City University of Hong Kong
Course Syllabus

offered by Department of Electronic Engineering
with effect from Semester B in 2017/2018

Part I Course Overview

Course Title:	Reliability Engineering in Electronics Industry
Course Code:	EE6614
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

The course aims to provide students with practical knowledge and skills in reliability engineering of electronics, and to provide them with exposures relevant to the local electronics industry via practical case studies and projects.

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.	Describe the theory of reliability engineering for electronics.		✓	✓	
2.	Apply failure prediction and modelling methods in reliability.		✓	✓	
3.	Apply reliability engineering knowledge systematically on cases in reliability testing.		✓	✓	✓
4.	Apply learned knowledge and skills for applications in handling the challenges in the local electronic industry via case studies and projects.		✓	✓	✓
		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			
Lectures, laboratory experiments, case studies, and group projects	Explain key concepts in reliability engineering through combination of experiments, case studies, and group projects, with applications to industry	✓	✓	✓	✓			3 hrs/wk (3 hrs Lect*) **Some of the lectures will be conducted in the laboratory as case studies, demonstrations and experiments*
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 reliability engineering and its applications to the real world of electronics industry.

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: 60%								
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.)

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.	PILO
1, 2	Awareness on the knowledge and analysis tools related to reliability engineering.
3, 4,5	Applications of learned knowledge and skills for practical cases: reliability analysis of electronics products in the local electronics industry.

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

1. Keyword Syllabus

Introduction to Reliability Engineering

Reliability Economics and Management, Failure distributions: Bathtub Failure Curve, and its applications. Environmental Stress Testing, and Accelerated Life Testing.

Design for Reliability

Reliable Design and Quality considerations, Essential reliability factors during product development. Reliability of Mechanical Components and Systems.

Reliability consideration in product manufacturing

Manufacturing Process Planning and Control, Control of Production Variability, Failure Reporting Analysis and Corrective Action system.

Failure modes and mechanisms

Types of failures modes and mechanisms in electronic packages and devices, Reliability of Electronic Components and Systems.

Reliability Testing

Planning Reliability Testing Environments, Testing for Reliability and Durability, Failure Reporting, Analysis and Corrective Action Systems (FRACAS).

Case Studies

Reliability engineering in experimental design

Case study based: design methods of reliability experiments, and acceleration-factor stress variables.

Results analysis and refining methods for enhancing reliability

Methods to give feasible refining feedback on: designing, materials' selection, and manufacturing processes.

Other Activities:

Industrial visits and field study trips to local industry:

A selection of visits and field study trips will be arranged to give a hands-on experience in reliability engineering practices carried out followed in the local industry..

Laboratory Experiments:

Highly accelerated life test (HALT/HAST) on electronic products, Thermal shock and its effects on electronic packages.

Teaching Methods:

Teaching will be conducted in 3-hour sessions, which are in the form of combined lecture, case studies, class and project discussions on various Reliability related topics. The laboratory support shall consist of several 1.5-hour sessions on topics mentioned above.

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.	Pascoe, Norman. Reliability Technology: Principles and Practice of Failure Prevention in Electronic Systems. Chichester: Wiley, 2011. Print.
2.	O'Connor, Patrick P., and Andre Kleyner. Practical Reliability Engineering. Oxford: Wiley-Blackwell, 2012. Print.

2.2 Additional Readings

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

1.	Ireson, William Grant, Clyde F. Coombs, and Richard Y. Moss. Handbook of Reliability Engineering and Management. New York: McGraw Hill, 1996. Print.
2.	Ohring, Milton, Reliability and Failure of Electronic Materials and Devices, 2nd Ed, Academic Press, 2010.
3.	Giulio Di Giacomo, Charles A. Harper, Reliability of Electronic Packages and Semiconductor Devices, New York: McGraw-Hill, 1996.
4.	Eugene R. Hnatek, Intergrated Circuit Quality and Reliability, New York: MARCEL DEKKER, INC. 1995.
5.	Bajenesco, Titu I. Reliability of Electronic Components: A Practical Guide to Electronic Systems Manufacturing, Berlin; New York: Springer, 1999.
6.	IEEE Standard Methodology for Reliability Prediction and Assessment for Electronic Systems and Equipment: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=741931
7.	IEEE reliability: http://www.ieee.org/web/education/Expert_Now_IEEE/Catalog/reliability.html
8.	Guidelines to Understanding Reliability Prediction: http://www.epsma.org/pdf/MTBF%20Report_24%20June%202005.pdf
9.	Reliability Standards & Handbooks: http://www.enre.umd.edu/publications/rs&h.htm
10.	EPA Centre: http://www.ee.cityu.edu.hk/~epa/home.htm
11.	Swiss Federal Laboratories for Materials Testing and Research: http://www.empa.ch/plugin/template/empa/3/*