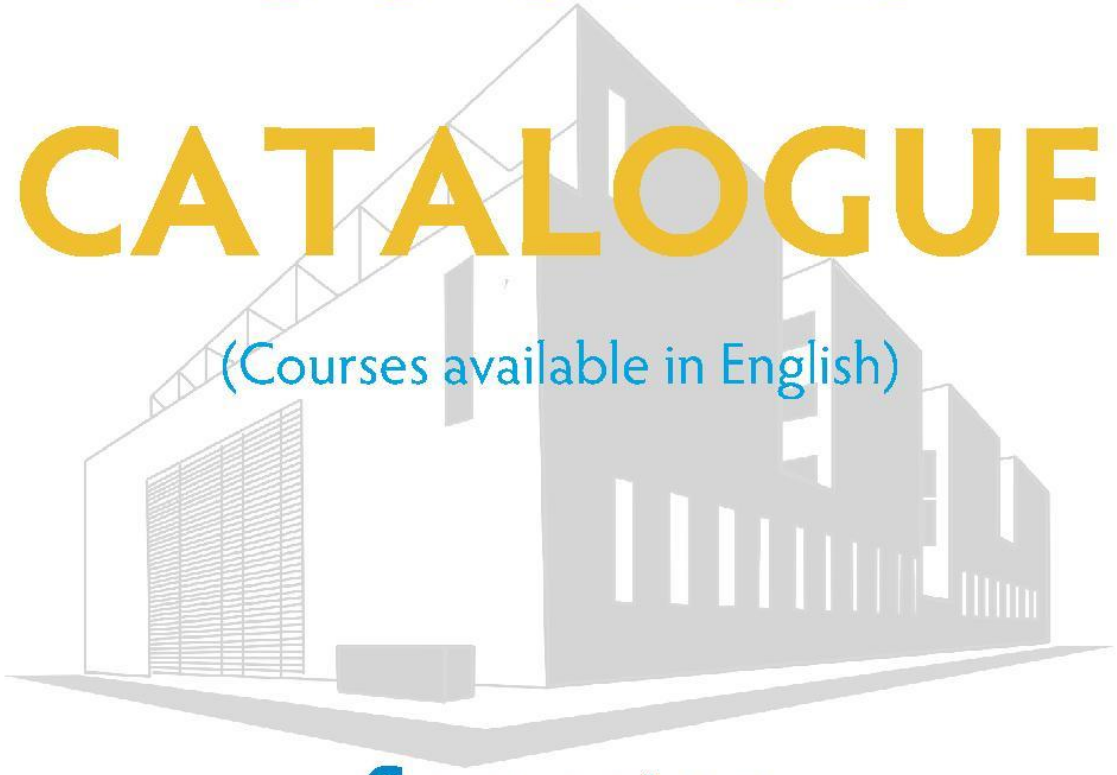
Pázmány Péter Catholic University

Faculty of Information Technology and Bionics

COURSE CATALOGUE

(Courses available in English)



Semester

2019/20/2

Application Development for Android Platforms

P-ITJEL-0011

Lecture:	1 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	3 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Tornai Kálmán

Course description:

The aim of the course is to provide market-ready knowledge regarding to Android system, on the most widespread version of the platform. The course is based on the knowledge provided on the course Basics of mobile application development.

Introduction, Activities, Intents, RecyclerView

Runtime permissions, Firebase, Storage options

Content Providers, Multithreading Services and Brodcast Receivers res qualifiers, Fragments, View Hierarchy, Material Design

Location Services, Maps, Libraries

Camera API, sound playback, communication protocols

Android file system, ADB, build process, testing

Other devices in the Android system, Google Play

REST API, Retrofit library, FireBase extra

Applications of Neural Microsystems

P-ITBIO-0042

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Fekete Zoltán

Course description:

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

fides et ratio

Basics of Software Testing

P-ITSZT-0029

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Rekeczky Csaba

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 would be to let the students learn the basics of this standard. The followings are the main topics:

- Basics
- Software development lifecycle
- Static testing
- Dynamic testing
- Test management
- Test tools

fides et ratio

Biomedical Innovation for the 21st Century: Introduction to Bionics

P-ITBIO-0043

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Laki András József

Course description:

The aim of the course (organised by Pázmány Péter Catholic University and Semmelweis University for PhD and MSc students) 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.

