COURSES OFFERED BY DEPARTMENT OF ELECTRONICS

Basic Science Courses

Experimental data analysis, **dr hab. I. Jabłoński**

Two parts fundamental course entitled „Experimental data analysis“ is dedicated for PhD students of all theoretical and applied departments in technical, economic, medical, environmental and life sciences universities. Initial requirement concerns university knowledge in mathematics studied at MSc level; no entrance requirements are specified as regards programming skills. Regular lectures are supported with the exemplary applications of the methodologies included in the curriculum.

Introduction relates to the planning, designing and realization of the optimal experiment. Mathematical modeling of physical and technical systems and signals is the leading topic of the first part of the course. It includes signal reconstruction and regularization, selection of an optimal model to experimental data, model validation and simulation procedures. Application of Monte Carlo modeling is demonstrated for technical and business cases. In the meantime, an introduction to the software tools suitable for work in data science, e.g. Matlab/Simulink, is delivered in this semester. Finally, the fundamental knowledge in a range of analytic and numerical problems of data exploration is formulated, together with the visualization modes proper for enhanced inference into data content.

The scope of the second part of the course includes: estimation theory, methods of artificial intelligence, nonlinear dynamics, etc. Problems of data cleaning, clustering, outlier detection are presented. Forecasting techniques are demonstrated with the use of financial data sets. Finally, machine learning and big data topics are presented.

Apart from the knowledge in detailed methods used for experimental data analysis, the course graduates will be able to algorithmize the problem and to assign the appropriate analytic tool for its solution. Knowledge delivered during the course titled “Experimental data analysis” (part I and part II) can be used in prospective research and industrial applications. Participation in the lectures enables to uplift the skills in data science at least to the pre-intermediate level.

Software Project Management**, prof. O. Unold**

(Software) Project Management is to strike a balance among time, resources, and goals. This course aims to give fundamentals of systems development life cycle, management structures, principles of creating effective working teams, pro-quality models, software testing, verification and validation.

Specialized courses

***Parallel programming*, prof. W. Bożejko**

The course deals with basic programming skills in parallel computing environments, including algorithmic approaches to classic problems of programming, such as parallel sorting or parallel shortest paths determination in graphs. The course will present at-the-moment applied supercomputing architectures (clusters, multi-GPU) and the programming environments (MPI, CUDA, OpenMP) as well as high level languages with embedded parallelism mechanisms. The latest parallel algorithms from the field of artificial intelligence methods will also be presented: parallel metaheuristics and concurrently implemented neural networks.

***Computational Intelligence and Its Applications*, prof. O. Unold, prof. J. Magott**

This course offers a thorough introduction into fuzzy sets theory, machine learning, and evolutionary algorithms. The topics of the lectures include fundamentals of fuzzy sets theory, safety analysis using fault trees with fuzzy probabilities and event trees with fuzzy probabilities, methods of data dimensionality reduction and feature extraction, tensor decomposition models, selected methods for statistical classification, evolutionary computation models, fundamentals of artificial immune systems, hybrid models and their applications.

***Efficient planning of scientific calculations*, dr inż. M. Tykierko**

Laboratory is focused on fundamentals of high performance computing and its applications. It is divided into two parts. In the first part, basics of Linux operating system, script programming languages, and textual data processing are introduced. In the second part basis of HPC systems, data visualization tools, public key infrastructure, job submission in cluster and grid infrastructure are presented. It is organized as hands-on laboratory on real HPC resources.

Research project

This course is to enable doctoral students realize research activity specific for a selected research field related to the doctoral thesis.

Humanities or management courses

***Practical aspects of research work and scientific achievements presentation,* prof. K. Walkowiak**

The course, conducted partially in a form of a lecture and partially in a form of a seminar, aims to present practical aspects of conducting scientific work and presenting scientific achievements and concerns, among others, the following issues: searching for knowledge necessary to carry out a doctoral dissertation; methodology and methodology of conducting scientific research; preparation

of the presentation of the results of the scientific work; implementation of scientific cooperation in research teams; implementation of cooperation with industry; writing scientific publications; preparation of applications for financial resources from various sources of financing, including research projects, promotion projects, scholarships, internship scholarships, conference grants. The course is intended primarily for PhD students pursuing a doctorate in the following disciplines: computer science, automation and robotics, electronics, telecommunications. But doctoral students from other disciplines can also take part in it.

Seminars

Interdisciplinary seminar, **prof. K. Walkowiak**

This seminar aims at encouraging theoretical discourse between doctoral researchers on various topics with the main focus on the following disciplines: computer science, automation and robotics, electronics, telecommunications. Each participant is to present several seminars presenting her/his research related to the doctoral thesis. The goals of this seminar are as follows:

- To gain knowledge in the field of the discipline of the doctorate.
- To acquire the ability to disseminate research results, initiate debate, and participate in scientific discourse.
- To acquire skills to plan and execute individual and team research projects, including international environment.
- To acquire skills in the use of knowledge in various fields of science or art for creative identification, formulation and innovative solving of complex problems or performing research tasks.

Additional M.Sc. level courses that can be taken by Ph.D. students

At the Faculty of Electronics there are four M.Sc. programs in English:

- Internet Engineering.
- Advanced Informatics and Control.
- Advanced Applied Electronics.
- Embedded Robotics.

Internet Engineering courses:

- *Information Systems Modeling.*
- *Computer Games: Designing.*
- *Signals, Systems and Control.*
- *Secure Systems and Networks.*
- *Information Systems Analysis.*
- *Advanced Databases.*
- *Multimedia and Computer Visualization.*

Advanced Informatics and Control courses:

- *Modeling and Optimization of Computer Networks.*
- *Methods of Computational Intelligence and Decision making.*
- *Optimization Methods: Theory and Applications.*
- *Introduction to Computer Vision in Quality Control.*
- *Information Storage and Management.*
- *Adaptive Control and Industrial Control Systems.*
- *Computer Games: Programming.*

Advanced Applied Electronics courses:

- *Numerical methods in differential equastions.*
- *Optical Fibers and Optocommunications.*
- *Numerical Algorithms.*
- *DSP Controllers Architecture.*
- *Lasers and Applications.*
- *Optoelectronics and Photonics.*
- *Optics and Nonlinear Optics.*
- *New Approaches to Electronics and Telecommunications.*
- *Terahertz Technique and Technology.*
- *Colorimetry and Photometry.*

Embedded Robotics courses:

- *Control Theory.*
- *Modeling and Identification.*
- *Applied Logic.*
- *Mathematical Methods of Automation and Robotics.*
- *Sensors and Actuators.*
- *Robotic Programming Environments.*
- *Control Theory for Embedded Systems.*
- *Artificial Intelligence and Machine Learning.*
- *Theory and Methods of Optimization.*
- *Mobile Robotics.*
- *Social Robots.*
- *Task and Motion Planning.*