PÁZMÁNY

Pázmány Péter Catholic University

Faculty of Information Technology and Bionics

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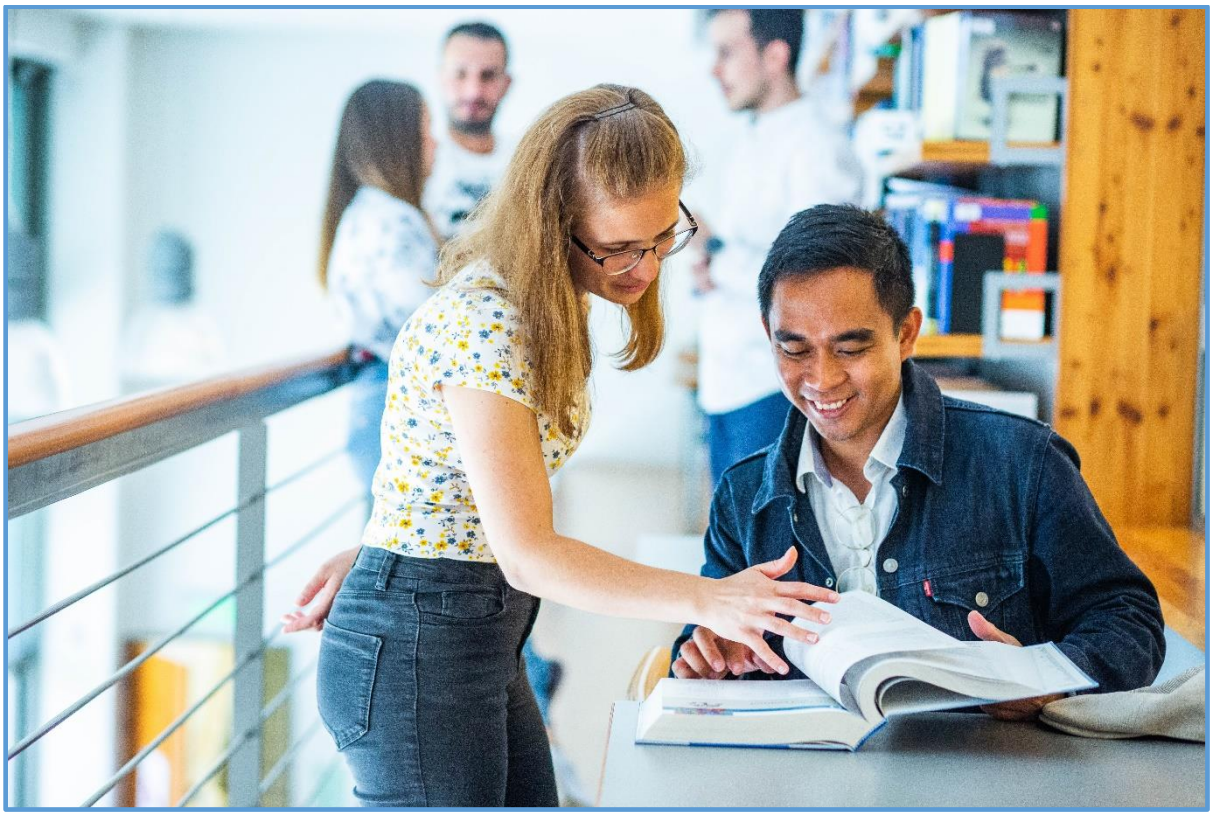
COURSE CATALOGUE

FOR VISITING STUDENTS
2023/2024 ACADEMIC YEAR



Advanced Java Programming

P-ITSZT-0017

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 0 /2 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Tornai Kálmán

Course Description:

The objective of this subject is to deepen the knowledge of students regarding the Java programming language and tools. In addition, students have to implement a complex programming project during the semester to gain experience. The technologies covered by the subject are Spring Boot, Injection+Bean, JPA, JS – frontend, Rest, Soap, and Maven.

Advanced Structural Bioinformatics

P-ITOBA-0120

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 3 /0 hours/week
Course credit	6 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Gáspári Zoltán

Course Description:

Advanced concepts and tools in biomolecular structure analysis.

- Assigning secondary structural elements from 3D coordinates
- The concept of domains: definitions based on structural and sequence features
- Origins and uses of global and local similarity in structures
- Structure classification and functional assignment
- Prediction of structural features from sequences
- Full 3D structure prediction
- Protein: ligand docking
- Ensemble-based structural models to represent protein internal dynamics
- Analysis of the structure of nucleic acids

Angular

P-ITSZT-0059

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 0 /2 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Tornai Kálmán
Comment	course availability to be confirmed

Course Description:

This subject's objective is to deepen students' knowledge regarding understanding the architecture behind an Angular application and how it works. The gained understanding of Angular fundamentals will improve students' frontend development skills by making it possible to develop complex, scalable, and responsive web applications. In addition, students have to implement a complex programming project during the semester to gain experience. The technologies covered by the syllabus besides Angular are HTML, CSS, Javascript, Typescript

Applications of Neural Microsystems

P-ITBIO-0042

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Fekete Zoltán
Comment	course availability to be confirmed

Course Description:

The course provides insight into the interdisciplinary field of neural microsensors and actuators relying on the recent advances in both material- and neuroscience. Operation principles, and technological challenges will be addressed through real applications.

Applied Immunology

P-ITMED-0024

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Falus András Géza

Course Description:

The practical applications of immunology- immune biotechnology, vaccination, flow cytometry, immunopharmacology, immunogenomics, cytofluorimetry, monoclonal antibodies- therapeutic antibodies, immune constructs, and immune databases.

Applied Systems Biology

P-ITBIO-0051

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	4/ 0 /0 hours/week
Course credit	4 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Csikász-Nagy Attila István

Course Description:

The goal of this course is to highlight recent results in systems biology-oriented applications. Local and guest lecturers will present the basic concepts and advanced research topics in key directions of systems biology. Discussed topics include: biological networks, network motifs, stochastic simulations, logical modelling, whole-cell models, metabolic networks, circadian rhythms, riboswitches, cancer, and others.

Basic Image Processing Algorithms

P-ITJEL-0014

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Benedek Csaba

Course Description:

The course aims to give an introduction to the basic algorithms used in digital image processing and computer vision. The lectures in the first part of the semester cover various topics from the classical image processing era, such as image representation, 2D convolutions, image enhancement and recovery, texture analysis and Fourier space-based image filtering. The second part of the course is dedicated to more recent tools, including Meanshift and Markov Random Field segmentation models, extraction and utilization of SIFT, HOG and BLP descriptors, and the basics of using machine learning approaches for image recognition problems. For attending this course, no prior knowledge of image processing or computer vision is assumed. However, the participating students need to have a good programming background, and experience with different data structures, linear algebra, vector calculus, and the basics of signal processing.

Basics of .NET Programming

P-ITSZT-0009

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 0 /3 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Tornai Kálmán

Course Description:

.NET Core is a new open-source, general-purpose development framework of Microsoft for building cross-platform applications. With .NET Core, you can develop applications for Windows, Linux, or macOS. It is the cross-platform successor to the .NET Framework.

The class gives a practical introduction to .NET Core development.

Basics of Hungarian Language

P-ITPRE-0018/A

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 4 /0 hours/week
Course credit	4 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton

Course Description:

Absolute beginner course for students to let them introduce to basic Hungarian. The vocabulary and grammar are appropriate to level A.1. Students will be able to read and understand simple sentences, and they can also form questions and answers. At the end of the semester, they can talk about themselves, their family, and their country, and they can also express themselves in simple, everyday situations such as shopping, restaurants, etc.

Basics of Mobile Application Development

P-ITJEL-0015

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 0 /3 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Tornai Kálmán

Course Description:

The aims of the course are to introduce the development of applications on common mobile platforms, furthermore to provide basic knowledge about mobile platforms. The course is augmented by platform-specific courses, which are planned for the next semester. The students may experience the basic problems of software ergonomics, they can learn the appropriate solutions and also can follow the techniques of handling the new peripheries the current and forthcoming mobile devices.

Basics of Neurobiology

P-ITBIO-0013

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 2 /0 hours/week
Course credit	6 credits
Final evaluation	Exam
Responsible lecturer	Dr. Freund Tamás

Course Description:

Understanding the structure and function of the nervous system at molecular, cellular and macroscopic levels.

