamic logic and domino logic design consideration and layout. - Memory: D-Flip-Flop and SRAM design and layout - Practical labs: Logic gate layout and synthesis tools