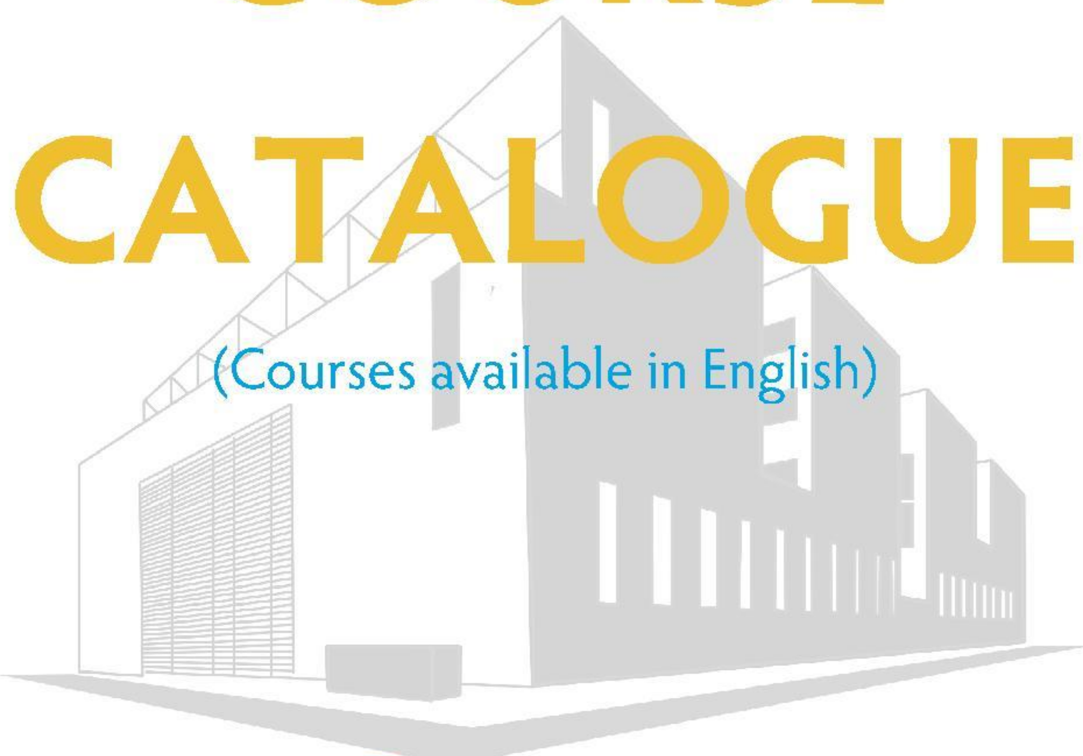
Pázmány Péter Catholic University

Faculty of Information Technology and Bionics

COURSE CATALOGUE

(Courses available in English)



Semester

2019/20/1

Advanced Telecommunication Systems

P-MIM_D41

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:

1. Theory and basic concepts in application of Wireless Local Area (WLAN) and Wireless Personal Area (WPAN) Networks. Typical WLAN and WPAN applications. Channel conditions in indoor and mobile radio communications. Layered structure, packet communication and encapsulation. Constraints of CMOS implementation. Theory of WLAN and WPAN data communication systems. Study of a BPSK data communication system.

2. Implementation issues and performance testing. Lowpass representation of bandpass signals and systems. Complex envelope, lowpass equivalent of bandpass signals and systems. Receiver architectures. Transmitter architectures. Antennas. Special techniques used in WLAN and WPAN applications to reduce power consumption and complexity. Transceiver performance testing Emission mask and unwanted emission, selectivity, third-order intercept point, 1-dB compression point, receiver blocking, sensitivity, dynamic range, intersymbol interference.

3. Low-Rate Wireless Personal Area Network (LR-WPAN), the IEEE Standard 802.15.4.

4. Survey and comparison of wireless IEEE 802 standards.

5. Application oriented issues. Calculation of the link budget.

Compulsory and/or recommended literature: S. Haykin, Communication Systems, 4th ed., John Wiley & Sons, 2001. B. Razavi, RF Microelectronics, Prentice Hall, 1998. J. A. Guti ´errez, E. H. Callaway and R. L. Barrett, Low-Rate Wireless Personal Area Networks, IEEE Press, 2003. K. Siwiak and D. McKeown, Ultra-Wideband Technology, John Wiley & Sons, Chichester,UK, 2004.

Homepages of related IEEE Working Groups: http://grouper.ieee.org/groups/802/11/ http://grouper.ieee.org/groups/802/15/

Basic Image Processing Algorithms

P-ITJEL-0014

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

Course description:

The aim of the course is 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.