Basics of Software Testing

P-ITSZT-0029

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Oláh András

Course Description:

Software testing is an essential part of the software development process. The International Software Testing Board (ISTQB) created the standard of software testing. The goal of the course is to let the students learn the basics of this standard.

Bioanalytics and Molecular Diagnostics

P-ITMED-0029

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Pongor Csaba
Comment	course availability to be confirmed

Course Description:

Aim of the course is to learn the basic principles of MEMS design and fabrication, familiarize with different biomedical MEMS devices and drug delivery systems. The students will get aquinted with the following topic: Introduction to BioMEMS, Soft microfabrication, Microfabrication (Si based), MEMS design and fabrication, Microfluidics, Clinical laboratory medicine, Sensor principles and microsensors, Microactuators and drug delivery, Lab-on-a-chip systems and microTAS, Genomics and DNA arrays, Proteomics and protein arrays, biosensors, immuno-isolation capsules, stents, microneedle arrays, micropumps and such applications, Biocompatibility, surface treatment methods, MEMS packaging, polymer based drug delivery, MEMS based drug delivery.

Bio- and Drug Delivery MEMS

P-ITEEA-0024

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 1 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Iván Kristóf

Course Description:

Aim of the course is to learn the basic principles of MEMS design and fabrication, familiarize with different biomedical MEMS devices and drug delivery systems. The students will get aquinted with the following topic: Introduction to BioMEMS, Soft microfabrication, Microfabrication (Si based), MEMS design and fabrication, Microfluidics, Clinical laboratory medicine, Sensor principles and microsensors, Microactuators and drug delivery, Lab-on-a-chip systems and microTAS, Genomics and DNA arrays, Proteomics and protein arrays, biosensors, immuno-isolation capsules, stents, microneedle arrays, micropumps and such applications, Biocompatibility, surface treatment methods, MEMS packaging, polymer based drug delivery, MEMS based drug delivery.

Biomedical Innovation for the 21st Century: Introduction to Bionics

P-ITBIO-0043

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Laki András József
Comment	course availability to be confirmed

Course Description:

The aim of the course is to represent the main bionics research fields. During this course, each week laboratory leaders and experts of the research fields will represent the novelties and their recent results. This course is suggested to students who are interested in research in the field of bionics. The constantly evolving bioinformatics discipline requires new knowledge in the medical specialities. For that reason, a new platform in medical and engineering education is needed to earn this interdisciplinary knowledge. Bionics or biologically inspired engineering is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology. This is a multidisciplinary field that brings together researchers with backgrounds in engineering, biology, medicine, and chemistry to build tissue-like constructs for patient treatment or research. In this highly multidisciplinary seminar, we want to provide a new platform where medical doctors and biomedical engineers can show the inventions of modern area and take new questions for advancement in their research field.

Biomedical Signal Processing

P-ITJEL-0024

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	4 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Gyöngy Miklós

Course Description:

Basic techniques in signal processing that are relevant for biomedical signals, with an illustration of the use of these techniques. Throughout the lectures, the following topics are encountered: biomedical signal genesis; signal representation; signal decomposition; source separation; AR estimation; Fourier analysis; frequency-time analysis; wavelets; sparse decomposition; data fusion; classification; non-stationary signals. Examples of signal modalities we will consider: pulse oximetry, phonocardiography, ECG, EEG.

Biometrics in Person Identification

P-ITJEL-0041

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Koller Miklós
Comment	course availability to be confirmed

Course Description:

The course gives an overview of various biometrical identification methodologies and existing systems based using computer vision tools. The introduced techniques provide great opportunities in the fields of surveillance systems and intelligent multimedia equipment.

Bionanotechnology

P-ITFIZ-0012

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Beke-Somfai Tamás
Comment	course availability to be confirmed

Course Description:

The course aims at providing advanced knowledge in the following subjects: - design, investigation and application of self-assembling systems - methods for cargo transport in biological systems - principles of molecular delivery through biomembranes - molecular design for enyzme catalysis - principles and applications of directed evolution techniques - applications of molecular recognition in medical diagnostics - design and application of biocompatible nanomaterials.

Biophotonics

P-ITJEL-0059

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Pongor Csaba
Comment	course availability to be confirmed

Course Description:

n/a

Biostatistics

P-ITMAT-0023

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Juhász János

Course Description:

The aim of the course is to understand the basics needed to understand and manage random fluctuations in natural phenomena. Introduction of the methodology of evaluation of research and measurement results. Acquire the knowledge needed to understand the scientific literature.

Brain Therapy Technologies

P-ITMED-0026

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 1 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Hillier Dániel
Comment	course availability to be confirmed

Course Description:

Therapy of brain diseases remains one of the greatest challenges of the century. Success will build on wide-interdisciplinarity ranging from computer science, engineering, medicine and molecular biology. This course offers a first glimpse into the field and offers small group work setting to get a practical experience.

Business English

P-ITANG-0008

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 2 /0 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton

Course Description:

The course will give an insight into the business world where English is used as a means of communication. Through topic-specific units, case studies, interviews, role plays, etc. the students are offered up-to-date information on how this environment works, what issues they might face in case they work in an international milieu. The course book, Business Result Advanced, provides very high-level language practice which can be challenging for students with good C1-level knowledge as well.

Cell Technology

P-ITMED-0027

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Garay Tamás Márton

Course Description:

The course is divided into two parts:

1) Cell biology – summary and intensification of cell biology knowledge with special emphasis on cell physiology;

2) Cell technology – theoretical knowledge in preclinical (cancer) research: how to use (cancer) cells as a model system in vitro and in vivo experiments.

Chemical Biology

P-ITBIO-0045

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	1/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Gáspári Zoltán

Course Description:

Chemical aspects of biological processes. Proteins and biopolymers, post-translational modifications. Intrinsically disordered proteins. Chemical aspects of protein synthesis in the laboratory and the cell. Internal dynamics of proteins and their significance, basic concepts in protein NMR spectroscopy. Chromatin organization and introduction to epigenetics.

Combinatorial Methods

P-ITMAT-0033

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Ács Bernadett

Course Description:

The course covers the following topics: Interval systems; Graph coloring, sequential algorithms; Classes of perfect graphs; Maximum and stable matchings in bipartite graphs; List coloring, kernel method; Large cuts in graphs; Greedy algorithm; probabilistic method; Dynamic programming algorithms; Balanced incomplete block designs, finite geometries; Extremal problems; forwarding index; Factorization, decomposition.

Computer Controlled Systems

P-ITJEL-0042

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szederkényi Gábor

Course Description:

The course covers the following topics:Models of continuous time linear time invariant (CT-LTI) systems (higher order linear differential equations, transfer function, impulse response function, state space model); Controllability and observability of CT-LTI systems; Joint controllability and observability of CT-LTI systems: minimality, irreducibility, system decomposition; Stability of CT-LTI systems (notion of stability in the general nonlinear case, Lyapunov function, Lyapunov theorem, BIBO stability, asymptotic stability of CT-LTI systems, Lyapunov theorem for CT-LTI systems); Transfer functions in the frequency domain (gain, phase), Bode and Nyquist diagrams, different interconnections of SISO CT-LTI systems, minimum phase systems; Basic control of CT-LTI systems: control goals, system inversion (and its problems), the notion and types of feedback, the role of the integrator in a control loop, PID controllers; Pole placement control design; State observer design for CT-LTI systems, the separation principle; Linear Quadratic Regulator (LQR); Sampling and discretization of CT-LTI systems, description of discrete time lineartime invariant (DT-LTI) systems (state space model, pulse transfer operator); Controllability, reachability and observability of DT-LTI systems; Stability of DT-LTI systems: stability of the solutions of DT state equations, asymptotic stability of DT-LTI systems, Lyapunov theorem for DT-LTI systems; DT LQR controller, deadbeat control, DT state estimation; DT stochastic models, Kalman filter.

Data Analysis in Molecular Diagnostics

P-ITMED-0012

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Ligeti Balázs
Comment	course availability to be confirmed

Course Description:

Advanced course in Bioinformatics. The course aims to provide deeper and hands-on knowledge in the fields of bioinformatics working with big data, especially dealing with large-scale sequencing data. DNA sequencing, covering the topics of metagenomics, exome sequencing, RNA-seq, etc. Algorithms and statistical methods to gain novel information on biological data such as NGS algorithms (BWT, FM-index). Modern data representations and frameworks (i.e. network analysis docker containers, working in HPC environment, SPARK). Understanding and designing capability of complex pipelines. Modern machine learning algorithms in biology (CART, LASSO, T-SNE, PCA, permanova). R and Python data science platforms. Data visualizations.

