MNE3107: PRINCIPLES OF NUCLEAR ENGINEERING

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Principles of Nuclear Engineering

Subject Code
MNE - Mechanical Engineering
Course Number
3107

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MBE2003/MNE2003 Mechanics or
MBE2036/BME2036/MNE2036 Engineering Computing or
MBE2109/BME2109/MNE2109 Engineering Mechanics

Precursors
Nil

Equivalent Courses
MBE3107 Principles of Nuclear Engineering

Exclusive Courses
Nil

Additional Information

#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

This course aims to introduce the fundamental of nuclear physics, interaction of radiation with matter, nuclear reactors and nuclear power plant, and basic nuclear reactor theory. It also gives an overview of transport equation and diffusion equation of neutrons, and methods for solving these equations.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the fundamentals of nuclear physics and interaction of radiation with matter.			x	
2	Describe the basic principles of nuclear reactors and different types of nuclear power plants.			x	
3	Demonstrate how the complex neutron transport and slowing-down processes can be described by simple analytical models.			x	
4	Discuss basic nuclear reactor theory, including one-group reactor equation, multigroup calculations and heterogeneous reactors.			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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	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.	1, 2, 3, 4	3hrs/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quizzes/Mid-term test	1, 2, 3, 4	30	
2	Homework and class performance	1, 2, 3, 4	20	

Continuous Assessment (%)

50

Examination (%)

50

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

1. Quizzes/ Mid-term test

Criterion

Capacity to understand the basic concepts and the important theories and principles during the 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

2. Homework and class performance

Criterion

Capacity to practice the problems related to the key concepts, principles, and theories after the 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
3. Examination

Criterion
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.

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
- 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

Reading List

Compulsory Readings

	Title
1	J.R. Lamarsh and A.J. Baratta, “Introduction to Nuclear Engineering”, Prentice Hall, ISBN: 0-201-82498-1.

Additional Readings

	Title
1	George Bell and Samuel Glasstone, “Nuclear Reactor Theory”, Robert E. Krieger Publishing, ISBN: 0-882-75790-3.
2	J.R. Lamarsh, “Introduction to Nuclear Reactor Theory”, Addison-Wesley Pub., ISBN: 0-894-48040-5.
3	O.C. Jones, Jr., “Nuclear Reactor Safety Heat Transfer”, Hemisphere, ISBN: 0- 891-116-224-0.