University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Digital Controllers		
Course Code:	ELEC414	Year of Study:	4
Compulsory/Elective:	Elective		
Course Prerequisites:	CPTG300		
Prerequisite Knowledge	Microprocessors Architecture, Bus, Timing, Fundamental Electronics, Digital Circuits		
Class/Laboratory Schedule:	2-hours lecturer, 3-hours tutorial/lab per week		
Duration	One semester	Credit Units	3.5
Text Books and References:	[1] SYNTHESIS OF ARITHMETIC CIRCUITS – FPGA, ASIC, and Embedded Systems, JEAN-PIERRE DESCHAMPS, WILEY, 2006 [2] VHDL: Programming by Example, Douglas L. Perry, Fourth Edition, McGraw-Hill, 2002 [3] A. Kent Stiffler, Design with Microprocessors for Mechanical Engineers, Mc Graw Hill [4] Arnold Berger, Embedded Systems Design, An Introduction to Processes, Tools, and Techniques, CMPBooks, 2001 [5] Wayne Wolf, Computers as Components Principles of Embedded computing System Design, Morgan Kaufmann, 2001		
Course Description:	This is a project based course to train the students the fundamentals of building an embedded system based on microelectronics or FPGA. It provides the students the general concepts and techniques for interfacing different peripherals as well as the communication among subsystems.		
Topics Covered	1. Introduction 2. Real time systems 3. Embedded OS 4. FPGA 5. SOPC 6. Interfaces 7. A/D D/A channels 8. Data exchange 9. Bus 10. Protocol 11. Examples		

Course Objectives:	1. To introduce to students the concept and theory of Embedded Systems [a, b, c, k] 2. To prepare students to know how to design embedded systems to meet different engineering requirements, [a, b, c, k] 3. To train students with concepts in selecting hardwired / software based embedded systems to compromise speed, reliability, cost, time, etc. [c, e] 4. To let students working in group for projects for engineering problems to build up team spirits, cooperation and presentation skills. [a, b, c, d, e, g, k]
Course Assessment:	Assignments and Labs: 30% Quizzes :10% Mid-term Exam. : 30% Final Exam. : 30%
Relationship to Program Objectives and Outcomes	This course primarily 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. k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice. This course secondarily contributes to EEE program outcomes that develop students abilities to: d. Ability to function on multidisciplinary teams. e. Ability to identify, formulate and solve engineering problems. g. Ability to communicate effectively.

<table>
<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>1</td><td>Introduction
What, Why, When Embedded Systems, the different between embedded systems and general computers, general architecture</td><td>CS, ES</td></tr>
<tr><td>0.5</td><td>Real time systems
Real time concepts, soft real time, hard real time, real time and embedded systems,</td><td>CS, ES</td></tr>
<tr><td>0.5</td><td>Embedded OS
Real time OS and non-real time OS, Multi-tasking, μC/OSII, Linux</td><td>CS, ES, DM</td></tr>
<tr><td>0.5</td><td>FPGA
FPGA development, HDL, Design with FPGA</td><td>CS, ES</td></tr>
<tr><td>0.5</td><td>SOPC
Configurable Computing Technology, Soft core microprocessors</td><td>CS, ES</td></tr>
<tr><td>1.5</td><td>Interfaces
Logic families, binaries, switches, keyboard, display, Mechanical devices</td><td>BS, CS, ES, CV, LA</td></tr>
<tr><td>1.5</td><td>A/D D/A channels
A/D, D/A channel structure, A/D, D/A converters, Filters, S/H, Amplifiers, multiplexers</td><td>BS, CS, ES</td></tr>
<tr><td>1.5</td><td>Data Exchanges
Synchronous & Asynchronous, Full/Half Duplex and Simplex, Serial and Parallel, Standard exchange interfaces</td><td>BS, CS, ES, DM</td></tr>
<tr><td>1.5</td><td>Bus
Serial and parallel, Synchronous & Asynchronous, Arbitration, Standard Buses</td><td>BS, CS, ES, DM</td></tr>
<tr><td>1.5</td><td>Protocols
Addressing, Data Format, Error Checking, Synchronization, Protocols for standard buses</td><td>BS, CS, ES</td></tr>
<tr><td>1.5</td><td>Examples
Examples for building up embedded systems</td><td>BS, CS, ES, LA, DM</td></tr>
</table>
</td></tr>
<tr><td>Contribution of Course to meet the professional component:</td><td>This course prepares students the professional skills and knowledge of the Embedded Systems design. Students should be able to design an embedded system for different applications.</td></tr>
<tr><td>Course Instructor(s):</td><td>Prof. Vai Mang I</td></tr>
<tr><td>Prepared by:</td><td>Prof. Vai Mang I</td></tr>
</table>

Part B: General Course Information and Policies

Instructor: Prof. Vai Mang I Office: N508 Phone: 4958

Office Hour: Monday 3:00~5:00 p.m in NG05/NG06 or by appointment

e-mail: fstmiv@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 Controllers	4		3	1	2		4	4	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 Controllers	H	H	H	S	S	N	S	N	N	N	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, no late homework is accepted. Zero mark will be given when homework is copied.
- Very short quizzes (a few minutes each) will be arranged for students randomly at the beginning or at the end of a class during the semester.
- labs / projects will be performed during the semester. 1 - 3 students form one group (student number in a group is subject to approval) and group report should be handed up on time. Presentation / Demonstration may be required.
- 1 mid-term exam and 1 final exam will be performed with 2 hours and 3 hours respectively.