**КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ УНИВЕРСИТЕТ ИМ. АЛЬ-ФАРАБИ**

**Механико-математический факультет**

**Кафедра дифференциальных уравнений и теории управления**

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|  | Утверждаю Декан факультета:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Жакебаев Д.Б.  «\_\_\_\_»\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2018 |

# УЧЕБНО-МЕТОДИЧЕСКИЙ КОМПЛЕКС ДИСЦИПЛИНЫ

### SPTMPh 7326 «Современные проблемы теории математической физики»

**Специальность: «6D060100 – Математика»**

**Образовательная программа: Проектирование и разработка ПО**

**Курс – 1**

**Семестр – 1**

**Кол-во кредитов – 3**

**Форма обучения дневная**

**Алматы 2018 г.**

Учебно-методический комплекс дисциплины составил д.ф.м.н профессор кафедры Серовайский С.Я.

На основании рабочего учебного плана по специальности «6D060100 – Математика».

Рассмотрен и рекомендован на заседании кафедры Дифференциальных уравнений и теории управления

от «\_\_\_ » \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2018 г., протокол №\_\_\_

Заведующий кафедрой \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Х. Хомпыш

### Рекомендовано методическим бюро факультета

«\_\_\_\_» \_\_\_\_\_\_\_\_\_\_\_ 2018 г., протокол №\_\_\_

Председатель методбюро факультета \_\_\_\_\_\_\_\_\_\_­­­­­ Кушербаева У.Р.

**AL-FARABI KAZAKH NATIONAL UNIVERSITY**

**Faculty of Mechanics and Mathematics**

**Department of Fundamental Mathematics**

**Educational program in the specialty «5B060100-Mathematics».**

**SYLLABUS**

**Modern problems in the theory of mathematical physics**

**Fall semester, 2018-2019**

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| **Discipline’s code** | **Discipline’s title** | **Type** | **No. of hours per week** | | | | **Number of credits** | | ECTS |
| **Lect.** | **Pract.** | | **Lab.** |
|  | Modern problems in the theory of mathematical physics |  | 2 | 1 | |  | 3 | |  |
| **Prerequisites** | Mathematical analysis, functional analysis, differential equations, numerical methods | | | | | | | | |
| **Lecturer** | S. Serovajsky | | | | **Office hours** | | | Scheduled | |
| **e-mail** | [serovajskys@mail.ru](mailto:serovajskys@mail.ru) | | | |
| **phone** | +7 701 8315197 | | | | **Auditory** | | | room 312 | |

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| --- | --- |
| **Description of the discipline** | Analysis of different forms of mathematical physics problems |
| **Course Objective** | The main purpose of the course is to familiarize students with the fundamental concepts of mathematical physics problems |
| **Learning Outcomes** | By the end the course, students should be able to:   * To know the definitions of mathematical physics problems * To know the physical sense of mathematical physics problems * To know practical methods of finding the solutions of mathematical physics problems * To be able to substantiate the different forms of mathematical models * To know the relations between the different forms of mathematical models * To use the distributions for the analysis of mathematical physics problems |

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| **Literature and Information resources** | 1. Тихонов А.Н., Самарский А.А. Уравнения математической физики. – М., Наука, 2008  2. Владимиров В.С. Обобщенные функции в математической физике. – М., Наука, 1979.  3. Vladimirov V.S. Methods of the theory of generalized functions. Taylor & Francis, 2002.  4. Антосик П., Микусинский Я., Сикорский P. Обобщенные функции. Секвенциальный подход. – М., Мир, 1976.  5. Серовайский С.Я. Секвенциальные модели математической физики. –  Алматы, Print-S, 2004.  6. Reed M., Simon B. Functional Analysis, N.Y., Academic Press 1980.  7. Самарский А. А. Теория разностных схем. – М., Наука, 1977. . | |
| **Organization of the course** | This course is an introductory course, where a general acquaintance with a large volume of theoretical and practical material is given. In the preparation for the discipline, an essential role is given to the textbook and the collection of problems. Sufficient attention is also paid to the actual solution of problems.  Two sets of homework assignments (in the form of a set of tasks) will give you the opportunity to fully in-depth acquaintance with the practical application of theoretical material. | |
| **Course Requirements** | You must present your assignments in written form before the deadline announced by teacher. The mark is given only after passing of the SIS in a form of quiz. Homework should be done in a thin notebook. Problems with solutions must be numbered and ordered. It is important that you show the work in an organized manner clearly showing the final answer with appropriate units. Final answers should be highlighted. Students may collaborate solving homework on the condition that each student actively works on solving of each problem and is able to give clear explanation for the solution of any problem.  For consultations on the implementation of homework, as well as additional information on the studied material, and all other questions, please contact the course instructor during his office hours.  Students with disabilities may receive advice on e-mail: [serovajskys@mail.ru](mailto:serovajskys@mail.ru) |
| **Evaluation system** | Criteria-based evaluation: assessment of learning outcomes in correlation with descriptors (verification of formation of competences on attestation controls and examinations).  Summative assessment: evaluation of attendance and activity in the classroom; evaluation of assignments and Student’s Individual Studies (SIS1, SIS2).  These types of evaluation are given in the table below:   |  |  | | --- | --- | | Types of work | % | | Attendance | 11% | | Active participation in the class work | 10% | | Homework (SIS-1, SIS-2) | 9% | | Control works (Quiz-1,2; Test-1,2) | 30% | | Exams | 40% | | TOTAL | 100% |   Your final grade is calculated by the formula:  Total = 0.6\*(At1+At2)\2+0.1\*MidTermExam+0.3\*FinalExam    The final grade will be calculated according to the evaluation system accepted in University:  95% - 100%: А 90% - 94%: А-  85% - 89%: В+ 80% - 84%: В 75% - 79%: В-  70% - 74%: С+ 65% - 69%: С 60% - 64%: С-  55% - 59%: D+ 50% - 54%: D- 0% -49%: F |
| **Policy of Discipline** | Cellular phones must be silenced during lecture or seminar. Regular and punctual attendance at all scheduled classes is expected. Attendance will be taken regularly. Students should consult with the instructor when an unavoidable absence due to an emergency or illness occurs. Deadlines of homework or control works can be prolonged in the case of circumstances such as illness, emergency, unforeseen events, etc. in accordance with the University's academic policy.  In order to maintain an excellent working environment, students are expected to be respectful and courteous to each other. Formulate your objections in correct manner. Plagiarism and other forms of cheating are not allowed. Any cheating is unacceptable during tests, quizzes and exams. Student convicted of falsifying any information of the course will receive a final grade «F». |

