**Al-Farabi KAZAKH NATIONAL UNIVERSITY**

**Faculty of mechanics and mathematics**

**Educational program for the specialty «5В060100-Mathematics»**

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|  | Approved by the Faculty Scientific Council meetingProtocol №\_\_\_ from \_\_\_\_\_\_\_\_\_\_\_\_ 2014 **Dean of the faculty**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_A. Kadyrbekuly** |

**SULLABUS**

**Module No. \_\_\_ “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_”**

# «\_\_\_\_\_\_\_\_\_» «Generalized functions and its applications»

master degree, 1 course, springs semester, 3 credits

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**Aim and problems of the course:**

**Aim** (in concordance with the aim of the module).

Definition of the generalized functions and its applications for mathematical physics problems.

**Problems:**

Mathematical physics problems.

**Results:**

Generalized and sequential solutions of the mathematical physics problems.

**Pre Essential Elements**:

Differential equations. Mathematical physics. Mathematical modeling. Numerical methods. Functional analysis.

**Post** **Essential Elements**:

Generalized solutions of the mathematical physics problems.

**STRUCTURE AND CONTENT OF THE COURSE**

|  |  |  |  |
| --- | --- | --- | --- |
| **week** | **subject** | **hours** | **maximal mark** |
| **Module 1. Classical models of mathematical physics** | | | |
| **1** | **Lecture 1.** Stationary heat transfer equation and modeling of physical processes | 2 | 0 |
| **Practical work 1**. Determination of the heat equation | 1 | 3 |
| **Homework 1**. Determination of the heat equation | 1 | 10 |
| **2** | **Lecture 2.** Heat equation. Classical solvability. | 2 | 1 |
| **Practical work 2**. Heat equation. Classical solvability. | 1 | 3 |
| **Homework 2**. Heat equation. Classical solvability. | 1 | 10 |
| **3** | **Lecture 3.** Stationary heat equation. Approximation and convergence of the numerical method. | 2 | 2 |
| **Practical work 3**. Heat equation. Approximation methods | 1 | 3 |
| **Homework 3.** Heat equation. Approximation methods | 1 | 10 |
| **Module 2. Generalized models of mathematical physics** | | | |
| **4** | **Lecture 4.** Generalized solution of the heat equation**.** Relations classical and generalized solution. | 2 | 1 |
| **Practical work 4**. Generalized derivatives. | 1 | 3 |
| **Homework 4**. Generalized derivatives. | 1 | 10 |
| **5** | **Lecture 5.** Physical sense of the generalized solution of the stationary heat equation. Extended model. | 2 | 2 |
| **Practical work 5**. Physical sense of the generalized solution of the stationary heat equation. | 1 | 3 |
| **Homework 5**. Physical sense of the generalized solution of the stationary heat equation. | 1 | 10 |
| **6** | **Lecture 6.** Approximation of the extended model for the stationary heat equation. | 2 | 1 |
| **Practical work 6.** Approximation of the extended model for the heat equation. | 1 | 3 |
| **Homework 6.** Approximation of the extended model for the heat equation. | 1 | 10 |
| **Module 3. Constructive methods of the convergence proof and Cauchy principle** | | | |
| **7** | **Lecture 7.** Convergence of the sequences and Cauchy principle. | 2 | 2 |
| **Practical work 7.** Proof of the convergence of sequences with using of Cauchy principle. | 1 | 3 |
| **Homework 7.** Proof of the convergence of sequences with using of Cauchy principle. | 1 | 10 |
|  |  |  |
| **Border control 1** |  | **100** |
|  | | | |
| **8** | **Lecture 8.** Picard method and contracting mapping theorem. | 2 | 1 |
| **Practical work 8.** Solvability of algebraic equation and convergence of iterative method by contracting mapping theorem. | 1 | 3 |
| **Homework 8.** Solvability of algebraic equation and convergence of iterative method by contracting mapping theorem. | 1 | 8 |
| **Module 4. Completion principle and sequential models of mathematical physics problems** | | | |
| **9** | **Lecture 9.** Completeness of the spaces. Examples of incomplete spaces | 2 | 2 |
| **Practical work 9.** Examples of incomplete spaces | 1 | 3 |
| **Homework 9.** Examples of incomplete spaces | 1 | 8 |
| **10** | **Lecture 10.** Cantor’s definition of the set of real numbers. | 2 | 1 |
| **Practical work 10.** Applications of Cantor’s definition of the set of real numbers. | 1 | 3 |
| **Homework 10.** Applications of Cantor’s definition of the set of real numbers. | 1 | 8 |
| **11** | **Lecture 11.** Completion theorem and its application. | 2 | 2 |
| **Practical work 11.** Applications of the completion theorem. | 1 | 3 |
| **Homework 11.** Applications of the completion theorem. | 1 | 8 |
| **12** | **Lecture 12.** Sequentialextension of extremum problems. | 1 | 1 |
| **Practical work 12.** Sequentialextension of extremum problems. | 1 | 3 |
| **Homework 12.** Sequentialextension of extremum problems. | 1 | 8 |
| **13** | **Lecture 13.** Sequential distributions theory | 2 | 2 |
| **Practical work 13.** Applications of the sequential distributions theory | 1 | 3 |
| **Homework 13.** Applications of the sequential distributions theory | 1 | 8 |
| **14** | **Lecture 14**.Sequential models of mathematical physics problems. | 2 | 1 |
| **Practical work 14.** Sequential model of stationary heat transfer phenomenon. | 1 | 3 |
| **Homework 14.** Sequential model of stationary heat transfer phenomenon. | 1 | 8 |
| **15** | **Lecture 15.** Sequential models of mathematical physics problems. | 2 | 2 |
| **Practical work 15.** Sequential model of stationary heat transfer phenomenon. | 1 | 3 |
| **Homework 15.** Sequential model of stationary heat transfer phenomenon. | 1 | 8 |
|  |  |  |
| **Border control 2** |  | **100** |
|  | **Examination** |  | **100** |
|  | **TOTAL** |  | **100** |