Data Analytics in Sports and Rehabilitation

P-ITEEA-0050

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Grand László
Comment	course availability to be confirmed

Course Description:

The course covers the data analytics methods mostly used in sports and rehabilitation, ranging from statistical analysis to cutting edge machine learning and deep learning algorithms. We provide an introduction to the sensor technologies applied in this field. We also overview the gross human muscular anatomy, heart, and vascular anatomy and physiology. We will discuss sport-specific data analytics strategies, techniques, and challenges. The acquired methods could be useful in other fields, where time series and complex network dynamics analytics or modeling play significant roles.

Data Compression Methods

P-ITPRO-0002

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 0 /2 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Feldhoffer Gergely
Comment	course availability to be confirmed

Course Description:

Compression algorithms and implementation for general-purpose lossless compressors and lossy multimedia compressors for audio, image, and video.

Data Mining and Machine Learning

P-ITSZT-0053

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Lukács Gergely István

Course Description:

This course covers the following fundamentals of data mining:

1. Input and output of data mining process;
2. Task types (e.g., clustering, classification, numeric prediction, association rule mining);
3. Evaluation;
4. Selected algorithms;
5. Pre-processing and post-processing;
6. Ensemble learning methods.

Data Visualization in Bioinformatics and Systems Biology

P-ITJEL-0057

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 0 /1 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Pongor Sándor
Comment	course availability to be confirmed

Course Description:

Presenting measured data and complex results emerges as a specific new problem in the life sciences. How can we design effective pictures from our numeric or textual data? How can we compact millions of data points into a pattern or trend presentable in a single picture? This class focuses on biological sequences, genomes, clinical data, metagenomes, gene expressions, molecular 3D data and (brain) networks also touching small molecules such as pharmacons. The goal is to give students knowledge that enables them to choose the right tools and to get acquainted with their advantages and disadvantages.

Database systems II.

P-ITSZT-0057

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	1/ 0 /1 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Lukács Gergely István

Course Description:

The course covers the following topics: Cost-based query optimization; Object-relational databases; Application development with DBMS, incl. object-relational mapping; Data warehousing, ETL and BI tools.

Design Patterns

P-ITSZT-0040

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Reguly István Zoltán

Course Description:

Students will learn about basic programming design patterns, through examples that demonstrate common problems and solutions that offer agility, reliability, and extensibility.

Diagnostic Ultrasound Imaging

P-ITJEL-0025

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	4 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Gyöngy Miklós
Comment	course availability to be confirmed

Course Description:

Understanding the physical basis of diagnostic ultrasound imaging, how conventional (B-mode) and other modes of ultrasound images are formed, what the images represent, and how image quality can be improved using various techniques. In addition to presenting the current understanding of ultrasound image formation, areas of active research will be highlighted.

Drug Delivery Systems

P-ITMED-0019

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	3/ 0 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Antal István

Course Description:

The subject is recommended for students interested in the areas of pharmaceutical development related to the formulation of dosage forms and medicinal preparations. Drug Delivery Systems can be defined as carrier systems for the desired application route of the dosage forms using the principles of optimized pharmacokinetics, as well as improving the effectiveness and tolerability with less side effects. The subject is focusing on the relationships between the pharmaceutical dosage forms and the fate of the drug in the body, the time course of drug action and intensity and the physicochemical properties of the drug as well as the dosage form.

Electromagnetic Metamaterials and Applications

P-ITFIZ-0010

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	4/ 0 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szabó Zsolt
Comment	course availability to be confirmed

Course Description:

The goal of these lectures is to introduce the topic of electromagnetic wave interaction with artificial electromagnetic structures (composites, metamaterials and photonic crystals) to engineering students. After explaining the physical foundations, the commonly used electromagnetic structures are described; and some devices, which utilize artificial structures from mm to nm scales are presented.

Embedded Electronic Systems

P-ITEEA-0045

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Zarándy Ákos

Course Description:

We have witnessed a proliferation of embedded systems in recent years. Their importance is increasing as their use is becoming widespread. They are used for communication, and collecting environmental parameters, and they make our devices smart. The Internet of Things (IoT), Cyber Physical Systems, Industry 4, are all based on embedded electrical systems. The objective of the course is to provide an understanding of the design concepts, architecture as well as basic components of embedded electronic systems. This course covers the description of the main electronic components of communicating and sensing embedded devices and their fundamental design principles. It introduces the critical aspects of implementation through examples from software, hardware, and system points of view. Upon successful completion of the course, the students should be able to understand the main engineering issues of modern embedded devices. Moreover, they will be able to use these devices to solve practical problems. A further objective of the course is to provide an opportunity for students with relevant ambitions to join international research projects in this area.

English for Academic Purposes

P-ITANG-0009

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton

Course Description:

Pursuing either BSc or MSc studies at PPKE ITK requires at least an overall 6.5 IELTS English level. Those who have already been admitted to the university but have not proved their knowledge at this level are required to take part in this course. The course will prepare students for the 6.5 or higher IELTS Academic examination level. As all skills of IELTS, reading, writing, speaking, and listening are vital in academic life the course tries to focus on all of them in a balanced way. Mock examinations, role plays, and test exercises in an academic environment make sure that the applicants can successfully acquire the required skills and pass the internal exam with an appropriate result.

English for Academic Purposes II.

P-ITANG-0011

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton

Course Description:

The English for Academic Purposes II class is an intensive analysis of the principles of excellent academic writing for Scientists preparing a range of texts including research papers, conference proposals, conference posters, book chapters, technical reports, and dissertations, as well as delivering effective presentations. Class discussion focuses on the central role of rhetorical positioning in the development of a clear, interesting, and rigorous science research paper. We talk about the significance of narrowing the problem space, the construction of logical arguments, the reporting and interpretation of data, as well as other important concepts including reader-oriented writing, genre, precision, tone, and strategies useful for redrafting and editing. Some of the sub-genres we analyze and practice include introductions, data commentaries, results/discussions, conclusions, and abstracts.

English for Erasmus Purposes

P-ITANG-0006

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 2 /0 hours/week
Course credit	0 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton
Comment	course availability to be confirmed

Course Description:

The course intends to provide assistance to students who wish to study in an English speaking higher educational institution via the Erasmus program. The course would like to prepare students for the situations in the academic environment they will face and also for the tasks and assignments they need to complete to fulfill the requirements of the host university. The curriculum will provide opportunities to practice reading comprehension, academic writing, presentation, and conversational skills in an academic environment.

Enrichment Analysis

P-ITOBA-0100

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csikász-Nagy Attila István
Comment	course availability to be confirmed

Course Description:

Introduction of the two most frequently applied approaches to locate the common features of large gene lists.

Main topics:

- Enrichment analysis: an overview
- Over-representation Analysis
- Gene Set Enrichment Analysis

FPGA-based Algorithm Design

P-ITEEA-0014

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Nagy Zoltán

Course Description:

The aim of the course is an introduction to the design of digital circuits using VHDL language to implement complex applications. Students will gain experience in modeling digital circuits using VHDL. Main topics covered: Register Transfer Level (RTL) description, simulation, implementation of the circuit on FPGA, testing and optimization of the designed circuits.

Functional Analysis

P-ITMAT-0025

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Gerencsérné Dr. Vágó Zsuzsanna

Course Description:

Metric spaces, Normed spaces, Inner product spaces. Basic: sequence- and function spaces. The topology of metric spaces. Open, closed, and compact sets. Completeness. Measure and integration. Riemann and Lebesue integral. Lebesgue Lp spaces. Fourier analysis in Hilbert space. An introduction to Abstract linear operator theory.

Genomics, Transcriptomics and Proteomics

P-ITOBA-0050

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	1/ 4 /0 hours/week
Course credit	5 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Csikász-Nagy Attila
Comment	course availability to be confirmed

Course Description:

Familiarity with Internet sources for genome-wide data; basic skills in using tools at these websites; understanding how modern high-throughput methods generate sequence data and gene and protein expression data; the practical skill of using genome browsers to access genome data and genome comparison data; understanding gene prediction and genome annotation pipelines; skill of performing individual gene predictions; understanding different levels of variation in human genomes; understanding basic workflows of microarray data analysis and next-generation sequencing data analysis; basic knowledge of experimental methods in proteomics and metabolomics which enables understanding data analysis in these fields; skill of identifying proteins frommass spectroscopic data.