**STRUCTURE AND CONTENT OF DISCIPLINE**

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| --- | --- | --- | --- |
| **Week** | **Title** | **Hours** | **Maximum score** |
| 1 | **Lecture 1.** Introduction into mathematical physics equations | 2 | 2 |
| **Seminar 1.** Determination of the heat equation and its classical solution. | 1 | 7 |
| **IWST 1.** Determination of the heat equation and classical solvability. | 4 | 3 |
| 2 | **Lecture 2.** Approximation and convergence of the numerical method for the heat equation. | 2 | 2 |
| **Seminar 2.** Heat equation. Approximation methods | 1 | 7 |
| **IWST 2.** Heat equation. Approximation methods | 4 | 3 |
| 3 | **Lecture 3**. Generalized functions. Generalized derivatives. Sobolev spaces | 2 | 2 |
| **Seminar 3.** Calculation of the generalized derivatives. | 1 | 7 |
| **IWST 3.** Calculation of the generalized derivatives. | 4 | 3 |
| 4 | **Lecture 4.** Generalized solution of the mathematical physics problems. Relations between classical and generalized solution. | 2 | 2 |
| **Seminar 4.** Relations between classical and generalized solution. | 1 | 7 |
| **IWST 4.** Relations between classical and generalized solution. | 4 | 3 |
| 5 | **Lecture 5.** Physical sense of the generalized solution of the stationary heat equation. Generalized model. | 2 | 2 |
| **Seminar 5.** Generalized solutions of the mathematical physics problems | 1 | 7 |
| **IWST 5.** Generalized solutions of the mathematical physics problems | 4 | 3 |
| 6 | **Lecture 6.** Approximation of the generalized model for the stationary heat equation. | 2 | 2 |
| **Seminar 6.** Approximation of the generalized model for the stationary heat equation. | 1 | 7 |
| **IWST 6.** Approximation of the generalized model for the stationary heat equation. | 4 | 3 |
| 7 | **Lecture 7.** Convergence of the sequences and Cauchy principle. | 2 | 2 |
| **Seminar 7.** Proof of the convergence of sequences with using of Cauchy principle. | 1 | 6 |
| **IWST 7.** Proof of the convergence of sequences with using of Cauchy principle. | 4 | 20 |
|  | **Midterm** |  | **100** |
| 8 | **Lecture 8.** Picard method and contracting mapping theorem. | 2 | 2 |
| **Seminar 8.** Solvability of algebraic equation and convergence of iterative method by contracting mapping theorem. | 1 | 5 |
| **IWST 8.** Solvability of algebraic equation and convergence of iterative method by contracting mapping theorem. | 4 | 3 |
| **9** | **Lecture 9.** Completeness of the spaces. Examples of incomplete spaces | 2 | 2 |
| **Seminar 9.** Examples of incomplete spaces | 1 | 5 |
| **IWST 9.** Examples of incomplete spaces | 4 | 3 |
| **10** | **Lecture 10.** Cantor’s definition of the set of real numbers. | 2 | 2 |
| **Seminar 10.** Applications of Cantor’s definition of the set of real numbers. | 1 | 5 |
| **IWST 10.** Applications of Cantor’s definition of the set of real numbers. | 4 | 3 |
| **11** | **Lecture 11.** Applications of the completion theorem. | 2 | 2 |
| **Seminar 11.** Completion theorem and its application. | 1 | 5 |
| **IWST 11.** Applications of the completion theorem. | 4 | 3 |
| **12** | **Lecture 12.** Sequential generalized functions theory | 2 | 2 |
| **Seminar 12.** Applications of the sequential generalized functions theory | 1 | 5 |
| **IWST 12.** Applications of the sequential generalized functions theory | 4 | 3 |
| **13** | **Lecture 13.** Sequentialextension of extremum problems. | 2 | 2 |
| **Seminar 13.** Sequentialextension of extremum problems. | 1 | 5 |
| **IWST 13.** Sequentialextension of extremum problems. | 4 | 3 |
| **14** | **Lecture 14.** Sequential models of mathematical physics problems. | 2 | 2 |
| **Seminar 14.** Sequential model of stationary heat transfer phenomenon. | 1 | 5 |
| **IWST 14.** Sequential model of stationary heat transfer phenomenon. | 4 | 3 |
| **15** | **Lecture 15.** Sequential models of mathematical physics problems. | 2 | 2 |
| **Seminar 15.** Sequential model of stationary heat transfer phenomenon. | 1 | 8 |
| **IWST 15.** Sequential model of stationary heat transfer phenomenon. | 4 | 20 |
|  | **End-of-term** |  | **100** |
|  | **Final exam** |  | **100** |
|  | **Total** |  | **100** |

Dean of the Faculty

Chairman of the Faculty Methodical Bureau

Head of the Department

Lecturer: