**Syllabus***Spring semester, 2018-2019 Academic year*

Academic course information

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| Discipline’s code | Discipline’s title | Type | No. of hours per week | | | Number of credits | | ECTS |
| Lect. | Pract. | Lab. |
|  | Mathematical physics equations | MC | 1 | 1 | 0 | 2 | |  |
| Lecturer | S. Serovajsky | | | Office hours | | | Scheduled | |
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| Telephone number | +7 701 8315197 | | | Auditory | | |  | |

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| Academic presentation of the course | **Type of university**: The main purpose of the course is to familiarize students with the fundamental concepts of mathematical physics equations  **Aim of course:**  as a result of the course students must be able to:  By the end the course, students should be able to:   1. To know the applications of mathematical physics equations; 2. To know the classification of mathematical physics equations; 3. To know the general mathematical physics equations; 4. To know the general boundary problem for mathematical physics equations; 5. To be able to analyze the mathematical physics equations. |
| Prerequisites | Ordinary differential equations, mathematical analysis, physics |
| Post requisites | Numerical methods, calculus of variations |
| Information resources | 1. Тихонов А.Н., Самарский А.А. Уравнения математической физики. – М.: Изд-во МГУ, 1999. 2. Tikhonov A.N., Samarskii A.A. Equations of Mathematical Physics. – New York, Dover Publ., 1990. 3. Полянин А.Д., Зайцев В.Ф. Справочник по нелинейным уравнениям математической физики: Точные решения. – М.: Физматлит, 2002. 4. Тирринг В. Курс математической и теоретической физики. – К.: TIMPANI, 2004. 5. Фарлоу С. Уравнения с частными производными для научных работников и инженеров. – М.: Мир, 1985. 6. Kusse B. Mathematical Physics: Applied Mathematics for Scientists and Engineers. – Germany: Wiley-VCH, 2006. 7. Stakgold I. Boundary value problems of mathematical physics. – Philadelphia: SIAM, 2000. |
| 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-  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 |

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

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| **Week** | **Topics** | **Hours** | **Max point** |
|  | **Module 1. Equations of mathematical physics  as mathematical models** |  |  |
| 1 | **Lecture 1.** *Equations of mathematical physics as mathematical models*. Derivative and its geometric and mechanical interpretation.  Determining of a curve by a known tangent.  Equation of the fall of the body as a mathematical model.  Cauchy problem for differential equations.  Determining of a surface on a tangent plane.  Partial differential equations of the first order. Characteristics. | 1 | 4 |
| **Practical work and homework 1**. Ordinary differential equations. | 1 | 10 |
| 2 | **Lecture 2.** *Mathematical physics equations as mathematical models*. Heat equation and its different interpretations.  Vibrating string equation.  Poisson and Laplace equations and their interpretation. | 1 | 4 |
| **Practical work and homework 2**. Partial differential equations of the first order. | 1 | 10 |
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|  | **Module 2. Classification of mathematical physics equations** |  |  |
| 3 | **Lecture 3.** *Classification of second order partial differential equations***.** Reduction of partial differential equations of the second order with two independent variables to the canonical form.  Classification of second order partial differential equations. | 1 | 4 |
| **Practical work and homework 3**. Reduction of equations to the canonical form. | 1 | 10 |
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|  | **Module 3. Hyperbolic equations** |  |  |

