**Al-Farabi Kazakh National University**

**Faculty of Mechanics and Mathematics**

**Department of Differential Equations and Control Theory**

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|  | APPROVED by **Dean of Faculty**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ D.B.Zhakebaev  (signature)  "\_\_\_" \_\_\_\_\_\_\_\_\_2019 |

### EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

### « Differential games»

**6D060100 – Mathematics**

Course – 2

Semester – 3

Number of credits – 3

**Almaty 2019**

Educational-methodical complex of the discipline is made by Simon Serovajsky, doctor of science, professor

Based on the classing curriculum on the specialty 6D060100 – Mathematics

Considered and recommended at the meeting of the department of Differential Equations and Control Theory

on “\_\_\_” \_\_\_\_\_\_\_\_\_, 2019, protocol № \_\_

Head of the department\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Kh.Khompysh

(signature)

### Recommended by the methodical bureau of the faculty

on “\_\_\_” \_\_\_\_\_\_\_\_\_, 2019, protocol № \_\_

Chairman of the methodical bureau

of the faculty\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_G.E.Abduakhitova

(signature)

**Syllabus**

**By Educational Program «-------------------»  
…. Semester …. Academic year**

Academic course information

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Discipline’s code | Discipline’s title | | IWS |  | | | | Number of credits | | IWST |
| Lect. | Pract. | | Lab. |
|  | Differential games | |  | 2 | 1 | | - | 3 | |  |
| Lecturer | | Simon Serovajsky, doctor of science, professor | | | | Office hours | | | Scheduled | |
| e-mail | | [serovajskys@mail.ru](mailto:serovajskys@mail.ru) | | | |
| Telephone number | | +7 701 8315197 | | | | Auditory | | |  | |
| Assistant | | Full name, academic degree, academic rank. | | | | Office hours | | |  | |
| e-mail | | E-mail: | | | |
| Telephone number | | Telephone: | | | | Auditory | | |  | |

|  |  |
| --- | --- |
| Academic presentation of the course | **Aim of course:** Analysis of general methods of differential games and its applications  **As a result of studying the discipline, students should be able to:**   1. To know the applications of differential games; 2. To know problem statements of differential games 3. To know the classification of the differential games; 4. To be able to analyze differential games; 5. To know the numerical methods for differential games |
| Prerequisites | Mathematical modelling, mathematical physics equations, functional analysis, differential equations, numerical methods, |
| Post requisites | Special courses |
| Information resources | **literature**:  1. Isaacs R. Differential Games. Dover Publ., 1999.  2. Мазалов В.В. Математическая теория игр и приложения. - Санкт-Петербург - Москва - Краснодар: Лань, 2010.  3. Тихонов А.Н., Самарский А.А. Уравнения математической физики. – М., Наука, 2008  4. Владимиров В.С. Обобщенные функции в математической физике. – М., Наука, 1979.  5. Vladimirov V.S. Methods of the theory of generalized functions. Taylor & Francis, 2002.  6. Антосик П., Микусинский Я., Сикорский P. Обобщенные функции. Секвенциальный подход. – М., Мир, 1976.  7. Серовайский С.Я. Секвенциальные модели математической физики. – Алматы, Print-S, 2004.  8. Reed M., Simon B. Functional Analysis, N.Y., Academic Press 1980.  9. Самарский А. А. Теория разностных схем. – М., Наука, 1977.  19. Serovajsky, S. Sequential models of mathematical physics. – London, CRS Press, 2019.  **Internet-resources:**  [Bressan, Alberto](https://en.wikipedia.org/wiki/Alberto_Bressan) (December 8, 2010). ["Noncooperative Differential Games: A Tutorial"](https://www.math.psu.edu/bressan/PSPDF/game-lnew.pdf) Department of Mathematics, Penn State University. |
| Academic policy of the course in the context of university moral and ethical values | **Academic Behavior Rules:** Obligatory attendance of classes, intolerance for being late, commitment to deadlines for completion and delivery of assignments (CDS, Practical classes, midterm exams, individual projects).  **Academic values:** According to Article 5 of the Code of Honor of students of Al-Farabi Kazakh National University, a student must strictly fulfill his academic duties and prevent academic and legal violations (plagiarism, forgery, use of cribs, deceit of and disrespectful attitude to teaching stuff, absenteeism and coming late without respectful reasons).  All students can receive counseling assistance in person, by phone at the numbers indicated or by e-mail provided. |
| Evaluation and attestation policy | **Criteria-based evaluation:** evaluation of achieving learning outcomes in accordance with the descriptors (checking competencies acquired at weeks of the intermediate control, midterm and final examinations)  **Summative evaluation:**  Final score of the discipline =  IC1, IC2, are intermediate controls, МТ is Midterm, FE – final exam.  Percent-rating letter system for assessing of achievements of leaning outcomes by students:  95% - 100%: А 90% - 94%: А- 75% - 79%: В-  85% - 89%: В+ 80% - 84%: В 60% - 64%: С-  70% - 74%: С+ 65% - 69%: С 25% -49%: FX  55% - 59%: D+ 50% - 54%: D- 0% -24%: F |
|  |  |