Heatmaps for Analyzing Gene Expression Data

P-ITOBA-0110

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csikász-Nagy Attila
Comment	course availability to be confirmed

Course Description:

Introduction of the frequently applied approaches to create heatmap plots from gene expression data using online and local software tools.

Main topics:

- Theoretical background of heatmap analysis
- Methodological overview including statistics and software aspects
- Practice with the heatmap tool at Gene Expression Omnibus
- Optional practice: How to create heatmaps with R?

High-level synthesis methods on FPGA-s

P-ITEEA-0016

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Nagy Zoltán

Course Description:

Digital circuits are traditionally designed using specialized hardware description languages like VHDL and Verilog at the Register Transfer Level (RTL). The increasing complexity of today's digital systems requires more efficient accessible design methodologies. High-Level Synthesis (HLS) methods have been an active research area since the 1980's and finally matured to use in industrial applications. Unlike traditional VHDL-based design flows the input of a HLS synthesis system is a standard ANSI C/C++ description and the structure of the synthesized architecture can be defined using compiler directives. By changing the directives less design effort and much shorter time is required to generate several different architectures for the same algorithm. Area, speed, power dissipation, and memory bandwidth parameters of the different solutions can be compared during design space exploration and the best one can be selected for a particular implementation.

Human Physiology I.

P-ITMED-0002

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	3/ 0 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Enyedi Péter

Course Description:

Cell biology background of physiological functions of the human body (electrophysiological background of the function/activity of excitable tissues) differences and similarities of different muscle types. Organization and function of the cardiovascular system. The respiratory system, ventilation, and gas exchange. Regulation of circulation and respiration based on the knowledge of the autonomic nervous system. Understanding the composition of the body fluids by focusing on the blood (significance of soluble and cellular components including defense reactions and hemostasis).

Human Physiology II.

P-ITMED-0003

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 0 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Enyedi Péter

Course Description:

The function of the kidneys, urine formation, regulation of the body fluid volume and osmotic parameters. Acid-base balance. The function of the gastrointestinal tract, energy metabolism, and regulation of the body temperature. Endocrine regulation of physiological processes, the hypothalamo-hypophyseal unit; the adrenal, thyroid glands, calcium metabolism together with bone physiology. Organization of the nervous system, and regulation of motor function. The somatosensory system. Sensory organs vision, hearing taste, and smell.

Hungarian and European Civilization and Culture

P-ITMUV-0019

Recommended level of study	BSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton

Course Description:

The course will provide information on the basic values and trends of the European Civilization and Culture to students from mainly a non-European background at Pázmány Catholic University. The topics cover the main cultural and historical events of the two European millennia that formed the continent as it is now. The course also intends to offer an insight into the history of Hungary from a Catholic perspective. The students are also required to prepare a 10-15-minute presentation on a previously chosen topic from European or Hungarian history or culture to prove they are able to research and understand the given topic in a broader context.

Hungarian Language Course

P-ITANG-0010

Recommended level of study	BSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton

Course Description:

This course is a post-beginner introduction to the Hungarian language. The course will provide students with the basic skills in reading, writing, and speaking in Hungarian at a post-beginner level. By the end of the course, students will be able to carry out basic conversations in a variety of everyday situations, both formal and informal. In addition to classroom meetings, we will have a scheduled field trip during the semester in Budapest. During this field trip, students will have a unique opportunity to practice Hungarian in a native environment and communicate in a broad range of everyday situations with locals.

Infocommunication Systems

P-ITTAV-0004

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Zarándy Ákos

Course Description:

The course covers the following topics: Introduction to info-communication systems; Wireline transmission systems (twisted pair, coaxial, fiber); Radio transmission systems (terrestrial, cellular, satellite); Coding, multiplexing and switching systems; Network structures PSTN networks, core networks; Mobile networks; Broadcasting systems; Private networks, indoor networks, Infocom services; IPTV, ADSL, Terminals, regulation of Infocom services; ADSL systems, radio-based data communication systems; Summary, Next generations of info-communication services.

Integrated Structural Bioinformatics

P-ITBIO-0028

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 0 /2 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Gáspári Zoltán

Course Description:

Structural representations of macromolecular structures, the Protein Data Bank and the PDB file format. Quality assessment of experimentally solved macromolecular structures. Assignment of secondary structural elements in 3D structures.Detection of domains. Algorithms for 3D structure comparison and alignment, structural classification databases. Predicting protein function from structure, identifying functionally important residues and contacts. Introduction to protein structure prediction methods, from '1D' to full 3D predictions. Basics of protein: ligand docking. Inclusion of internal dynamics in structural representations. Principles of protein design.

Integration of Information Systems

P-MIM_D26

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csapodi Márton

Course Description:

The course deals with the standards and methodology of integration, middleware, and intelligent CASE tools supporting different levels of integration.

Introduction to Artificial Intelligence

P-ITSZT-0022

Recommended level of study	BSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Karacs Kristóf

Course Description:

Introduction: (Embedded) intelligent system and its environment. Intelligent agents. Formalization of problem-solving. Informed and uninformed search. Knowledge, representation, conclusion - universal issues. Logical knowledge-representation. Propositional calculus. Predicate calculus. Situation calculus. Building knowledge-representations. Representation of uncertain knowledge. Modelling uncertainty with fuzzy logic. Planning. Learning agent. Learning. Conclusion.

Introduction to Bioinformatics

P-ITBIO-0009

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Pongor Sándor

Course Description:

The course is a theoretical and practical introduction to bioinformatics. During the course, we cover the theoretical basics and some important applications of computer use in biology concentrating on the analysis of DNA and protein sequences. We discuss the basic concepts of bioinformatics (e.g.: similarity, proximity measures, data aggregation, and projection), alignment techniques (local, global, pairwise, multiple), similarity searching (BLAST), and evolution (phylogenetics). We learn to use some important databases of bioinformatics (e.g.: NCBI services). Finally, we get familiar with the core concepts and some typical computational tasks (e.g.: assembly, annotation, variant calling) and workflows connecting to NGS and functional genomics.

Introduction to Functional Neurobiology

P-ITBIO-0037

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	3/ 2 /0 hours/week
Course credit	6 credits
Final evaluation	Exam
Responsible lecturer	Dr. Freund Tamás

Course Description:

The main objective of the course is to understand the structural and functional concepts characterising neuronal networks. The course covers the following topics: Membrane characteristics of neurons. The action potential. The synaptic transmission. Synaptic plasticity. Techniques applied in electrophysiology. Motor control by the spinal cord: reflexes and locomotion. Descending supraspinal motor control. Voluntary and involuntary movements. Role of the cerebellum in motor coordination. Brain-machine interfaces. Receptors in the olphactory epithelium. Neuronal networks and function of the olphactory bulb. Structure of retina. Visual information processing in the retina, thalamus, and the visual cortex (demonstration of electrophysiological recordings from the visual cortex). The receptive field. Detection of movement, colour and contour. Function of the auditory cortex (demonstration of electrophysiological recordings from the auditory cortex). Thalamocortical neuronal networks. Information processing in the thalamus. EEG. Neuronal connections of the hippocampus. Neuronal communication in the hippocampus. Role of the principal neurons and the inhibitory interneurons. Feedback and feed-forward inhibition. Theta activity: mechanism and function. The binding problem: role of gamma oscillation. Molecular mechanism of memory. Learning at cellular and network levels. Behavioural aspects of learning and memory. Computational modelling of neuronal networks. Localization of cognitive processes in the brain. Functional brain mapping. Functional imaging methods (video demonstration of functional imaging techniques; PET, fMRI). Symptoms of neurological diseases. Pathomechanism of epilepsy. Anxiety and depression. Neurosurgery. The hypothalamic-hypophyseal-peripheral gland system. The magno- and parvocellular system. Regulation of adaptation and metabolism. Neurobiology of reproduction.

Introduction to Lab-on-a-chip Devices

P-ITLAB-0045

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Laki András József

Course Description:

The course covers the following topics:

Introduction to Lab-on-a-chip devices;

Hard fabrication I. II. III. ;

Soft fabrication;

Microfluidic principles I. II. III;

Practice.

