**DAUGAVPILS UNIVERSITY**

**DESCRIPTION OF THE STUDY COURSE**

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| Name of study course | Using computers in mathematics II |
| Code of study course (DUIS) | MateD018 |
| Scientific branch | Mathematics |
| Course level | 7 |
| Credits | 2 |
| ECTS credits | 3 |
| Total contact hours | 16 |
| Number of lecture hours | 4 |
| Number of seminar hours | 12 |
| Hours of practical work | - |
| Hours of laboratory work | - |
| Number of hours of independent work | 64 |
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| Course author(-s) | |
| Dr.math., Associated Professor Armands Gricāns (DU)  Ph.D., Docent Anita Kiričuka (DU) | |
| Course docent(-s) | |
| Dr. math., Associated Professor Armands Gricāns (DU)  Ph.D., Docent Anita Kiričuka (DU) | |
| Prior knowledge | |
| MateD017 | |
| Annotation of the study course | |
| The aim of the course is to provide a basic understanding of the capabilities of Wolfram Mathematica for symbolic and numerical calculations.  Course tasks:  - to learn Mathematica basic syntax;  - to learn basic differential and integral calculus with Mathematica;  - to learn basic matrix algebra calculations with Mathematica;  - to learn creating of graphic images with Mathematica;  - to learn to solve differential equations and their systems symbolically and numerically with Mathematica. | |
| Calendar plan of the study course | |
| Course structure: lectures (L) - 4 hrs, seminars (S) - 12 hrs, students' independent work (Pd) - 64 hrs.  1. Overview of Mathematica syntax. Structuring a Mathematica file. Symbolic and numerical solving of equations and systems of equations. (L2, S2, Pd6)  2. Basic programming commands. Lists. (L2, S2, Pd6)  3. Creating graphical representations. (S2, Pd8)  4. Differential and integral calculus. Matrix algebra. (S2, Pd8)  5. Symbolic and numerical solution of differential equations. Bifurcation analysis of boundary value problems for ordinary differential equations. (S2, Pd18)  6. Symbolic and numerical solution of systems of differential equations. (S2, Pd18) | |
| Study outcomes | |
| Knowledge:   1. Is familiar with basic Mathematica syntax. 1. Knows how to simplify and split into multiples. Knows basic programming commands. Knows basic operations on lists. 2. Knows how to solve equations and systems of equations symbolically and numerically. Is familiar with the techniques of differential and integral calculus and basic matrix algebra. Knows how to create different types of graphical representations. 3. Knows how to solve differential equations and systems of differential equations symbolically and numerically. Understands the techniques of graphical representation of the solutions obtained. Understands the techniques for constructing bifurcation curves for boundary value problems of ordinary differential equations.   Skills:   1. Knows how to use basic Mathematica commands. Knows how to simplify expressions and divide into multiples. Knows how to use basic programming commands. Performs basic operations on lists. 2. Is able to solve equations and systems of equations symbolically and numerically. Is able to solve differential and integral calculus and basic matrix algebra problems. Is able to create graphical representations. 3. Is able to solve differential equations and systems of differential equations symbolically and numerically. Is able to graph the solutions obtained. Is able to represent numerically the bifurcation curves of boundary value problems of ordinary differential equations.   Competence:   1. Actively participates in discussions on the issues involved in using Mathematica. 2. Independently develops own competence by identifying current trends in the use of Mathematica in the theory of differential equations. | |
| Description of the organization and tasks of students' independent work | |
| Students carry out 6 independent works on the following topics:   1. basic Mathematica syntax; simplification; division into factors; equations and their systems; basic programming commands; lists; 2. creating graphic images; 3. differential and integral calculus; matrix algebra; 4. solving differential equations symbolically and numerically; displaying the acquired solutions graphically; 5. solving systems of differential equations symbolically and numerically; displaying the acquired solutions graphically. | |
| 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. | | | Independent work I | + |  |  | + |  |  | + | + | | | Independent work II | + | + |  | + | + |  | + | + | | | Independent work III | + | + |  | + | + |  | + | + | | | Independent work IV | + | + | + | + | + | + | + | + | | | Independent work V | + | + | + | + | + | + | + | + | | | Test | + | + | + | + | + | + | + | + | |   Final differentiated test assessment. The mark is calculated as the average mark of the independent work. | |
| Course content | |
| Overview of Mathematica syntax. Structuring a Mathematica file. Symbolic and numerical solving of equations and systems of equations. (L2, S2, Pd6)  2. Basic programming commands. Lists. (L2, S2, Pd6)  3. Creating graphical representations. (S2, Pd8)  4. Differential and integral calculus. Matrix algebra. (S2, Pd8)  5. Symbolic and numerical solution of differential equations. Bifurcation analysis of boundary value problems for ordinary differential equations. (S2, Pd18)  6. Symbolic and numerical solution of systems of differential equations. (S2, Pd18)  Independent work - 64 acad. h. Students complete 5 independent works, the average mark of which is the differentiated credit mark. | |
| Mandatory sources of information | |
| 1. M.L. Abell. Differential Equations with Mathematica, Elsevier Academic Press, 2004. <https://biblio.du.lv/Alise/lv/book.aspx?id=45555&ident=1042286&c=1&c=2&c=3> 2. C. Getz. Graphics with Mathematica, Elsevier, 2004.   <https://biblio.du.lv/Alise/lv/book.aspx?id=46884&ident=1044136&c=1&c=2&c=3>   1. S. Lynch. Dynamical Systems with Applications Using Mathematica, Birkhäuser, 2007. <https://biblio.du.lv/Alise/lv/book.aspx?id=49796&ident=1047836&c=1&c=2&c=3> 2. Wolfram Language & System Documentation Center.   <https://reference.wolfram.com/language/> | |
| Additional sources of information | |
| 1. F.F. Cap. Mathematical Methods in Physics and Engineering with Mathematica, Chapman& Hall/CRC, 2003.   <https://biblio.du.lv/Alise/lv/book.aspx?id=49098&ident=1046967&c=1&c=2&c=3>   1. D.A. McMahon. A Beginner's Guide to Mathematica, Chapman & Hall/CRC, 2006. <https://biblio.du.lv/Alise/lv/book.aspx?id=47349&ident=1044744&c=1&c=2&c=3> | |
| Periodicals and other sources of information | |
| 1. Mathematics for Materials Scientists and Engineers. <https://ocw.mit.edu/courses/3-016-mathematics-for-materials-scientists-and-engineers-fall-2005/pages/lecture-notes/> | |
| Notes | |
| Part A of the doctoral study program "Mathematics".  The course is taught in Latvian or English. | |