Course Syllabus

1. Course Title:

Modern Computer Technologies in Modeling

2. Academic Level:

Master

3. ECTS Credits:

5 ECTS

4. Semester:

3, autumn semester

5. School/Department:

Institute of Mathematics, Mechanics, and Computer Science named after I.I. Vorovich

6. Location:

8-A Milchakova St., Rostov-on-Don

7. Instructor:

Assoc. Prof. Vasily Govorukhin, email: vngovoruhin@sfedu.ru

8. Language of Instruction:

English

9. Course Description:

The study of modern computer technologies and numerical methods including programming skills for solving wide range of mathematical modeling problems. Basic theoretical knowledge on the principles of constructing and implementing algorithms for mathematical modeling problems, methods for parallelizing algorithms, numerical methods for computational experiment, and visualization of research results. Discipline supplements and expands knowledge in mathematical physics, and numerical methods. Programming using OpenMP and MPI technologies for parallelizing algorithms. and visualizing using Matlab tools.

The knowledge, skills acquired during the study of this discipline can be used to solve professional problems in research, scientific-production and design activities, in particular, in the preparation of graduation qualification work.

10. Course Aims:

The course aims at developing students' competencies in the use of modern computer technologies in mathematical modeling of problems of science and technology; mastering the basics of constructing and implementing algorithms and numerical methods for parallel computers; mastering the basic methods of visualizing the results of mathematical modeling; mastering the apparatus of a computational experiment for the study of models, equations and systems.

11. Specific entry requirements (if any):

BSc. courses of analysis, linear algebra, ODE, PDE, programming, calculus.

12. Course Content:

Module 1. Principles of developing methods and algorithms for solving mathematical modeling problems on modern computers. The finite-difference, projection and meshless methods and parallel algorithms of their realization. OpenMP and MPI technologies for parallelizing algorithms in the C ++ programming language.

Module 2. The principles of a computational experiment and verification of methods and algorithms. The main methods of analyzing the results of a computational experiment. Key features of the Matlab package. Visualization and animation tools in Matlab. Ways of interfacing various computational approaches and tools.

13. Intended Learning Outcomes:

On successful completion of the course, students are expected to know and apply:

basic concepts of programming technologies OpenMP and MPI;

techniques for constructing algorithms for solving mathematical modeling problems for parallel computers;

methods of analysis and visualization of research results of mathematical models;

basic Matlab system commands.

14. Learning and Teaching Methods:

Lectures, laboratory and pre-laboratory work, self-study with writing a report

15. Methods of Assessment/Final assessment information:

Exam

16. Reading List:

- OpenMP Application Program Interface. Free manual. https://www.openmp.org/wp-content/uploads/OpenMP4.0.0.pdf
- Hands-On Introduction to OpenMP, Mattson and Meadows. Free course. https://www.openmp.org/wp-content/uploads/omp-hands-on-SC08.pdf
- A brief Introduction to parallel programming. Tim Mattson. Intel Corp.https://indico.cern.ch/event/625333/contributions/2587002/attachments/1491364/2318328/intro_par_prog_with_openMP.pdf
- Introduction to MPI: Argonne MPI Tutorials. http://www.mcs.anl.gov/~balaji/permalinks/2014-06-06-argonne-mpi-basic.pptx
- C. Moler. Numerical Computing with MATLAB.https://uk.mathworks.com/moler/index_ncm.html
- C. Moler. Experiments with MATLAB.https://uk.mathworks.com/moler/exm/chapters.html