Introduction to Nanotechnology

P-ITFIZ-0004

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 0 /0 hours/week
Course credit	1 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csaba György

Course Description:

The class is intended to give you a survey of Nanotechnology and Nanoelectronics, fields that may lead to major engineering breakthroughs in the 21st century. The origins of Nanotechnology go back to the drive to miniaturize electronic integrated circuits, so in the first half of the class we will cover microelectronic fabrication and characterization technologies, to understand how atomic-scale structures can be built and characterized and what is the new physics that appears on nanoscale. Then we switch gears and survey all (or at least most) disciplines where nanotechnology makes or is expected to make an impact.

Introduction to Startup Innovation

P-ITKOZ-0010

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Iván Kristóf

Course Description:

The direct purpose of the course is to create the foundations of an innovation ecosystem which supports the market translation of research in the areas related to topics of our faculty. This will enable the students and researchers of the faculty to work in an inspirational environment allowing them, in a sustainable and motivating way, to deploy their creative idea successfully. This is achieved by acquiring themost relevant business and soft skills necessary to succeed in the technological development inducing, competitive world of startups today.

Java Programming for Bionics

P-ITOBA-0130

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 3 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Gáspári Zoltán

Course Description:

Introduction to the Java programming langauge.

Main topics:

- Basics of object-oriented programming in Java
- Classes, interfaces, inheritance, function overloading
- Basics of file input/output
- Basics of GUI programming
- Concept of threading in Java
- Use of external APIs to solve bioinformatics-related tasks

Machine Learning

P-ITSZT-0041

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Karacs Kristóf

Course Description:

Data preprocessing, attribute selection, Supervised learning, Regression analysis, classification, linear models, distance metrics, prototype based methods, naive Bayes, kernel methods, evaluation, performance measures, unsupervised, clustering, dimensionality reduction, latent variable models, graphical models, reinforcement learning, expectation maximization, ensemble techniques, static, dynamic, stochastic methods (MoE, RBM), end to end learning, deep belief networks.

Methods in Laboratory Diagnostics

P-ITMED-0021

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Vásárhelyi Barna

Course Description:

Laboratory results form the basis of up to 70% of clinical decision making. The ordering and evaluation of laboratoryresults has a strong impact on the standard of clinical care. Basic knowledge regarding most common factorsinfluencing the precision and accuracy of laboratory results is essential bothfor clinicians and for patients. The aim of the course is to provide generalinformation on these issues and to give basic milestones to be adhered when the students are planning studies applying laboratory methods.

Microbiology in Healthcare and Food Industry

P-ITBIO-0047

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szabó Dóra

Course Description:

During the course, students will get information about general microbiology and especially about microbes being responsible for human diseases.

The medical microbiology include the microbiological diagnosis (identification of bacteria, viruses, fungi and parasites causing diseases), the causative treatment (application of the active drugs, drug resistance and its detection and drug discovery), the methods of prevention and immunization.

In connection with food-borne microbiology, food-mediated bacterial, viral and parasitic infections and their detection will be discussed as well.

The human normal microflora and its role will be also detailed in the course.

Modelling Neurons and Networks

P-ITBIO-0040

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kalló Imre

Course Description:

Mathematical models and computer simulations have become indispensable tools in neurobiological research, providing quantitative links between data collected using disparate experimental techniques, and even between different levels of description. The course introduces the basic methods employed in the biophysically realistic modeling of single neurons and networks, provides hands-on experience with some of the most commonly used software tools, and demonstrates through examples several fundamental principles of neural information processing.

Molecular Biology

P-ITBIO-0046

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	4/ 0 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csala Miklós

Course Description:

The storage, maintenance, and expression of genetic information, as well as their molecular mechanisms, are fundamental topics of the course. DNA replication, DNA damage and repair, RNA synthesis and processing, protein synthesis, maturation and targeting, and different ways of regulating gene expression are discussed. Regulation of cell cycle and apoptosis, in the light of the molecular background of tumor development, is also part of the subject. Some of the lectures provide insights into molecular biology research.

Further information: https://semmelweis.hu/molekularis-biologia/en/students/med-biotech-msc/

Molecular Genetics, Genomics, Sytems Biology

P-ITMED-0015

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Tamási Viola

Course Description:

During the semester the students will learn the basics of genetics and genomics as well. They will gain knowledge of how the genome is organized, what annotation means, what was the HGP project, what we know about chromosomes, mutations, epigenetic regulation mechanisms, the role of the genome in medicine. They will learn parallel techniques to each topic; both analysis on genetic or genomic level.

Molecular Pathology

P-ITMED-0007

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	1/ 0 /1 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Timár József

Course Description:

The course covers the following topics:

1. Cell society – stem cells - major tasks for regulation: proliferation and death to maintain different specific activities – metabolism for energy;
2. Main methods: immunohistochemistry, PCR-based techniques, NGS, liquid biopsy, meta-analysis;
3. Signalling pathways (ligands, receptors) – feed-back – mutation;
4. Epigenetics – splicing – non-coding RNA;
5. Carcinogenesis – oncogene – clonal selection;
6. Local invasion - road to distant metastasis (epithelial-mesenchymal-transition) – fen-expression;
7. Gene expression (primary vs secondary) – dormant cells;
8. (Onco)hematology;
9. Intra- et inter-heterogeneity – organ cancers;
10. Targeted therapy (concept and reality) – driver genes;
11. Resistande – synthetic lethality – DNA repair;
12. Noncancer;
13. Ethics in publications – how to digest information;
14. Consultation. Molecular Laboratories to visit: SE II Inst Pathol, Oncompass.

Molecular Targets in Tumor Therapy

P-ITMED-0016

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Keszler Gergely

Course Description:

Currently, malignancies are the second most frequent cause of death in Hungary. Several genetic, environmental, and lifestyle factors predispose to the development of tumors. The lectures provide up-to-date insights into the (epi)genetics, molecular biology, and metabolism of neoplasias. We review potential molecular targets (enzymes, transporters, and nucleic acids) and molecular mechanisms of action of conventional and targeted anti-tumor chemotherapeutical drugs. The principal goal of the course is to make students familiar with a molecular way of thinking that might be useful in the understanding of the molecular basis of targeted chemotherapy in particular and in the pathogenesis of human diseases in general.

Multimodal Sensor Fusion and Navigation

P-ITEEA-0038

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Horváth András

Course Description:

The main goal of the course is to give an overview of real-time algorithms and architectures used in multi-sensor data fusion and navigation. The focus of the course is multiparallel processing and target tracking. The course introduces estimation theory, the necessary definitions in static, dynamics linear and non-linear cases, and also in discrete and continuous systems. Reveals and explains such generally used algorithms like the Kalman- and Bootstrap filters. Also the limitations and applications of these algorithms in practical problems. The course gives comprehensive knowledge about system-level computations in both top-down and bottom-up design of adaptive algorithmic solutions. Examines the topographic and non-topographic partitioning of data-flows regarding the modern multi-parallel architectures.

Multi-photon Microscopy

P-ITJEL-0044

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Rózsa József Balázs

Course Description:

The course is focusing on how to use a two-photon laser scanning microscope in research. This is a multitask subject when the students are not just learning the theoretical basics of multiphoton microscopy but are also getting some knowledge of the engineering side. Moreover, they have to improve their rhetorical skills (presenting scientific articles) and do some labwork in the Two-photon Laboratory. During the semester the students will learn how a microscope builds up and how to use it in a neurobiological project.

Neural Interfaces and Prostheses

P-ITBIO-0038

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 0 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Ulbert István

Course Description:

In this course, the students will become familiar with the new developments of neural engineering in the field of neuroprosthetic devices that can restore lost neural functions. These devices require direct interfaces with the peripheral and central nervous systems. Some of these devices are already routinely used in clinical practice like cochlear prostheses for restoring hearing, while others are still in the developmental or experimental phase.

Neural Networks

P-ITEEA-0011

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Zarándy Ákos

Course Description:

During this course, students will understand and learn the theory of deep convolutional neural networks, and learn how to design, implement, and train these nets in practice. Students will gain knowledge about the modern feedforward networks for classification, detection, and segmentation, as well as the recurrent networks and dimension reduction techniques.

Neural Sensing and Plasticity

P-ITBIO-0039

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Takács József Miklós

Course Description:

The subject deals with the different forms of neural plasticity in general and in detail the developmental plasticity of different sensory and motor systems and the adult nervous system plasticity. Provides knowledge on the neurobiological background of neural reorganization following injuries from the cellular to the neuronal network levels. The subject might help the students to construct and develop neuro-prosthesis of different kinds (somatosensory, visual, auditory, motor), brain-machine interfaces, and neuro-robotics.

