**DAUGAVPILS UNIVERSITY**

**DESCRIPTION OF THE STUDY COURSE**

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| Name of study course | Current problems in differential equations and dynamical systems theory I |
| Code of study course (DUIS) | MateD035 |
| Scientific branch | Mathematics |
| Course level | 7 |
| Credits | 2 |
| ECTS credits | 3 |
| Total contact hours | 16 |
| Number of lecture hours | 12 |
| Number of seminar hours | 4 |
| 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) | |
| Course docent(-s) | |
| Dr.math., Assoc. Professor Armands Gricāns (DU) Dr.math., Professor Felikss Sadirbajevs (DU) | |
| Prior knowledge | |
| MateD012,   MateD014,   MateD015 | |
| Annotation of the study course | |
| The aim of the course is to provide knowledge of the basic concepts of the theory of ordinary differential equations (ODEs). It discusses the existence and unity of solutions, the continuity of solutions and the dependence of solutions on initial conditions and parameters.  Course tasks:  - to acquire knowledge of the basic issues in the theory of ordinary differential equations (ODEs);  - to acquire knowledge of subtle continuity of solutions issues;  - to acquire a basic knowledge of linear equations and special functions. | |
| Calendar plan of the study course | |
| Course structure: lectures (L) - 12 hrs, seminars (S) - 4 hrs, students' independent work (Pd) - 64 hrs.  1. Basic concepts of ordinary differential equation (ODE) theory. (L2, Pd8)  2. ODE classification. ODE order. ODE systems. (S2, Pd8)  3. Linear and non-linear ODE. (L2, Pd8)  4. Bright questions of the existence and unity of solutions to a problem. (L2, Pd8)  5. ODE and integral equations. Method of increment approximations. (S2, Pd8)  6. Continuity of solutions and related issues. (L2, Pd8)  7. Dependence of solutions on initial conditions and parameters. (L2, Pd8)  8. Special functions. (L2, Pd8) | |
| Study outcomes | |
| Knowledge:   1. Understands the basic concepts of the theory of ordinary differential equations. 2. Knows the difference between linear and non-linear differential equations, the principle of superposition. 3. Knows the relationship of elementary functions to differential equations. 4. Knows some special functions.   Skills:   1. Is able to transform a differential equation into an integral equation. 2. Is able to give examples of non-unity and non-continuity of solutions of differential equations. 3. Is able to use special functions to solve some differential equations.   Competence:   1. Actively participate in discussions on the theory of differential equations. 2. Independently develops his/her competence by identifying current trends in the theory of differential equations. | |
| Description of the organization and tasks of students' independent work | |
| Students carry out 3 independent works on the following topics:   1. investigating the unity and continuity of solutions of nonlinear equations; 2. normal form of normal DE systems and reduction of given DEs to normal form. 3. comparison of linear and non-linear equations. | |
| 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. | 8. | 9. | | 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. Basic concepts of ordinary differential equation (ODE) theory. (L2, Pd8)  2. ODE classification. ODE order. ODE systems. (S2, Pd8)  3. Linear and non-linear ODE. (L2, Pd8)  4. Bright questions of the existence and unity of solutions to a problem. (L2, Pd8)  5. ODE and integral equations. Method of increment approximations. (S2, Pd8)  6. Continuity of solutions and related issues. (L2, Pd8)  7. Dependence of solutions on initial conditions and parameters. (L2, Pd8)  8. Special functions. (L2, Pd8) | |
| Mandatory sources of information | |
| 1. M.W. Hirsch, S. Smale, R.L. Devaney.Differential equations, dynamical systems, and an introduction to chaos. 2nd edition, 2004. 2. L. Perko. [**Differential Equations and Dynamical Systems**](https://biblio.du.lv/Alise/lv/book.aspx?id=47747&ident=1045210). Springer, 2001. 551 p. 3. G. Teschl. Ordinary differential equations and Dynamical Systems. Copyright 2000-2004 by Gerald Teschl, 2004. | |
| Papildus informācijas avoti | |
| 1. E.A. Coddington, N. Levinson. Theory of Ordinary Differential Equations. – Mc Graw – Hill, 1955. (Э.А. Коддингтон, Н. Левинсон. Теория обыкновенных дифференциальных уравнений. – М., ИЛ, 1958). 2. F. Dumortier, J. Llibre, Joan C. Artés. Qualitative theory of planar differential systems. Springer, 2006. 3. J.D. Logan. A first course in differential equations, Springer, 2010. 4. S. Lynch. Dynamical systems with applications using Mathematica, Birkhäuser, 2007. 5. L.S. Pontryagin. Ordinary differential equations, 1962. https://archive.org/details/pontryagin-ordinary-differential-equations 6. М.В.Федорюк. [**Обыкновенные дифференциальные уравнения**](https://biblio.du.lv/Alise/lv/book.aspx?id=65390&ident=1076386). . Наука, 1980. 350 с. 7. Л.Э. Эльсгольц. [**Дифференциальные уравнения и вариационное исчисление**](https://biblio.du.lv/Alise/lv/book.aspx?id=65393&ident=1076389).. Наука, 1969. 424 c. | |
| Periodicals and other sources of information | |
| 1. A. Mattuck. Differential equations [Resources | Differential Equations | Mathematics | MIT OpenCourseWare](https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/resources/) | |
| Notes | |
| Part B course of the doctoral study program "Mathematics".  The course is taught in Latvian and English. | |