City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A 2022/2023

Part I Course Overview

Course Title:	Green Electronics - Theory, Eco-design, Experiments and Applications
Course Code:	EE6613
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	EE2301 Basic Electronics Circuit or EE3003(I and II) Electronic Product Design
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to provide students with knowledge on the theories, eco-design concepts, methods, and relevant hands-on experience for designing a range of sustainable green electronic products. It is expected that students will develop their ability to address relevant issues on environmental impact; product design, operating life, and the 3R concept (reduce, reuse, and recycle).

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.	Recognise and address the issues relating to the need for a greener world, and environmental electronic design and manufacturing in the local industry.		✓	✓	
2.	Recognize the importance of various environmental regulations in indifferent major countries around the world and the need for compliance with these regulations.		✓	✓	
3.	Apply the principles and practices of green electronics in selected consumer products.		✓	✓	
4.	Describe the process and techniques of assessment of the environmental hazards and suggest ways to reduce them.		✓	✓	
5.	Realize the impact of the environmental regulations on the design, supply chain, manufacturing and recycling of the electronic products.		✓	✓	✓
		100%			

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	4	5		
Lectures, laboratory experiments, and group projects	Explain key concepts in green electronics through combination of experiments, case studies, and group projects, with applications to industry	✓	✓	✓	✓	✓		3 hrs/wk (*Some of the lectures will be conducted in the laboratory as case studies, demonstrations, project discussions, Eco-design simulations, and experiment)*
Lectures, laboratory experiments, in-class exercise, case studies, group and individual projects	Apply the key concepts learnt through the combination of case studies, lectures, and experiments to demonstrate the applications of knowledge in both group and individual projects	✓	✓	✓	✓	✓		

Discovery Learning Experience (DLE) is also a key to this course - with tasks assigned via the case studies of the coursework, and supported with discussion with students to assess their progress ; students are feed-backed on their quality of their case studies for progression.

For each of the case studies, group and individual projects (assessments in S.4), research-type discovery learning experience and approach will be provided to activate students' understanding of the various topics of green electronics, and its applications to designing green electronics products for the real world.

4. Assessment Tasks/Activities (ATs)

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

Indicative of the possible activities and tasks designed to assess how well the students achieve the CILOs. Fine details will be provided for students upon the commencement of the course. The course assessment will take the form of 2 continuous assessments I and II, and a written exam.

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5			
Continuous Assessment: <u>60%</u>								
Course work I: Group Projects, Lab Experiments (30%)	✓	✓	✓	✓	✓		30%	At least 1 assignment included
Course work II: Individual Projects, and Case Studies (30%)	✓	✓	✓	✓	✓		30%	At least 2 assignments included
Examination: 40% (closed-book, duration: 2 hours)								
							100%	

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

5. Assessment Rubrics

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

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

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

6. Constructive Alignment with Programme Outcomes

PILO No.	How the course contribute to the specific PILO(s)
1, 2, 3, 4, 5	This course aims to provide students with knowledge in major areas of Green Electronics. Upon completion of this course, students will gain general knowledge of Green Electronics for launching greener electronic products in the open market.
2, 3, 4, 5	Students are required to complete assignment in the form of group and individual projects, and case studies designed to gain practical hands-on experience on Green Electronics and applications carried out in test houses, and some practical methods for sustainable Eco-Design.

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

1. Keyword Syllabus

Introduction to Green Electronics and environmental regulations:
Environmental concerns of the modern society, Overview of electronics industry and their relevant regulations in China, European Union and other key countries, Restriction of Hazardous substances (RoHS), Waste Electrical and electronic equipment (WEEE), Energy using Product (EuP) and Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH).

Green electronics materials &products, and Recycling:
Introduction to green electronic materials and products. X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products. Technology and management on e-waste recycle system construction, global collaboration, and product disassemble technology

Product design and Sustainable Eco-Design
Stages of product development process in green design: Materials, Manufacturing, Packaging and use, End of Life and disposal, Design for recycling. Life Cycle Assessment (LCA), and Eco-design tools. Environmental management systems, Eco-design in electronics industry.

Case Studies
Selected cases are used to illustrate some of the above topics. Laboratory experiments, class discussions and project work will be used to substantiate the relevant cases in question, with a view to integrating the discovery-enriched curriculum (DEC) elements.

Other Learning Activities:-
Field study trip(s) to local industry:
A selection of field study trip(s) will be arranged to facilitate a hands-on relevant experience in the local industry.

Laboratory experiments & Eco-design simulations:
A range of laboratory experiments, and Eco-design simulations will be carried out by students to understand the practical aspects of green electronics, with a view to substantiating the various concepts taught in lectures.

Teaching Methods:
Teaching will be conducted in 3-hour sessions, which are in the form of combined lecture class discussions, case studies, and projects (group/individual). The experiments shall consist of several laboratory sessions designed to complement the lecture materials and integrate the DEC elements.

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.	Goldberg L.H., Green Electronics / Green Bottom Line, Environmentally Responsible Engineering, 1st Edition Newnes 2000 ISBN 0-7506-9993-0
2.	Shina, Sammy G. Green Electronics Design and Manufacturing. New York: McGraw-Hill Professional, 2008.
3.	Wimmer, Wolfgang et.al. Ecodesign Implementation: A Systematic Guidance on Integrating Environmental Consideration into Product Development. Berlin: Springer, 2014.

2.2 Additional Readings

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

1.	Y.C. Chan (2006). *ROHS & WEEE: status, compliance, issues and implications*. Hong Kong: City University of Hong Kong. 153 Pages
2.	H. Lewis and J. Gertsakis (2001). *Design + Environment: A Global Guide to Design Greener Goods.* Greenleaf Publishing Ltd.
3.	John H. Lau (2003). *Electronics manufacturing: with lead-free, halogen-free, and conductive-adhesive materials*. New York: McGraw-Hill. 1v.
4.	Ulrich K.T. and Eppinger S.D. (2003). Product Design and Development. McGraw-Hill.
5.	Joseph Fiksel (1996). *Design for environment: creating eco-efficient products and processes*. New York: McGraw-Hill. 513 pages.
6.	Eco Conscious design of Electrical and Electronic Equipment: http://www.ecodesignguide.dk/
7.	Eco design (Hong Kong Polytechnic University): http://www.ecodesign.ise.polyu.edu.hk/eng/
8.	Centre for sustainable design of Electronics: SEEBA: http://www.cfsd.org.uk/seeba/index.html & http://www.thaieei.com/neweei/aede & http://www.cfsd.org.uk/nepd/nepd_main.html
9.	ECO-Design Pilot tool for Electronics: http://www.ecodesign.at/pilot/eeg/ENGLISH/INDEX.HTM
10.	Sustainable Electronics Initiative (University of Illinois): http://www.sustainelectronics.illinois.edu/
11.	Innovative Electronics Manufacturing Research Centre (Loughborough University): http://www.lboro.ac.uk/research/iemrc/index.html
12.	Hong Kong Green Manufacturing Network: http://www.gmn.hkpc.org/

13.	Research and Education in Green Materials (University of California) http://greenmat.soceco.uci.edu/
14.	ROHS : http://www.rohs.gov.uk/
15.	WEEE : http://ec.europa.eu/environment/waste/weee/index_en.htm
16.	EuP : http://ec.europa.eu/energy/efficiency/ecodesign/eco_design_en.htm
17.	REACH : http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm