TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

Director of Nuclear Science & Engineering School

_____ / Oleg Yu. Dolmatov
"31" 08 2021

Course Name: Professional Training in English Language

Field of Study: Nuclear Science and Technology

Programme name: Nuclear Science and Technology

Specialization: Nuclear Power Engineering

Level of Study: Master Degree Programme

Year of admission: 2021

Semester, year: semester 1,2, year 1

ECTS: 6

Total Hours: 216

Contact Hours: 64

- **Practical experience:** 64

Self-study: 152

Assessment: credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Vera V. Verkhoturova

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Course name: Professional Training in English Language

Course Overview

Course Objectives	The objective of the training course is to develop communication skills, which enable learners to solve communicative tasks while performing professional activity in a variety of forms including research and technological activities in the fields related to nuclear science and technology.
Learning Outcomes	**Upon completion of the course, a graduate is expected to acquire the knowledge of:** – main ways of interaction of neutron radiation, gamma-ray fluxes, light and heavy charged particles with matter; – basic concepts and terms related to nuclear physics; – theory of nuclei structure and their characteristics; – types and laws of radioactive decays; – mechanisms of nuclear reactions and their types; **Graduates are also expected to develop the following skills:** – to carry out calculations of the interaction of ionizing radiation with various materials and substances; – to predict nuclear transformations based on radioactive series; – to interpret characteristics and parameters of nuclei in accordance with the basic models of nuclei; – to perform theoretical and experimental data analysis of radioactive transformations parameters; – to apply knowledge of modern communicative technologies in a foreign language in the field of nuclear physics; **Graduates should acquire the practical experience in:** – use of mathematical analysis and modeling; – theoretical study of the processes of interaction of flows of ionizing radiation with matter; – carrying out evaluative and engineering calculations of the parameters of nuclear reactions; – application of methods to analyze nuclear transformations of substances due to their decays, and interpretation of the obtained results.
Course Outline	The course is taught though practical experiences and accompanied with learners' self-study activities. The course includes the following obligatory components: – 32 practical experiences; – 2 colloquiums. Main sections of the course are as follows: **Section 1.** Introduction to atomic and nuclear physics **Section 2.** Nuclear technologies and ecology of nuclear fuel cycle **Section 3.** Materials of nuclear power facilities **Section 4.** Nuclear power plant **Section 5.** Dosimetry and protection from ionizing radiation **Section 6.** Radioactive waste management

	Section 7. International nuclear non-proliferation regime **Section 8.** Accounting and control of nuclear materials, nuclear security of nuclear materials and facilities Practical training tasks with theoretical questions and exercises have been developed for each course topic. Students will do a part of practical work in the classroom, whereas another part of practical work will be done individually as a self-study work. The current assessment allows revealing the quality of learners mastering the course material referring to all sections of the course "Professional Foreign Language (English)". Current assessment forms include oral reports, presentations, projects, colloquiums, reviews, translation tasks. Oral report is performed at the end of the course topic study and covers the summarized learning materials of the section. Performance of oral report is evaluated with 5 points. Presentation is prepared by students in small groups and covers the topic of the studies section or its subsection and requires learners to search for additional information on the target topic, structure and organize it in the form of multimedia presentation. Learners should pay special attention to the usage of terms relate to the content of the section of its subsection. Presentation is evaluated in accordance with evaluation criteria and is scored with 10 points. Presentation is accompanied with writing a review related to the topic of the presentation. Review is performed in pairs and submitted for evaluation to the instructor on the day when presentation is delivered. This is scored with 10 points. Project work is one of the assessment forms, which requires learners to work as a team over a task given by the instructor. There is one project for the course which is carried out within the section 5 Dosimetry and protection from ionizing radiation. This is scored with 15 points. In order to assess the current level of knowledge, it is supposed to conduct 2 colloquiums in the form of an oral interview. It is necessary to answer 3 theoretical questions based on the material of the relevant sections of the course. The correct answers to all questions of the colloquium are assessed with 10 points.
Prerequisites (if available)	There are no special prerequisites to study this course.
Course Structure	The course material is divided into eight sections. **<u>Section 1. Introduction to atomic and nuclear physics</u>** Matter. Structure of matter. Atom. Atomic structure. Structure of nucleus. Models of atoms. Electron orbitals. Nucleons. Nuclear reactions. Radioactivity. Ionizing radiation. Types of ionizing radiation. Stability of atoms and nucleons. **<u>Section 2. Nuclear fuel cycle (NFC)</u>** Uranium based NFC: open and closed. Uranium NFC stages: mining, processing, enrichment, fuel fabrication, radioactive waste disposal. Isotope separation methods: centrifugal, electromagnetic, gaseous diffusion, liquid thermal diffusion, laser, chemical methods. Isotopes used in nuclear power engineering. Ion exchange resins for nuclear power plants. Thorium based NFC. **<u>Section 3. Materials of nuclear power facilities</u>** Nuclear fuel. Types of nuclear fuel. Fuel elements. Uranium fuel. Mixed oxide fuel (MOX)/ Main properties of materials, special properties of materials,

