



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

13223 Elektronikas pamatu katedra

### General data

|   |   |
|---|---|
| Code  | RTR207  |
| Course title  | Computerization of Mathematical Tasks in Electrical Engineering   |
| Course status in the programme  | Compulsory/Courses of Limited Choice  |
| Course level  | Undergraduate Studies   |
| Course type   | Academic  |
| Field of study  | Electronics and Telecommunications  |
| Responsible instructor  | Pēteris Misāns  |
| Academic staff  | Gatis Valters<br>Māris Tērauds<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  |
| Possibility of distance learning                                      | Not planned   |
| Maximum auditorium capacity   | 200   |
| Maximum number of students per semester                               | 200   |
| Abstract  | Symbolic and numerical technical computing in electronics and telecommunications context. Technical computing and programming in MATLAB (ML). Programming, matrix computing, numerical solving of linear, nonlinear and ordinary differential equations using ML. Approximation, interpolation, numerical integration, and numerical solving of simple differential equations using ML.   |
| Goals and objectives of the course in terms of competences and skills | Introduction into technical computing and system simulation and programming environment MATLAB (ML) and the possibilities for symbolic and numerical computations in electronics and telecommunications. The goal of the course is to ensure the development of skills in solving technical computing tasks in the field of electronics and telecommunications using ML and the ability to improve these skills independently.  |
| Structure and tasks of independent studies                            | 1. Review of lectures topics. Assessment is based on the blitz tests during the lecture. Objective: to promote detailed study of the topics of the lectures and motivation for work on a regular basis.<br>2. Accomplishment of offered home works. Objective: to promote the skills to work with text books regularly and independently.<br>3. Preparation for tests (such tests are offered mainly at lab works). Objective: to stimulate systematic study during the semester.<br>4. Preparation for lab works, report writing, submission and presentation. Objective: to promote understanding of the content of the course, to develop initial research skills.   |
| Recommended literature  | 1.W. H. Press et al. Numerical Recipes 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.С. В. Поршнеv. 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. Zviēdris. 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.P. Misāns. Ievads inženiermatemātikas datorrealizācijā. Lekciju konspekts. Elektroniskā versija *.pdf datnes formātā, RTU, 2007.<br>16.P. Misāns, M. Tērauds, G. Valters. Ievads inženiermatemātikas datorrealizācijā. Laboratorijas darbi. PIMARS, 2010. |
| Course prerequisites  | Some topics of Calculus (complex numbers, linear algebra, differentiation, integration). Basic skills in advanced programming languages (C or others).  |

### Course outline

| Theme  | Hours |
|--|-------|
| MATLAB overview, technical computing related to electronics and telecommunications (lect.) | 2     |

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

### ***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 test and exam. Successful completion and presentation of lab works reports  |
| Able to operate independently with matrices, symbolic computation and MATLAB graphics             | Passed corresponding blitz tests (at the lectures), home works and exam. Successful completion and presentation of lab works reports |
| Able to develop independently properly working script and function modules in MATLAB language     | Passed corresponding blitz tests, tests, home works and exam. Successful completion and presentation of lab works reports            |
| Able to solve linear and nonlinear equations in MATLAB  | Passed corresponding blitz tests, tests, home works and exam. Successful completion and presentation of lab works reports            |
| Able to approximate and interpolate acquired measurements data in MATLAB                          | Passed corresponding home work and exam. Successful completion and presentation of lab works reports                                 |
| Able to integrate functions and solve ordinary differential equations in MATLAB numerically       | Passed corresponding home work and exam. Successful completion and presentation of corresponding lab work report                     |
| Summary:<br>Able to work and solve basic technical computing tasks in MATLAB independently        | All home works submitted, successful presentation of all lab works reports, passed exam  |

### ***Study subject structure***

| Part | CP  | ECTS | Hours per Week |           |      | Tests |      |      |
|------|-----|------|----------------|-----------|------|-------|------|------|
|      |     |      | Lectures       | Practical | Lab. | Test  | Exam | Work |
| 1.   | 3.0 | 4.5  | 1.5            | 0.0       | 1.5  |       | *    |      |