University of Macau

Faculty of Science and Technology

Department of Electrical and Computer Engineering

Part A: Course Outline

Course Title:	Power Quality and Energy Saving		
Course Code:	ELEC372	Year of Study:	3
Course Mode:	Design		
Compulsory/Elective:	Elective		
Course Prerequisites:	Power Electronics		
Prerequisite Knowledge	Power System, power electronics		
Class/Laboratory Schedule:	2.5-hour lecturer, 1.5- hour laboratory		
Duration	One semester	Credit Units	3
Text Books and References:	[1] "Power Quality in Electrical Systems", A. Kusko, M. T. Thompson, McGraw-Hill, c2007. [2] "Electrical Power System Quality", Surya Santoso, H. Wayne Beaty, Roger C. Dugan, etc. McGraw-Hill, 2nd edition, c2003. [3] "Handbook of Energy Efficiency and Renewable Energy", Kreith, Goswami, CRC Press, 2007		
Course Description:	Power Quality and Energy Saving provides student with an overall understanding of power quality and energy saving measures. Topics include power quality terms and definitions, voltage distortion, harmonics and filtering, strategies for improving power quality, power quality monitoring and survey. It also includes the topics of energy efficiency, energy conservation, energy management in buildings and energy audit.		
Topics Covered	1. Introduction to Power Quality 2. Power Quality Terms and Definition 3. Voltage Distortions 4. Harmonics and Filtering 5. Power Quality Measurements and Survey 6. Power Quality Compensation 7. Introduction to Energy Saving 8. Energy Management in Buildings 9. Energy Audit.		
Course Objectives:	1. To introduce to students the term and definition of power quality disturbances, and their causes, detrimental effects and solutions. [a, g, k] 2. To introduce the harmonic sources, passive filters, active filters and standards. [a, c, e, g, k]		

<table>
<tr><td></td><td>3. To prepare students to know the power quality monitoring method, equipments and develop the ability to analyze the measured data. [a, b, c , g, k]
4. To introduce to student the global energy consumption, energy management in buildings, energy efficient technologies.[a, e]
5. To develop student the ability to do simple energy audit. [a, e]</td></tr>
<tr><td>Course Assessment:</td><td>Assignments : 15%
Simulation Projects: 20%
Mid-term Projects: 30%
Final Exam. : 35%</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.
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.
e. Ability to identify, formulate and solve engineering problems.
g. Ability to communicate effectively.</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>0.5</td><td>Introduction to Power Quality
Introduction to power system, Power quality and Power quality standards.</td><td>BS</td></tr>
<tr><td>1.5</td><td>Voltage Distortion
Voltage sag, transient, Voltage Sag, Voltage Swell, Impulse transient, Oscillatory transient, Notching, Voltage fluctuation and flicker, Unbalance.</td><td>DIC, BS, ES,</td></tr>
<tr><td>1.5</td><td>Harmonics and Interharmonics
Fourier Analyses, Root-mean square value, Total harmonic distortion, Crest factor, Power and power factor, Symmetrical component.</td><td>DIC, BS, ES</td></tr>
<tr><td>4</td><td>Harmonics Sources and Filters
Harmonic sources, Effects of harmonic distortion, Principles for controlling harmonics, Instantaneous reactive power theory , Harmonic compensators, Harmonic Standards.</td><td>BS, CS, ES</td></tr>
<tr><td>1</td><td>Power Quality Compensators
Dynamic voltage restorer, uninterruptable power supply.</td><td>BS, ES</td></tr>
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	2	**Power Quality Measurements and Survey** Monitoring considerations, Instruments, Assessment of power quality measurement data, Case study.	PS, ES, CS,
	1	**Introduction to Energy Saving** Global energy system, Energy Efficiency for appliances, Electrical Distribution system, Power quality and Energy Saving, Renewable energy sources.	ES
	1.5	**Energy Management in buildings** Electricity use in buildings, End-use management, Electricity-saving techniques, Energy Efficient Technologies	BS, ES
	1	**Energy Audit** Type of energy audit, Procedure for a detailed energy audit, Case study	PS, ES
Contribution of Course to meet the professional component:	This course prepares students to work professionally in the area of electrical engineering fields. Students could learn the basic knowledge about power quality, energy management and energy saving, and be able to apply the knowledge to explain or solve practical engineering problems.		
Course Instructor(s):	Dr. Dai Ning-Yi		
Prepared by:	Dr. Dai Ning-Yi		

Part B: General Course Information and Policies

Instructor: Dr. Dai Ning Yi Office: B1-A703

Office Hour: Tuesday 3:00~5:00 p.m. or by appointment Phone: 8470

e-mail: nydai@umac.mo

Programme Educational Objectives

1. **Problem Solving:** Graduates have the ability to think in a critical and evaluative manner and to consider a broad perspective, in order to solve technical and nontechnical problems.
2. **Leadership and Communication:** Graduates will provide effective leadership, act in an ethical manner and skills will include 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 computer 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	**Leadership and**	**Market**	**Technical**

	Solving	Communication	Acceptance	Competence
Measurement And Instrumentation II	1	4	2	1

Remark:

- Objective for “Problem Solving” can be achieved by assignments, simulation projects, mid-term projects and final exam.
- 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 contents that are required in industries.
- Objective for “Technical Competence” can be achieved by using fundamentals of math and science in electrical and computer engineering and experience in engineering project design and computer simulation.

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Power Quality and Energy Saving	4	4	3	3	2				

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 Quality and Energy Saving	H	S	S	N	S	N	S	N	N	N	H	N

The electrical and Computer 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

Curriculum Detail

ELEC 372 Power Quality and Energy Saving

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
2.5	0	1.5	14	56	1/3 hours	35	65

Term: 6th

Hours			Percentage content of					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
35	21	0	10	0	40	35	0	15

Design Elements

% of Design Content	Design Content in Course Work	Design Project	Design Content in Laboratories
15%	X	X	X

Course Assessment Policy:

- Homework assignments will be given to students, no late homework is accepted. Presentation is required together with the report for some assignments.
- Simulation Practice will be given to students according to the course progress. Reports are required for each simulation practice.
- One mid-term project will be provided, which include experiment in the laboratory, and

simulation. Each student should hand in a report and give a 10-minute presentation.

- One two-hour final exam will be performed.