Bionics in Practice

P-ITEEA-0035

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Gyöngy Miklós

Course description:

Introducing bionic research, development, manufacture and applications through visiting labs and companies. Students have to work in teams and make a presentation about bionics related topic (e.g. bionic sensory perceptions, bionic prosthesis, neurostimulators, bioanalytics etc.), which will be evaluated by other teams based on the given evaluation scheme. After the presentation the team has to lead a discussion about the related (ethical) questions. The aim of the class is understanding more about the bionic field and its opportunities, results, attempts, challenges, successes and failures by learning from each other.

fides et ratio

Chemical Biology

P-ITBIO-0045

Lecture:	1 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Gáspári Zoltán

Course description:

Chemical aspects of biological processes.

Proteins ans biopolymers, postttranslational modifications.

Intrinsically disordered proteins.

Chemical aspects of protein synthesis in the laboratory and in the cell.

Internal dynamics of proteins and its significance, basic concepts in protein NMR spectroscopy.

Chromatin organization and introduction to epigenetics.

fides et ratio

Combinatorial Methods

P-ITMAT-0033

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Ács Bernadett

Course description:

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

fides et ratio

Compressions

P-ITPRO-0001

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Feldhoffer Gergely

Course description:

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

fides et ratio

Data Mining and Machine Learning

P-ITSZT-0053

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	1 hours/week
Course credit:	5 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Lukács Gergely István

Course description:

This course covers 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. Preprocessing and postprocessing
6. Ensemble learning methods.

fides et ratio

Data Security and Cryptography

P-ITSZT-0023

Lecture:	3 hours/week
Practice:	0 hours/week
Lab:	1 hours/week
Course credit:	5 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Csapodi Márton Endre

Course description:

Cryptography, first of all, public key cryptography became an important discipline in the last 40 years. Its importance is indicated not only by immense theoretical research but also the prevalence of secure IT systems and common use of security applications. Cryptographic protection is a basic requirement in many area of communication, and a vast number of standards emerged in the past years to support this. Today, public key cryptography is commonplace in the financial services and government applications, and gained wide use for business and private applications (SSL/TLS, S/MIME). This course introduces the students into the most important techniques and applications of cryptography. We provide a general idea of the following areas:

- Mathematical foundations
- Random generators
- Symmetric key encryption (stream and block ciphers,
- TDEA, AES, secure mobile communication)
- Public key encryption (basics, RSA encryption, Diffie-Hellmann, elliptic curves)
- Hash coding
- Authentication (passwords, challenge-response protocols)
- Public key infrastructure, electronic signatures

The laboratory sessions enable examination of security mechanisms of operating systems and network protocols, as well as building cryptographic programming ability.

Drug Delivery Systems

P-ITMED-0019

Lecture:	3 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Antal István

Course description:

The subject is recommended for the 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 the 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 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.

fides et ratio

Embedded Electronic Systems

P-ITEEA-0045

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Zarándy Ákos

Course description:

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.

fides et ratio

English for Academic Purposes

P-ITANG-0004

Lecture:	0 hours/week
Practice:	4 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Péri Márton

Course description:

The purpose of the course is to prepare students for the fifth, English semester at FIT PPCU. The main goal is the improvement of the basic English skills of students needed for the special course English language subjects of the semester (reading, listening, writing and speaking skills). Special attention is paid to the needs related to the taught fields (presentations, scientific articles, academic situations, etc) as well as speaking situations (complaints, telephoning, interviews, etc). After several years it has been found that without presentational skills scientific life cannot be imagined. So the course consisting of 20 units starts with basic presentation skills.

fides et ratio

English for Academic Purposes II.

