Course Syllabus

1. Course Title:

Mathematical Models of Process and Systems

2. Academic Level:

Master

3. ECTS Credits:

5 ECTS

4. Semester:

2, spring 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:

Prof. Galina Muratova, email: muratova@sfedu.ru

8. Language of Instruction:

English

9. Course Description:

Course deals with advanced concepts and techniques of mathematical modeling of different processes and systems, which are based on differential equations. The course is devoted to a review of mathematical models of various processes and phenomena.

10. Course Aims:

The subject of the course is focused on constructing mathematical models of crucial problems of our time. The emphasis is on tasks related to the ecological problems. Models based on the Navier-Stokes and convection-diffusion equations, which are the basis of the problems of hydro-gas dynamics, are considered. In addition, an overview of difficult-to-formalize tasks from biology, medicine, and conflict management is presented. Algorithms for the implementation of the constructed mathematical models are considered.

11. Specific entry requirements (if any):

BSc. courses of analysis, linear algebra, ODE, PDE, calculus, scientific computing (Maple, Matlab)

12. Course Content:

Methodology of mathematical modeling. Different approaches to the constructing model algorithms for various processes and phenomena ODE and PDE as mathematical models. Modeling in environmental problems.

13. Intended Learning Outcomes:

On successful completion of the course, students are expected to be able to

describe and compare different approaches to the construction of mathematical models of various processes;

use fundamental laws and variational principles for constructing models;

investigate the behavior and properties of mathematical models;

choose and implement a suitable software for realization of mathematical models.

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:

- Samarskiy A.A., Mikhailov A.P., Mathematical modeling, 2005, Publisher: Science. Fizmatlit, 320 p.. ISBN 5-9221-0120-X.
- Zvonarev, S.V. Fundamentals of mathematical modeling: textbook / - Yekaterinburg: Publishing house Ural. Un., 2019. 112 p.
- L. A. Krukier, G. V. Muratova, L. G. Chikina, T. S. Martynova, E. M. Andreeva, S. A. Vinogradova, B. L. Krukier, O. A. Pichugina " Numerical solution of stationary convection-diffusion problems ", monograph, Publishing house of the Southern Federal University, 2017. - 120 p. ISBN 978-5-9275-2615-4 (RSCI)