Basics of Mobile Application Development

P-ITJEL-0015

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 aims of the course are to introduce the development of applications on the 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 ergonomic, they can learn the appropriate solutions and they also can follow the techniques of handling the new peripheries the current and forthcoming mobile devices.

Basics of Neurobiology

P-ITBIO-0013

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

Bio- and drug delivery MEMS

P-ITEEA-0024

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

Course description:

The 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 Signal Processing

P-ITJEL-0024

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

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

Course description:

The course gives an overview on 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 equipments.

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.

Biostatistics

P-ITMAT-0023

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

Course description:

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.

Business English

P-ITANG-0008

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 course will give an insight into the business world where English is used as the 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 Biology - Cell Technology

P-ITMED-0009

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	1 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer:	Garay Tamás Márton

Course description:

The course is divided into two parts:

Part 1: Cell biology summary and intensification of cell biology knowledge with special emphasis to cell physiology

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

Computer controlled systems

P-ITJEL-0042

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

Course description:

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 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.

Database Advanced

P-ITSZT-0031

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	2 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer:	Dr. Lukács Gergely István

Course description:

The course has a double goal: to give students advanced hands-on experience with database management systems and to widen their perspective on database management beyond relational database management systems. Advanced SQL (e.g. data warehouse queries, analytic functions) Oracle Data dictionary Join-execution, database indices, cost-based query optimization SQL procedural extension (Oracle pl/sql) Objectrelational databases (geographic databases) JDBC, O/R mapper (Hibernate) Data warehouses Scalable data processing (scale up, scale out in data management, noSQL)

Design patterns

P-ITSZT-0040

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

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	1 hours/week
Course credit:	4 credits
Final evaluation:	Term mark
Responsible lecturer:	Dr. Gyöngy Miklós

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.

English for Academic Purposes

P-ITANG-0009

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:

Pursuing either BSc or MSc studies at PPCU FITB 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 to 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, test exercises in a really academic environment make sure that the applicants can successfully acquire the required skills and pass the internal exam with an appropriate result.

Course requirements: one mock test per week as home assignment, class attendance, final test

English for Erasmus Purposes

P-ITANG-0006

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

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 to the situations in the academic environment they will face and also to the tasks and assignments they need to complete in order to fulfil 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.

FPGA-based Algorithm Design

P-ITEEA-0014

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

Course description:

The aim of the course is 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.

High-level synthesis methods on FPGA-s

P-ITEEA-0016

Lecture:	2 hours/week
Practice:	0 hours/week
Lab:	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 in the Register Transfer Level (RTL). The increasing complexity of today digital systems requires more efficient and flexible design methodologies. High Level Synthesis (HLS) methods are an active research area since 1980s 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, 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 II.

P-ITMED-0003

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:

The function of the kidneys, urin formation, regulation of the body fluid volume and osmotic parameters.

Acid-base balance.

Function of the gastrointestinal tract, energy metabolism, regulatin 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, regulation of motor function.

The somatosensory system.

Sensory organs vision, hearing taste and smell.

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.

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 students 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

Infocommunication Systems

P-ITTAV-0004

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

Course description:

Introduction to infocommunication 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 infocommunication services

Intelligent sensors

P-MIM_D52

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

Course description:

Main types of intelligent sensors, criteria of intelligence. Architectures. Main technologies, CMOS/LSI, surface and bulk MEMS, application of glass and plastic materials. Typical electronic circuits, low-power low-noise preamplifiers, analog switches, RF communication circuits, E-class power amplifiers, low-power subthreshold circuits, sleep applications. Efficient inductive power links, two- and three-way channel communications. Coupled coils. Structures of implanted inductors, on-chip RF coils. Load-shift-key backward data transfer. Wireless strain, force, pressure and acceleration sensing. MEMS remote respiratory flow sensors. 3D tactile microsensor and data evaluation. Cantilever and SAW applications. Integrated multi-site microarray potentiostats. Ion-selective and CHEMFET sensors, micro hotplates for different specimens. Problems of selective gas sensing, E-nose experiments. Wearable sensing systems for blood pressure, ECG, PCG, arterial stiffness, pulse oximetry. Body sensor networks for health care, continuous monitoring by smart phone, Biological sensors. Advanced ultra low-power endoscopic sensors. On-chip implanted multi-site biological sensors. Bone and dental implanted sensors. Implanted multi-site neural sensors for high resolution measurement and RF transfer of actual potential. Bandwidth problems. Systems for checking the operation of different retina and cochlea implantations. Microsensors for glaucoma test. Home monitoring systems. Supervision of sleep using bed and floor pressure sensing elements. Remote sensors for supervision for living mode, motions, gait and irregular events, including fall detection. Intelligent sensor networks. Models for telemedicine networks. Identification systems and sensor integration for telemedicine. Smart wireless sensor nodes for structural health monitoring.