P-ITANG-0011

Lecture:	0 hours/week
Practice:	3 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Term mark
Responsible lecturer	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, 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/discussion, conclusions, and abstracts.

English language practice II.

P-ITANG-0002

Lecture:	0 hours/week
Practice:	4 hours/week
Lab:	0 hours/week
Course credit:	0 credits
Final evaluation:	Term mark
Responsible lecturer	Péri Márton

Course description:

The continuation of the English course of the first semester on the adequate levels. The general English classes intend to practise the English language communication through converstations and situational practise. Depending on the students' needs it is possible to deal with questions related to academic topics.

fides et ratio

Functional analysis

P-ITMAT-0025

Lecture:	2 hours/week
Practice:	2 hours/week
Lab:	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 finction 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.

fides et ratio

Human Physiology I.

P-ITMED-0002

Lecture:	3 hours/week
Practice:	0 hours/week
Lab:	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 (electophysiological 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 the circulation and respiration based on the knowledge of the autonomic nervous system. Understanding the composition of the body fluids with focusing on the blood (significance of solubile and cellular components including defense reactions and hemostasis).

fides et ratio

Hungarian and European Civilization and Culture

P-ITMUV-0019

Lecture:	0 hours/week
Practice:	3 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Term mark
Responsible lecturer	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 from a previously chosen topic from European or Hungarian history or culture in order to prove they are able to research and understand the given topic in a broader context.

fides et ratio

Hungarian Language Course

P-ITANG-0010

Lecture:	0 hours/week
Practice:	3 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Term mark
Responsible lecturer	Péri Márton

Course description:

This course is an introduction to the Hungarian language. The course will provide students with the basic skills in reading, writing and speaking in Hungarian at a 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 scheduled fieldtrip during the semester in Budapest. During this fieldtrip, students will have a unique opportunity to practice Hungarian in a native environment and communicate in a broad range of everyday situations with locals.

fides et ratio

Hungarian Language Course 2.

P-ITANG-0012

Lecture:	0 hours/week
Practice:	2 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Péri Márton

Course description:

The Hungarian Language Course 2 focuses on speaking, listening, writing and reading skills and deepens generally grammatical and oral skills. By the end of the semester interested student will have enough language to get by, with sufficient vocabulary to express themselves with some hesitation and circumlocutions on topics such as family, eating out, hobbies, travel. Students are introduced to more complex grammar. Verbs: prefixes, definite and indefinite conjugation, Genitive

fides et ratio

Immunobiology

P-ITMED-0013

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Falus András

Course description:

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

fides et ratio

Integrated Structural Bioinformatics

P-ITBIO-0028

Lecture:	1 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Gáspári Zoltán

Course description:

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

fides et ratio

Introduction to Artificial Intelligence

P-ITSZT-0022

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	5 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Karacs Kristóf

Course description:

Course name: Introduction to Artificial Intelligence Credits: 5 Class type: lecture/practical/lab, hours per week: 2/1/1 Type of the exam: oral exam Semester: 8 Prerequisities (if exist): Probability, Statisctics; Introduction to Programming II. 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.

Required reading: Russell, Stuart J.; Norvig, Peter (2003), Artificial Intelligence: A Modern Approach (2nd ed.), New Jersey: Prentice Hall, ISBN 0-13-790395-2;Winston, Patrick Henry (1984). Artificial Intelligence. Reading, Massachusetts: Addison-Wesley. ISBN 0-201-08259-4. Recommended reading: Materials available on the webpage of the course.

Introduction to Functional Neurobiology

P-ITBIO-0037

Lecture:	3 hours/week
Practice:	2 hours/week
Lab:	0 hours/week
Course credit:	6 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Freund Tamás

Course description:

Understanding the structural and functional concepts characterising neuronal networks. 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 co-ordination. 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 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 hypothalamo-hypophyseo-peripheral gland system. The magno- and parvocellular system. Regulation of adaptation and metabolism. Neurobiology of reproduction.

