JC4231: NUCLEAR REACTOR PHYSICS

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Nuclear Reactor Physics

Subject Code
JC - Joint Course
Course Number
4231

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Co-offering Academic Unit(s)

Academic Unit(s)
Physics

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MNE3107 Principles of Nuclear Engineering

Precursors
Nil

Equivalent Courses
PHY4231 Nuclear Reactor Physics

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to give an overview of the physics of nuclear reactors and their behaviour. It also introduces how chain reaction can be used to induce controlled rate of fission in fissile materials for energy generation in reactors. Finally, it describes the factors that affect the design and behaviour of nuclear reactors.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the general principles of reactor configuration required to maintain a self-sustaining chain reaction.		x	x	
2	Explain reactor dynamics in both the critical and subcritical core.		x	x	
3	Analyse reactivity feedback effects such as temperature effects, fission product poisoning, and fuel burnup.			x	x
4	Discuss operational considerations when reactor operates at low and high power conditions.		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

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Class Participation	2, 3, 4	5	
2	Homework	2, 3, 4	35	
3	In-class Quiz	2, 3, 4	20	

Continuous Assessment (%)

60

Examination (%)
40

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
Class Participation

Criterion
Attitude to attend classes and ask questions.

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

Criterion
Ability to complete challenging assignments related to the key concepts, principles, and theories taught in 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
In-class Quiz

Criterion
Ability to explain and solve of the in-class assigned reactor physics problems.

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 to explain and derive the details of reactor physics.

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

- Criticality
- Starter sources
- Subcritical multiplication
- Neutron moderators
- Moderators and reactor design
- Delayed neutrons and controllability
- Effects of temperature and voiding on core reactivity
- Long-lived poisons and fuel reprocessing
- Short-lived poisons and controllability
- Uranium enrichment

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Weston M. Stacey, “Nuclear Reactor Physics”, Wiley-Interscience, ISBN: 0471391271.
2	Lamarsh J. R. and Baratta A. J., “Introduction to Nuclear Engineering”, Prentice Hall, ISBN: 0-201-82498-1.