

**City University of Hong Kong  
Course Syllabus**

**offered by  
Department of Biomedical Engineering /  
Department of Mechanical Engineering  
with effect from Semester A 2018 / 19**

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**Part I Course Overview**

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| <b>Course Title:</b>   | Risk and Reliability Engineering   |
| <b>Course Code:</b>  | MBE5103  |
| <b>Course Duration:</b>                                      | 1 semester   |
| <b>Credit Units:</b>   | 3 credits  |
| <b>Level:</b>  | P5   |
| <b>Medium of Instruction:</b>                                | English  |
| <b>Medium of Assessment:</b>                                 | English  |
| <b>Prerequisites :</b><br><i>(Course Code and Title)</i>     | Nil  |
| <b>Precursors:</b><br><i>(Course Code and Title)</i>         | SEEM3101 Basic Methodologies and Tools for Risk Engineering<br>or equivalent |
| <b>Equivalent Courses:</b><br><i>(Course Code and Title)</i> | Nil  |
| <b>Exclusive Courses:</b><br><i>(Course Code and Title)</i>  | 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<br>(if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) |    |    |
|-----|---|------------------------------|---|----|----|
|     |   |                              | A1  | A2 | A3 |
| 1.  | <b>Explain</b> the key aspects of reliability and risk engineering.   |                              | ✓   | ✓  |    |
| 2.  | <b>Apply</b> effectively some of the methods of risk assessment (e.g. hazard identification, fault tree and event tree analyses, etc.).   |                              |   | ✓  | ✓  |
| 3.  | <b>Identify</b> the risk-critical points of a system and optimally decide on their elimination or protection of the systems' environment. |                              |   | ✓  | ✓  |
| 4.  | <b>Implement</b> 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 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 |                            |
| 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 |           |         |
| Examination: 100%                       |          |   |   |   |           |         |
| Mid-term Examination                    | ✓        | ✓ | ✓ | ✓ | 49%       |         |
| Final Examination (duration: 2.5 hours) | ✓        | ✓ | ✓ | ✓ | 51%       |         |
|   |          |   |   |   | 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.)*

| Assessment Task         | Criterion  | Excellent<br>(A+, A, A-) | Good<br>(B+, B, B-) | Fair<br>(C+, C, C-) | Marginal<br>(D) | Failure<br>(F)                    |
|-------------------------|--|--------------------------|---------------------|---------------------|-----------------|-----------------------------------|
| 1. Mid-term Examination | 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. Examination          | Through the examination, the students will be evaluated on the application knowledge in the risks and reliabilities to nuclear engineering | High                     | Significant         | Moderate            | Basic           | 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.)*

None

**2.2 Additional Readings**

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

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|----|--|
| 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.   |