University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Power Electronics		
Course Code:	ELEC323	Year of Study:	3
Compulsory/Elective:	Compulsory		
Course Prerequisites:	None		
Prerequisite Knowledge	Circuit Analysis, fundamental electronics circuits, differential equations and Calculus		
Class/Laboratory Schedule:	2-hours lecturer, 1.5 hours simulation and 0.5 hour tutorial per week		
Duration	One semester	Credit Units	3.5
Text Books and References:	[1] "Power Electronics: Circuits, Devices, and Applications " , M.H.Rashid , Prentice-Hall International [2] "Power Electronics: Converters, Applications, and Design", Mohan / Undeland / Robbins , Wiley . [3] "Principles of Power electronics ", John G. Kassakian , Addison Wesley		
Course Description:	Power electronics deals with the application of solid-state electronics for the control and conversion of electric power. Applications include electronic power supplies, aerospace and vehicular power systems, and renewable energy systems. The course is an introduction to switched-mode power converters. It provides a basic knowledge of circuitry for the control and conversion of electrical power with high efficiency. These converters can change and regulate the voltage, current, or power.		
Topics Covered	1. Introduction of Power Electronics and Its applications 2. Power Semiconductor Switches 3. DC Choppers 4. Uncontrollable and Controllable Rectifiers 5. DC/AC Inverters 6. Control of Power Electronics Systems		
Course Objectives:	1. To introduce to students the theory and applications of power electronics systems for high efficiency, renewable and energy saving conversion systems, [a, e, k] 2. To prepare students to know the characteristics of different power electronics switches, drivers and selection of components for different applications, [a, b, e] 3. To develop students with an understanding of the switching behavior and design of power electronics circuits such as DC/DC, AC/DC, DC/AC and AC/AC converters.[a, b, c, d, e, k]		

<table>
<tr><td>Course Assessment:</td><td>Assignments : 10%
Quiz :15%
Simulation Projects and Experiments: 25%
Mid-term Exam. : 25%
Final Exam. : 25%</td></tr>
<tr><td>Relationship to Program Objectives and Outcomes</td><td>This course primarily contributes to EEE program outcomes that develop students abilities to:
a. Ability to apply knowledge of mathematics, science and engineering.
e. Ability to identify, formulate and solve engineering problems.
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:
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.</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>3</td><td>Introduction
Power Electronics Applications, power electronics system elements, steady-state and transient response of circuits, circuit commutation</td><td>DIC, ES, DE,</td></tr>
<tr><td>2</td><td>Power Semiconductor Devices
PN Junction operation , Breakdown , Diodes, BJT, Thyristor, GTO, MOSFET, IGBT, MCT, Reversed Recovery Characteristics, snubber circuit and its operation, switching component simulation</td><td>DIC, ES, CS</td></tr>
<tr><td>3</td><td>DC Choppers
Step-up, Step-down, Step up and down converters, chopper circuit simulation, Full Bridge, Bipolar and Unipolar PWM Operations</td><td>DIC, ES, CS, DE</td></tr>
<tr><td>3</td><td>Uncontrollable and Controllable Rectifiers
Diode rectifiers, IGBT rectifiers, freewheeling circuit, communication, limiting inductor and short circuit, rectifier simulation</td><td>ES, CS,</td></tr>
<tr><td>3</td><td>DC/AC Inverters, AC/AC Converters and PWM Control
Inverters, converters & PWM Operations</td><td>ES, CV</td></tr>
</table>
</td></tr>
<tr><td>Contribution of Course to meet the professional component:</td><td>This course prepares students to work professionally in the area of power and power related fields. Students should be able to apply knowledge of mathematics and engineering, and identify formulas to solve power and power electronics engineering problems.</td></tr>
<tr><td>Course Instructor(s):</td><td>Dr. Han Ying- Duo, Dr. Wong Man-Chung</td></tr>
<tr><td>Prepared by:</td><td>Dr. Man-Chung Wong</td></tr>
</table>

Part B: General Course Information and Policies

Instructor: Dr. Man Chung Wong Office: N421
Office Hour: Monday 3:30~5:30 p.m. or by appointment Phone: 4391
e-mail: mcwong@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
Power Electronics		3		3	1	3		4	

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	l
Power Electronics	H	S	S	S	H	N	N	N	N	N	H	S

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.

l. Ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations

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.
- 3 Quizzes will be held during the semester.
- 5 simulation projects will be performed during the semester. 2 students form one group and group report should be handed up.
- 1 mid-term exam and 1 final exam will be performed with 2 hours and 3 hours respectively.