EEM 200 Radiation Safety Engineering

3rd and 4th quarters, Sophomore

Instructors	TAMAGAWA YOICHI, YOSHIDA TAKUO, OGAWA IZUMI, IZUMI YOSHINOBU, YASUDA NAKAHIRO
Style of Class	Lecture
Number of Credits	2
Day and Period	Wednesday, period 1

Course Description

Fukui Prefecture is home to a number of nuclear power plants which have assumed a major role as a primary source of power supply to the Kansai area. Against this backdrop, many nuclear-related facilities are situated in Fukui Prefecture (or the Reinan area in particular), with a larger proportion of the population working for these power plants or nuclear-related facilities than in other regions. In view of such regional characteristics, University of Fukui aims to equip its students with accurate essential knowledge about "nuclear power" and "radiation/radioactivity" before graduation, providing fundamental education on "nuclear power" broadly to students of other disciplines as well.

Being invisible and not detectable by human senses, radiation can be harmful to human health in large doses, or even lethal in a large momentary dose. For this, it is often perceived as highly hazardous in itself. We know, however, that radiation has always been around us since ancient times.

Toward the goal described above, this course is designed to equip students with essential knowledge about radiation and radioactivity in a plain and systematic manner, composed of lectures by specialists in the topics covered. The course includes not only lectures but also demonstration experiments and practice to help students' understanding.

Course Objectives

Students will:

(1) acquire essential knowledge about the properties of radiation and radioactivity and methods of detection, and consider interactions between radiation and materials

(2) understand methods of protection against radiation and the biological effects of radiation in different dose levels, and consider the benefits and risks involved in the use of radiation in the society

Prerequisites

None (Students are recommended, although not required, to be able to perform simple calculations including calculus and differential equations).

Class Materials

Students will print out class materials downloaded from a designated address before every class.

Reference book:

(1) Shibata Tokushi, *Hoshasen gairon* (Introduction to radiation), Tsushosangyo-kenkyusha, 2013.

(2) Tada Jun'ichiro, *Wakari yasui hoshasen butsurigaku* (Simple radiation physics), Ohmsha, 2008.

Course Method

Classes will be conducted basically in a lecture format. This is an omnibus-style course consisting of lectures by instructors specialized in respective topics. Students will download class materials from a designated website and print them out before each class. Students are recommended to study further by obtaining reference materials as much as possible. To help students' understanding, instructors may require them to answer practice questions. Students will be required to bring a scientific calculator, to plot graphs from demonstration experiments to verify theories in class.

Evaluation/Assessment

Students will be required to submit papers in response to assignments from instructors.

Grading

30% Assignment (response papers)
70% Term-end examination

Course Schedule

Week 1: (TAMAGAWA YOICHI) Fundamental issues on atomic nucleus
Learn about the structure and decay of atomic nucleus.
Week 2: (TAMAGAWA YOICHI) Mass deficiency of atomic nucleus
Understand mass deficiency in nuclear decay and binding energy. To use the special theory of relativity to calculate the amount of this energy, the concept will be explained plainly to students including beginners.
Week 3: (TAMAGAWA YOICHI) Radiation and radioactivity
Understand the properties of radioactive emissions from nuclear decay.
Week 4: (YOSHIDA TAKUO) Interaction of radiation and matter -I
Learn about energy transfer occurring when charged particles (radiation) enter matter.
Week 5: (YOSHIDA TAKUO) Interaction of radiation and matter -II
Learn about energy transfer between matter and electromagnetic waves (gamma rays etc.), among other types of radiation.
Week 6: (YOSHIDA TAKUO) Interaction of radiation and matter -III
Learn about interactions between incoming particles and matter.
Week 7: (OGAWA IZUMI) Radiation detectors
Understand the operating principles of various detectors.
Week 8: (OGAWA IZUMI) Radiation detectors
Learn how to select a radiation detector appropriate for the target as well as about more advanced measurement technologies.
Week 9: (IZUMI YOSHINOBU) The concept of radiation dose and radiation protection
Students will acquire basic knowledge about the biological effects of radiation and learn about radiation effects at cellular levels.
Week 10: (IZUMI YOSHINOBU) The concept of radiation dose and radiation protection
Students will systematically learn about the concept of radiation dose to correctly understand the meanings of units such as Gy and Sv.
Week 11: (IZUMI YOSHINOBU) The concept of radiation dose and radiation protection
Learn about the differences between short-term exposure and long-term exposure concerning the biological effects of radiation doses.
Week 12: (TAMAGAWA YOICHI) Radioactive materials in natural environment and environmental radiation
Learn about radiation sources present in our living environments and their radioactive intensity, and assess their effects.
Week 13: (YASUDA NAKAHIRO) Utilization of radiation
Students will be shown how humans utilize different types of radiation with sample applications to consider how we should deal with radiation into future.
Week 14: (YASUDA NAKAHIRO) Law concerning radiation protection
Learn about the current law concerning the use of radiation and exposure, and understand the current situations of regulations and ideas about safety.
Week 15: (TAMAGAWA YOICHI) Practice quiz
Students will have practice quizzes about what they have learned, followed by detailed explanatory comments, to reach more profound understanding.
Week 16: (TAMAGAWA YOICHI) Term-end examination

Preparation and Follow-up

Preparation: Read through the relevant chapters of reference books (about 1 hour)
Follow-up: Read again the class material to review the class and deepen understanding (about 1 hour)