**LITERATURE**

**Basic:**

1. Серовайский С.Я. Секвенциальные модели математической физики. – Алматы, Print-S, 2004.
2. Владимиров В. С. Обобщенные функции в математической физике. – М., Наука, 1979. – 318 с.
3. Владимиров В. С. Уравнения математической физики. – М., Наука, 1971.
4. Самарский А. А. Теория разностных схем. – М., Наука, 1977.

**Additional:**

1. Serovajsky S. Practical Course of the Optimal Control Theory with Examples. – Almaty, Қазақ университеті, 2011.
2. Серовайский С.Я. Контрпримеры в теории оптимального управления. – Алматы, Қазақ университеті, 2001.
3. Антосик П., Микусинский Я., Сикорский. Обобщенные функции. Секвенциальный подход. – М., Мир, 1976. – 311 с.
4. Васильев Ф.П. Методы оптимизации. В двух томах. – М.: МЦНМО, 2011.
5. Канторович Л. В., Акилов Г. П. Функциональный анализ. – М., Наука, 1977.

АКАДЕМИЧЕСКАЯ Политика курса

Все виды работ необходимо выполнять и защищать в указанные сроки. Студенты, не сдавшие очередное задание или получившие за его выполнение менее 50% баллов, имеют возможность отработать указанное задание по дополнительному графику. Студенты, пропустившие лабораторные занятия по уважительной причине, отрабатывают их в дополнительное время в присутствии лаборанта, после допуска преподавателя. Студенты, не выполнившие все виды работ, к экзамену не допускаются. Кроме того, при оценке учитывается активность и посещаемость студентов во время занятий.

будьте толерантны, уважайте чужое мнение. Возражения формулируйте в корректной форме. Плагиат и другие формы нечестной работы недопустимы. Недопустимы подсказывание и списывание во время сдачи СРС, промежуточного контроля и финального экзамена, копирование решенных задач другими лицами, сдача экзамена за другого студента. Студент, уличенный в фальсификации любой информации курса, несанкционированном доступе в Интранет, пользовании шпаргалками, получит итоговую оценку «F».

За консультациями по выполнению самостоятельных работ (СРС), их сдачей и защитой, а также за дополнительной информацией по пройденному материалу и всеми другими возникающими вопросами по читаемому курсу обращайтесь к преподавателю в период его офис-часов.

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| --- | --- | --- | --- |
| Letter mark | Number mark | % | Traditional mark |
| А | 4,0 | 95-100 | Very good |
| А- | 3,67 | 90-94 |
| В+ | 3,33 | 85-89 | Good |
| В | 3,0 | 80-84 |
| В- | 2,67 | 75-79 |
| С+ | 2,33 | 70-74 | Satisfactory |
| С | 2,0 | 65-69 |
| С- | 1,67 | 60-64 |
| D+ | 1,33 | 55-59 |
| D- | 1,0 | 50-54 |
| F | 0 | 0-49 | Non satisfactory |
| I  (Incomplete) | - | - | «The course is not finished»  (*do not take into consideration of GPA)* |
| P  (Pass) | **-** | **-** | «given a credit»  (*do not take into consideration of GPA)* |
| NP  (No Рass) | **-** | **-** | «did not give a credit»  (*do not take into consideration of GPA)* |
| W  (Withdrawal) | - | - | «renunciation of the course»  (*do not take into consideration of GPA)* |
| AW  (Academic Withdrawal) |  |  | Renunciation of the course by academic cause  (*do not take into consideration of GPA)* |
| AU  (Audit) | - | - | «the course is listen»  (*do not take into consideration of GPA)* |
| Атт. |  | 30-60  50-100 | Attested |
| Не атт. |  | 0-29  0-49 | No attested |
| R (Retake) | - | - | Retake the course |

Session № \_\_ of « \_\_ » \_\_\_\_\_\_\_\_\_\_\_ 2014.

**Head of the Department S. Muhambetzhanov**

**Lecturer S. Serovajsky**