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| 4 | | **Lecture 4.** *Cauchy problem for the vibrating string equation.*  Motion of unlimited string.  Formulation of the Cauchy problem for the vibrating string equation.  D'Alembert method.  Running waves. | 1 | 4 |
| **Practical work and homework 4**. Cauchy problem for the vibrating string equation. | 1 | 10 |
| 5 | | **Lecture 5.** *Vibrating string equation with fixed ends.*  First boundary value problem for the vibrating string equation.  Method of variable separation.  Sturm – Liouville problem.  Solution of the first boundary value problem for the vibrating string equation. | 1 | 4 |
| **Practical work and homework 5**. Vibrating of string with fixed ends. | 1 | 10 |
| 6 | | **Lecture 6.** *Vibrating string equation with free ends* Problem statement. Second boundary value problem for the vibrating string equation.  Method of variable separation.  Sturm – Liouville problem.  Solution of the second boundary value problem for the vibrating string equation. | 1 | 6 |
| **Practical work and homework 6.** Vibrating of string with free ends. | 1 | 10 |
| 7 | | **Lecture 7.** *Forced vibrating of the string.*  Inhomogeneous vibrating string equation.  Fourier method.  Solution of boundary value problems for the inhomogeneous vibrating string equation. | 1 | 5 |
| **Practical work and homework 7.** Forced vibrations of the string. | 1 | 10 |
| Border control 1 | | |  | 100 |
| Midterm | | |  | 100 |
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|  | **Module 4. Parabolic equations** | |  |  |
| 8 | | **Lecture 8.** *Heat equation with known temperature at the boundary.* First boundary problem for the heat equation.  Method of variable separation.  Sturm – Liouville problem.  Solution of the first boundary value problem for the heat equation. | 1 | 2 |
| **Practical work and homework 8.** Heat equation with known temperature at the boundary. | 1 | 10 |
| 9 | | **Lecture 9.** *Heat equation with known heat flux through the boundary.* Second boundary problem for the heat equation.  Method of variable separation.  Sturm – Liouville problem.  Solution of the second boundary value problem for the heat equation. | 1 | 3 |
| **Practical work and homework 9.** Heat equation with known heat flux through the boundary. | 1 | 10 |
| 10 | | **Lecture 10.** *Heat equation in the presence of heat sources.*  Inhomogeneous heat equation.  Fourier method.  Solution of boundary value problems for the inhomogeneous heat equation. | 1 | 2 |
| **Practical work and homework 10.** Heat equation in the presence of heat sources. | 1 | 10 |
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|  | | **Module 5. Elliptic equations** |  |  |
| 11 | | **Lecture 11.** *Laplace equation and its connection with theory of functions of a complex variable and variational calculus.*  Analytical and harmonic functions.  Minimization of functions and stationary condition.  Dirichlet integral and variational method. | 1 | 3 |
| **Practical work and homework 11.** Variational method in mathematical physics problems. | 1 | 10 |
| 12 | | **Lecture 12.** *Electrostatic field equation in a circle.*  Potential of the electrostatic field of a point charge and an infinite wire.  Laplace equation in a circle.  Method of variable separation.  Solution of the inner and outer boundary value problem for the Laplace equation in a circle. | 1 | 2 |
| **Practical work and homework 12.** Laplace equation in a circle. | 1 | 10 |
| 13 | | **Lecture 13.** *Green functions method for the Laplace and Poisson equations.*  Integration by parts and Green formulas.  Integral representation of the harmonic function.  Green function method for mathematical physics problems. | 1 | 3 |
| **Practical work and homework 13.** Green function method mathematical physics problems. | 1 | 10 |
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|  | | **Module 6. Approximate solution  of mathematical physics problems** |  |  |
| 14 | | **Lecture 14**.*Finite difference method for mathematical physics problems.* Approximation of derivatives.  Euler method for ordinary differential equations.  Finite difference method for the heat equation.  Explicit difference scheme for the heat equation. | 1 | 2 |
| **Practical work and homework 14.** Finite difference method for mathematical physics problems. | 1 | 10 |
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|  | | **Module 7. Inverse problems of mathematical physics** |  |  |
| 15 | | **Lecture 15.** *Inverse problems of mathematical physics***.**  Identification of the mathematical models.  Direct and inverse problems of mathematical physics.  Inverse problems of mathematical physics and the theory of extremum. | 1 | 3 |
| **Practical work and homework 15.** Inverse problems of mathematical physics. | 1 | 10 |
| Border control 2 | | |  | 100 |
| Total | | |  | 100 |

Lecturer S. Serovajsky

Head of the department of Kh. Khompysh

Chairman of the Faculty Methodical Bureau U.R.Kusherbayeva