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: **Principles of Nuclear Engineering**

Course Code: **MBE5101**

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 establish the professional background for nuclear engineering students, is an advanced course to the course of "Basic Principles and Theory of Fission Reactors". The contents of the course are emphasized at the key issues concerning the origins and applications of nuclear energy. At the very beginning of the course, atomic and nuclear physics is reviewed, while the ways that radiation particles interact with matter is introduced subsequently. Furthermore, the course directs to the practical aspects of nuclear power, nuclear reactors, and nuclear cycles. Finally, the major part of the course leads to nuclear reactor theory which includes the topics such as criticality, neutron diffusion and moderation, one- and multi-energy-group models, and time-dependent neutronics behaviours.

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 fundamental of atomic and nuclear physics related nuclear fission and how radiation particles interact with matter.	4
2.	**Explain** the concepts of nuclear reactors and nuclear cycles.	3
3.	**Perform** neutron diffusion and criticality calculation under various conditions.	1
4.	**Analyze** reactivity feedback effects due to the variations in temperature, fission product poisoning, fuel burnup, etc.	2

***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	9	(5)	9(+5) = 14
CILO 2	6	(5)	6(+5) = 11
CILO 3	15	(15)	15(+15) = 30
CILO 4	9	(9)	9(+9) = 18
Total (hrs)	**39**	**(34)**	**39(+34) = 73**

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

Small class activities: Students will be provided with reading lists to assist their study of the subject, and they will be expected to prepare material in advance of the sessions for discussion.

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)	Homework	Mini-project	Total (%)
CILO 1	18	5	-	23
CILO 2	10	5	5	20
CILO 3	22	10	5	37
CILO 4	10	5	5	20
Total (%)	**60**	**25**	**15**	**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 (60%), homework (25%), and mini-project (15%) 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:

- uranium enrichment
- radioactive decay
- activity
- mass defect
- nuclear binding energy
- cross section
- neutron attenuation
- compound nucleus formation
- radiation
- nuclear fission / fusion
- chain reaction
- prompt / delayed neutrons
- neutron moderation
- lethargy

- fissile / fissionable / fertile isotopes
- fission products
- nuclear conversion / breeding
- burnup
- reflector
- pressurized-water / boiling-water reactors
- control rod / chemical shim
- nuclear fuel cycles
- nuclear fuel management
- spent fuel / radioactive waste
- neutron transport / diffusion
- criticality
- multiplication factor
- reactivity

Recommended Reading:

Textbook

Lamarsh J R and Baratta A J, "*Introduction to Nuclear Engineering*," 3rd edition, Prentice Hall, 2001, ISBN: 0-201-82498-1.

References

1. Almenas K and Lee R, "*Nuclear Engineering, An Introduction*," Springer Verlag, 1992.
2. Connolly T J, "*Foundations of Nuclear Engineering*," John Wiley & Sons, 1978.
3. Foster A R and Wright R L Jr., "*Basic Nuclear Engineering*," 2nd edition, Allyn and Bascon, 1973.
4. Meyerhof W E, "*Elements of Nuclear Physics*," McGraw-Hill, 1967.
5. Eisberg R and Resnick R, "*Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles*," 2nd edition, John Wiley & Sons, 1985.
6. Glasstone S, "Nuclear Reactor Engineering," Van Nostrand Reinhold Company, New York, 1958.