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| **Course unit title** | **HIGH PERFORMANCE COMPUTING** |
| **Course unit code** | InfT6006 |
| **Type of course unit** | A part – Compulsory part |
| **Level of course unit** | 2nd cycle (Master) |
| **Year of study** | - |
| **Semester** | IV |
| **Number of ECTS credits** | 3 |
| **Name of lecturer(s)** | Jānis Rimšāns, Dr.math. |
| **Learning outcomes of the course unit** | **Aims of the course**  The aim of the course is to impart knowledge and skills, which are required for realisation of numerical methods in data processing parallel technologies and for usage in doing practical tasks, as well as develop skills in versatile usage of appropriate programming language and resources for solving problems of modeling.  **Objectives of the course**  To develop practical skills in solving quantity mathematical problems and programming.  To acquire different paralel data processing algorithms and master practical skills in their realisation, using available programming languages and dedicated resources.  To acquire basics of data processing parallel technology, using FORTRAN and C languages and MPI dedicated resources.  **Results of the course (competences to be developed)**  To be able to use numerical methods' basic algorithms in data processing parallel technologies |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | Quantity methods, basic programming |
| **Recommended optional programme components** | - |
| **Course contents** | In introduction of the course are considered basic algorithms of functions approximation. Solutions' reduction of linear algebra equations and LU decomposition methods are set out. An introduction into basic procedures of MPI, as well as FORTRAN and C programming. To acquire functions approximations and algebra algorithms using MPI parallel programming procedures.  Numerical differentiation and integration is considered. MPI procedures of data sending and recieving are outlined. Numerical differentiation and integration algorithms using MPI parallel programming resources are acquired.  Common and partial differential equations’ numerical solving methods are considered for Koshi problem and border problem. MPI collective communication procedures are outlined. Differential equations’ numerical solving algorithms are acquired using MPI parallel programming procedures. |
| **Course plan** | |  |  | | --- | --- | | **Theme** | **Sub-theme** | | 1. Functions approximations parallel algorithms 2. Introduction into MPI basic procedures, FORTRAN and C programming. | * 1. Lagrange interpolation   2. Aitken's method   3. Least mistakes method   4. Splain-approximation   5. Solutions' reduction of linear algebra equations and LU decomposition methods for three diagonals thin matrices.   6. Parallel computer architectures   7. MPI general procedures in FORTRAN   and in C programming languages   * 1. Approximation's algorithms realization in data precessing MPI technology | | 1. Numerical   differentiation and integration algorithms on an irregular grid   1. Computation of equations roots and functions extreme 2. MPI procedures of data sending and recieving | 3.1. Usage of Taylor's and Lagrange's polynomials  in numerical  differentiation algorithms  3.2. Algorithms of numerical integration trapezium  formulas and Simpson's  formula's parallel realization  4.1. Calculation of equations roots  algorithms. Newton's and  Secant methods  4.2. Functions' extreme points, their  numerical calculation methods   * 1. MPI data sending and recieving procedures in FORTRANand in C programming languages | | 1. Common differential equations 2. Partial differential equations 3. MPI collective communication procedures | 6.1. Koshi problem. Euler's and Picar's  methods  6.2. Predicate-correction methods  6.3. Runge\_Kutt methods  6.4. Sturm- Liouville problem's numerical  algorithms  7.1. Equations' discretization. Differences  scheme structure's algorithms. Integral  interpolation's method.  7.2. Matrices equations parallel  solving algorithms. ScaLapack  resources usage for solving linear  algebra equations systems   * 1. MPI collective communication procedures. Groups and communicators | |
| **Recommended or required reading** | D.W. Heermann. Computer Simulation Methods in Theoretical Physics, Berlin, Springer-Verlag, 1986  A.S.Antonov. Introduction in parallel calculations, M, MGU, 2002 |
| **Planned learning activities and teaching methods** | **Test**  Lectures, practical works, seminars, student's individual work |
| **Assessment methods and criteria** | All practical works have to be done. Successfully passed credit test, where has to be acknowledged skills in solving tasks and knowledge in theory. |
| **Language of instruction** | English |
| **Work placement(s)** | N/a |