

**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: Fundamentals of Nuclear Engineering

Course Code: MNE8114

Course Duration: 1 semester

Credit Units: 3 credits

Level: R8

Medium of Instruction: English

Medium of Assessment: English

Prerequisites: Nil
(Course Code and Title)

Precursors: Nil
(Course Code and Title)

Equivalent Courses: Nil
(Course Code and Title)

Exclusive Courses: Nil
(Course Code and Title)

Part II Course Details

1. Abstract

Nuclear engineering is an extremely broad field, covering several professional aspects. The one-semester course of “fundamental of nuclear engineering” is aim to equip research students:

- With the knowledges of atomic and nuclear physics, interaction of radiation with matter, principles of fission reactors, nuclear reactor theory, and the development of advanced nuclear energy systems.
- With the ability to identify the neutron transport theory, diffusion theory, criticality calculations, reactor kinetics, neutron slowing down theory and numerical solution to the diffusion equation.

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.	Learn the nuclear physics and interaction of radiation particles with matter.	20		✓	
2.	Describe the principles of fission nuclear reactors and different types of nuclear power plants.	10	✓		
3.	Identify how the complex neutron transport and slowing-down processes can be described by simple analytical models.	30		✓	
4	Demonstrate the basic nuclear reactor theory, including one-group reactor equation, multi-group calculations and heterogeneous reactors.	30		✓	
5	Study the conceptual design of Generation-IV (Gen-IV) reactors and D-T fusion reactors.	10	✓		
		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 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	5	
Lecture	Explain key concepts, principles, theories, and their applications in fundamentals of nuclear physics, nuclear reactors and nuclear power plants, neutron transport and slowing-down processes, and the basic nuclear reactor theory.	✓	✓	✓	✓	✓	
Tutorial	Homework, in class quiz review.	✓	✓	✓	✓	✓	
Self-study Activities	Pre-reading course materials, doing assignments.	✓	✓	✓	✓	✓	
Mini-project	Choose one of Generation-IV (Gen-IV) reactors or D-T fusion reactor, study, review, discussion and presentation.	✓	✓	✓	✓	✓	

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	5		
Continuous Assessment: 50 %							
Homework	✓	✓	✓	✓	✓	20%	For every lecture, total 11
Mini-project	✓	✓	✓	✓	✓	10%	Report submission and presentation to be made
Quiz	✓	✓	✓	✓	✓	20%	Taken during every lecture, total 11 times
Examination: 50 % (duration: 2 hours)							
Examination	✓	✓	✓	✓	✓		
						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. Homework	Capacity to practice the problems related to the key concepts, principles, and theories after the lectures.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mini-project	Ability to explain in detail for the design of advanced nuclear energy system.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Quiz and class performance	Capacity to understand the basic concepts and the important theories and principles during the lectures.	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	Capacity to understand the key concepts, principles, theories, and their applications in fundamentals of nuclear physics, nuclear reactors and nuclear power plants, neutron transport and slowing-down processes, and the basic nuclear reactor theory.	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. Homework	Capacity to practice the problems related to the key concepts, principles, and theories after the lectures.	High	Significant	Moderate	Not even reaching marginal levels
2. Mini-project	Ability to explain in detail for the design of advanced nuclear energy system.	High	Significant	Moderate	Not even reaching marginal levels
3. Quiz and class performance	Capacity to understand the basic concepts and the important theories and principles during the lectures.	High	Significant	Moderate	Not even reaching marginal levels
4. Examination	Capacity to understand the key concepts, principles, theories, and their applications in fundamentals of nuclear physics, nuclear reactors and nuclear power plants, neutron transport and slowing-down processes, and the basic nuclear reactor theory.	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.)

- Nuclear Fission/Nuclear Fusion
- Nuclear Reactions
- Distribution of Nuclides
- Neutron Reactions and Characteristics
- Scattering of Neutrons
- Nuclear Fission
- Chain Reaction
- Neutron Flux and Cross-section
- Criticality
- Neutron moderators
- Moderators and reactor design
- Delayed neutrons and controllability
- Effects of temperature and voiding on core reactivity
- Reactor poisons
- Transport Equation and Diffusion Equation
- Interaction of fast neutrons with matter

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.	J.R. Lamarsh and A.J. Baratta, "Introduction to Nuclear Engineering", Prentice Hall, ISBN: 0-201-82498-1.
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2.2 Additional Readings

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

1.	George Bell and Samuel Glasstone, "Nuclear Reactor Theory", Robert E. Krieger Publishing, ISBN: 0-882-75790-3.
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