TOMSK POLYTECHNIC UNIVERSITY | ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

**Course Name: Special Chapters of Advanced Mathematics**

**Field of Study:** Nuclear Physics and Technology

**Programme name:** Nuclear Science and Technology

**Specialization:** Nuclear Power Engineering

**Level of Study:** Master Degree Programme

**Year of admission:** 2020

**Semester, year:** semester 2, year 1

**ECTS:** 2

**Total Hours:** 72

**Contact Hours:** 32

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

**Self-study:** 40

**Assessment:** credit-test

**Division:** Nuclear Fuel Cycle

**Director of Programme** _____ / Vera V. Verkhoturova

**Instructor** _____ / Alexey V. Bogdanov

TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

**Course name: Special Chapters Advanced Mathematics**

**Course Overview**

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| **Course Objectives** | The main objective of this course is to form knowledge and skills to solve both mathematical and physical problems, which could be transformed to integral equations. the and. |
| **Learning Outcomes** | **Upon completion of the course, a graduate is expected to acquire the knowledge of:**<br>– types of integral equations (including ill-posed problem);<br>– methods for solving integral equations of the second kind);<br>– methods for integral equations of the first kind (ill posed problems);<br>– ways to obtain analytical results.<br>**Graduates are also expected to develop the following skills:**<br>– to convert differential equations to integral equations and vice versa;<br>– to solve integral equations;<br>– to apply knowledge of modern communicative technologies in a foreign language in the field of nuclear physics/<br>**Graduates should acquire the practical experience in:**<br>– using methods for solving integral equations;<br>– obtaining analytical results. |
| **Course Outline** | The course includes two types of teaching forms: lectures and practical experience. There are seven individual home assignments, which should be done during the study of the course to apply both theoretical and practical knowledge to solve integral equations The quality and completeness of calculations in home assignment are taken into account in final score. The usage of mathematical packages for main calculation in home assignments could decrease the maximum score. Packages could be used only for self-checking of the correctness of calculations.<br>The course ends with a credit-test which is arranged in a form of solving tasks in writing. This requires examinees to solve 2 equations out of 3. Each of them is cored 10. |
| **Prerequisites (if available)** | Bachelor degree with a good knowledge of mathematics. |
| **Course Structure** | The lectures cover the following topics:<br>1. Introduction. Forms and types of integral equations.<br>2. Volterra integral equations. Basic definitions.<br>3. Resolvent of Volterra integral equations. Solving an integral equations using resolvent.<br>4. Fredholm equations. Basic definitions.<br>5. The Fradholm determinants method.<br>6. The Fredholm's resolvent construction with the help of iterated kernels.<br>7. Fredholm integral equations with degenerate kernels.<br>8. Homogeneous integral equation.<br>9. Fredholm alternative.<br>10. The construction of the Green's function for the boundary value problem.<br>11. Integral equations of first kind. Ways to solve them. |

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| | The topics of practical experiences are:<br>**1. Volterra integral equations solving. Part I and Part II.**<br>**2. Fredholm integral equations solving. Part I, Part II, Part III, Part VI.**<br>**3. Fredholm alternative.**<br>**4. Green's function.**<br>The practical examples for the corresponding topics of this course are explained during practical tutorials. In addition to this, the solution of individual homework assignments can be organized at practical tutorials. There are seven individual homework assignments, which should be done by the end of the course.<br>The credit test at the end of this course comprises three equations, two of which should be chosen and done by a student. Maximum score for the credit test is 10. |
| **Facilities and Equipment** | Classroom with a DLP projector is used for lectures and practical experiences: 634050, Tomsk, Lenina Ave., building 10, room 228. |
| **Grading Policy** | In accordance with the TPU assessment system we use:<br>– Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering of theoretical material. Max score for current assessment is 100 scores, min – 55 scores.<br>The final rating is determined by summing up the scores of the current assessment during the semester and credit test scores at the end of the semester. Maximum overall score corresponds to 100, min pass score is 55. |
| **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 are obligatory to presence.<br>In addition, submission of home assignment for verification after deadline reduces the maximum score for the assignment by 10% for every week of delay. |
| **Teaching Aids and Resources** | **Compulsory reading:**<br>1. Zemyan, S. M. The Classical Theory of Integral Equations / S. M. Zemyan. – Boston: Birkhäuser, 2012. – 344 p. – Текст: электронный // SpringerLink.– URL: https://link.springer.com/book/10.1007/978-0-8176-8349-8 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.<br>2. Wazwaz, A.-M. Linear and Nonlinear Integral Equatons: Methods and Applications / A.-M. Wazwaz. – Berlin: Springer, 2011. – 639 p. – Текст: электронный // SpringerLink.– URL: https://link.springer.com/book/10.1007/978-3-642-21449-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.<br>**Additional reading:**<br>1. Sakhnovich, L. A. Integral Equations with Difference Kernels on Finite Intervals / L. A. Sakhnovich. - 2nd ed. - Cham: Birkhäuser, 2015. – 226 p. – Текст: электронный // SpringerLink.– URL: https://link.springer.com/book/10.1007/978-3-319-16489-2 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.<br>2. Methods of Mathematical Physics. Special Functions. Equations of Mathematical Physics : учебник / V. G. Bagrov, V. V. Belov, V. N. Zadorozhnyi, A. Y. Trifonov. — Томск : ТПУ, 2012. — 257 с. — Текст : электронный // Лань : электронно-библиотечная система. — URL: https://e.lanbook.com/book/45130. — Режим доступа: для авториз. |

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| | пользователей.<br>3. Elements of Modern Mathematical Physics : учебник / V. G. Bagrov, V. V. Belov, V. N. Zadorozhnyi, A. Y. Trifonov. — Томск : ТПУ, 2012. — 161 с. — Текст : электронный // Лань : электронно-библиотечная система. — URL: https://e.lanbook.com/book/45161 . — Режим доступа: для авториз. пользователей. |
| **Instructor** | Alexey V. Bogdanov, senior lecturer, Nuclear Fuel Cycle Division, School of Nuclear Science & Engineering, TPU, pPhone: + 7 3822 701-777 (ext. 2251). e-mail: sheridan@tpu.ru, personal site: http://portal.tpu.ru/SHARED/s/SHERIDAN |