TOMSK POLYTECHNIC UNIVERSITY | ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

Director of Nuclear Science & Engineering School
_____ / Oleg Yu. Dolmatov
"25" 06 2020

Course Name: Dosimetry and Protection from Ionizing Radiation

Field of Study: Nuclear Science and Technology

Programme name: Nuclear Science and Technology

Specialization: Nuclear medicine

Level of Study: Master Degree Programme

Year of admission: 2020

Semester, year: semester 1, year 1

ECTS: 3

Total Hours: 108

Contact Hours: 32

- **Lectures:** 16
- **Laboratory work:** 16

Self-study: 76

Assessment: Graded credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Valentina S. Yakovleva

TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

Course name: Dosimetry and Protection from Ionizing Radiation

Course Overview

Course Objectives	The objective of the course is to form a set of competences (learning outcomes) to prepare students for operational and engineering activities involving application of methods for dosimetry and radiation protection, assessment and analysis of attenuation of radiation in a substance and radiation exposure risks, nuclear and radiation safety improvement.
Learning Outcomes	**Upon completion of the course, a graduate is expected to acquire the knowledge of:** – ionizing radiation sources; – basic methods of production personnel and population protection against possible unsafe accidents and disasters; – radiation safety standards, – methods for calculating protection against charged particles, from gamma and neutron radiation; – methods and means of dosimetry and radiometry, rules for registration of measurement results in accordance with the requirements of relevant standards and regulatory documents; – physical fundamentals of dosimetry of ionizing radiation, dose values and units of measurement, characteristics of ionizing radiation fiels. **Graduates are also expected to develop the following skills:** – to assess nuclear and radiation safety, impact of the radiation on the environment; – to select and apply measurement tools and instruments and draw up the measurement results in accordance with the requirements of relevant standards and regulatory documents; – to calculate protection from charged particles, gamma and neutron radiation, evaluate radiation conditions, simulate radiation transfer; – to calculate protection from various types of ionizing radiation by using engineering methods to create mathematical models of radiation transfer; – to carry out individual dosimetric control and radiation monitoring of the environment. **Graduates should acquire the practical experience in:** – application of methods for calculation of biological protection and ionizing radiation intensity, radiation safety standards; – using skills to select the necessary measurement instruments for conducting individual dosimetric monitoring and radiation monitoring of the environment; – implementation of engineering methods for calculating protection from ionizing radiation of various kinds, creating mathematical models of radiation transfer; – using dosimetry and radiometry methods to assess levels of radiation hazardous environmental factors, of substances and materials radioactivity.

Course Outline	The course is taught using a variety of teaching forms, including lectures, practical experience and learners' self-study. The course includes the following obligatory components: – 8 lectures; – 8 laboratory works; – 2 tests (in a written form). **Main sections of the course are as follows:** – Characteristics of ionizing radiation fields (lectures – 2 hours, lab – 2 hours); – Quantities and units of the measurement of ionizing radiation (lectures – 4 hours, lab – 4 hours); – Dosimetric and radiometric measurement methods and means (lectures – 6 hours, lab – 6 hours); – Protection against ionizing radiation (lectures – 4 hours, lab – 4 hours). The course ends with a graded credit-test. Learners are expected to demonstrate their knowledge, skills and understanding of the course material by giving full and extensive answers to 4 questions each referring to one of the course sections.
Prerequisites (if available)	1. Nuclear Physics 2. Special chapters of Advance Mathematics
Course Structure	The target course consists of the five sections. **Section 1. Characteristics of ionizing radiation fields** Introduction to dosimetry. Course main aims and objectives. Characteristics of ionizing radiation fields. **Section 2. Quantities and units of ionizing radiation measurement** Basic and equi-dosimertic quantities and units of their measurements. Ionizing radiation interaction with matter. Relative biological effectiveness of radiation. The Inverse Square Law. Gamma-Equivalent. Specific Gamma-Ray Constants. **Section 3. Dosimetric and radiometric measurement methods and means** Review of dosimetric and radiometric measurement methods. Types of dosimetric control. Applications of dosimetry and radiometry in radioecology and geophysics. Radiation monitoring arrangement. **Section 4. Protection against ionizing radiation** Protection against external and internal irradiation. Calculation methods for protection against alpha-, beta-, gamma-radiation and neutrons.
Facilities and Equipment	1. Lecture room 228, TPU building 10. 2. Laboratory room 121, TPU building 10. Classroom for laboratory work equipped with dosimeters and radiometers.
Grading Policy	In accordance with the TPU rating system we use: - Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering of theoretical material and the results of practical activities (performance tests, perform tasks). Max score for current assessment is 10 points, min – 6 points. - Defense of lab is performed on a regular basis during the semester. Max score for assessment is 10 points, min – 6 points. The final rating is determined by summing the points of the current assessment during the semester and credit test scores at the end of the semester. Maximum overall rating corresponds to 100 points, min pass score is 55 points.
Course Policy	Class attendance will be taken into consideration when evaluating students' participation in the course. Students are expected to be actively engaged in class

	discussions about the assigned readings. Attendance is strictly controlled. All classes require obligatory presence.
Teaching Aids and Resources	**Compulsory reading:** 1. Stabin, M. G. Radiation Protection and Dosimetry: An Introduction to Health Physics / M. G. Stabin. – New York : Springer, 2007. – Текст : электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-0-387-49983-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 2. Cerrito, L. Radiation and Detectors: Introduction to the Physics of Radiation and Detection Devices / L. Cerrito. – New York : Springer, 2017. – Текст : электронный // SpringerLink. – URL: https://www.springer.com/gp/book/9783319531793 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. **Additional reading:** 1. Bréchignac, F. Yu. Kutlakhmedov, P. Balan, V. Kutlakhmedova-Vishnyakova, Equidosimetry – Ecological Standardization and Equidosimetry for Radioecology and Environmental Ecology / F. Bréchignac, G. Desmet. – Dordrecht : Springer, 2005. – Текст : электронный // SpringerLink. – URL: https://www.springer.com/gp/book/9781402036484 (дата обращения: 20.04.2020). – Режим доступа: из корпоративной сети ТПУ. 2. Gupta T. K., Radiation, Ionization, and Detection in Nuclear Medicine / T. K. Gupta. – Berlin; Heidelberg : Springer-Verlag, 2013. — Текст : электронный // SpringerLink – URL: https://www.springer.com/gp/book/9783642340758 (дата обращения: 20.04.2020). – Режим доступа: из корпоративной сети ТПУ.
Instructor	1. Yakovleva Valentina Stanislavovna, Doctor of Technical Sciences, Professor of Nuclear Fuel Cycle Division, Nuclear Science & Engineering School, TPU, +7 (3822) 70182 (ext 520)9, e-mail: vsyakovleva@tpu.ru Personal page: http://portal.tpu.ru/SHARED/v/VSYAKOVLEVA/eng