Subject Description Form

Subject Code	AP30010
Subject Title	Radiation Physics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject aims to provide a fundamental knowledge of the physical properties of radiation, its production and interactions with matter.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) explain the origin, nature and production of radiation; (b) describe the structure of the atom and explain the fundamental intra-atomic phenomena; (c) describe the nuclear structure using various models; (d) explain the basic radioactive decay processes and perform fundamental radioactivity decay calculations; (e) demonstrate understanding of the physical properties of nuclear radiation and its applications in nuclear medicine; (f) describe and analyse the interaction processes of different types of ionising radiations with matter and explain their roles in medical imaging and radiation therapy; and (g) describe the units for radiation quantities, the principle of radiation dosimetry and the common radiation detection methods.
Subject Synopsis/ Indicative Syllabus	**Atomic structure and intra-atomic phenomena**: atomic structure; the electromagnetic radiation and spectrum; quantum theory and duality principle; inverse square law; Einstein's mass-energy relationship; electron energy levels; electron energy bands; ionisation and excitation; continuous and characteristic X-rays production; factors affecting quality and quantity; fluorescence, phosphorescence and thermoluminescence. **Radioactivity**: nuclear structure; radionuclide notation; nuclear binding energies; nuclear instability and line of stability; use of radionuclide chart; radioactive decay processes; alpha, beta, electron capture and positron decay; annihilation radiation; radioactivity units; decay schemes; decay constant and decay factor; physical, biological and effective half life; fundamental radioactivity decay calculations; radionuclide production and radiopharmaceuticals used in nuclear medicine. **Interactions of X-ray and gamma photons with matter**: interaction processes of X-ray and gamma photons with matter applicable to medical imaging and radiation therapy; photoelectric effect, Compton effect and pair production; linear attenuation coefficient; energy-absorption coefficient; half value layer; lead equivalent. **Interactions of particulate radiation with matter**: alpha, beta, proton, positron and neutron interactions; energy-loss mechanisms; collisional stopping power and range. **Radiation quantities and units**: units for radiation quantities: exposure, air dose,

equivalent dose and effective dose; f-factor; LET and KERMA; introduction to radiation dose concept.

Radiation detection methods: principles of common radiation detection and measurement methods: air ionisation chamber, film, scintillation detector, semiconductor detector and thermoluminescent detector (TLD).

Teaching/Learning Methodology

Lectures are the basic medium to deliver the fundamental knowledge of the physical properties of radiation, its production and interactions with matter. The lecture materials are reinforced with figures and animations to facilitate the students to learn and understand the concepts easily and intuitively. Tutorials are scheduled for students to work on in-class exercises so as to help them understand the teaching materials and apply the knowledge in solving problems. Students are encouraged to discuss and share their idea with their classmates in doing the exercises (promoting cooperative learning).

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
(1) Continuous assessment	40	✓	✓	✓	✓	✓	✓	✓
(2) Examination	60	✓	✓	✓	✓	✓	✓	✓
Total	100							

Continuous assessment consists of assignments and mid-term test. Assignments are used to strengthen the basic knowledge of students and their analytical skill to solve the problems related to radiation physics.
Problem questions, including short and long questions, are used in tests and final examination to measure the student knowledge of fundamental radiation physics. The questions are designed to cover all the intended learning outcomes. The students are required, through answering all the questions, to demonstrate their capability in comprehending, explaining and analyzing the physical properties of radiation, its production and interactions with matter.

Student Study Effort Required

Class contact:	
• Lecture	33 h
• Tutorial	6 h
Other student study effort:	
• Self-study	81 h
Total student study effort	120 h

Reading List and References

Graham, Donald T. Principles of radiological physics. 5th ed. 2007. Edinburgh: Churchill Livingstone.

	Bushberg, J.T., Seibert, J.A., Leidholdt, Jr. E.M., and Boone, J.M. The essential physics of medical imaging. 2nd ed. 2002. Philadelphia: Lippincott Williams & Wilkins. Bushong, Stewart C. Radiologic science for technologists: physics, biology, and protection. 9th ed. 2008. St. Louis, Mo.: Mosby/Elsevier. Dendy, P.P. Physics for diagnostic radiology. 2nd ed. 1999. Bristol: Institute of Physics Pub.