	structural materials of nuclear power plants, moderator materials, coolant materials, neutron absorber materials, burnable absorbers, radiation resistance, corrosion resistance, compatibility. **Section 4. Nuclear power plant** Nuclear power plant (NPP). Nuclear island. Steam generators, heat exchangers, biological protection, turbines. Factors determining safety of NPP. NPP Safety systems. Defense in depth, reactor control and safety systems. IAEA International Nuclear Event Scale (INES), major accidents: Three Mile Island, Fukushima, Chernobyl, etc. **Section 5. Dosimetry and protection from ionizing radiation** Interaction of radiation with matter. Radiation dose. Risks of radiation exposure. Radiation safety standards for NPP personnel and the public. Detectors and devices for radiation monitoring. Methods and means of protection against ionizing radiation. **Section 6. Radioactive waste management** The concept of radioactive waste. Radioactive waste classification. Norms and regulations for radioactive waste management. Radioactive waste management strategies and technologies. Types of storage and disposal facilities, basics of ecology. National systems for radioactive waste management. **Section 7. International nuclear non-proliferation regime** Nuclear non-proliferation regime, problems, possible solutions to problems and prospects for the international nuclear non-proliferation regime sustainability. Organizations that regulate nuclear energy, disarmament. Nuclear weapons, international activities of the IAEA. IAEA safeguards system. **Section 8. Accounting and control of nuclear materials, nuclear security of nuclear materials and facilities** Basic concepts of nuclear materials accounting and control, physical protection of nuclear materials, accounting units, nuclear materials balance, categorization of nuclear materials. Physical protection system, principles of physical protection system design and evaluation.
Facilities and Equipment	Room for practical experiences equipped with multimedia equipment (projector, PC): 634050, Tomsk, Lenina Ave, building 10, room 226A.
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. The final score is determined by summing the scores of the c and exam score at the end of the semester. Maximum overall score corresponds to 100 points, min pass score is 55 points.
Course Policy	Class attendance is 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.
Teaching Aids and Resources	**Compulsory Reading:** 1. Kamal, A. Nuclear Physics / A. Kamal. — Berlin : Springer-Verlag , 2014. — 612 p. –Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-642-38655-8 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 2. Takigawa N. Fundamentals of Nuclear Physics / N. Takigawa K. Washiyama. — Tokyo : Springer, 2017. — 269 p. – Текст: электронный // SpringerLink.

	– URL: https://link.springer.com/book/10.1007/978-4-431-55378-6 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 3. Marguet, S. The Physics of Nuclear Reactors / S. Marguet. — Cham : Springer International Publishing AG, 2017. — 1445 p. – Текст: электронный // SpringerLink. – https://link.springer.com/book/10.1007/978-3-319-59560-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. **Additional Reading:** 1. Saha, G. B. Physics and Radiobiology of Nuclear Medicine / G. B. Saha. — New York : Springer Science, 2013. — 328 c. – Текст: электронный // SpringerLink. – https://link.springer.com/book/10.1007/978-1-4614-4012-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 2. Greiner W. Nuclear Physics: Present and Future/ W. Greiner. — Cham : Springer International Publishing, 2015. — 309 c. — – Текст: электронный // SpringerLink. – https://link.springer.com/book/10.1007/978-3-319-10199-6 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.
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