# RTU Course "Computerization of Mathematical Tasks in Electrical Engineering"

**13223 Department of Fundamentals of Electronics**

*General data*

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| Code | RTR207 |
| Course title | Computerization of Mathematical Tasks in Electrical Engineering |
| Course status in the programme | Compulsory/Courses of Limited Choice |
| Responsible instructor | Māris Tērauds |
| Academic staff | Gatis Valters<br>Raisa Smirnova |
| Volume of the course: parts and credits points | 1 part, 3.0 Credit Points, 4.5 ECTS credits |
| Language of instruction | LV, EN |
| Annotation | The study course is designed to familiarise students with the mathematical package MATLAB. The following topics are discussed: symbolic and numerical technical computing, technical computing and programming in MATLAB (ML), programming, matrix computing, approximation, interpolation, numerical integration, solving differential equations. |
| Goals and objectives of the course in terms of competences and skills | The objective of the study course is to familiarise itself with the design and programming environment of complex systems in MATLAB (ML) and with the possibilities to address electronics challenges symbolically and numerically in this environment.<br>Tasks of the study course:<br>1. To promote skills to work independently and regularly with literature.<br>2. To promote understanding of theoretical material.<br>3. To develop self-research skills.<br>4. To develop skills to independently address real engineering tasks in ML environments and the ability to develop these skills independently. |
| Structure and tasks of independent studies | 1. Review of lectures topics. Assessment is based on the tests during the lecture. Objective: to promote the detailed study of the topics of the lectures and motivation for work on a regular basis.<br>2. Completing of offered home works. Objective: to promote the skills to work with textbooks regularly and independently.<br>3. Preparation for tests (such tests are offered mainly at lectures). Objective: to stimulate systematic study during the semester.<br>4. Preparation for practical works, report writing, submission and presentation.<br>Objective: to promote understanding of the content of the course, to develop initial research skills. |
| Recommended literature | Obligātā/Obligatory:<br>1. Matlab online documentation: https://matlab.mathworks.com/, last accessed on 03.02.2022<br>2.P. Misāns. Ievads inženiermatemātikas datorrealizācijā. Lekciju konspekts. Elektroniskā versija *.pdf datnes formātā, RTU, 2007.<br>3.P. Misāns. Pirmie soļi darbā ar MATLAB. Lekciju konspekts. – PIMARS, 2003.<br>4.P. Misāns. Ievads inženiermatemātikas datorrealizācijā. Lekciju konspekts – PIMARS, 2003.<br>Papildu/Additional:<br>1.W. H. Press et al. Numerical Recipies in C, The Art of Scientific Computing. Cambridge Univ. Press, 1992.<br>2.G. J. Borse. Numerical Methods with MATLAB. PWS Publishing Company, 1997.<br>3.L. F. Shampine, R. C. Allen, Jr. S. Pruess. Fundamentals of Numerical Computing, John Willey & Sons Inc., 1997.<br>4.J. H. Mathews, K. D. Fink. Numerical Methods Using MATLAB. - Pearson Prentice Hall. – 4-th ed. – New Jersey, 2004.<br>5.R. C. Gonsales, R. E. Woods, S. L. Eddins. Digital Image Processing using MATLAB. – Pearson Prentice Hall. – New Jersey, 2004.<br>6.J. Vlach, K. Singhal. Computer Methods for Circuit Analysis and Design. Van Nostrand Reinhold Company, NY, 1983.<br>7.J. B. Dabney, T. L. Harman. Mastering SIMULINK. – Pearson Prentice Hall. – New Jersey, 2004.<br>8.P. Marchand, O. T. Holland. Graphics and GUIs with MATLAB. – Chapman&Hall/CRC Hall. – New York, 2003.<br>9.MATLAB/SIMULINK/Toolboxes/Blocksets User Guides for Version 7. – MathWorks, 2004.<br>10. Kiusalaas, Jaan. Numerical methods in engineering with MATLAB® /2016<br>10.С. В. Поршнев. Учебник MATLAB 7. Основы работы и программирования. - Москва: Изд-во - Бином, 2006.<br>11.H. Kalis. Diferenciālvienādojumu tuvinātās risināšanas metodes. Rīga, Zvaigzne, 1984.<br>12.A. Zviedris. Datorrealizācijas matemātiskās metodes. Lekciju konspekts. RTU, 1999.<br>13.P. Misāns. Pirmie soļi darbā ar MATLAB. Lekciju konspekts. – PIMARS, 2003.<br>14.P. Misāns. Ievads inženiermatemātikas datorrealizācijā. Lekciju konspekts – PIMARS, 2003.<br>15. J.Kiusalaas, Numerical methods in engineering with MATLAB® - 2016. |
| Course prerequisites | Some topics of Calculus (complex numbers, linear algebra, differentiation, integration). Basic skills in advanced programming languages (C or others). |