Neuromorph Movement Control

P-ITEEA-0043

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Laczkó József

Course Description:

Solving direct (forward) and inverse kinematic problems of multi-joint systems. Optimization in the neural control of movements - minimal jerk, minimal energy, minimal torque change models. Geometric and material and neuro-mechanical muscle characteristics. Electromyography. Redundancy of the motor system. Variances in movement execution, controlled and uncontrolled manifolds. Muscle- and joint synergies. Sensory-motor transformations, high dimensional biological coordinate systems. Dimension reduction methods, non-negative matrix factorization, principal component analysis, and their application in control of human-machine interfaces. Body-machine interface. Motor impairments and medical rehabilitation. Application of functional electrical neuro-muscular stimulation.

Neurophysiological Data Analysis

P-ITBIO-0044

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Ulbert István

Course Description:

The course covers the most significant mathematical data analysis methods which are useful for understanding the neurophysiological processes and allows the extraction of more information from the measurements. We will start with the traditional ones but will reach the most advanced contemporary methods, while open questions of the field will be discussed as well. Although our guiding lines will be the analysis of the electrophysiological signals, the learned techniques will be applicable in principle to all branches of science and not only science but everywhere, where the aim is to reveal the structure and function of a complex system.

Nonlinear Dynamical Systems

P-ITEEA-0037

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 2 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Garay Barnabás

Course Description:

Content of the course: Basic concepts of the theory of continuous time and discrete time dynamical systems (induced by ordinary differential equations and continuous mappings, respectively): well-posedness of problems in differential equations, linearization near hyperbolic equilibria, stability and attraction for compact invariant sets, structural stability and bifurcations, chaos and fractals with indicators and applications, synchronization between two chaotic Chua circuits, elements of time-series analysis. The objective of the course: Dynamical systems as a basic model for describing spatiotemporal processes, their numerics, and related computer exercises. In addition to basic concepts of nonlinear dynamics, the emphasis is laid on error estimates between exact and approximate solutions, on the preservation of qualitative properties of the dynamics by numerical approximations as well as on developing a critical attitude to results provided by the computer.

Numerical Analysis I.

P-ITMAT-0036

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kovács Mihály

Course Description:

The purpose of the course is to give an introduction to selected modern topics in numerical analysis. Upon completion of the course, the students will have a basic understanding of various numerical methods; both theory and practice. The students will be able to write computer code for the algorithms they study and solve practical problems with them.

Numerical Analysis II.

P-ITMAT-0031

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kovács Mihály

Course Description:

Numerical integration in 1D, simple quadrature rules, Euler's method and the theta method for ODEs, multistep methods, Runge-Kutta methods, error control: the Milne device and embedded Runge-Kutta methods, numerical methods for stiff problems, finite difference and finite element methods for boundary value problems of elliptic PDEs in 1D and multiple dimensions, the notion of stability and convergence, the finite element method for parabolic and hyperbolic problems in 1D and in multiple dimensions.

Optical Devices and Photonics

P-ITEEA-0051

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 1 /1 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csaba György

Course Description:

The class gives an introduction to classical (electromagnetic) optics, while the second half of the semester is devoted to photonics, quantum optics, and the quantum theory of light. Optical devices are described by various models. Lab exercises contain problem-solving and several hours of experiments using a Michelson interferometer.

Optimalization Methods

P-ITMAT-0032

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Ruszinkó Miklós

Course Description:

No doubt that artificial intelligence, combined with deep learning, is one of the most rapidly developing areas in computer science. On the other hand, optimization methods used, e.g., the gradient method have been well known for decades. Still, the theoretical background of this discipline is not well explored. During this course, we will introduce some classical optimization methods and point out their relevance in artificial intelligence.

Parallel Computing Architectures

P-ITEEA-0022

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szolgay Péter

Course Description:

Computing models Basics of computer architectures, physical limits. Neuman architecture, Harvard architecture, integration of sensors. Digital signal processors - fixed point implementations; floating point architectures Fast buses and processing, SCSI processors, FPGA-based processor implementations, Parallel processor architectures, and instruction types of parallel processing. Instruction Level Parallel processors, Pipeline processors, Design case study - Design of an emulated digital CNN chip Data-parallel processors Structure of a cell processor Systolic architectures Vector architectures MIMD architectures.

Parallel Programming

P-ITSZT-0048

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 0 /3 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Reguly István

Course Description:

Students will learn about parallel hardware and parallel programming methods, including shared memory parallelism and distributed memory parallelism on traditional CPUs, and programming graphical processing units (GPUs).

Parameter Estimation

P-ITMAT-0026

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szederkényi Gábor

Course Description:

The course covers the following topics: Introduction and revision (probability distributions, system representations, stochastic models, linear models); Linear regression and its properties; Predictive models, prediction error minimization, parameter estimation based on least squares; Maximum likelihood method, Cramer-Rao inequality; Recursive estimation methods; The instrumental variable method; Bayesian parameter estimation; Optimization-based estimation of nonlinear models (gradient method, simplex method, etc.); Identifiability and distinguishability; State estimators for parameter estimation; Practical implementation, application examples.

Personal Navigation

P-ITEEA-0042

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Karacs Kristóf

Course Description:

The course covers the following topics:

- Navigation systems: global and local navigation;
- Objectives: scientific and social aspects;
- System requirements for different application areas;
- Implementation platforms;
- A case study: bionic eyeglasses;
- Scene perception and classification;
- Object and object primitive detection, Noise filtering;
- Feature extraction methods;
- Clustering and classification methods;
- Optical flow;
- Object tracking;
- Visual semantics and knowledge representation;
- Learning and adaptation.

Pharmacology

P-ITMED-0014

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 0 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Tóth Pálné Dr. Gyires Klára

Course Description:

The course covers the following topics:

1. Basic pharmacology: Pharmacodynamics, pharmacokinetics

2. Pharmacology of the autonomic nervous system (sympathetic, parasympathetic)

3. Pharmacology of the central nervous system (sedatohypnotics, anxiolytics, anti-depressive, antipsychotic agents, local, general anesthetics)

4. Cardiovascular pharmacology (pharmacology of ischemic heart disease, hypertension, cardiac failure, diuretics)

5. Pharmacology of endocrinology (adrenals, anticoncipients)

6. Pharmacology of pain and inflammation (opioid, non-opioid analgesics, non-steroidal anti-inflammatory drugs.

7. Pharmacology of gastrointestinal tract (pharmacology of gastric ulcer and inflammatory bowel diseases).

Physical Biology of the Living Cell I.

P-ITMED-0005

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kellermayer Miklós

Course Description:

The course covers the following topics: Qualitative and quantitative modelling in biology; Formation of biological structures; Structural hierarchy of proteins; Stability of biological structures; Experimental methods to study biological structures; Microscopy studies of intracellular structures; Super-resolution microscopy; Dynamic intracellular protein structures; Single-molecule biological activity.

Physical Biology of the Living Cell II.

P-ITMED-0006

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kellermayer Miklós

Course Description:

The course covers the following topics: Diffusion, polymerization, reputation; Motor proteins, processes far from equilibrium; Second law of thermodynamics is small systems, Evans-Searles fluctuation theorem; Crooks fluctuation theorem, Jarzinski equality; Thermodynamics of molecular motors; Microscopy of motor proteins - Laboratory demonstration; Protein structure prediction, use of structural databases; Molecular dynamics modeling; Thermodynamic characterization of protein - protein and protein-ligand interactions.

Physics of Information Technology and Bionics II.

P-ITFIZ-0007

Recommended level of study	BSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 1 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csaba György

Course Description:

The first half of the course will cover wave mechanics, and principles of quantum mechanics. We show key applications of these concepts in chemistry and solid-state physics. Some of the topics we will cover: The Bohr model of the atom. Wave-particle duality of light. Interference and collision. Particle-wave duality of the electron. Louis de Broglie wave. Nature of the matter-wave: complex-valued wave-function with probabilistic interpretation of the absolute square. Particles and waves: the free-particle Schrödinger equation. The Schrödinger Theory of Quantum Mechanics. The time-dependent Schrödinger equation. Quantum Mechanical expectation values. The time-independent Schrödinger equation. Qualitative interpretation of the wave functions. Periodic Table of the Elements. Molecules: the chemical bond. Hueckel theory, modeling molecular systems. Single electron in the electrostatic field of a one-dimensional periodic potential. The one-dimensional approximation: the Kronig-Penney model. Allowed and forbidden energy bands. Intrinsic semiconductors: electrons and holes. Light Amplification by Stimulated Emission of Radiation (LASER). Three-level and four-level lasers. Photodetecting devices and semiconductor lasers. Introduction to quantum electrodynamics (QED) and superconducting quantum circuits. Elements of nuclear physics. Principles of cosmology and extragalactic astronomy.

