University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Digital System – I		
Course Code:	ELEC110	Year of Study:	2nd semester of 1st year
Compulsory/Elective:	Compulsory		
Course Prerequisites:	None		
Prerequisite Knowledge	Fundamental knowledge of electricity and electronics circuits		
Class/Laboratory Schedule:	2-hour Lecture and 2-hour Tutorial, Quiz or Lab-Experiment per week		
Duration	One semester	Credit Units	3
Text Books* and References:	[1] * "Digital Design–Principles & Practices", John F. Wakerly, Prentice-Hall Inc., Chapter 1 to Chapter 6 and Section 11.1. [2] "Digital Principles and Design", Donald D. Givone, The State University of New York, McGraw-Hill Higher Education. [3] "A First Course In Digital Systems Design: An Integrated Approach", John P. Uyemura, (數字系統設計入門教程---集成方法 [英文影印版]), 科學出版社. [4] "數字電子技術基礎"，閻石(清華大學)，高等教育出版社.		
Course Description:	Info. Tech., Power Electronics Tech. Communication Tech. and Computer Network Tech. etc. are widely used nowadays. Their common background is Digital Electronics and Digital System. The course is divided into two parts: Digital System–I and Digital System–II. In Digital System–I, mainly teaches the basic elements of Digital System, such as **various gates** (AND, OR, Invert, NAND, NOR, NOT-AND-OR, Exclusive, Inclusive, OC, OD, TS, TG, SW gates) and **different types of digital circuit** like DTL, TTL, CMOS, ECL etc. Learn their feature characteristics and calculate the parameter values of components. The rather important content in Digital System–I is **Switching Algebra or Boolean Algebra** including Formula simplification method, Karnaugh Map simplification method and Hybrid simplification method, which is a key theoretical tool often used in the Analysis & Design of Digital Systems. Then the **Analysis & Design method** of **Combinational Circuits** will be explained with detail and some typical Combinational Circuits, such as Encoder, Decoder-Displayer, Half-Adder, Full-Adder, Comparator, Multiplexer, Demultiplexer and other ALU (Arithmetic and Logic Unit), MSI (Middle Size Integrated circuit) etc. will be introduced. Finally, the **VHDL programming language and a CAD tool** for designing and simulating the Combinational Circuits will be briefly described.		

Topics Covered	1. **Basic elements** of **Combinational Logic Circuits**, such as **various gates** (AND, OR, Invert, NAND, NOR, NOT-AND-OR, Exclusive, Inclusive, OC, OD, TS, TG, SW gates) and **different types of digital circuit** like DTL, TTL, CMOS, ECL etc. 2. **Switching Algebra** 3. **Analysis & Design method** of **Combinational Logic Circuits**, such as analyze and design Encoder, Decoder-Displayer, Half-Adder, Full-Adder, Comparator, Multiplexer, Demultiplexer and other ALU (Arithmetic and Logic Unit), MSI (Middle Size Integrated circuit) etc. 4. **VHDL programming language and a CAD tool** for designing and simulating the combinational logic circuits.
Course Objectives:	1. Digital System–I is the background of further studying the Digital System–II; 2. Provide the useful knowledge, analysis & design methods and development skills to students, educate them be able to analyze, design, create, implement, test and adjust the various digital systems according to the concrete demands of real world by using the existing popular digital hardware components and CAD tools in both board-level & VLSIC systems [a, b, c, d, e, k], [h, j].
Course Assessment:	Assignments and Quiz: 20% Lab-Experiments: 30% Final Examination: 50%
Relationship to Program Objectives and Outcomes	This course contributes to EEE program outcomes that develop students' abilities to: a. Ability to apply knowledge of mathematics, science and engineering. b. Ability to design and conduct experiments. c. Ability to design a system, component or process to meet desired needs. d. Ability to function on multidisciplinary teams. e. Ability to identify, formulate and solve engineering problems. k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice. a) analyze, design, simulate, construct and test the various combinational logic circuits according to the engineering requirements or technical specifications. b) calculate the proper parameter values of components in combinational logic circuits. c) identify, formulate and solve encountered engineering problems in combinational logic circuits.

