University of Macau

Faculty of Science and Technology

Department of Electrical and Computer Engineering

Part A: Course Outline

Course Title:	Renewable Energy Conversion		
Course Code:	ECEB454	Year of Study:	3/4 or 4/4
Course Mode	Design		
Compulsory/Elective:	Elective		
Course Prerequisites:	Power Electronics		
Prerequisite Knowledge	Power System, Power Electronics		
Classroom	E11-1021	Class meet up time	9:00-10:45
	E11-1028		2:30-4:15
Class Schedule	2.5-hour lecturer, 1.5- hour laboratory		
Duration	One semester	Credit Units	3
Text Books and References:	[1] Ewald F. fuchs, Mohammad A.S.Masoum "Power Conversion of Renewable Energy Systems", Springer, 2011 [2] A.Khaligh, O.C.Onar, "Energy Harvesting: Solar, Wind and Ocean Energy Conversion Systems", CRC Press, 2009. [3] M. Antchev, "Technologies for electrical power conversion, efficiency, and distribution: methods and Processes", Engineering Science Reference 2009		
Course Description:	This course introduces the engineering and technical aspects of renewable energy conversion systems utilizing solar, wind and others. It emphasizes basic generation and power conversion technologies of renewable energy generation systems. Topics include different available sources of sustainable energy and power, their applications, their limitations, energy conversion, integration circuits and storage for renewable technologies.		
Topics Covered	1. Introduction to Energy Conservation and Renewable Energy Systems 2. Basics for power converter control 3. Power electronics Converters 4. Energy Storage and Conversion 5. Solar Energy Conversion 6. Wind Energy Conversion 7. Other Renewable Energy Sources		
Course Objectives:	1. To prepare students to know the overview of energy conservation and renewable energy systems. [a] 2. To introduce power electronics converters and their basic control techniques. [a, c, e, g, k]		

	3. To introduce solar energy conversion, including I-V characteristics of PV systems, MPPT techniques and power electronics interface. [a, c , e, k] 4. To introduce wind energy conversion, including wind turbines, electrical machines in wind turbines and application of power converters in wind power generation. [a, c, e, k] 5. To introduce to students ways and technique means to store energy and the corresponding energy conversion techniques. [a, c, k] 6. To introduce to students other renewable energy sources [a, g]
Course Assessment:	Assignments : 10% Simulation Projects: 20% Mid-term Projects: 30% Final Exam. : 40%
Relationship to Program Objectives and Outcomes	This course primarily contributes to ECE 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 ECE program outcomes that develop students abilities to: 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.
Course Contents and Relationship to Program Criteria:	(see table below)

Week no.	Topics	Program Criteria
1	**Introduction to Renewable Energy Systems** Introduction to energy and energy conservation, Renewable Energy Systems, role of power electronics, power quality	BS, ES
1	**Basics for power converter control** Review of differential equations, open-loop and closed-loop control, PI controller	DIC, BS, ES
3	**Power Electronic Converters** Basic concepts, DC/DC, AC/DC, DC/AC and AC/AC converters.	DIC, ES
2	**Energy Storage and Conversion** Review ways to store energy as electrochemical, electromagnetic, and other ways. The power conversion techniques involved	ES

		are also briefly introduced	
	3	**Solar Energy Conversion** I-V characteristics of PV system, MPPT techniques, Power electronics interface for PV systems and related standards	ES
	3	**Wind Energy Conversion** Wind turbine, Electrical machines in wind turbines, application of power converters in wind energy conversion and related wind integration standards.	ES
	1	**Other renewable energy sources** Fuel Cells, Tidal Energy, etc.	BS , 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 energy and energy conservation, renewable energy generation and conversion. Students also learn how to apply the power electronics converters in the renewable energy conversion systems.	
Course Instructor(s):		Dr. Chi Kong Wong	
Prepared by:		Dr. Dai Ning-Yi	

Part B: General Course Information and Policies

Instructor: Dr. Chi Kong Wong   Office: E11-2052
Office Hour: Monday 11:00~12:00 and Friday from 9:30-10:30 or by appointment
Phone: 4364
e-mail: ckwong@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 Solving	**Leadership and Communication**	**Market Acceptance**	**Technical Competence**
Renewable Energy Conversion	2	4	2	2

Remark:

- Objective for "Problem Solving" can be achieved by assignments.
- Objective for "Leadership and Communication" can be achieved by group 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 site visit.
- Objective for "Technical Competence" can be achieved by using fundamentals of math and science in electrical and computer engineering on reports.

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Renewable Energy Conversion		4	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)

Relationship of course to Programme Outcomes:

Course VS Course Outcomes

	Program Outcomes											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**

ECEB454 Renewable Energy Conversion	T	P	TP		P	T					P	P

*T – TEACH; P – PRACTICE; M – MEASURED

The electrical and computer engineering program outcomes are:

(a)   an ability to apply knowledge of mathematics, science, and engineering appropriate to the degree discipline

(b)   an ability to design and conduct experiments, as well as to analyse and interpret data

(c)   an ability to design a system, component or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability

(d)   an ability to function on multi-disciplinary teams

(e)   an ability to identify, formulate and solve engineering problems

(f)   an ability to understand professional and ethical responsibility

(g)   an ability to communicate effectively

(h)   an ability to understand the impact of engineering solutions in a global and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public

(i)   an ability to stay abreast of contemporary issues

(j)   an ability to recognise the need for, and to engage in life-long learning

(k)   an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline

(l)   an ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations

Curriculum Detail

ECEB454 Renewable Energy Conversion

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	1/2 hours	40	60

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	45	30	0	15

Design Elements

Design Content in Course Work	Design Project	Design Content in Laboratories
5%	10%	

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.
- One two-hour final exam will be performed.

STUDENT DISABILITIES SUPPORT SERVICE

The University of Macau is committed to providing an equal opportunity in education to persons with disabilities. If you are a student with a physical, visual, hearing, speech, learning or psychological impairment(s) which substantially limit your learning and/or activities of daily living, you are encouraged to communicate with your instructors about your impairment(s) and the accommodations you need in your studies. You are also encouraged to contact the Student Disability Support Service of the Student Counselling and Development Section (SCD) in Student Affairs Office, which provides appropriate resources and accommodations to allow each student with a disability to have an equal opportunity in education, university life activities and services at the University of Macau. To learn more about the service, please contact SCD at scd.disability@umac.mo, or 8822 4901 or visit the following website: http://www.umac.mo/sao/scd/sds/aboutus/en/scd_mission.php.