MNE5101: PRINCIPLES OF NUCLEAR ENGINEERING

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Principles of Nuclear Engineering

Subject Code
MNE - Mechanical Engineering
Course Number
5101

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
MNE3107 Principles of Nuclear Engineering or equivalent

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the fundamental of atomic and nuclear physics related nuclear fission and how radiation particles interact with matter.		x	x	
2	Explain the concepts of nuclear reactors and nuclear cycles.			x	
3	Perform neutron diffusion and criticality calculation under various conditions.			x	x
4	Analyze reactivity feedback effects due to the variations in temperature, fission product poisoning, fuel burnup, etc.			x	x

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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Delivery of the course will be achieved through a series of formal lectures supported by practical case studies.	1, 2, 3, 4	3 hrs/week
2	(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.	1, 2, 3, 4	(34 hours)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Homework	1, 2, 3, 4	25	
2	Mini-project	2, 3, 4	15	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

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

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Through examination, the students will be evaluated on the basics and principles of nuclear engineering

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Homework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Tutorials mainly covering the topics of lectures

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Mini-project (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Mini-projects mainly covering the related topics of lectures

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Through examination, the students will be evaluated on the basics and principles of nuclear engineering

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Homework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Tutorials mainly covering the topics of lectures

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Mini-project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Mini-projects mainly covering the related topics of lectures

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
- 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

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
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.