

**FACULTY OF APPLIED MATHEMATICS AND INFORMATICS**

**autumn SEMESTER 2020/2021**

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| **Row No.** | **Course Title** | **Department** | **Level (Year)** | **Language** | **ECTS** | **Semester** |
| **1** | **Applied Problems of Computational Finance** | Information Systems | M (2) | English | 3 | 1 |
| **2** | **Mathematical Modeling and Simulation** | Applied Mathematics | M (2) | English | 4.5 | 1 |
| **3** | **Optimization of Complex Systems** | Applied Mathematics | M (2) | English | 6 | 3 |

**COURSE DESCRIPTION**

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Status** | **Course code / number in the book:** Applied Problems of Computational Finance **Taught by:**Yaroslav Kondratiuk | | | | | | in plans | | **Acad. cycle** | **ECTS credits** | **Duration** | **Semester** | **Contact hours** |  | | Bachelor | 1.5 | 1 semester | Autumn | 32 |  | | **Year of study** | **Weekly lectures/seminars** | | **Prerequisites** | | | | 2-nd | 1/1 | | Numerical methods, basics of programming | | | | **Languages** | **Examination** | | **Assessment** | | | | English | Report/presentation | | 100-point scale | | | | **Aims and objectives:** presentation and analysis of modern problems in computational finance and construction of corresponding efficient methods and algorithms.  **Description:** In this course we discuss complicated problems that arise in practical applications of computational finance and require advanced numerical methods and sophisticated algorithms. High dimensional applications and complexity of algorithms are central points in our approach.  **Reading list:**   1. Rudiger Seydel, Tools for Computational Finance. Springer Nature, 2017. 2. Paul Glasserman, Monte Carlo Methods in Financial Engineering, Springer Nature, 2013. 3. Alonso Peсa, Advanced Quantitative Finance with C++, Packt, 2014. 4. Lee, Raymond S. T., Quantum Finance: Intelligent Forecast and Trading Systems, Springer Nature, 2019. | | | | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Status** | **Course code / number in the book:** Mathematical Modeling and Simulation **Taught by:**Andriy Styahar | | | | | | in plans | | **Acad. cycle** | **ECTS credits** | **Duration** | **Semester** | **Contact hours** |  | | Master | 4.5 | 1 semester | Autumn | 48 |  | | **Year of study** | **Weekly lectures/seminars** | | **Prerequisites** | | | | 2-nd | 2/1 | | Numerical Methods of Mathematical Physics, Equations of Mathematical Physics, Programming | | | | **Languages** | **Examination** | | **Assessment** | | | | English | Test | | 100-point scale | | | | **Aims and objectives:** to teach students to solve industrial real-world problems on an example of earthquake modeling; to create models and numerical methods for earthquake modeling; to teach the students to treat difficulties in different aspects of industrial modeling.  **Description:** Mathematical modeling is one of the very important directions in applied mathematics. In this course we study the structure of industrial projects, difficulties and applications of different topics of applied mathematics in industry on an example of earthquake modeling. We consider practical examples and various computer experiments. In particular, we look from the practical point of view which numerical method one should choose to efficiently solve earthquake problems, how to develop a well-suited model, also we consider typical inverse problems. Programming and computational issues for large-scale applications are analyzed.  **Reading list:**   1. Pozrikidis C. Introduction to Finite and Spectral Element Methods with Matlab, 2nd edition. CRC Press, 2014. – 793 pp. 2. Lohner R. Applied Computational Fluid Dynamics Techniques: an Introduction Based on Finite Element Methods. Wiley, 2008 – 519 pp. 3. Igel, H. Computational Seismology: a Practical Introduction. Oxford University Press, 2017. – 323 pp. 4. Quarteroni A. Numerical Models for Differential Problems. MS&A. Springer, 2009. – 601 pp. 5. Shearer P. Introduction to Seismology. Cambridge University Press, 2009. – 396 pp. | | | | | | |

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| |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Status** | **Course code / number in the book:** Optimization of Complex Systems **Taught by:**Mykhaylo Shcherbatyy | | | | | | | | | in plans | | **Acad. cycle** | **ECTS credits** | **Duration** | **Semester** | | **Contact hours** |  | | MS | 6 | 1 semester | Autumn | | 180 |  | | **Year of study** | **Weekly lectures/seminars** | | | **Prerequisites** | | | | | 2-nd | 2/2 | | | Linear Algebra, Mathematical Analysis, Ordinary and Partial Differential Equations, Numerical Methods, Mathematical Programming (Numerical Optimization), Functional Analysis, some experience with Matlab/Octave (or other SCM) | | | | | **Languages** | **Examination** | | | **Assessment** | | | | | English | Written exam | | | 100-point scale | | | | | **Aims and objectives:** give an overview of the theory and numerics of optimal control of ODEs and PDEs including applications in different fields; teach students formulate of optimization problems for mathematical models of different types, elaborate numerical algorithms and software (using Matlab/Octave or other SCM) for solution of optimization problems, analyze received solutions using optimality conditions.  **Description:** This course concerns optimization problems of complex systems, governed by ordinary differential equations (ODEs) and partial differential equations (PDEs). Numerical methods for solution of optimization problems, which are based on direct and indirect approaches, are considered. Sensitivity analysis relations in discrete and continuous formulations that are obtained using various methods are presented. A number of applications examples from different fields illustrate the material of this course.  **Reading list:**   1. F. Tröltzsch, *Optimal Control of Partial Differential Equations (Graduate Studies in Mathematics),* AMS 2010. 2. J.C. De Los Reyes. *Numerical PDE-Constrained Optimization,* SpringerBriefs in Optimization, 2015. 3. M. Hinze, R. Pinnau, M. Ulbrich, S. Ulbrich, *Optimization with PDE Constraints.* Springer 2009. 4. J. Nocedal, S.J.Wright, *Numerical Optimization*. Springer, New York 2006. 5. J.S. Arora, *Introduction to Optimum Design*. Elsevier Inc. 2012. | | | | | | | | | | |