NAZARBAYEV UNIVERSITY
SCHOOL OF SCIENCE AND TECHNOLOGY

Course Syllabus: PHYS 511 Computational Modeling and Simulation

Semester: Fall 2017 Lecture and Lab Times: MWF 4:00 pm-4:50 pm in Room 7.212

Instructors:

Ernazar Abdikamalov
Office hours: Tuesdays and Thursdays 12:00-14:00 in office 7.219, or by appointment
Office phone: +77172694662
Email: ernazar.abdikamalov@nu.edu.kz

Sergiy Bubin
Office hours: Tuesdays and Thursdays 10:20-11:30 in office 7.204, or by appointment
Office phone: +77172694663
Email: sergiy.bubin@nu.edu.kz

Course Description and Objectives

In Computational Modeling and Simulation (PHYS 511) course, students will acquire the knowledge and skills for solving various scientific problems and analyzing data using modern computational techniques. The course will include certain subjects related to the traditional numerical analysis (finding roots of systems of algebraic equations, numerical interpolation and extrapolation of data, numerical differentiation and integration, Fourier transforms) as well as the methods of simulating various systems and phenomena governed by ordinary and partial differential equations (Finite element and Galerkin methods). In the scope of the course, students will

- Learn the advantages and limitations of common numerical techniques
- Get acquainted with various scientific software and tools
- Use modern software development tools
- Practice writing flexible, efficient, and practical code in a modern language
- Learn the basics of parallel computations and programming
- Learn common techniques for analyzing and plotting data
- Practice writing reports in the scientific style

The course is designed to help the students gain experience carrying out computational tasks and data analysis. It will partly utilize the `Python` programming language (there will be an introduction to `Python`). In recent years, `Python` became a widely used general-purpose, high-level programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts and computational operations in a concise form. Moreover, it features a dynamic type system and automatic memory management and has a large and comprehensive standard libraries (e.g., numpy, scipy matplotlib, etc). `Python` supports multiple programming paradigms, including object-oriented, imperative and functional programming styles. In addition to `Python`, students will acquire familiarity with a computer language suitable for high-performance computing, such as `Fortran` or `C`, commonly used numerical libraries (e.g. LAPACK), and parallel programming paradigms.

Course Materials

Some course material will be based on the following textbooks:

- Numerical Methods for Engineers, Steven C. Chapra, Raymond P. Canale, 6th edition, McGraw-Hill, 2010
- Computational Physics with Python, Mark Newman, CreateSpace Independent Publishing Platform, 2012
- Numerical Recipes, 3rd. edition, by W. H. Press, S. Teukolsky, W. Vetterling, and B. Flannery, Cambridge University Press, Cambridge, UK, 2007
- Python Scripting for Computational Science, Langtangen H. P., 3rd ed. 2008 (freely available for download online)

Course Assessment

Activity	**Weight**
Homework assignments	100%

A grade bonus of up to 5% will be awarded to students with 100% attendance and active participation (e.g. asking relevant questions during the class and answering instructor questions).

Course Policies and Academic Honesty

You are welcome and encouraged to discuss homework assignments with your fellow students. However, the work you submit should be *your own* and reflect your own understanding of the subject. All submitted homework problem sets and reports will be graded and returned to you during the semester. Anyone suspected of violating academic integrity (e.g. through plagiarism) will be subject to NU's disciplinary procedures described in NU Student Code of Conduct and Disciplinary Procedures Handbook.

Attendance policy

Students are expected to attend both lectures and labs. Attendance of lectures is particularly important as the information provided during them may be crucial the homework assignments and may not always appear in lecture notes. An excuse to missed lectures and labs for students who fall below 80% attendance will only be given if medical notes signed by an NU doctor are provided. Notes from outside clinics will not be accepted.

Office Hours Policy

Every student is encouraged to visit the instructor during office hours. It is particularly important for students who have little or no prior experience with computer simulations and/or those who show below average performance. Please make appointments if the office hours of the instructors are in conflict with your schedule.

Electronic resources

You are expected to regularly check your Nazarbayev University email for updates and announcements about the course. You are also required to use Moodle as determined by the instructor.