City University of Hong Kong

Information on a Course
offered by Department of Mechanical and Biomedical Engineering
with effect from Semester A in 2013/2014

Part I

Course Title: **Corrosion and Radiation Reduction at Nuclear Power Plant Using Water Chemistry**

Course Code: **MBE6106**

Course Duration: **One Semester**

No. of Credit Units: **3**

Level: **P6**

Medium of Instruction: **English**

Prerequisites: **Nil**

Precursors: **Nil**

Equivalent Courses: **Nil**

Exclusive Courses: **Nil**

Note:
Students may repeat a course, or an equivalent course, to improve course grade only if the previous course grade obtained is C or below.

Part II

1. Course Aims

This course aims to introduce methodologies and their working principles for corrosion mitigation and radiation dose reduction via coolant chemistry optimization at both light water and heavy water reactors. Typical water chemistry profiles of different types of water reactors are also introduced. Furthermore, water chemistry guidelines for operating water reactors at different action levels are also discussed.

2. Course Intended Learning Outcomes (CILOs)

Upon successful completion of this course, students should be able to:

No.	CILOs	Weighting* (if applicable)
1.	Describe the primary designed functions of a reactor coolant and the phenomenon of water radiolysis in a nuclear reactor.	1
2.	Describe the general water chemistry in the primary coolant circuits (and in the secondary coolant circuits if any) and the major components along the circuits of major water reactors.	1
3.	Understand the importance and the principle of water chemistry optimization for corrosion and radiation reduction.	1
4.	Identify water chemistry conditions for different action levels and exercise necessary tasks at each action level	1
5.	Design an optimized water chemistry specification for a water reactor	1

***Weighting ranging from 1,2,3 to indicate the relative level of importance in an ascending order.**

3. Teaching and Learning Activities (TLAs)

(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)

Activity Type	Timetabled Activity (Hours per week)
Lecture/Tutorial/Laboratory Mix	Lecture (3)

TLAs	Large Class Activities	Self-study Activities	Total hours/week (if applicable)
CILO 1	6	6	6(+6)
CILO 2	12	12	12(+12)
CILO 3	12	12	12(+12)
CILO 4	12	12	12(+12)
CILO 5	6	6	6(+6)
Total (hrs)	39	39	39(+39)

4. Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

ATs	Examination (2 hrs)	Test	In class Q/A	Mini-project	Total (%)
CILO 1	4	4	2	-	10
CILO 2	8	8	2	-	18
CILO 3	15	15	4	-	34
CILO 4	8	8	2	-	18
CILO 5	-	-	-	20	20
Total (%)	**35**	**35**	**10**	**20**	**100**

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

5. Grading of Student Achievement:

The grading is assigned based on students' performance in assessment tasks/activities. Examination and Test (35% each), in-class Q&A (10%) and mini-project (20%) will be marked numerically and grades will be awarded accordingly.

Grade Table

Letter Grade	Grade Point	Grade Definitions
A+ A A-	4.3 4.0 3.7	Excellent
B+ B B-	3.3 3.0 2.7	Good
C+ C C-	2.3 2.0 1.7	Adequate
D	1.0	Marginal
F	0.0	Failure
P	-	Pass

Please refer the SGS's website for details.

Part III

Keyword Syllabus:

- Light Water Reactor, Boiling Water Reactor, pressurized Water Reactor
- Heavy Water Reactor, Supercritical Water Reactor
- Reactor Coolant
- Radiolysis
- Water Chemistry
- pH Control
- Coolant Conductivity
- Impurity
- Primary Coolant Circuit
- Secondary Coolant Circuit
- Structure Integrity
- Corrosion
- CRUD
- Corrosion Product
- Corrosion Mitigation
- Fuel Cladding
- Fuel Integrity

- Fuel Failure
- Radioactive Impurities
- Radiation Field
- Operation Dose Rate
- Shutdown Dose Rate
- Chemical Additives
- Chemical Decontamination
- Chemistry Specifications
- Action Level

Recommended Reading:

Text(s)

C. C. Lin, *Radiochemistry in Nuclear Power Reactors*, National Academy Press, Washington D. C., USA, 1996.

BWR Water Chemistry Guidelines - 2008 Revision, BWRVIP-190, EPRI, Palo Alto, CA, USA (2008).

Pressurized Water Reactor Primary Water Chemistry Guidelines, EPRI Technical Report 1014986, EPRI, Palo Alto, CA, USA (2007).

Pressurized Water Reactor Secondary Water Chemistry Guidelines - Revision 7, EPRI Technical Report 1016555, EPRI, Palo Alto, CA, USA (2009).