Introduction to Javascript Programming

P-ITSZT-0039

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Góth Júlia Krisztina

Course description:

After finishing this course, the student will be familiar with the Javascript programming language and its specialities. They will embrace the basics of the server side Javascript (Node.js + MongoDB) and a client side MVVM framework (knockout.js) and the fundamentals of task automation and testing (Grunt vs. Gulp).

fides et ratio

Java Programming for Bionics

P-ITSZT-0049

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	3 hours/week
Course credit:	3 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Gáspári Zoltán

Course description:

Basics of Java programming. The aim of the course is that ath the end of the semester the students are able to implement programs performing simple bioinformatics tasks in Java. Main points: Basics of object-oriented programming in Java, classes, interfaces, inheritance, function overloading. Basics of file input/output, simple GUI programming. Use of external APIs to solve bioinformatics-related tasks

fides et ratio

Machine Learning

P-ITSZT-0041

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	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.

fides et ratio

Methods in Laboratory Diagnostics

P-ITMED-0021

Lecture:	1 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Vásárhelyi Barna

Course description:

Laboratory results form the basis of up to70% 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 thestudents are planning studies applying laboratory methods.

fides et ratio

Molecular Biology

P-ITBIO-0046

Lecture:	4 hours/week
Practice:	0 hours/week
Lab:	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 regulation of 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.

fides et ratio

Molecular Genetics, Genomics, Sytems Biology

P-ITMED-0015

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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 basic of genetics and genomics as well. They will gain knowledge how is the genom organized, what annotation means, what was the HGP project, what do we know about chromosomes, mutations, epigenetic regulation mechanisms, role of the genom in medicine. They will learn parallel techniques to each topics; both analysis on genetic or genomic level.

fides et ratio

Molecular Targets in Tumor Therapy

P-ITMED-0016

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Keszler Gergely

Course description:

Currently, malignancie sare the second most frequent causes 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.

fides et ratio

Multi-photon Microscopy

P-ITJEL-0044

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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 learn the theoretical basics of multifoton microscopy but also get some knowledge of the engineering side. Moreover they have to improve the retorical skills (presenting scientific articles) and do some labwork in the Two-photon Laboratory. During the semester the students will learn how a microscope build up and how to use in a neurobiological project.

fides et ratio

Neural Sensing and Plasticity

P-ITBIO-0039

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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 details of developmental plasticity of different sensory and motor systems and of the adult nervous system plasticity. Provides knowledges on the neurobiological background of neural reorganisation 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.

fides et ratio

Neuromorph Movement Control

P-ITEEA-0043

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	0 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Karmos György

Course description:

Solving direct (forward) and inverse kinematic problems of multi-joint systems. Optimization in 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.

fides et ratio

Neurophysiological Data Analysis

P-ITBIO-0044

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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 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 all branches of science and not only the science, everywhere, where the aim is to reveal the structure and the function of a complex system.

fides et ratio

Numerical Analysis II.

P-ITMAT-0031

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	0 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Kovács Mihály

Course description:

Numerical integration in 1D, simple quadrature rules, Eulers 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.

fides et ratio

Optimalization methods

P-ITMAT-0032

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	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 area in computer science. On the other hand, optimization methods used, e.g., the gradient method are well known since 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.

fides et ratio

Parallel Programming

P-ITSZT-0048

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	3 hours/week
Course credit:	3 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Reguly István Zoltán

Course description:

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

fides et ratio

Parameter Estimation

P-ITMAT-0026

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	5 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Szederkényi Gábor

Course description:

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 nonlinearmodels (gradient method, simplex method etc.) Identifiability and distinguishability State estimators forparameter estimation Practical implementation, application examples

fides et ratio

Physical Biology of the Living Cell I.

P-ITMED-0005

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Kellermayer Miklós

Course description:

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

fides et ratio

Physics of Information Technology and Bionics II.

