MNE6131: NUCLEAR REACTOR SYSTEMS, SAFETY AND WASTE MANAGEMENT

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Nuclear Reactor Systems, Safety and Waste Management

Subject Code
MNE - Mechanical Engineering
Course Number
6131

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
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to provide a detailed introduction on the major subsystems and components of nuclear power plants which use mainly light water reactor technology. It also introduces passive heat removal system used in Generation III reactors and the Gen-IV nuclear systems. Nuclear reactor safety analysis often involves multiphysics from many disciplines simultaneously in achieving satisfactory solutions. The course aims to equip the students with the principles of nuclear reactor safety analysis, and with the understanding of the complete nuclear reactor system including the balance of plant, support systems and resulting interdependencies affecting the overall safety of the plant and regulatory oversight. Finally, the waste management as part of the fuel cycle will also be covered in this course.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the major systems of nuclear power plants, the principles of nuclear reactor safety analysis, and the waste managements in nuclear power plants.		x	x	
2	Explain the interconnection and importance of the major subsystems, the reactor safety systems and their functions.		x	x	
3	Analyse the nuclear system operations, accidents, and safety.		x	x	x
4	Demonstrate reflective practice in an engineering context for nuclear systems.			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	To take place in the classroom. The main teaching activities will be in the form of lectures, which will be given related to the topics in the keyword syllabus.	1, 2, 3, 4	2 hrs/week

2	Tutorial	To take place in the classroom. The tutorials are problem-solving and Q&A sessions for strengthening students' understanding of the contents of the lectures. The course project will also help in the learning practice.	1, 2, 3, 4	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Mid-term Test	1, 2, 3, 4	20		
2	Mini-projects	1, 2, 3, 4	20	Report submission and presentation to be made	

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

Mid-term Test

Criterion

Ability to describe the design and operation of the light water reactors and other advanced reactor designs, and understand the theories and engineering practices for the design and operation of the advanced reactor designs.

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-projects

Criterion

Ability to apply the learned theories to conduct the research and self-learning for a nuclear power plant system and safety related topic.

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

Criterion

Ability of in-depth understanding of the nuclear systems, safety analysis and waste management.

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

Additional Information for AR

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

Part III Other Information

Keyword Syllabus

- Light water reactor systems
- Advanced nuclear systems
- Fuel cycle and waste management
- Reactor safety systems and their functions
- Reactor safety analysis
- Major nuclear accidents: Fukushima, Three Mile Island, and Chernobyl
- Probabilistic risk assessment

Reading List

Compulsory Readings

	Title
1	Lamarsh, J. R. and Baratta, A. J., "Introduction to Nuclear Engineering", 4th Edition, Pearson, 2017.
2	Knief, R. A., "Nuclear Engineering: Theory and Technology of Commercial Nuclear Power", 2nd Edition, American Nuclear Society, c2008.
3	Todreas, N. and Kazimi, M., "Nuclear Systems I: Thermal Hydraulic Fundamentals", CRC Press, Taylor & Francis Group, Boca Raton, U.S.A., 2012, ISBN: 978-1-4398-0887-0.

Additional Readings

	Title
1	Murray, R. L., "Nuclear Energy", 6th Edition, Butterworth-Heinemann, 2009.
2	Kok, Kenneth D., "Nuclear Engineering Handbook", CRC Press, ISBN: 978-1-4200-5390- 6.
3	Students are encouraged to find out related publications to widen their knowledge in the subjects.