**Calendar (schedule) the implementation of the course content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Week / date** | **Topic title (lectures, practical classes, laboratory classes,** **Independent class of students)** | **Number of hours** | **Maximum score** |
| **1** | **2** | **3** | **5** |
| 1 | **Lecture 1.** Introduction into mathematical physics equations | 1 | 5 |
| **Practical class 1.** Determination of the heat equation and its classical solution. | 1 | 15 |
| Laboratory class 1. |  |  |
| 2 | **Lecture 2.** Approximation and convergence of the numerical method for the heat equation. | 1 | 5 |
| **Practical class 2.** Heat equation. Approximation methods | 1 | 15 |
| Laboratory class 2. |  |  |
| 3 | **Lecture 3.** Generalized functions. Generalized derivatives. Sobolev spaces | 1 | 5 |
| **Practical class 3.** Calculation of the generalized derivatives. | 1 | 15 |
| IWST. Colloquium (orally). |  |  |
| 4 | Lecture 4. |  |  |
| **Lecture 4.** Generalized solution of the mathematical physics problems**.** Relations between classical and generalized solution. | 1 | 5 |
| **Practical class 4.** Relations between classical and generalized solution. | 1 | 15 |
| 5 | **Lecture 5.** Physical sense of the generalized solution of the stationary heat equation. Generalized model. | 1 | 5 |
| **Practical class 5.** Generalized solutions of the mathematical physics problems | 1 | 15 |
| Laboratory class 5. |  |  |
| **INTERMEDIATE CONTROLS 1.** | |  | **100** |
| 6 | **Lecture 6.** Approximation of the generalized model for the stationary heat | 1 | 5 |
| **Practical class 6.** Approximation of the generalized model for the stationary heat | 1 | 15 |
| Laboratory class 6. |  |  |
| 7 | **Lecture 7.** Convergence of the sequences and Cauchy principle. | 1 | 5 |
| **Practical class 7.** Proof of the convergence of sequences with using of Cauchy principle. | 1 | 15 |
| Laboratory class 7. |  |  |
| IWST. Colloquium (orally). |  |  |
| 8 | **Lecture 8.** Picard method and contracting mapping theorem. | 1 | 5 |
| **Practical class 8.** Solvability of algebraic equation and convergence of iterative method by contracting mapping theorem. | 1 | 15 |
| Laboratory class 8. |  |  |
| 9 | **Lecture 9.** Completeness of the spaces. Examples of incomplete spaces | 1 | 5 |
| **Practical class 9.** Examples of incomplete spaces | 1 | 15 |
| Laboratory class 9. |  |  |
| IWST. Submission of IWS 2. «Theme» Control class. |  |  |
| 10 | **Lecture 10.** Cantor’s definition of the set of real numbers. | 1 | 5 |
| **Practical class 10.** Applications of Cantor’s definition of the set of real numbers. | 1 | 15 |
| Laboratory class 10. |  |  |
| **INTERMEDIATE CONTROLS. (MIDTERM)** | |  | **100** |
| 11 | **Lecture 11.** Applications of the completion theorem. | 1 | 5 |
| **Practical class 11.** Completion theorem and its application. | 1 | 15 |
| Laboratory class 11. |  |  |
| IWST. Colloquium (orally). |  |  |
| 12 | **Lecture 12.** Sequential generalized functions theory | 1 | 5 |
| **Practical class 12.** Applications of the sequential generalized functions theory | 1 | 15 |
| Laboratory class 12. |  |  |
| 13 | **Lecture 13.** Sequentialextension of extremum problems. | 1 | 5 |
| **Practical class 13.** Sequentialextension of extremum problems. | 1 | 15 |
| Laboratory class 13. |  |  |
| IWST. Colloquium (orally). |  |  |
| 14 | **Lecture 14.** Sequential models of mathematical physics problems. | 1 | 5 |
| **Practical class 14.** Sequential model of stationary heat transfer phenomenon. | 1 | 15 |
| Laboratory class 14. |  |  |
| 15 | **Lecture 15.** Sequential models of mathematical physics problems. | 1 | 5 |
| **Practical class 15.** Sequential model of stationary heat transfer phenomenon. | 1 | 15 |
| IWST. Submission of IWS 3. «Theme» Control class. |  |  |
| **INTERMEDIATE CONTROLS 2.** | |  | **100** |
| **EXAM** | |  | **100** |
| **GENERAL** | |  | **100** |
| *Note:* IWST *is planned in the amount of 7 hours per semester, points are not put, only the type of class is written (examination, Colloquium).* IWS *is planned in the amount of 3 hours per semester, points must be weight, not less than 20 points. All the CDs it must be the name of the theme. Points for the lecture are not put.* | | | |

Head of the Department of DE and CT KH.KHompysh

Chairman of the Faculty Methodical Bureau G.E.Abduakhitova

Lecturer S. Serovajsky