City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A in 2020/2021

Part I Course Overview

Course Title:	Sustainable Energy Systems
Course Code:	EE4101
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	B4
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	EE3110 Analogue Electronic circuits
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The aim of this course is to provide students with an understanding of the concepts / techniques / basic principles of power conversion techniques and their applications.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Recognize and differentiate different state-of-the-art energy generation, conversion, storage and utilization technologies		✓	✓	
2.	Analyze different architectures for energy conversion, storage, and utilization		✓	✓	
3.	Design systems for real-life applications		✓	✓	
		100%			

** If weighting is assigned to CILOs, they should add up to 100%.*

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3				
Lectures	Key concepts are described, illustrated, and applied	✓	✓	✓				3 hrs/wk
Tutorial	Students will be taught how to apply the techniques discussed in lectures	✓	✓	✓				

Mini-project / Practice class	Design projects on renewable energy systems.	✓	✓	✓				3 hrs/wk for 6 weeks

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3					
Continuous Assessment: 50%								
Tests (min.: 2)	✓	✓	✓				35%	
#Assignments (min.: 3)	✓	✓	✓				15%	
Examination: 50% (duration: 2 hrs , if applicable)								
Examination	✓	✓	✓				50%	
** The weightings should add up to 100%.*							100%	

Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

may include homework, tutorial exercise, project/mini-project, presentation

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achieving all CILOs	High	Significant	Moderate	Margin	Not even reaching marginal
2. Coursework	Achieving all CILOs	High	Significant	Moderate	Margin	Not even reaching marginal

6. Constructive Alignment with Major Outcomes

Please state how the course contribute to the specific MILO(s)

MILO	How the course contribute to the specific MILO(s)
1	An ability to apply knowledge of mathematics, science and engineering.
3	An ability to design a system, component, or process that conforms to a given specification within realistic constraints.
4	An ability to function effectively and responsibly as a team member.
5	An ability to identify, evaluate, formulate and solve engineering problems.
7	An ability to communicate effectively.
8	Knowledge in contemporary issues and an awareness of the impact of engineering solutions in a broad, global and societal context.
10	An ability to use necessary engineering tools.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Electrical System and Pollution

Electrical transmission system. High-voltage AC and DC Transmission. Power Quality. Electromagnetic compatibility. Power factor. Displacement factor. Distortion factor. Voltage Sags and Swells. Active and Passive Power Filters. Dynamic Voltage Restorers. Uninterruptible power supply. Flexible AC Transmission.

Smart Grids

National and local electricity consumption. Global distribution of renewable energy resources. Definition of Smart Grids. Microsource control. Energy Management Network. Smart Metering Infrastructure. Protection Control. Smart Grid Economics.

Photovoltaic (PV) Systems

Current PV technologies. Cell efficiencies. Circuit Models. Maximum Power Point (MPP). Irradiance and temperature Effects. Partial Shading. Local and global MPP tracking. PV system classification. Requirements of off-grid and on-grid PV inverters. Islanding.

Wind Power Systems

Global cumulative wind power capacity. Turbine dimension and power rating. Betz's limit. Power coefficient and tip speed. Electrical power versus wind speed. Cut-in, rated, and cut-out wind speeds. Control structure of a wind turbine. Fixed speed operation. Double-fed induction generator. Converter-connected structure. Off-grid and on-grid systems.

Fuel Cell Technology

Basic operation. Different types of fuel cells - Proton Exchange Membrane, Alkali, Phosphoric acid, and Solid oxide fuel cells. Static and transient characteristics. Fuel starvation. Transient compensation.

Battery Technology

Battery chemistry. Solid electrolyte battery. Battery geometry. Characterization. Memory effect. Hysteresis characteristics. State-of-charge and state-of-health. Cell balancing. Battery modeling. Electrochemical impedance spectroscopy. Single and double pulse testing.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Jean-Claude Sabonnadiere, Renewable Energies, London: ISTE Ltd.; Hoboken, NJ: John Wiley & Sons, 2009.
2.	Bollen, Math H. J., Smart grid : adapting the power system to new challenges, San Rafael, California : Morgan & Claypool Publishers, 2011.
3.	John R. Shaw Balfour, Nash Michael, Bremer Nicole, Advanced photovoltaic system design, Burlington, Mass. : Jones & Bartlett Learning, 2013.
4.	Ted R Moore and Ewarld I Bailey, Wind power : systems engineering applications and design models, Hauppauge, N.Y. : Nova Science Publishers, c2012.
5.	Ryan O'Hayre, Suk-Won Cha, Whitney Colella, and Fritz B Printz, Fuel Cell Fundamentals, 3rd ed. Somerset : Wiley, 2016.
6.	Bruno Scrosati, K. M Abraham, and Walter A. van Schalkwijk, Lithium batteries : advanced technologies and applications, Hoboken, NJ : John Wiley & Sons, Inc., c2013.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Technology Roadmap: Smart Grids, International Energy Agency, 2011.
2.	Geoff Stapleton and Susan Neill, Grid-Connected Solar Electric Systems : The Earthscan Expert Handbook for Planning, Design and Installation, Routledge, 2012.