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<tr><td></td><td>d) use techniques, skills and modern CAD engineering tools independently in engineering practice.</td></tr>
<tr><td>Course Contents and Relationship to Program Criteria:</td><td>
<table>
<tr><th>Week no.</th><th>Topics</th><th>Program Criteria</th></tr>
<tr><td>5</td><td><u>Gate Circuits and Characteristic Curves</u>:
• Various gate circuits like AND, OR, Invert, NAND, NOR, NOT-AND-OR, Exclusive, Inclusive gates and different types of digital circuit like DTL, TTL, CMOS, ECL etc.;
• TTL NAND gate: basic circuit, static and dynamical characteristic curves;
• Calculate the proper parameter values of components in gates and combinational logic circuits by using characteristic curves
• Other type of gate: OC, TS gates</td><td>BC, CS, ES, CV</td></tr>
<tr><td>3</td><td><u>Switching Algebra and Its Application</u>:
• Operational Principle of Switching Algebra;
• Formula Simplification Method;
• Karnaugh Map Simplification Method;
• Hybrid Simplification Method;
• Simplify the Logic Function with Constraints.</td><td>BC, CS, ES, CV</td></tr>
<tr><td>4</td><td><u>Combinational Logic Circuits: Analysis and Design</u>:
• Analysis Method of Combinational Circuit: Exclusive/Inclusive gates and Half-Adder, Various Combinational Logic Circuits;
• Design Method of Combinational Logic Circuit: Encoder/Priority Encoder, Full-Adder, Full & Half subtracters, Digital Comparator, Odd/Even Inspector, Multiplexer, Dimultiplexer and other ALU (Arithmetic and Logic Unit);
• Flexible Applications of Middle-Size IC;
• Race-Hazard problems of Combinational Logic Circuit and their solutions.</td><td>BC, CS, ES, CV</td></tr>
<tr><td>1</td><td><u>VHDL Language and CAD Tool for Designing & Simulating Combinational Logic Circuits</u>:
• HDL and VHDL Hardware Description Language for designing and simulating Combinational Logic Circuit
• CAD Tool: Max+Plus-II
• Design and Simulate Combination Logic Circuits by using CAD tool</td><td>BC, CS, ES, CV</td></tr>
<tr><td>1</td><td><u>MOS, CMOS and Hybrid Logic</u>:
• MOS and CMOS basic gate circuits and characteristic curves
• OD, TG, SW gates
• Hybrid Logic and its applications</td><td>BC, CS, ES, CV</td></tr>
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<tr><td>Contribution of Course to meet the professional component:</td><td>This course prepares students to work professionally in the area of digital electronics and digital system related fields. Students should be able to apply knowledge of digital electronics and digital system, and methods of analysis, design and CAD to solve digital electronics engineering problems.</td></tr>
<tr><td>Course Instructor(s):</td><td>Prof. DONG Mingchui</td></tr>
<tr><td>Prepared by:</td><td>Prof. DONG Mingchui</td></tr>
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Part B: General Course Information and Policies

Instructor: Prof. DONG Mingchui Office: 1/F of Block III
Office Hour: Wednsday 3:30~6:00 p.m. or by appointment Phone: 4520
e-mail: mcdong@umac.mo; dmc@sftw.umac.mo

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Digital System - I			1	1	1			3	

Terms:

Probability and Statistics (PS), Differential and Integral Calculus (DIC), Basic Science (BS), Computer Science (CS), Engineering Science (ES), Differential Equation (DE), Linear Algebra (LA), Complex Variables (CV), Discrete Mathematics (DM)

Program Outcome Policy:

Course VS Course Outcomes

(H= Highly Related, S = Supportive, N = None)

Course	a	b	c	d	e	f	g	h	i	j	k
Digital System - I	H	H	H	S	H	N	N	S	N	S	H

The electrical and electronics engineering program outcomes are:

a. Ability to apply knowledge of mathematics, science and engineering.

b. Ability to design and conduct experiments.

c. Ability to design a system, component or process to meet desired needs.

d. Ability to function on multidisciplinary teams.

e. Ability to identify, formulate and solve engineering problems.

f. Understanding of professional and ethical responsibility.

g. Ability to communicate effectively.

h. Broad education necessary to understand the impact of engineering solutions in global and societal context.

i. Recognition of the need for and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Course Assessment Policy:

- Homework assignments will be given to students according to the course progress. The result of each assignment should be done independently by student and submitted to teacher within 2 weeks, no late homework is accepted. Zero mark will be given when homework is copied.
- At least 5 quizzes will be held during the tutorial courses in a semester.
- 5 Lab-experiments will be performed during the semester. 2 students form one group and group report should be handed up within 2 weeks after assignment.
- At the end of semester, a 3-hour close-book final examination will be performed.