TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name: Modern medical imaging technologies

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: 48

- **Lectures:** 16
- **Practical experience:** 16
- **Labs:** 16

Self-study: 60

Assessment: Credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Dan A. Verigin

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Course name: Modern medical imaging technologies

Course Overview

Course Objectives	The objective of the course is to develop knowledge and skills to perform professional activity in a variety of forms including research and technological activities in the fields related to X-ray generation and X-ray interaction with matter, nuclear magnetic resonance to understand the work of modern medical imaging tools.
Learning Outcomes	**Upon completion of the course, a graduate will obtain the knowledge of:** – Specific of professional etiquette in local and foreign country; – Bases of report structuring and preparation of presentations in foreign languages accepted in international community ; – main types of medical imaging techniques based on ionizing radiation – main types of x-ray emitters used in medical imaging and their parameters affecting on quality of obtained images. **Upon completion of the course, graduates are expected to develop the following skills:** – compose and present technical and scientific information used in professional activities by presentations; – comprehend authentic audio and video materials associated with area of training; – manipulate with x-ray tube, tune up parameters in according with tasks of diagnostics; – calculate the main characteristics of the resulting images obtained in medical imaging. **Upon completion of the course, graduates should acquire the practical experience in:** – monologue utterance in foreign language according to the profile of his specialty, reasonably states his position and using auxiliary means (tables, graphs, charts, etc.); – using obtained knowledge in foreign language at sufficient level of their future professional activity; – work with an x-ray tube and control its operation modes for obtaining diagnostic images with required quality; – imaging of the internal structure of objects using beam diagnostics.
Course Outline	The training course is delivered through the following teaching modes: – 8 classes of lectures; – 8 classes of practical experiences; – 4 laboratory works The course consists of 5 sections, which are given below. Section 1. Interaction of radiation with matter Section 2. Generation of X-rays in an X-ray tube Section 3. Radiation Detectors in X-Ray Medical Imaging Section 4. Methods of obtaining images using an X-ray tube. Section 5. Nuclear magnetic resonance in tomography

	To finish the course successfully, students shall perform and defend reports of 4 laboratory works and pass to control tests and two colloquiums. Lab defense is assessed with the score of 11 points: 5 points are allocated for the preparation of the report and 5 points for the report defense, one additional point is for report itself. Test should be done in writing during the semester. The structure of the test includes two test questions, 3 test exercises. Each task is assessed with two points. The whole test is assessed with 10 points. Colloquium should be done in oral during the semester. The structure of the colloquium includes 5 questions. Each answer to the question is assessed with two points. The whole colloquium is assessed with 10 points. In addition there is 16 scores points for attending all lectures and practical seminars. The maximum score for all activities is 100 points.
Course Structure	All course is divided in 5 parts. Some parts have practical experience in solving problems, some parts have practical experience in laboratory works. **Section 1. Interaction of radiation with matter** As a result of mastering the section the student will know the main types of interaction of X-rays and electrons with the substance, their characteristics and features, how do photon and electron fluxes are attenuated in matter. In addition, student will be able to calculate the attenuation of radiation flux when passing through various materials. **Section 2. Generation of X-rays in an X-ray tube** As a result of the mastering of the section, the student will know how X-rays are generated in x-ray tube, what are the main parts of X-ray tube and characteristics of X-ray tubes. In addition, they will know how photon radiation beams are formed for medical imaging and will have experience of work with an x-ray tube and control its operation modes. **Section 3. Radiation Detectors in X-Ray Medical Imaging** As a result of mastering the section, the student will know how and by what radiation is recorded after passing through a biological object and how the image of the internal structure of the object is formed. In addition, student will be able to calculate the main characteristics of the resulting images obtained in x-ray visualization. **Section 4. Methods of obtaining images using an X-ray tube.** As a result of the mastering of the section, the student will know the main X-ray based medical imaging systems. In addition, they will have experience of obtaining images using source of radiation and detector line. **Section 5. Nuclear magnetic resonance in tomography** As a result of mastering the section, the student will know the basics of nuclear magnetic resonance and how it is used for the purpose of medical visualization of the internal structure of biological objects.
Facilities and Equipment	1. Room for lectures and practical experience with PC: 634050, Tomsk, Lenina Ave, 2, building 10, room 125A. 1. Laboratory of spectroscopy: 634050, Tomsk, Lenina Ave, 2, building 10, room 123. 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, defending reports on laboratory works, colloquiums). Max score for current assessment is 100 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 on the assigned reading materials. Medical allowance to work with radiation is required. Students should pass briefing about electrical, work and radiation safety in laboratories of Nuclear Fuel Cycle Division.
Teaching Aids and Resources	**Compulsory reading:** 1. Diagnostic Radiology Physics : a handbook for students and teachers / by editors D. R. Dance, S. Christofides, A. D. A. Maidment [et.al.]. — Vienna : International Atomic Energy Agency, 2014. - Текст: электронный // IAEA. – URL: https://iaea.org/publications/8841/diagnostic-radiology-physics (дата обращения: 20.09.2020). – Режим доступа: по подписке. 2. Burbridge, B. Undergraduate Diagnostic Imaging Fundamentals / B. Burbridge, E. Mah. – Montreal : University of Saskatchewan, 2017. - 743 p. - Текст: электронный // Open Textbook Library. – URL: https://open.umn.edu/opentextbooks/textbooks/undergraduate-diagnostic-imaging-fundamentals (дата обращения: 20.09.2020). – Режим доступа: по подписке. 3. Hendee, W. R., Ritenour, E. R. Medical Imaging Physics / W. R. Hendee, E. R. Ritenour. - Fourth Edition. - New York: Wiley Liss, 2002. - 512 p. - Текст: электронный // Wiley Online Library. – URL: https://onlinelibrary.wiley.com/doi/book/10.1002/0471221155 (дата обращения: 20.09.2020). – Режим доступа: по подписке. **Additional reading**: 1. Saha, Gopal B. Basics of PET Imaging: Physics, Chemistry, and Regulations / Gopal B. Saha. – New York: Springer Science+Business Media, Inc., 2005. - 219 p. - Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/b138655 (дата обращения: 20.09.2020). Режим доступа: по подписке. 2. Hamidreza Mahboobi. Evidence- Based Medicine for Medical / Hamidreza Mahboobi, Sharma Akshay, Khorgoei Tahereh, Keramat Allah Jahanshahi [and etc.] //Australasian Medical Journal. - 2010. – № 3. – P. 190-193. - URL: https://www.researchgate.net/publication/43655583_Evidence-_Based_Medicine_for_Medical_Students (дата обращения: 20.09.2020). — Режим доступа: свободный доступ из сети Интернет. - Текст : электронный.
Instructor	Verigin Dan Alexandrovich, Associate professor, Nuclear Fuel Cycle Division, School of Nuclear Science & Engineering, TPU, e-mail: verigin@tpu.ru, Tel.: +7 (3822) 701-777 ext. 5207, personal site: http://portal.tpu.ru/SHARED/v/VERIGIN/eng