TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name: Ionizing radiation installations

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 2, year 1

ECTS: 3

Total Hours: 108

Contact Hours: 32

- **Lectures:** 8
- **Practical experience:** 8
- **Laboratory work:** 16

Self-study: 76

Assessment: Credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Leonid G. Sukhikh

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Course name: Ionizing Radiation Installations

Course Overview

Course Objectives	The objective of the training course "Ionizing Radiation Installations" is the formation of students' knowledge of basics of ionizing radiation installations used for radiotherapy, including principles of their operation, main characteristics, advantages and disadvantages of particular models available on the market. The course includes theoretical information, installations design characteristics and their clinical application.
Learning Outcomes	**Upon completion of the course, a graduate will obtain the knowledge of:** – main types of installations used for radiotherapy (gamma-apparatus, linacs, proton machines, apparatus for brachytherapy, radiosurgery, intraoperative radiotherapy, tomotherapy and neutron therapy); – operation principles of the different types of apparatus; – main characteristics of the different types of radiotherapy apparatus. **Upon completion of the course, graduates are expected to develop the following skills:** – to analyze and compare different types of radiotherapy apparatus; – to analyze and compare characteristics of different types of apparatus; – to simulate dose fields of different apparatus. **Upon completion of the course, graduates should acquire the practical experience in:** – analysis and comparison of the different types of radiotherapy apparatus; – analysis and comparison of the characteristics of different types of apparatus. As a result of mastering the training course, students shall achieve the following results: – consider a problem situation, perform searching, analysis and ranking of information in a foreign language in the field of radiation therapy apparatus; – compose professional texts and organize a discussion of the results of professional activities in a foreign language in the field of radiation therapy apparatus; – know the basic physical and technical principles of the operation of apparatus for radiation therapy, be able to compare and analyze their characteristics, have experience in comparison and analysis. – know the basic principles of ensuring the quality of the physical and technical aspects of radiation therapy used in the operation of radiation therapy apparatus – be able to calculate radiation dose fields.
Course Outline	The training course is delivered through the following teaching modes: – 4 lectures (8 contact hours); – 4 practical experiences (8 contact hours); – 4 laboratory works (16 contact hours); – students' self-study. The course consists of 4 sections, which are given below.

	Section 1. Gamma-apparatus for external beam radiotherapy **Section 2. Linacs** **Section 3. Proton beam accelerators used in radiotherapy** **Section 4. Apparatus for brachytherapy** Each section includes lectures, practical experiences and laboratory works.
Course Structure	The content of the course covers 4 topics. Each topic is studied through lecture, practical experience and laboratory work. **Section 1. Gamma-apparatus for external beam radiotherapy** The section is devoted to the consideration of devices for remote gamma therapy, cobalt guns and includes the main design features, application, operation features **Section 2. Linacs** The section is devoted to the consideration of linear electron accelerators, which are used for remote radiation therapy with photon beams of MeV energies and high-energy electrons, and includes the main design features, application, operation features **Section 3. Proton beam accelerators used in radiotherapy** The section is devoted to the consideration of proton beam accelerators used in radiation therapy (cyclotrons, synchrotron), which are used for remote radiation therapy, and includes the main design features, application, operation features **Section 4. Apparatus for brachytherapy** The section is devoted to the consideration of brachytherapy devices, which are used for contact radiation therapy with high-energy gamma-ray beams, and includes the main design features, application, operation features
Facilities and Equipment	1. Lecture rooms with multimedia equipment (projector, PC): 228 room of the 10^{th} building of TPU, 125A room of the 10^{th} building of TPU. 2. Rooms for practical experience with PC: 228 room of the 10^{th} building of TPU, 125A room of the 10^{th} building of TPU, 123 room of the 10^{th} building of TPU. 3. Laboratories: laboratory of spectroscopy 123 room of the 10^{th} building of TPU, computational class, 122 room of the 10^{th} building of TPU. Laboratory equipment includes gamma-ray sources, detectors of gamma radiation, dosimeters and photon counters. PcLab software for simulation interaction of photons, electrons and protons with matter, Wolfram Mathematica software for data treatment and preparation of reports.
Grading Policy	In accordance with TPU assessment system we use: - Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering the theoretical material and the results of practical activities (tests, tasks, problem solving). Max score for current assessment is 100 points. Attendance of the classes is obligatory. Each attended lecture, practical experience or lab is scored with 1 point. Lab defense is scored with 10 points: 4 points are allocated for the preparation of the report and 6 scores are given for the report defense. Four labs must be done within the course. The defense is required to provide a report on the work performed. The current assessment allows revealing the quality of learners' professional training. Three seminars are planned for the semester. The structure of the seminar includes preparation of the presentation on the topic and collaborative discussion of the seminar topic. Volume of information analyzed, presentation prepared by a student and his/her performance during the discussion are used for grading general activity of learners for a seminar. .The maximal score for 3 seminars is equal to 44

	pts.
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 on the assigned reading materials. All classes are obligatory to visit. All labs and practical tasks should be fulfilled to cover the course material successfully.
Teaching Aids and Resources	**Compulsory Readings:** 1. Podgorsak, Ervin B. Radiation Physics for Medical Physicists [Electronic resource] / Ervin B. Podgorsak. – Electronic data. – Copyright Information: Springer International Publishing Switzerland 2016, Publisher Name: Springer, Cham, 2016. – 906 p. – Available: https://www.springer.com/gp/book/9783319253800 2. Podgorsak, Ervin B. Compendium to Radiation Physics for Medical Physicists [Electronic resource] / Ervin B. Podgorsak. — Electronic data. — Copyright Information: Springer-Verlag Berlin Heidelberg 2014, Publisher Name: Springer-Verlag Berlin Heidelberg, 2014. – 1148 p. – Available: https:// https://www.springer.com/gp/book/9783642201851 3. Amestoy, William. Review of Medical Dosimetry [Electronic resource] / William Amestoy. — Electronic data. — Copyright Information: Springer International Publishing Switzerland 2015, Publisher Name: Springer, Cham, 2015. — 867 p.— Available: https://www.springer.com/gp/book/9783319136257 4. Lucio Cerrito. Radiation and Detectors: Introduction to the Physics of Radiation and Detection Devices [Electronic resource] / Lucio Cerrito. – Electronic data. – Copyright Information: Springer International Publishing AG, 2017, Publisher Name: Springer International Publishing, 2017. – 210 p. – Available: https://www.springer.com/gp/book/9783319531793 5. Muhammad Maqbool. An Introduction to Medical Physics [Electronic resource] / Muhammad Maqbool. – Electronic data. – Copyright Information: Springer International Publishing AG, 2017, Publisher Name: Springer International Publishing, 2017. – 416 p. – Available: https://www.springer.com/gp/book/9783319615387 6. Helmut Wiedemann. Particle Accelerator Physics [Electronic resource] / Helmut Wiedemann. – Electronic data. – Copyright Information: The Author(s), Publisher Name: Springer International Publishing, 2015. – 1021 p. – Available: https://www.springer.com/gp/book/9783319183169 **Internet Resources:** 1. Official website: Best Theratronics Ltd. http://www.theratronics.ca/index.html 2. Official website: Elekta https://www.elekta.com/ 3. Official website: Varian https://www.varian.com/ 4. Official website: IBA https://iba-worldwide.com/ 5. Official website: Protom https://www.protom.ru/ 6. Official website: Eckert & Ziegler BEBIG https://www.bebig.com/home/ 7. Official website: Accuray https://www.accuray.com/ 8. Official website: Intraop https://intraop.com/ 9. Official website: S.I.T. – Sordina IORT Technologies https://www.soiort.com/

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