Study: Physics				
Type and level of studies: Bachelor studies				
Course name: Modelling of Physical Processes				
Lecturer**: Branko Drljača**				
Status: Elective				
ECTS: 6				
Attendance prerequisites: Physical Mechanics; Molecular Physics and Thermodynamics; Electromagnetism 1; Optics; Basics of Informatics; Basics of Programming				

Course aims

The aim of the course is to provide students with the basic knowledge about the various models used to describe physical processes and enable them to recognise, create and apply these models.

Course outcome

Introducing students to the basic concepts of physical processes modeling and the most important model categories. Enabling students to:
- recognize physical processes, determine the model category and build an appropriate model;
- understand the importance of modelling physical processes;
- apply the acquired knowledge of other natural sciences and techniques;
- use computer tools to model and simulate physical processes.

Course content

Theoretical part

Model and modelling. The concept of a model. Types of models (isomorphic and homomorphic, deterministic and stochastic, mathematical and physical, numerical). Role, significance and history. First-order deterministic models: electrical, mechanical, fluid (hydraulic, pneumatic, acoustic), liquid leakage, heating and cooling, growth processes, radioactive decay. Euler numerical method. Second-order deterministic models: electrical systems, mechanical systems. Sinusoidal response, damped and forced oscillations. Harmonic and mathematical pendulum. Modelling basic equations (Poisson's equations, continuity equations, transport equations, Maxwell's equations) and processes (diffusion, electrical conductivity, generation-recombination processes, thermal generation, thermal conductivity). The Monte Carlo method, basic idea. Modelling random variables. Random number generators. Statistical verification of random numbers. Simulation of a random experiment. Reliability theory. Characteristics of element and system reliability. Application of Monte Carlo method. Stochastic modelling. Homogeneous and inhomogeneous Poisson stream. Growth and death processes. Modelling of radioactive decay, radiation absorption, gas breakthrough.

Practical Part:

PRACTICAL EXERCISES: Practicing using computer tools. Developing and testing models discussed in lectures.

Literature

1. Gerd Baumann, Mathematica® in theoretical physics, Springer-Verlag-Heildeberg, 1993
2. Катарина Сурла, Ђорђе Херцег, Сања Рапајић, Mathematica® за физичаре и хемичаре, Универзитет у Новом Саду, 1998
3. P.P.J. van den Bosch, A.C. van der Klauw: Modeling, Identification and Simulation of Dynamical Systems, CRC Press, 1994.
4. S. Selberherra: Analysis and simulation of semiconductor Devices, Springer.Verlag, Wien,1985. god.
5. Д. Петковић: Математичко моделовање физичких процеса, необјављен рукопис

Number of active classes				Other classes
Lectures: 2	Practical classes: 2	Other forms of teaching:		

Teaching methods

Lectures (2 classes per week during the semester), practical exercises with computer use (2 classes per week during the semester).

Assessment (maximum 100 points)			
Course assignments	**points**	Final exam	**Points**
Lectures	10		
Practical classes	20	oral exam	30
Projects (2)	40	....	
Total	70		30