P-ITFIZ-0007

Lecture:	3 hours/week
Practice:	1 hours/week
Lab:	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, principles of quantum mechanics. We show key application 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.

Solutions of the Schrödinger equation. Elementary solutions of the Schrödinger equation. Transmission of a particle through a potential barrier (quantum tunneling). The harmonic oscillator. The hydrogen atom. Principal, orbital, magnetic and spin quantum numbers. Features of the atomic wave functions. Periodic Table of the Elements. Molecules: the chemical bond.

Numerical solutions to the 1D Schrodinger equation, link between operators and matrices. Hueckel theory, modeling molecular systems

Quantum complexity and classical complexity, Simulating physics with computers.

Single electron in 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. Electron and hole densities in intrinsic semiconductors at thermal equilibrium. The Fermi level of intrinsic semiconductors. The principle of charge neutrality. Carrier densities and Fermi levels in n type and p type semiconductors. Carrier transport in semiconductors: drift and diffusion. Carrier generation and recombination in semiconductors.

Metal metal junction: the contact potential. Band scheme of a p n junction diode: contact potential. Equilibrium currents across the p n junction.

Quantum devices: resonant tunneling diodes, quantum transistors.

Interaction of an atom with electromagnetic radiation. Two-level atoms in resonant electromagnetic field Photon absorption, spontaneous emission and stimulated emission. Stimulated coherence. 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 extragalactical astronomy.

fides et ratio

Programmable Optical Devices

P-ITEEA-0044

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	1 hours/week
Course credit:	5 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Csaba György

Course description:

The class gives an introduction to the 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.

fides et ratio

Quantitative and Medical Biochemistry

P-ITMED-0001

Lecture:	3 hours/week
Practice:	1 hours/week
Lab:	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 essential for future specialists in Biotechnology are emphasized: modern biochemical techniques in the characterization of intermolecular interactions and enzyme action, in silico modelling of biochemical processes and systems. Medical orientation is implemented with 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.

Recombinant DNA Techniques

P-ITMED-0008

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	3 hours/week
Course credit:	6 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Barta Csaba Attila

Course description:

During the lectures, the students get familiar with the following concepts and examples: 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, the first human recombinant medicine. Trasgenic 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 sudents 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

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Novák Borbála

Course description:

The goal of the course to give a brief overview of technologies in Python which allows 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.

fides et ratio

Scrum Agile Development Methodology

P-MIM_D63

Lecture:	0 hours/week
Practice:	2 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Prószéky Gábor

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 the agile way.

Sensory Robotics

P-ITEEA-0039

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	1 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Cserey György Gábor

Course description:

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

Software Defined Electronic and Information Systems

P-ITEEA-0040

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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.

Theoretical background: Characterization of signals, LTI systems and random processes both in the time- and in the frequency domains. Relationship between the real-world analog signals and the data streams processed on a computing platform. The A/D and D/A converters, the data acquisition (DAQ) cards. Operation principle of a complex ICT system to be implemented and tested. Theory and practice of Software Defined Electronics (SDE) method and Virtual

Instrumentation (VI). Idea of equivalent BaseBand (BB) information processing. Derivation of BB equivalents. Applications implemented entirely in SW. Remote control of stand-alone devices and test equipment. Remote control via GPIB and Ethernet interfaces. System level analysis and design of complex automated production lines, process control systems and testbeds.

