

SPH 327: Radiation Physics

(Instructor: Dr. Angeyo H. Kalambuka)

Scope

The course focuses on the fundamentals of ionizing radiation needed for applications in nuclear and medical physics. It examines the production of ionizing radiation emphasizing X-ray production and radioactivity, which are the main sources, its fundamental interactions with matter, as well as radiation dose measurement quantities and techniques. The course first examines models for the constituents and properties of nuclei, nuclear processes and especially particle radiation interactions with matter from radioactive processes as examples of strong, weak and electromagnetic interactions. It then considers the properties of ionizing radiation in terms of the dosimetric means of measuring the effect of the interaction in biological materials. The course includes applications such as detection of radiation, nuclear power generation, fusion and fission, and environmental and biological exposure to radiation, risk assessment, and radiation protection. Finally it covers the uses of ionizing radiation with emphasis on medicine.

Objectives

The course aims to provide a sound basic knowledge and understanding of the nature and various uses of ionizing radiations in nuclear and medical physics. Specifically to impart knowledge and understanding on the theoretical principles of a) ionizing radiation: production, propagation in materials and methods of detection and b) ionizing radiation: sources, interactions in materials, dosimetry and medical applications. A key objective is to investigate the physical properties of the radiation and to impart knowledge on the instrumentation involved, to provide a platform for further courses in more specialized applications, and to provide the core knowledge for career work within the fields of Nuclear Science Techniques, Nuclear Instrumentation, Radiation Physics, Health Physics, Radiation Oncology, Medical Physics, Nuclear Medicine, Radiotherapy, Radiometry, Diagnostic Radiology, Medical Imaging.

Outcome

This course deepens the students' understanding of the constituents, properties and processes of atomic nuclei, as well as the properties, interaction processes and practical use of ionizing radiation from nuclear processes. Students will be able to find and use relevant data to assess and evaluate the occurrence and effects of nuclear processes and ionizing radiation.

Course Content

X-rays and X-ray spectra. Production and application of X-rays. Diffraction of X-rays. Nuclear structure. Natural radioactivity. Radioactivity series and isotopes. Properties and uses of radioactivity. Artificial radioactivity. Nuclear bombardment experiments. The neutron. Neutron physics. Cosmic rays. Measurement and detection charged particles. Accelerators in nuclear physics. Nuclear fission and applications. Thermonuclear reactions and nuclear fusion. Uses of radiation in medicine. Biological effects of nuclear and EM radiation. Maximum permissible radiation levels of safety. Fundamentals of radioprotection.

Course Structure

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| Strength | 35 hours |
| Examination | 1 (out of 70 marks) |
| CATS | 2 (out of 15 marks): In week 7 and week 11 |
| Tutorials | 2 (out of 15 marks): In week 4 and week 8 |

Recommended Text Books

1. Attix, F H., 1968. Radiation Dosimetry
2. Greening, J R., 1985. Fundamentals of Radiation Dosimetry.
3. Lapp R. E. and Andrews, H.L. 1948. Nuclear Radiation Physics
4. Evans, R. D., 1982. The Atomic Nucleus

Prerequisites: SPH 326 Applied Atomic and Nuclear Physics