Printed Circuit Board Design Practice

P-ITEEA-0017

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	1/ 0 /2 hours/week
Course credit	3 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Szolgay Péter
Comment	course availability to be confirmed

Course Description:

This course gives an introduction to the fundamentals of printed circuit board design using computer-aided design tools. Overview of the Printed circuit board design process from high-level design to final output and manufacture of printed circuit boards. Studies will include an introduction to Packaging and Interconnecting Structures, Mechanical, Electrical and Manufacturing design considerations. Students will learn how to interpret a schematic, how to select the appropriate components of the PCB, how to arrange them, and how to export files for manufacturing.

Programming Methodology

P-MIM_T4A

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Feldhoffer Gergely

Course Description:

The course covers the following topics:

Problem and program; Methods and tools for specification; Program description tools and methods; Significance and levels of abstraction; Abstract data types; Programming theorems and their application; Program transformations; Algorithm correctness, proving techniques.

Quality Assurance

P-ITKOZ-0008

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	1/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Vidáné dr. Erdő Franciska

Course Description:

To work according to quality assurance systems is a basic requirement nowadays for appearance and getting a position in the international market. The course gives an overview of the application possibilities of quality assurance (QA) in different fields. The main foci are biotechnology, drug research and development, and the pharmaceutical industry. After a historical introduction, the students receive a wide spectrum of information on the processes of quality assurance, quality control, and quality management.

Quantitative and Medical Biochemistry

P-ITMED-0001

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	3/ 1 /0 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kolev Kraszimir

Course Description:

The course offers a concise overview of the dynamic metabolic networks in the cell focusing on the general principles of enzyme kinetics, structure, and control of metabolic pathways. Aspects are essential for future specialists in Biotechnology are emphasized: modern biochemical techniques in the characterization of intermolecular interactions and enzyme action, and in silico modelling of biochemical processes and systems. Medical orientation is implemented with a discussion of the molecular basis of selected diseases with major public health impact (cardiovascular, neurodegenerative diseases) focusing on the molecular targets of therapy. Students participate in formal lectures, tutorials, and computer-simulated practical lessons.

Quantitative Biology

P-ITBIO-0052

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	2 credits
Final evaluation	Exam
Responsible lecturer	Dr. Csikász-Nagy Attila

Course Description:

The goal of this course is to highlight recent results in systems biology-oriented applications. Local and guest lecturers will present the basic concepts and advanced research topics in key directions of systems biology. Discussed topics include: biological networks, network motifs, stochastic simulations, logical modelling, whole-cell models, metabolic networks, circadian rhythms, riboswitches, cancer, and others.

Quantitative Modelling and Control of Nonlinear Molecular Processes

P-ITJEL-0031

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szederkényi Gábor

Course Description:

The main objective of the course is to emphasize the importance of dynamics and the system theoretic framework in the understanding and control of molecular biological systems. to introduce the basic notions and tools of nonlinear systems and control theory, and analyze the dynamics and control of molecular processes of great importance via case studies. The course covers the following topics: 1. Introduction: Modelling of dynamical phenomena and feedback in molecular dynamical systems. The role of dynamics and control in cells. 2. The system classes applied for the dynamical description and their properties. 3. Fundamental state-space properties of nonlinear systems (stability, local observability, and controllabiliy). 4. Feedback linearization (zero-dynamics, relative degree, SISO-MIMO linearization) 5. Reaction Kinetic Networks I: Assumptions, representations, validity of the model class, biological examples. 6. Reaction Kinetic Networks II: Important relationships between the structure and the qualitative dynamics. 7. Reaction Kinetic Networks III: Search and design of possible reaction kinetic structures according to predefined properties. 8. The basics of enzyme-kinetics in system theoretical framework: Enzymatic regulation mechanisms (competitive/noncompetitive inhibition, product/substrate inhibition), Michaelis-Menten and Hill-kinetics, quasi-steady state assumption and its effect. 9. Quantitative modelling of transcriptional, translational, and protein-interaction processes, gene-regulation networks, and dynamics. 10. Dynamics of regulatory and signaling building blocks in the cell: Positive and negative feedback, saturation, oscillation. 11. G-protein coupled receptors and their kinetical model. Calcium dynamics and connections with electrophysiological models. 12. Molecular model of the glucose-insulin system, the analysis and application of regulation mechanisms. 13. Analysis and design of energy-optimal metabolic pathways.

Recombinant DNA Techniques

P-ITMED-0008

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	3/ 0 /2 hours/week
Course credit	6 credits
Final evaluation	Exam
Responsible lecturer	Dr. Barta Csaba

Course Description:

During the lectures, the students get familiar with the following concepts and examples: The definition of recombinant DNA, genomic, and cDNA libraries. Molecular hybridization techniques. The Human Genome Project. Differences between individual genomes. Gene identification and genome annotation. Polymerase chain reaction and targeted mutagenesis. Gene expression platforms. Cloning into bacteria. Insulin, is the first human recombinant medicine. Transgenic animals and animal cloning. Use of recombinant DNA techniques in the pharmaceutical industry. Human gene therapy. Bioinformatics in recombinant DNA technology. In the practicals, the students perform the following experiments: Preparation of genomic DNA and genotyping by PCR-RFLP, PCR-ASA, and real-time PCR; Isolation and purification of plasmid DNA, restriction mapping; PCR amplification of recombinant DNA fragments and subsequent agarose gel electrophoresis; Protein expression using bacterial cells and in vitro translation systems.

Scientific Python

P-ITSZT-0050

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 0 /2 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Novák Borbála

Course Description:

The goal of the course is to give a brief overview of technologies in Python that allow the handling of scientific/engineering problems effectively. The knowledge acquired can be fruitfully utilized in fields of artificial intelligence, image processing, data mining, natural language processing, mathematical modeling, and bioinformatics.

Scrum Agile Development Methodology

P-MIM_D63

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	0/ 2 /0 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Prószéky Gábor
Comment	course availability to be confirmed

Course Description:

Students interested in agile methods can refresh their methodological knowledge and peek into the reality of agile work through a two-day workshop, a supplementary one-day session, and a remote feedback session. The course is based on real-life examples and allows students to bring in their own ideas and experiences. Starting with an interactive theoretical introduction, students will have a chance to revitalize their knowledge about the core concept of agile development. However, challenging common practices and letting real-life examples speak for themselves are essential for embracing agile methods. Participants can apply previously discussed concepts and experience daily agile work via an intensive sprint simulation of the agile development circle by going through all the relevant steps. The primary goal of the course is to enable participants to easily fit into an agile environment and to gain the necessary insight and courage to introduce agile techniques and processes from scratch in any (start-up and corporate) environment or even to set up and implement their own projects in an agile way.

Sensory Robotics

P-ITEEA-0039

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Cserey György

Course Description:

The course covers the following topics: 1. Introduction – sensors. Motivation and parallelism with biology; sensing categories, proprioception, exteroception, exproprioception; reviewing the history of robotic sensors from the 70s, sensor revolution, state-of-the-art robotics, challenges and future of the sensors; 2. Human sensing and sensors in biology. Mechano-, termo-, and nociceptors; fast-slow adaptation; touch; pain; balancing; vision; visual-tactile-motori mechanisms; hearing; smell and taste; sensing the inner state; special sensors in biology: localization (eg. birds, and salmon), distance measurement (eg. owl, bat, whale); 3. Behaviour-based robotics, introducing behaviour methods in robotics, deliberative and reactive systems, description and coding of behaviours, behaviour design and coordination, and design decisions; 4. Behaviour coordination, emergence, fusion, and synchronization methods of behaviours; 5. Sensor characteristics; basic principles through examples; sensitivity; accuracy; dynamic range; hysteresis; nonlinearity; resolution; environmental factors; special properties; transfer function; approximations; interpolation; calibration; 6. Sensors, general properties: distance measurement sensors, sensors for localization and navigation, impact, touch, pressure and force measurement, temperature and measuring internal state; 7. Sensor arrays and sensor networks, visual perception – machine vision, depth cameras, motion tracking systems; 8. Sensor fusion, the connection of human and machine sensing; 9. Sensors of a mobile robot, sensors of a humanoid robot, and remotely controlled robotics; 10. The sensors and measurement methods of the Curiosity rover on Mars.