Required reading:

Detailed lecture notes available on-line: http://users.itk.ppke.hu/~kolumban/software_defined

S. Haykin, Communication Systems, 5th ed., John Wiley & Sons, 2009. G. Kolumbán, T. Krébesz and F. C. M. Lau, "Theory and Application of Software Defined Electronics: Design Concepts for the Next Generation of Telecommunications and Measurement Systems," IEEE CAS Magazine, Second Quarter, 2012, no. 2, vol. 12, pp.8-34. On-line: http://www.eie.polyu.edu.hk/~enkgeza/own_papers/software12defined_electronics.pdf

Recommended reading:

„GPIB Programming Tutorial," Free University Amsterdam, The Netherlands. Available on-line: http://g2pc1.bu.edu/~qzpeng/gpib/manual/GpibProgTut.pdf

fides et ratio

Stem Cell Biology

P-ITMED-0010

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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 on stem cells is constantly growing each day. During our lectures we give an introduction on different stem cells, clinical research data, recent results and difficulties in the field of stem cells. There will be an emphasis on critical evaluation of information about stem cells, stem cell banking and stem cell treatments. Topics: General characteristics of stem cells, visit in the stem cell laboratory, cell culturing. Clinical studies in biomarker research, proteomics. Analysis of clinical data. Embryonic stem cells, induced pluripotent stem cells. Adult stem cells: mesenchymal stem cells, adipose tissue derived stem cells. Dermal stem cell niche in healthy and tumor tissues. Epidermal stem cells, clinical practice of wound management, mutation correction. Neural stem cells. Stem cell therapies in neurological disorders. Intestinal stem cells. Cancer stem cells in intestinal tumors. Other adult stem cells, problems of stem cell therapy and gene therapy, immunogenicity, tumor formation, variability, genetic instability, epigenetics, senescence. Hematopoietic stem cells, bone marrow stem cell niche. Bone marrow transplantation, stem cell banks and bioethical questions.

Technologies of Data Intensive Applications

P-ITMAT-0012

Lecture:	0 hours/week
Practice:	2 hours/week
Lab:	0 hours/week
Course credit:	2 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Lukács Gergely István

Course description:

Designing enterprise IT systems Development environment (version management, Jenkins, Gitlab) Docker for developers Oracle database for developers PL/SQL JavaEE platform Spring framework Oracle cloud Python System testing in large enterprises JS frontend technologies

fides et ratio

Tutored Research and Development Project I.

P-ITLAB-0041

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	6 hours/week
Course credit:	6 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Szederkényi Gábor

Course description:

Completing a project work for Computer Science Engineering MSc students. Note that the responsible lecturer has only administrative tasks in the coordination of the students, the scientific work should be completed under the supervision of the individual advisor of each student.

fides et ratio

Tutored Research Project II.

P-ITLAB-0042

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	6 hours/week
Course credit:	6 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Szederkényi Gábor

Course description:

Completing a project work for Computer Science Engineering MSc students. Note that the responsible lecturer has only administrative tasks in the coordination of the students, the scientific work should be completed under the supervision of the individual advisor of each student.

fides et ratio

Tutored Research Project for Medical Biotechnology

P-ITLAB-0033

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	6 hours/week
Course credit:	6 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Kellermayer Miklós

Course description:

Completing a project work for Medical Biotechnology MSc. Note that the responsible lecturer has only administrative tasks in the coordination of the students, the scientific work should be completed under the supervision of the individual advisor of each student.

fides et ratio

Tutored Research Project I. (IMNM-AIB)

P-ITLAB-0028

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	6 hours/week
Course credit:	6 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Iván Kristóf

Course description:

Completing a project work for Info-Bionics Engineering MSc. Note that the responsible lecturer has only administrative tasks in the coordination of the students, the scientific work should be completed under the supervision of the individual advisor of each student.

fides et ratio

Tutored Research Project II. (IMNM-AIB)

P-ITLAB-0029

Lecture:	0 hours/week
Practice:	0 hours/week
Lab:	6 hours/week
Course credit:	6 credits
Final evaluation:	Term mark
Responsible lecturer	Dr. Iván Kristóf

Course description:

Completing a project work for Info-Bionics Engineering MSc. Note that the responsible lecturer has only administrative tasks in the coordination of the students, the scientific work should be completed under the supervision of the individual advisor of each student.

fides et ratio

Web Mining

P-ITSZT-0033

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	0 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer	Dr. Góth Júlia Krisztina

Course description:

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.

fides et ratio