City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering /
Department of Mechanical Engineering
with effect from Semester A 2018 / 19

Part I Course Overview

Course Title:	Nuclear Materials
Course Code:	MBE4112
Course Duration:	1 semester
Credit Units:	3 credits
Level:	B4
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Basic materials course
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

(A 150-word description about the course)

The aims of this course are to equip students:

- with knowledge of the properties and structures of nuclear materials and engineering alloys used in nuclear power reactor applications; and

- with ability to identify the common range of nuclear fuel elements, assemblies, and fuel rod failure mechanisms as well as the materials issues involving the core internals, reactor pressure vessel, and primary circuit-piping systems for light water reactors (LWRs) and extended the materials issues into the advanced nuclear reactor systems.

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 basic structure and properties of nuclear materials used for nuclear reactor systems.		✓		
2.	**Describe** the technology of fuel elements and assemblies for light water reactor applications.		✓		
3.	**Outline** the problems and remedies of nuclear fuels and the fuel rod failure mechanisms.			✓	
4.	**Identify** the materials problems and remedies regarding the core internals, reactor pressure vessel and primary circuit-piping systems.			✓	
5.	**Identify** radiation effects on nuclear materials.			✓	
	** If weighting is assigned to CILOs, they should add up to 100%.*	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 self-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. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lecture	Explain basic materials physics, structural materials for nuclear systems.	✓	✓	✓	✓	✓	2 hrs/week + 1 hr/week
Tutorial	Homework, in class quiz review.	✓	✓	✓	✓	✓	
Self-study Activities	Pre-reading course materials, doing assignments.	✓	✓	✓	✓	✓	1.5 hr/week
Mini-project	Choose a major component in nuclear power plant, study, review, discussion and presentation.	✓	✓	✓	✓	✓	1 hr/week

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	5		
Continuous Assessment: 50%							
Homework	✓	✓	✓	✓	✓	20%	For every lecture, total 11
Mini-project	✓	✓	✓	✓	✓	10%	Report submission and presentation to be made
Quiz	✓	✓	✓	✓	✓	20%	Taken during every lecture, total 11 times
Examination: 50% (duration: 2 hours)							
** The weightings should add up to 100%.*						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.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Homework	Capacity to practice the problems related to the key concepts, principles, and theories after the lectures.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mini-project	Ability to explain in detail the systems in nuclear power plant.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Quiz	Capacity to understand the basic concepts and the important theories and principles during the lectures.	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	Capacity to understand the key concepts, principles, theories, and their applications in fundamentals of materials science, nuclear fuels and nuclear structural materials; the possible stressors, failure mechanisms of structural materials and the remedies of them.	High	Significant	Moderate	Basic	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.)

1) Introduction to Nuclear Reactors Systems and their Materials
- Structure and properties of materials used in the nuclear reactor systems.
- Nuclear fuel elements, fuel assemblies and their technology.
- Reactor core internals, reactor pressure vessel, and primary water-piping systems.

2) The Problems and Remedies of Nuclear Materials in Light Water Reactor
- Fuel rod failure mechanisms.
- Corrosion and inter-granular stress corrosion cracking.
- Radiation damage and microstructural evolution.
- Radiation effects in metals.

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.)

1.	"Light-Water Reactor Materials", Donald R. Olander and Arthur T. Motta, 2014.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	"Aging and Life Extension of Major Light Water Reactor Components", Ed. V.N. Shah and P.E. MacDonald, Elsevier Science Publishers B.V., ISBN 0-444-89448-9, (TK9203.L45A35), 1993.