Required reading: S. Y. Yurish, M. T. S. T Gomez: Smart Sensors and MEMS, Kluwer Academic Publ., 2004 A. Hierlemann: Integrated Chemical Microsensor Systems in CMOS Technology, Springer, 2005 F. Hu, Q. Hao: Intelligent sensor networks, CRC Press, Taylor & Francis, 2013 6 selected copies from IEEE Sensors Journal and IEEE Trans. on Biomedical Circuits and Systems Recommended reading: - Papers from IEEE Sensors Journal and IEEE Trans. on Biomedical Engineering

Introduction to Bioinformatics

P-ITBIO-0009

Lecture:	2 hours/week
Practice:	2 hours/week
Lab:	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 Nanotechnology

P-ITFIZ-0004

Lecture:	1 hours/week
Practice:	0 hours/week
Lab:	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, in order 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 expected to make an impact.

IT Technologies in Large Enterprises

P-ITMAT-0011

Lecture:	0 hours/week
Practice:	1 hours/week
Lab:	0 hours/week
Course credit:	1 credits
Final evaluation:	Term mark
Responsible lecturer:	Dr. Lukács Gergely István

Course description:

Introduction to up-to-date industrial technologies for IT systems in large enterprises.DBMS Architecture Architecture of enterprise information systems DBMS requirements and optional features Middleware Application infrastructure Identity management Virtualization and cloud Monitoring and error handling Docker and cubernetes Automated IT infrastructure Big data and distributed data management

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

Modelling Neurons and Networks

P-ITBIO-0040

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

P-ITMED-0007

Lecture:	1 hours/week
Practice:	0 hours/week
Lab:	1 hours/week
Course credit:	3 credits
Final evaluation:	Exam
Responsible lecturer:	Dr. Kopper László

Course description:

1. Cell socsilsty stem cells - major tasks for regulation: proliferation and death to maintain different specific activity metabolism for energy

2. Main methods: immunohistoemchemistry, PCR-based techniques, NGS, liquid biopsy, meta-analysis

3. Signalling pathways (ligands, receptors) feed-back - mutation

4. Epigenetics splicing non-coding RNA

5. Carcinogenesis oncogen clonal selection

6. Local invasion - road to distant metastasis (epithelial-mesenchimal-transition) fenexpression

7. Gene expression (primary vs secundary) dormant cells

8. (Onco)hematology

9. Intra- et interheterogeneity organ cancers

10. Targeted therapy (concept and reality) driver genes

11. Resistande synthetic lethality DNA repair

12. Non cancer

13. Ethics in publications how to digest nformations

14. Consultation Molecular Laboratoris to visit: SE II Inst Pathol, Oncompass

Multimodal Sensor Fusion and Navigation

P-ITEEA-0038

Lecture:	2 hours/week
Practice:	1 hours/week
Lab:	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 about 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 explained such generally used algorithms like the Kalman- and the Bootstrap-filter. 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.

Neural Interfaces and Prostheses

P-ITBIO-0038

Lecture:	3 hours/week
Practice:	0 hours/week
Lab:	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 system. Some of these devices are already routinely used in the clinical practice like the cochlear prostheses for restoring hearing, others are still in the developmental or experimental phase.

Neural networks

P-ITEEA-0011

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

Course description:

During this course will understand learn the theory of the 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 the dimension reduction techniques.

Nonlinear Dynamical Systems

P-ITEEA-0037

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

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. 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-0009

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

Course description:

Solution of equations by iteration, polynomial interpolation (Lagrange, Hermite), piecewise polynomial interpolation (splines, linear, natural cubic, Hermite cubic), polynomial approximation in the infinity norm, polynomial approximation in the 2 norm via Gram-Schmidt orthogonalization, condition number of matrices and sensitivity of solutions linear systems to rounnding errors, QR factorization (Gram-Schmidt, modified Gram-Schmidt, Hausholder triangularization) and its applications to solve linear systems and least squares problems, Krylov subspace methods for solving linear systems of equations

Parallel Computing Architectures

P-ITEEA-0022

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

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, 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

Pharmacology

P-ITMED-0014

Lecture:	3 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	4 credits
Final evaluation:	Exam
Responsible lecturer:	Tóth Pálné Dr. Gyires Klára

Course description:

1. Basic pharmacology: Pharmacodynamics, pharmacokinetics

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

3. Pharmacology of central nervous system (sedatohypnotics, anxiolytics, antidepressive, 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 II.

P-ITMED-0006

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:

Diffusion, polymerization, reptation 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

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.

Programming methodology

P-MIM_T4A

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

Course description:

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.Design patterns of object-oriented programming; creational, structural and behavioural patterns.

