**DAUGAVPILS UNIVERSITY**

**DESCRIPTION OF THE STUDY COURSE**

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| Name of study course | Differential equations. Basic course III |
| Code of study course (DUIS) | MateD015 |
| Scientific branch | Mathematics |
| Course level | 7 |
| Credits | 2 |
| ECTS credits | 3 |
| Total contact hours | 16 |
| Number of lecture hours | 8 |
| Number of seminar hours | 8 |
| Hours of practical work | - |
| Hours of laboratory work | - |
| Number of hours of independent work | 64 |
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| Course author(-s) | |
| Dr.math., Professor Felikss Sadirbajevs (DU)  Dr.math., Associated Professor Ināra Jermačenko (DU) | |
| Course docent(-s) | |
| Dr.math., Professor Felikss Sadirbajevs (DU)  Dr.math., Associated Professor Ināra Jermačenko (DU) | |
| Prior knowledge | |
| - | |
| Annotation of the study course | |
| The aim of the course is to provide a basic knowledge of functional-analytical methods in the theory of differential equations, the main methods of solving partial differential equations.  Course tasks:  - to learn the basic issues in the theory of partial differential equations;  - to learn the classification of linear partial differential equations;  - to learn the main methods for solving boundary value problems for partial differential equations. | |
| Calendar plan of the study course | |
| Course structure: lectures (L) - 8 hrs, seminars (S) - 8 hrs, students' independent work (Pd) - 64 hrs.  1. Partial differential equations as mathematical models of real phenomena and processes (L2, Pd8)  2. Particular partial differential equations. Linear transport partial differential equation. (S2, Pd8)  3. Hyperbolic equations and systems. Problem statement. Classical solutions. (L2, Pd8)  4. First order hyperbolic systems. Conservation laws, generalizations of the solution concept. (S2, Pd8)  5. Parabolic equations and systems. Problem statement. Classical solutions, maximum principle, Green's function. (L2, Pd8)  6. Generalized solution, a priori estimates, smoothness properties of the generalized solution. (S2, Pd8)  7. Laplace DV, harmonic functions. Elliptic equations and systems. Boundary value problems. Classical solutions, maximum principle. Green's function. (L2, Pd8)  8. Cauchy-Kovalevskaya theorem. Fundamental solution. Characteristic surfaces and characteristic directions. General classification of differential equations. (S2, Pd8) | |
| Study outcomes | |
| Knowledge:   1. Is familiar with the basic theory of partial differential equations. 2. Is familiar with the classification of partial differential equations.   Skills:   1. Is able to identify the type of partial differential equation. 2. Is able to use the Green's function method to solve parabolic and elliptic equations. 3. Is able to use the properties of harmonic functions to solve problems.   Competence:   1. Actively participates in discussions on basic issues in the theory of partial differential equations and their boundary value problems. 2. Independently develops own competence by identifying current trends in the application of partial differential equations in mathematical modelling. | |
| Description of the organization and tasks of students' independent work | |
| Students carry out 3 independent works on the following topics:   1. hyperbolic equations and systems; 2. parabolic equations and systems; 3. elliptic equations and systems. | |
| Requirements for obtaining credits | |
| CRITERIA FOR EVALUATING THE LEARNING OUTCOMES  The acquisition of the study course is evaluated by using 10-point scale according to the laws and regulations of the Republic of Latvia and in accordance with the "Regulations on studies at Daugavpils University" (approved at DU Senate meeting on 17.12.2018., Minutes No. 15), based on the following evaluation criteria of learning outcomes: the scope and quality of acquired knowledge, acquire skills and competencies in accordance with the planned study results.  EVALUATION OF LEARNING OUTCOMES   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Type of test | Learning outcomes | | | | | | | | 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 1. Independent work I | + | + | + |  |  | + | + | | Independent work II | + | + | + | + |  | + | + | | Independent work III | + | + | + | + | + | + | + | | Test | + | + | + | + | + | + | + |   Final differentiated test assessment. The mark is calculated as the average mark of the independent work. | |
| Course content | |
| 1. Partial differential equations as mathematical models of real phenomena and processes (L2, Pd8)  2. Particular partial differential equations. Linear transport partial differential equation. (S2, Pd8)  3. Hyperbolic equations and systems. Problem statement. Classical solutions. (L2, Pd8)  4. First order hyperbolic systems. Conservation laws, generalizations of the solution concept. (S2, Pd8)  5. Parabolic equations and systems. Problem statement. Classical solutions, maximum principle, Green's function. (L2, Pd8)  6. Generalized solution, a priori estimates, smoothness properties of the generalized solution. (S2, Pd8)  7. Laplace DV, harmonic functions. Elliptic equations and systems. Boundary value problems. Classical solutions, maximum principle. Green's function. (L2, Pd8)  8. Cauchy-Kovalevskaya theorem. Fundamental solution. Characteristic surfaces and characteristic directions. General classification of differential equations. (S2, Pd8)  Students' independent work - 64 acad. h.: students perform 3 independent works, the average grade of which is the grade of the differentiated test. | |
| Mandatory sources of information | |
| 1. M.A. Pinsky. Partial Differential Equations and Boundary-value Problems with Applications, AMS, 2011. 2. L. Debnath, T. Myint-U. Linear Partial Differential Equations for Scientists and Engineers, Birkhauser Boston, 2007. 3. P. Drabek, G. Holubova. Elements of Partial Differential Equations, W. de Gruyter, 2007. 4. L.C. Evans.  Partial Differential Equations, AMS, 1998. | |
| Additional sources of information | |
| 1. R. P. Agarwal, D. O'Regan. Ordinary and Partial Differential Equations: With Special Functions, Fourier Series, and Boundary Value Problems, Springer, 2008.  2. R. Haberman. Elementary Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, Prentice Hall, 1987.  3. I.N. Sneddon. Elements of Partial Differential Equations, Dover Publications, 2006.  4. D.L. Powers. Boundary Value Problems and Partial Differential Equations, Academic Press, 2005.  5. H. Kalis. Matemātiskās fizikas vienādojumi, klasifikācija un izvedumi. Stīgas svārstības vienādojums, R., LU, 1992. | |
| Periodicals and other sources of information | |
| 1. K. Schmit, R.C. Thompson. Nonlinear Analysis and Differential Equations. An Introduction <http://www.math.utah.edu/~schmitt/ode1.pdf> | |
| Notes | |
| Part A of the doctoral study program "Mathematics".  The course is taught in Latvian or English. | |