University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Digital Systems II		
Course Code:	ELEC210	Year of Study:	1st semester of 2nd year
Course Mode:	Theoretical with substantial laboratory/practice content		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	Digital Systems I		
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 7 to the end. [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□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(□華大學), 高等□育出版社.		
Course Description:	Based on the previous study of **various Gates and their characteristic curves, Switching Algebra** and **Combinational Circuits** in Digital System-I, this Digital System–II will further teacher more important part of digital system – **Sequential Logic Circuits**, which includes bi-stable elements: S-R / D latches / J-K / D / T / T' flip-flops, single-stable elements, integrated timer, Schmitt trigger as well as ROM (Read Only Memory), RAM (Random Access Memory), CPLD (Complex Programmable Logic Devices) and FPGA (Field-Programmable Gate Arrays) etc.; analyze and design the basic circuits: registers and shift-registers, counters, shift-register type counters, synchronous/asynchronous state machines, sequential PLDs, sequential-pulse generator, function generator, etc. Learn their feature characteristics and calculate the parameter values of components. The course will teach students to grasp the basic analysis, design and CAD principles and be able to make analysis and design practices in both board-level & VLSIC (Very Large Scale Integrated Circuit) systems independently. Some up-to-date advanced **Computer-Aided Design Tools** will be introduced and used in this course.		
Topics Covered	1. **Basic elements** of **Sequential Logic Circuits**, such as bi-stable elements: S-R / D latches / J-K / D / T / T' flip-flops; single-stable trigger, integrated timer, Schmitt trigger as well as ROM (Read Only Memory), RAM (Random Access Memory), CPLD (Complex Programmable Logic Devices) and FPGA		

	(Field-Programmable Gate Arrays) etc.; 2. **Analysis & Design method** of **Sequential Logic Circuits**, such as analyze and design registers and shift-registers, counters, shift-register-type counters, synchronous/asynchronous state machines, sequential PLDs, single pulse generator, sequential-pulse generator, function generator etc. 3. **VHDL programming language and a CAD tool** for designing and simulating the sequential logic circuits
Course Objectives:	1. Digital System is the background of further studying the Computer Science and Power Electronics [d]; 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]; 3. Through experiments to train students having the capability of using components to construct the required digital systems and using measurement instruments to test and adjust them [a, b, c, d, e, k].
Course Assessment:	Assignments and Quiz: 20% Lab-Experiments: 30% Final Examination: 50%
Relationship to Program Objectives and Outcomes	This course primarily contributes to EEE program outcomes that develop students abilities to: a) analyze, design, simulate, construct and test the various sequential logic circuits according to the engineering requirements or technical specifications. b) calculate the proper parameter values of components in sequential logic circuits. c) identify, formulate and solve encountered engineering problems in sequential logic circuits. d) use techniques, skills and modern CAD engineering tools independently in engineering practice.

<table>
<tr><td rowspan="5">Course Contents and Relationship to Program Criteria:</td><td colspan="3"></td></tr>
<tr><td>Week no.</td><td>Topics</td><td>Program Criteria</td></tr>
<tr><td>1~3</td><td><u>Components of Sequential Logic Circuits</u>:
• Bi-stable elements: like Basic and Synchronous S-R Latches, T’ (Toggle) Latch, J-K / D / T / T’ Flip-Flops, Sequential PLDs etc.;
• Transformation between different Flip-Flops</td><td>BC, CS, ES, CV, DM</td></tr>
<tr><td>4~11</td><td><u>Sequential Logic Circuits: Analysis and Design</u>:
• Analyze and Design Registers: Shift registers, Integrated circuits of registers, Application Examples of IC Registers;
• Analyze and Design Counters: Asynchronous counters, Synchronous counters, shift-register-type counters;
• Analyze and Design Sequential Pulse Generator: Integrated timer, Schmitt Trigger, Single Pulse Generator, Oscillators etc.
• Analyze and Design Digital Systems.</td><td>BC, CS, ES, CV, DIC, DM</td></tr>
<tr><td>12</td><td><u>VHDL Language and CAD Tool for Designing & Simulating Sequential Logic Circuits</u>:
• HDL and VHDL Hardware Description Language for designing and simulating Sequential Logic Circuit
• CAD Tool: Max+Plus-II
• Design and Simulate Sequential Logic Circuits by using CAD tool
• Design and Simulate Digital System by using CAD tool</td><td>BC, CS, ES, CV, DM</td></tr>
<tr><td>13~14</td><td><u>Memory, CPLD and FPGAS</u>:
• Structure and Working Principle of ROM and RAM
• CPLD and Its Applications
• FPGA and Its Applications</td><td>BC, CS, ES</td></tr>
<tr><td>Contribution of Course to meet the professional component:</td><td colspan="3">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 colspan="3">Prof. Ming Chui DONG</td></tr>
<tr><td>Prepared by:</td><td colspan="3">Prof. Ming Chui DONG, Mr. Chi Pio TOU</td></tr>
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Part B: General Course Information and Policies

Instructor: Prof. Ming Chui DONG 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

Programme Educational Objectives

1. **Problem Solving:** Provide the useful knowledge, analysis & design methods and development skills to students. Graduates will be able to analyze, design, create, implement, test and adjust the various digital systems according to the concrete demands of real world.
2. **Leadership and Communication:** Graduates will provide effective leadership, act in an ethical manner with the skills, which includes the ability to communicate well and to work successfully within diverse groups.
3. **Market Acceptance:** Graduates will have successful careers in the academic environment, industrial and government organizations.
4. **Technical Competence:** Graduates will be technically competent and have a thorough grounding in the fundamentals of math and science in electrical and electronics engineering and experience in engineering design. They will be able to use modern engineering techniques, skills, and tools to fulfill societal needs.

Scale: 1 (Highest) to 4 (Lowest)

	Problem Solving	**Leadership and Communication**	**Market Acceptance**	**Technical Competence**
Digital Systems II	1	3	3	1

Remark:

- Objective for “Problem Solving” can be achieved by assignments, quizzes, experiments, final exam and projects.
- Objective for “Leadership and Communication” can be achieved by report writing and presentation. However, leadership training is not given by this course.
- Objective for “Market Acceptance” can be achieved by the course subject that is related to design/implement/test the concrete digital systems according to the demands raised from real-world by using the existing popular digital hardware components and CAD tools in both board-level & VLSIC systems.
- Objective for “Technical Competence” can be achieved by learning fundamental knowledge of math and science in electrical and electronics engineering as well as

the experience in design/implementation/test and CAD of digital systems.

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Digital Systems II		3	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 Systems II	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.

Curriculum Detail

ELEC210: Digital Systems II

Timetabled work in hours per week			**No of teaching weeks**	**Total hours**	**No /Duration of exam papers**	**Max marks available from:**	
Lecturer	**Tutor**	**Practice**				**Exams**	**Course**
2	1.3	0.7	14	56	1/2 hours	50	50

Term: 3th

Hours			**Percentage of content**					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
28	10/18	0	10	10	30	40	0	10

Design Elements

% of Design Content	**Design Content in Course Work**	**Design Project**	**Design Content in Laboratories**
40%	X	X	X

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 4 quizzes will be held during the tutorial courses in a semester.
- 5 Lab-experiments will be performed during the semester. 2~3 students form one group and group report should be handed up within 2 weeks after assignment.
- At the end of semester, a 2-hour close-book final examination will be performed.