City University of Hong Kong
Course Syllabus

offered by
Department of Mechanical Engineering
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Risk and Reliability Engineering
Course Code:	MNE5103
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P5
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
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

This course aims to present the mathematical modelling and system simulation methods for evaluating, managing and controlling the reliability, safety and risk of complex engineering systems such as the nuclear systems. The objective is to provide the students with the adequate tools for handling with scientific rigor the complexities and uncertainties associated to the problem. Previous knowledge on basic probability theory and statistics is helpful.
The expertise offered is part of the background knowledge of safety, reliability and risk analysts, operators and managers, in the industrial sector, including in particular nuclear.
Practical examples and numerical exercises will be provided in support to the comprehension of the material covered in class.

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.	**Explain** the key aspects of reliability and risk engineering.		✓	✓	
2.	**Apply** effectively some of the methods of risk assessment (e.g. hazard identification, fault tree and event tree analyses, etc.).			✓	✓
3.	**Identify** the risk-critical points of a system and optimally decide on their elimination or protection of the systems' environment.			✓	✓
4.	**Implement** the risk assessment in the nuclear industry.			✓	✓
		N.A.			

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 real-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. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Lectures on the topics of the keyword syllabus.	✓	✓	✓	✓	3 hrs/week
Individual work Activities (Self study)	Students are required to carry out self study on webs and search appropriate information/data in conjunction with the lecturing materials to accomplish a set of given requirements. The work of the self study will be presented as an individual report for assessment.	✓	✓	✓	✓	(20 hours)

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	4		
Continuous Assessment: 50%						
Mid-term Test	✓	✓	✓	✓	20%	
Mini-project		✓	✓	✓	30%	
Examination: 50% (duration 2 hours)						
Final Examination	✓	✓	✓	✓	50%	
** The weightings should add up to 100%.*					100%	

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

5. Assessment Rubrics

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

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Mid-term Test	Through the mid-term examination, the students will be evaluated on the base knowledge in the risks and reliabilities.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mini-project	Through the mini-project, the students will be evaluated on the understanding and application of the learned knowledge to the risk modelling and assessment in engineering, societal and/or financial risk problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Through the examination, the students will be evaluated on the application knowledge in the risks and reliabilities to engineering problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Mid-term Test	Through the mid-term examination, the students will be evaluated on the base knowledge in the risks and reliabilities.	High	Significant	Moderate	Not even reaching marginal levels
2. Mini-project	Through the mini-project, the students will be evaluated on the understanding and application of the learned knowledge to the risk modelling and assessment in engineering, societal and/or financial risk problems.	High	Significant	Moderate	Not even reaching marginal levels
3. Examination	Through the examination, the students will be evaluated on the application knowledge in the risks and reliabilities to engineering problems.	High	Significant	Moderate	Not even reaching marginal levels

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

1. Keyword Syllabus

(An indication of the key topics of the course.)

- Definition of reliability, availability, safety, risk; structure of risk analysis
- Probabilistic Risk Assessment (PRA)
- Hazard identification: functional analysis, Hazard Operability (HAZOP) analysis and Failure Modes, Effects and Criticality Analysis (FMECA)
- Reliability and availability of simple systems
- Fault tree and event tree analysis
- Markov models for reliability and availability analysis
- Monte Carlo simulation for reliability and risk analysis
- Common cause failures
- Important measures
- Industrial examples

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.)

N.A.

2.2 Additional Readings

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

1.	Zio E., An introduction to the basics of reliability and risk analysis, World Scientific, 2007.
2.	Zio E., Computational methods of reliability and risk analysis, World Scientific, 2009.
3.	Zio, E. Baraldi, P. and Cadini F., Basics of reliability and risk analysis: Worked Out Problems and Solutions, World Scientific, 2011.
4.	Kroger, W. and E. Zio, Vulnerable systems, Springer, 2011.