City University of Hong Kong
Course Syllabus

offered by Department of Physics
with effect from Semester A 2018/19

Part I Course Overview

Course Title:	**Environmental Radiation**
Course Code:	**PHY4271**
Course Duration:	**One semester**
Credit Units:	**3**
Level:	**B4**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**Nil**
Precursors: *(Course Code and Title)*	**AP3206/PHY3206 Nuclear Radiation and Detection OR AP4272/PHY4272 Environmental Radiation Measurements**
Equivalent Courses: *(Course Code and Title)*	**AP4271 Environmental Radiation**
Exclusive Courses: *(Course Code and Title)*	**AP4230/PHY4230 Radiation Safety**

Part II Course Details

1. Abstract

Student will be able to apply physical principles to evaluate environmental radiation problems, solve them and reach sound conclusions.

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.	Identify the irradiation effects of common radiations.		✓		
2.	Apply theoretical models to estimate radiation dose.			✓	
3.	Evaluate biological effects of radiation.		✓		
4.	Select and compare methods for measurement of radon gas and its progenies.			✓	
5.	Apply protection measures, appreciate recommended limits and safety issues on environmental radiation.			✓	
	** If weighting is assigned to CILOs, they should add up to 100%.*	100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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	Including teaching of lecture materials, tutorial and problem solving sessions	✓	✓	✓	✓	✓	2 hours/week
Tutorials	Questions and answers sessions, during which students will be asked questions and can ask questions, and there will be time for discussion.	✓	✓	✓	✓	✓	1 hour/week
Problem Solving	Numerical problems will be given to the students to solve. If needed, the lecturer and/or TA will give information or hints to help the students solve the problems.	✓	✓	✓	✓	✓	0.5 hour/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: _40_%							
Mid-term Tests	✓	✓	✓	✓	✓	28%	
Assignments	✓	✓	✓	✓	✓	12%	
Examination^: 60% (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 the examination must 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. Mid-term Tests	The student can thoroughly apply physical principles to evaluate environmental radiation problems, solve them and reach sound conclusions.	High	Significant	Moderate	Basic	Not reaching marginal level
2. Assignments	The student can thoroughly apply physical principles to evaluate environmental radiation problems, solve them and reach sound conclusions.	High	Significant	Moderate	Basic	Not reaching marginal level
3. Examination	The student can thoroughly apply physical principles to evaluate environmental radiation problems, solve them and reach sound conclusions.	High	Significant	Moderate	Basic	Not reaching marginal level

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

- Units and terminology used in radiation

  Activity (Curie and Becquerel). Specific activity. Absorbed dose D (rad and gray). Equivalent dose H (rem and Sievert). Effective dose E. Committed Equivalent Dose. Committed Effective Dose. Collective Equivalent Dose. Collective Effective Dose. Collective Effective Dose Commitment.

- Common radiations

  α-particles: Bethe-Bloch expression. Range of α particles. Use of SRIM program. β-particles: range of β particles. γ-rays: broad beam conditions. Build up factor. Bremsstrahlung radiation. Neutrons.

- Biological effects of radiation

  Acute or chronic effects. Somatic or genetic effects. Stochastic or non-stochastic effects.

- Radiation protection and recommended radiation limits

  Three fundamental principles of protection. International Commission of Radiological Protection (ICRP) limits for occupational workers and members of the public. Effective dose limits. Annual equivalent dose limits. Stochastic or non-stochastic limits. Protection of the Embryo or Fetus. De Minimis Dose and Negligible Individual Dose. Exclusion and exemption.

- Natural radiation

  Natural radiation. Cosmogenic radionuclides. Radioactive series.

- Radon properties

  Radioactive decay series. Potential alpha energy. Potential alpha energy concentration (PAEC). Equilibrium-equivalent concentration (EC or EEC). Equilibrium factor. Working level (WL). Potential alpha energy exposure - working level month (WLM).

- Radon measurements

  Solid-sate nuclear track detectors. Activated charcoal canister method. Scintillation method. Wire screen method. Collection mechanisms of radon progeny. Radon measurements in Hong Kong.

- Radon dosimetry

  Properties of radon progeny. Jacobi room model. Lognormal size distribution. Lung morphometry models. Dosimetric assumptions and model. Dose conversion coefficients (DCC).

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.	C R Cothern and J E Smith, Jr, Environmental Radon, Plenum Press: New York (1987).

2.2 Additional Readings

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

1.	National Research Council. Comparative Dosimetry of Radon In Mines and Homes, National Academic Press: Washington, D C (1991).