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: **Advanced Nuclear Reactor Safety**

Course Code: **MBE5106**

Course Duration: **One Semester**

No. of Credit Units: **3**

Level: **P5**

Medium of Instruction: **English**

Prerequisites: **Nil**

Precursors: **MBE3107 Principles of Fission Reactors or equivalent**

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 equip the students with the basic principles of nuclear reactor and safety analysis. It is designed to introduce the use of the theory and methods of nuclear reactor kinetics, and to provide analytical methods for estimation of heat removal from nuclear reactors, and to introduce the safety analysis theories related to the reactor licensing. The areas of accident analysis, space/time-dependent analysis, and reactivity feedback analysis in reactor transients will also be 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 basic principles of nuclear reactor control and safety analysis.	1
2.	**Explain** the feedback mechanism and effects	2
3.	Model the reactor core dynamics (Analyse the reactor core dynamics)	3
4.	**Analyse** the safety of reactor	3

***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	Laboratory Work	Min-Project	Hours/week (if applicable)
CILO 1	3	-	(+2)	3(+2) = 5
CILO 2	9	-	(+0)	9(+0) = 9
CILO 3	14	-	(+4)	14(+4) = 18
CILO 4	13	-	(+4)	13(+4) = 17
Total (hrs)	**39**	**-**	**(+10)**	**39(+10) = 49**

Large class activities: Delivery of the course will be achieved through a series of formal lectures supported by practical case studies.

Laboratory work will mainly teach the students the software tools for reactor modelling.
NIL

Min-Project: A typical reactor modelling task will be given to students to solve. The students are expected to work in teams to tackle the given problems. This learning activity will be mainly student-led but with some structural guidance from the teacher. At the end of the learning activity, a presentation session will be organised for all the students to present their solutions for the given problem.

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)	Lab. Reports	Mid-projects	Total (%)
CILO 1	4	-	6	10
CILO 2	15	-	9	24
CILO 3	30	-	6	36
CILO 4	26	-	4	30
Total (%)	**75**	**-**	**25**	**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. The 2-hour examination (75%), and mini-project (25%) will be marked numerically and final grades will be awarded accordingly.

Grade Table

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

Please refer the SGS's website for details.

Part III

Keyword Syllabus

- Introduction to system modelling
- Basic Equations and Physical Parameters
- Point reactor kinetics equations.
- Thermal-hydraulic transients.
- Point reactor dynamics without feedback.
- Reactivity feedback effects
- Power reactor dynamics and feedback effects.
- Modelling reactor core dynamics and simulation.
- Control rod reactivity estimation.
- Safety analysis
- Heat generation in reactor
- Heat transfer and boiling heat transfer
- Thermal design of a Reactor
- Effluent dispersion
- Environmental radiation doses

Recommended Reading:

Text(s)

Karl O. Ott and Robert J. Neuhold, Introductory Nuclear Reactor Dynamics, American Nuclear Society, ISBN-10: 0894480294

Ziya Akcasu, Louis M. Shotkin, Ziyaeddin A. Akcasu and Gerald S. Lellouche, Mathematical Methods in Nuclear Reactor Dynamics (Nuclear Science & Technology),Publisher: Academic Press Inc, ISBN-10: 0120471507

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

Jones O C Jr, Nuclear Reactor Safety Heat Transfer, Hemisphere, ISBN 0-891-116-224-0 Collier J G, Convective Boiling and Condensation, McGraw Hill, ISBN 0-07-011798-5

Plate E J, Engineering Meteorology, Hemisphere, ISBN: 0 444 419792 1