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:	Principles of Nuclear Engineering
Course Code:	MNE5101
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)*	MNE3107 Principles of Nuclear Engineering or equivalent
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to establish the professional background for nuclear engineering students, is an advanced course to the course of "Basic Principles and Theory of Fission Reactors". The contents of the course are emphasized at the key issues concerning the origins and applications of nuclear energy. At the very beginning of the course, atomic and nuclear physics is reviewed, while the ways that radiation particles interact with matter is introduced subsequently. Furthermore, the course directs to the practical aspects of nuclear power, nuclear reactors, and nuclear cycles. Finally, the major part of the course leads to nuclear reactor theory which includes the topics such as criticality, neutron diffusion and moderation, one- and multi-energy-group models, and time-dependent neutronics behaviours.

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 fundamental of atomic and nuclear physics related nuclear fission and how radiation particles interact with matter.		✓	✓	
2.	**Explain** the concepts of nuclear reactors and nuclear cycles.			✓	
3.	**Perform** neutron diffusion and criticality calculation under various conditions.			✓	✓
4.	**Analyze** reactivity feedback effects due to the variations in temperature, fission product poisoning, fuel burnup, etc.			✓	✓
		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	Delivery of the course will be achieved through a series of formal lectures supported by practical case studies.	✓	✓	✓	✓	3 hrs/week
(Self-study Activities)	Students will be provided with reading lists to assist their study of the subject, and they will be expected to prepare material in advance of the sessions for discussion.	✓	✓	✓	✓	(34 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: 40%						
Homework	✓	✓	✓	✓	25%	
Mini-project		✓	✓	✓	15%	
Examination: 60% (duration: 2 hours)						
					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. Examination	Through examination, the students will be evaluated on the basics and principles of nuclear engineering	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Homework	Tutorials mainly covering the topics of lectures	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Mini-project	Mini-projects mainly covering the related topics of lectures	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. Examination	Through examination, the students will be evaluated on the basics and principles of nuclear engineering	High	Significant	Moderate	Not even reaching marginal levels
2. Homework	Tutorials mainly covering the topics of lectures	High	Significant	Moderate	Not even reaching marginal levels
3. Mini-project	Mini-projects mainly covering the related topics of lectures	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.)

- uranium enrichment
- radioactive decay
- activity
- mass defect
- nuclear binding energy
- cross section
- neutron attenuation
- compound nucleus formation
- radiation
- nuclear fission / fusion
- chain reaction
- prompt / delayed neutrons
- neutron moderation
- lethargy
- fissile / fissionable / fertile isotopes
- fission products
- nuclear conversion / breeding
- burnup
- reflector
- pressurized-water / boiling-water reactors
- control rod / chemical shim
- nuclear fuel cycles
- nuclear fuel management
- spent fuel / radioactive waste
- neutron transport / diffusion
- criticality
- multiplication factor
- reactivity

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.	Lamarsh J R and Baratta A J, "*Introduction to Nuclear Engineering*," 3rd edition, Prentice Hall, 2001, ISBN: 0-201-82498-1.
2.	Almenas K and Lee R, "*Nuclear Engineering, An Introduction*," Springer Verlag, 1992.
3.	Connolly T J, "*Foundations of Nuclear Engineering*," John Wiley & Sons, 1978.
4.	Foster A R and Wright R L Jr., "*Basic Nuclear Engineering*," 2nd edition, Allyn and Bascon, 1973.
5.	Meyerhof W E, "*Elements of Nuclear Physics*," McGraw-Hill, 1967.
6.	Eisberg R and Resnick R, "*Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles*," 2nd edition, John Wiley & Sons, 1985.
7.	Glasstone S, "Nuclear Reactor Engineering," Van Nostrand Reinhold Company, New York, 1958.
8.	Introduction to Nuclear Engineering: Pearson New International Edition, by John R. Lamarsh (Author), Anthony J. Baratta (Author); Publisher: Pearson; 3 edition (August 29, 2013), Publication Date: August 29, 2013.
9.	Nuclear reactor physics, by Weston M. Stacey; Publisher: Wiley-VCH; 2 edition June 18, 2007.