Required reading:

Brian W. Kernighan, The Practice of Programming, Pearson (1999);

Weinberg, Gerald M., The Psychology of Computer Programming, New York: Van Nostrand Reinhold.

Quality Assurance

P-ITKOZ-0008

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

Course description:

To work according to qualitity assurance systems is a basic requirement nowadays for the appearance and getting a position in the international market. The course gives an overwiev on the application possibilities of quality assurance (QA) on different fields. The main foci are biotechnology, drug research and development and 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.

Signal Transduction

P-ITMED-0011

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

Course description:

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

Spin 1/2 Quantum Systems

P-ITEEA-0031

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

Course description:

The Spin and the Hamiltoinian Operators. Pure and Mixed State Dynamics. Bloch Equations. The rotating Wave Approximation (RWA). The Jaynes-Cummings Model. The Quantum Master Equation in Lindblad form. The Two-State Atom. Rabi's Problem. Two-State Atom inside a Cavity. Equivalent Circuits. Required reading: Pier P. Civalleri, Marko Gilli, Spin ˝ Quantum Systems: Dynamics and Circuit Models, Politecnico di Torino, 2013 Recommended reading: Pier P. Civalleri, Finite-dimensional open quantum systems, Politecnico di Torino, 2013 Lecturer (name, position, degree): Árpáéd I. Csurgay, Prof. Member HAS and Pier P. Civalleri Prof. Member of ASP Additional lecturers, if exist (name, position, degree): --- A new technology, called "Quantum Technology" is emerging with strong impacts on information technologies and bionics. The potential new applications are "Quantum Cryptography", "Quantum Computing" and "Quantum Biology". Recently, we have been witnessing the "Dawn of Quantum Biology". This course does not deal with these applications, The course is devoted only to introductory theoretical foundations which are needed to understand the emerging engineering literature on Quantum Technologies. 1. Quantum Binary Devices 2. Classical definition of the Cell 3. Classical Dynamics of the Cell 4. Quantum Definition of the Cell 5. Quantum Dynamics of the Closed Cell 6. Quantum Dynamics of the Open Cell 7. Passage to the Rotating Reference Frame 8. Quantum Dynamics in Bloch Space 9. Rabi's Problem 10. Power Dissipation 11. Linearisation 12. The Equivalent Circuit Synthesis

Stochastic Signals and Systems

P-ITMAT-0018

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

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 fillterinG, Identification of AR processes, Identification of MA and ARMA models, Non-stationary models, Stochastic volatility: ARCH and GARCH models

Systems Bioinformatics

P-ITBIO-0048

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

Course description:

Advanced course in systems bioinformatics. The aim of the course is 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. Other important aspect of the course is to give an insight on 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.

Systems Biology: a Bionics Perspective

P-ITBIO-0029

Lecture:	4 hours/week
Practice:	0 hours/week
Lab:	0 hours/week
Course credit:	4 credits
Final evaluation:	Term mark
Responsible lecturer:	Dr. Csikász-Nagy Attila

Course description:

The goal of this course is to highlight elementary design principles inherent in biology. Many of the underlying principles governing biochemical reactions in a living cell can be related to network circuit motifs with multiple inputs/outputs, feedback and feedforward. This course draws on control theory and elementary biology to provide a mathematical framework to understand biological networks. The topics examined in the course are drawn from current research and include: transcription networks, stochastic gene induction, adaptation, oscillators (circadian rhythms), riboswitches, plasticity, metabolism, pattern development and cancer.

Both the time and the dates of the lectures are determined be the University of Notre Dame and thus differ from the routine at PPCU. Students interested are requested to consult Zoltán Gáspári before taking the course.

TOEFL/IELTS/CAE English Exam Preparation

P-ITANG-0005

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

Course description:

The course intends to provide assistance to students who wish to prepare to TOEFL/CAE/IELTS exams. The nesessary background of the above mentioned exams is provided then through appropiate 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 no English speak students. The test result is valid for two years after which it cannot be used for applications since the candidates 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 and Development Project I.

P-ITLAB-0035

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

Course description:

Completing a project work for Computer Engineering MSc students.

Please 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.

Tutored Research and Development Project II.

P-ITLAB-0036

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

Course description:

Completing an advanced project work for Computer Engineering MSc students.

Please 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.

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 students.

Please 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.

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 an advanced project work for Info-Bionics Engineering MSc students.

Please 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.

VLSI design theory and practice

P-ITEEA-0041

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

Course description:

The subject covers the general introduction of the VLSI and in general, the integrated circuit, design aspects. It also includes the manufacturing process, analog and digital design flows, IP blocks and SoC solutions, 3D IC variants and their roles in integration, packaging options and other important properties of the complex topic.