RĪGAS TEHNISKĀ UNIVERSITĀTE

RTU Course "Numerical Methods"

12501 null

General data

Code	DOP204
Course title	Numerical Methods
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Mathematics and Statistics
Responsible instructor	Ilmārs Iltiņš
Academic staff	Raisa Smirnova Andrejs Koliškins
Volume of the course: parts and credits points	1 part, 2.0 Credit Points, 3.0 ECTS credits
Language of instruction	LV, EN
Annotation	Solution of linear equation systems by direct, iterative and variation methods. Solution of nonlinear equations and systems. Interpolation, aproximation, mean square method, their applications. Incorrect problems. Regularization with Tikhonov method.
Goals and objectives of the course in terms of competences and skills	After successful completion of the study course, a student is able to perform the simplest numerical methods; to understand problems that can occur in the process of applying numerical methods; to use the MATHEMATICA software in order to solve the simplest problems; to use the built-in functions of MATHEMATICA.
Structure and tasks of independent studies	Within the framework of the study course, a student is expected to fulfill two homework assignments. The homework assignments receive a weight of 40% in the final grade.
Recommended literature	1. M. Iltiņa, I. Iltiņš. Skaitliskās metodes. Rīga, RTU, 2002, 95 lpp. 2. R. Smirnova, M.Iltiņa, I. Iltiņš. Skaitlisko metožu pielietojumi Mathcad vidē. Rīga, RTU, 2003, 93 lpp 3. H. Kalis. Diferenciālvienādojumu tuvinātās risināšanas metodes. R., Zvaigzne, 1986. 4. Samarskis A. A., Guļins A. B. Skaitliskās metodes. M., Zinātne, 1989. (krievu valodā).
Course prerequisites	Linear algebra, analytical geometry, calculus and preliminary knowledge of MATHEMATICA software.

Course outline

Theme	Hours
Direct methods of solution of linear simultaneous equations. Appliance of the methods.	4
Methods of iteration for linear simultaneous equations. Concept of convergence.	4
Theorems that characterize convergence of methods of iteration and application problems connected with them.	4
Interpolation and approximation, their appliance.	4
Methods of solution for nonlinear equations and simultaneous equations.	4
Numerical differentiation and integration, smoothing.	4
Numerical methods of solving of differential equations. Methods of Euler and Runge-Kutta.	4
Concept of ill-conditioned problems. Coefficient of determination. Regularization.	4

Learning outcomes and assessment

Learning outcomes	Assessment methods
After successful completion of the study course, a student is able to demonstrate the understanding of methods of solving simultaneous linear equations based on factoring of matrix. Able to apply these methods by means of MATHEMATICA software.	Homework assignment. Assignments relevant to the material studied are included in the final examination.
Able to demonstrate the understanding of Seidel method, Jacobi method, method of simple iteration, method of minimal discrepancy. Able to apply these methods by means of MATHEMATICA software.	Homework assignment. Assignments relevant to the material studied are included in the final examination.
Able to demonstrate the understanding of the concept of convergence and the causes of eventual nonconvergence.	Homework assignment. Assignments relevant to the material studied are included in the final examination.
Able to perform table interpolation by linear combination of functions, by cubic spline. Able to perform table approximation by means of method of minimal squares.	Homework assignment. Assignments relevant to the material studied are included in the final examination.
Able to apply the method of simple iterations and the Newton's method to solve equations and simultaneous equations.	Homework assignment. Assignments relevant to the material studied are included in the final examination.
Able to demonstrate the understanding of the main methods of numerical differentiation and integration.	Homework assignment. Assignments relevant to the material studied are included in the final examination.

Able to demonstrate the understanding of the concept of difference equations. Able to apply Euler's method and the method of Runge-Kutta to solve Cauchy problem.	Homework assignment. Assignments relevant to the material studied are included in the final examination.
Able to demonstrate the understanding of the concept of ill-conditioned problem. Able to demonstrate the understanding of the influence of the coefficient of determination on the quality of solution.	Assignments relevant to the material studied are included in the final examination.

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	2.0	1.0	1.0	0.0		*	