*Course contents*

| Content | Full- and part-time intramural studies | | Part time extramural studies | |
|---|---|---|---|---|
| | Contact Hours | Indep. work | Contact Hours | Indep. work |

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|---|---|---|---|---|
| MATLAB overview, technical computing related to electronics and telecommunications (lect.) | 2 | 3 | 0 | 0 |
| Introduction into MATLAB environment and programming language (lect.) | 4 | 4 | 0 | 0 |
| Matrix computations and MATLAB Toolboxes (lect.) | 2 | 3 | 0 | 0 |
| Application of symbolic computation in technical computing (lect.) | 2 | 3 | 0 | 0 |
| MATLAB graphics, introduction to Handle Graphics (lect.) | 2 | 3 | 0 | 0 |
| Basics of numerical solving of simultaneous linear equations (lect.) | 2 | 3 | 0 | 0 |
| Basics of numerical solving of nonlinear equations (lect.) | 2 | 3 | 0 | 0 |
| Basics of approximation and interpolation (lect.) | 2 | 3 | 0 | 0 |
| Basics of numerical integration methods (lect.) | 2 | 3 | 0 | 0 |
| Basics of solving of ordinary differential equations (lect.) | 2 | 3 | 0 | 0 |
| Reserved (lect.) | 2 | 0 | 0 | 0 |
| Introductory work – Basics of 2D graphics (practical work) | 2 | 3 | 0 | 0 |
| Interpretation of acquired data (practical work) | 4 | 6 | 0 | 0 |
| Introduction into symbolic computation (practical work) | 2 | 3 | 0 | 0 |
| Building of piece-wise signals (practical work) | 4 | 4 | 0 | 0 |
| Simulation of multi loop linear circuit (practical work) | 4 | 4 | 0 | 0 |
| Simulation of nonlinear circuit (practical work) | 2 | 3 | 0 | 0 |
| Evaluation of mean and mean square value for piece-wise signal (practical work) | 4 | 6 | 0 | 0 |
| Reserved (practical work) | 2 | 0 | 0 | 0 |
| Consultations and final test | 12 | 0 | 0 | 0 |
| Total: | 60 | 60 | 0 | 0 |

*Learning outcomes and assessment*

| Learning outcomes | Assessment methods |
|---|---|
| Able to work in MATLAB environment, and able to find the necessary information in the help system. | Passed final test. Successful completion and presentation of practical works reports. |
| Able to operate independently with matrices, symbolic computation and MATLAB graphics. | Passed corresponding tests (at the lectures), homeworks and final test. Successful completion and presentation of laboratory works reports. |
| Able to develop independently properly working script and function modules in MATLAB language. | Passed corresponding, tests, homeworks and final test. Successful completion and presentation of laboratory works reports. |
| Able to solve linear and nonlinear equations in MATLAB. | Passed corresponding tests, homeworks and final test. Successful completion and presentation of laboratory works reports. |
| Able to approximate and interpolate acquired measurements data in MATLAB. | Passed corresponding homework and final test. Successful completion and presentation of laboratory works reports. |
| Able to integrate functions and solve ordinary differential equations in MATLAB numerically. | Passed corresponding homework and final test. Successful completion and presentation of corresponding laboratory work reports. |
| Able to work and solve basic technical computing tasks in MATLAB independently. | All home works submitted, successful presentation of all laboratory works reports, passed final test. |

*Evaluation criteria of study results*

| Criterion | % |
|---|---|
| Completing homework | 20 |
| Tests given during lectures | 20 |
| Execution and defence of laboratory works | 30 |
| Final test | 30 |
| Total: | 100 |

*Study subject structure*

| Part | CP | Hours per Week | | | Tests | | |
|---|---|---|---|---|---|---|---|
| | | Lectures | Practical | Lab. | Test | Exam | Work |
| 1. | 3.0 | 1.5 | 1.5 | 0.0 | | * | |