Sequence Analysis with BioPython

P-ITOBA-0090

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	1/ 3 /0 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Gáspári Zoltán

Course Description:

The Biopython Project adopts the flexibility and easy-to-code features of Python to classic bioinformatics projects. After this course, students will be able to use Python to address the following problems:

- Parsing FASTA and GenBank sequence files
- Parsing multiple sequence alignment files
- Creating multiple sequence alignments
- Accessing BLAST services programmatically

Signal Transduction

P-ITMED-0011

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Sipeki Szabolcs

Course Description:

The course covers the following topics: Principles of signal transduction (classification of the receptors, main signaling routes, reversible protein phosphorylation). Protein domains in signal transduction. Signaling with cAMP (adenylyl cyclase, protein kinase A, CREB transcription factor). Signaling with phosphoinositide derivatives (phospholipase C, protein kinase C, PI 3-kinase, protein kinase B). Receptor protein tyrosine kinase signaling. Signaling through the insulin receptor, diabetes mellitus. Non-receptor tyrosine kinase signaling. Signal transduction to and from adhesion molecules (integrins). NF-kappaB signaling. TGF-beta signaling. The regulation of the cell cycle (oncogenes, tumor suppressor genes). The programmed cell death (the survival signal, mechanisms of apoptosis). Molecular basis of tumorigenesis.

Software Defined Electronic and Information Systems

P-ITEEA-0040

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Kolumbán Géza

Course Description:

Complex up-to-date ICT and test systems are implemented in SW. The complex systems including many remote-controlled devices and equipment are embedded into a computing environment. This subject will teach the theory and practice of SW-based implementation, the system-level analysis and design of very large ICT and test systems, and the methods used in remote control.

Software Test Automatization in Practice

P-ITJEL-0029

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	0/ 0 /2 hours/week
Course credit	2 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Oláh András
Comment	course availability to be confirmed

Course Description:

Software testing and test automation are essential parts of the software development process and methodologies (Agile, Scrum, XP, etc.). The course aims to let the students learn the main tools and techniques (TDD, DDT, Unit testing, Mock, Web UI testing, Selenium, Docker) used in the test automation process via practicing it.

The course covers the following topics: Version control systems (GIT); Unit testing (basics, DDT, and mocking); API testing (basics); Continuous integration; Web UI testing (basics, few parts of a framework, page object usage); Docker (Container-based software development and testing).

Stem Cell Biology

P-ITMED-0010

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 0 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Mayer Balázs

Course Description:

Stem cell biology is currently one of the most intensely studied areas of biomedical research, and our knowledge of stem cells is constantly growing each day. During our lectures, we give an introduction to different stem cells, clinical research data, recent results, and difficulties in the field of stem cells. There will be an emphasis on the critical evaluation of information about stem cells, stem cell banking, and stem cell treatments.

Stochastic Signals and Systems

P-ITMAT-0037

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Gerencsérné Dr. Vágó Zsuzsanna
Comment	course availability to be confirmed

Course Description:

Wide sense stationary processes, Orthogonal processes and their transformations, Prediction, innovation and the Wold decomposition, Singular processes, Spectral theory, Random orthogonal measures, Representation of a wide sense stationary process, AR, MA, and ARMA processes, Multivariate time series, State-space representation, Kalman filtering, Identification of AR processes, Identification of MA and ARMA models, Non-stationary models, Stochastic volatility: ARCH and GARCH models

Systems Bioinformatics

P-ITBIO-0048

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /1 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Ligeti Balázs

Course Description:

Advanced course in systems bioinformatics. The course aims to provide deeper and hands-on knowledge in the fields of bioinformatics working with big data, from a systems biology perspective, especially dealing with large-scale sequencing data. DNA sequencing, covering the topics of metagenomics, exome sequencing, RNA-seq, etc. We do not only focus on sequence data but on various complex network representations (including hierarchical networks) of the data. Another important aspect of the course is to give an insight into the basic text mining tools to understand the texts as one of the most important layers of data networks. The course is about understanding and designing complex pipelines.

The Finite Difference Time Domain Method for Engineers

P-ITFIZ-0011

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	3/ 0 /1 hours/week
Course credit	4 credits
Final evaluation	Exam
Responsible lecturer	Dr. Szabó Zsolt
Comment	course availability to be confirmed

Course Description:

Nowadays the engineer's daily activity widely involves the utilization of different software packages. This allows full prototyping with computer software, and the desired products are fabricated with high reliability as the final step only. These lectures introduce the Finite Difference Time Domain Method (FDTD), which is the most efficient electromagnetic design algorithm. The FDTD method allows the design of many devices from the microwave to optical frequencies. Telecommunication antennas, medical instruments such as MRI, multilayers, which act as mirrors for high-intensity lasers, optical sensors, or even the full electromagnetic compatibility analysis of a vehicle are a few examples, where the FDTD has been successfully applied.

TOEFL/IELTS/CAE English Exam Preparation

P-ITANG-0005

Recommended level of study	BSc
Semester	Autumn / Spring
Number of classes (lecture/practice/lab)	0/ 2 /0 hours/week
Course credit	0 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Péri Márton
Comment	course availability to be confirmed

Course Description:

The course intends to assist students who wish to prepare for TOEFL/CAE/IELTS exams. The necessary background of the above-mentioned exams is provided then through appropriate test exercises the chosen exam is practised. The TOEFL (Test of English as a Foreign Language) test measures the candidates' English language proficiency in an academic environment. Several English-speaking universities and colleges require it as an entrance examination for non-English-speaking students. The test result is valid for two years after which it cannot be used for applications since the candidate's language proficiency might deteriorate significantly. The course prepares for the four modules of the exam (Reading, Listening, Speaking, and Writing) through role-plays and test exercises. During the classes, the candidates learn effective strategies for successfully taking the exam. They also learn the basics of debating, essay writing, academic reasoning, etc. Essays are prepared as home assignments for the classes.

Tutored Research Project for Medical Biotechnology

P-ITLAB-0033

Recommended level of study	MSc
Semester	Autumn / Spring
Number of classes (lecture/practice/lab)	0/ 0 /6 hours/week
Course credit	6 credits
Final evaluation	Term mark
Responsible lecturer	Dr. Kellermayer Miklós

Course Description:

The student undertakes an individual project that prepares her/him for the diploma thesis work. (S)he gets familiar with a specific research question, surveys the relevant scientific literature, learns specific laboratory and/or computational techniques, and might perform preliminary experiments. Her/his work is continuously monitored and supervised by the thesis mentor. At the end of the semester, his/her work is presented both as a written and oral report and is evaluated by a committee.

VLSI Design Theory and Practice

P-ITEEA-0041

Recommended level of study	MSc
Semester	Autumn
Number of classes (lecture/practice/lab)	2/ 0 /2 hours/week
Course credit	5 credits
Final evaluation	Exam
Responsible lecturer	Dr. Földesy Péter

Course Description:

Integrated Circuits are everywhere, the course is a deep introduction to IC design, from the manufacturing process, price of development, analog and digital design flows, 3D IC variants and their roles in integration, packaging options, DIY chips, and other important and interesting details. Besides the design background, we analyze the hottest chips around, including deep learning neural inference accelerators, GPUs, TPUs, FPGAs, low-power IoT microcontroller architectures, and microelectronic technological solutions to get a broad view of what happens today in this industry. The requirement to fulfill the course is a short presentation of your own field from the IC background point of view.

Web Mining

P-ITSZT-0033

Recommended level of study	MSc
Semester	Spring
Number of classes (lecture/practice/lab)	2/ 1 /0 hours/week
Course credit	3 credits
Final evaluation	Exam
Responsible lecturer	Dr. Góth Júlia Krisztina
Comment	course availability to be confirmed

Course Description:

The course covers the following topics:

- Introduction, concepts;
- Text mining (concepts, application fields);
- Information retrieval, data mining;
- Preprocessing of the text information.
- Document representation;
- Vector-space model, indexing methods;
- Information extraction;
- Text mining methods; Classification methods;
- Extraction, Summarization, Annotation;
- Recommendation systems;
- Sentiment Analysis, Opinion mining. Rapid Miner.