

List of courses in English – WINTER SEMESTER

COMPUTER SCIENCE COURSES								
No	Subject	Lectures	Laboratories	Exercises	Project	Seminar	Rigor	ECTS Grade
1.	Introduction to the Cryptography	16	14	-	-	-	Exam/Pass	4
2.	Basics of Computer Engineering	28	24	8	-	-	Exam/Pass/Pass	8
3.	Basics of Numerical Analysis and Technical Computations	16	-	14	-	-	Pass/Pass	5
4.	Computer Architecture and Operating Systems	16	16	8	-	-	Exam/Pass/Pass	6
5.	Introduction to Computer Networking	16	16	8	20	-	Exam/Pass/Pass/Pass	8
6.	Introduction to Stochastic Processes	15	15	-	-	-	Pass/Pass	3
7.	Probabilistic Analysis	15	15	-	-	-	Exam /Pass	3

List of courses in English – SUMMER SEMESTER

COMPUTER SCIENCE COURSES								
No	Subject	Lectures	Laboratories	Exercises	Project	Seminar	Rigor	ECTS Grade
1.	Project – Cryptography	-	-	-	20	-	Pass	8
2.	Elliptic Curve and its Application in Cryptography	16	14	-	-	-	Pass/Pass	6
3.	Robotics and Computer Vision Systems	28	16	16	-	-	Exam/Pass/Pass	8
4.	Digital Image Processing	16	16	8	-	-	Pass/Pass/Pass	6
5.	Trends in computer technology	20	-	10	-	-	Pass/Pass	2
6.	Statistics	30	30	-	-	-	Exam/Pass	6

List of courses in English

COMPUTER SCIENCE COURSES

Basics of Computer Engineering

ECTS: 8

Lectures: 28h

Exercises: 8h

Laboratories: 24h

Exam / Pass/Pass

Binary system

- Basic concepts
- Binary addition and subtraction
- Binary multiplication and division
- Binary conversion (decimal, hexadecimal)

Basic electronics

- Resistance, inductors, capacitors
- Series and parallel circuits
- Semiconductors: diodes, bipolar and unipolar transistors
- Analog and digital signals, signal generators
- Differential and operational amplifiers
- AD and DA converters
- Serial and parallel digital transmission

Logic gates and functions

- Boolean algebra
- Transistor inverter
- Basic logic gates
- Derived logic functions and gates

Combinational logic

- Arithmetic and logical functions: adders, subtractors, and comparators
- Data transmission: multiplexers, demultiplexers, encoders, and decoders

Sequential logic

- SR NAND latch and SR-NOR latch, clocked latch
- Flip-flops: JK, D, and T

Computer memory

- Types of registers
- Clocks and counters
- CPU's registers and cache memory
- RAM and ROM memory, cells and arrays
- Flash memory

CPU - central processing unit

- Operation: fetch, decode, execute
- Control unit, arithmetic logic unit, memory management unit
- Microprocessors

Computer design

- Turing machine
- Von Neumann architecture
- Architecture of modern personal computers
- Servers and supercomputers

Basics of Numerical Analysis and Technical Computations

ECTS: 5

Lectures: 16h

Exercises: 14h

Pass /Pass/Pass

Basic ideas of numerical analysis. Linear spaces and linear transformations. Norms of vectors and matrices. Floating point arithmetic; round-off errors in numerical computations. Condition of problem. Numerically correct algorithms.

Methods for solving systems of linear algebraic equations. Condition of problem. Gauss elimination with partial and total pivoting, Cholesky-Banachiewicz method.

Linear least-squares problem. Linear problem of mean-square approximation. Eigenvalues and eigenvectors of matrix. Singular value decomposition of matrix. Generalised inverse of matrix. Generalised solution (pseudosolution) of system of linear algebraic equations and of linear least-squares problem. Algorithm of normal equations. Regularisation of ill-conditioned problems.

Computer Architecture and Operating Systems

ECTS: 6

Lectures: 16h

Laboratories: 16h

Exercises: 8h

Exam / Pass/Pass

Computer Architecture

- A brief history of computer engineering
- Personal computer and server architecture
- Modern microprocessors and chipsets
- Volatile computer memory (RAM)
- PCI-E and QPI bus standards
- I/O devices and interfaces
 - graphics adapters
 - SATA and m.2 standards, RAID technology
 - non-volatile computer memory (HDD, SSD)
 - USB vs Thunderbolt
 - Ethernet and InfiniBand

Operating Systems

- Evolution of operating systems
- Windows family
 - Windows NT architecture
 - .NET Framework
 - drivers
- Linux family
 - architecture
 - popular distributions
 - Linux Live CDs: KNOPPIX, Kali Linux
- Networking aspects, web servers (XAMPP)
- Web browser as operating system, web applications

Impact of new trends

- Mobile solutions
- Virtualization
- Cloud Computing
- IoT devices

Digital Image Processing

ECTS: 6

Lectures: 16h

Exercises: 8h

Laboratories: 16h

Pass/Pass/Pass

Basics

- Image acquisition and quantization
- Vector graphics and raster graphics
- Colour space concepts and conversions
- Raster graphics resolution and basic characteristics

Algorithms of Image Processing

- Histogram operations
- Binary and arithmetic operations
- Convolution operations
- Smoothing operations
- Derivative operations
- Morphology operations

Techniques of Image Processing

- Shading correction
- Enhancement and restoration techniques
- Introduction to segmentation

Steganography

- Origin and terminology
- Digital steganography
- Applications

Elliptic Curve and its Application in Cryptography

ECTS: 6

Lectures: 16h

Laboratories: 14h

Pass/Pass

Finite fields theory and their extensions. Elliptic curves over arbitrary fields. Isomorphisms, group of rational points. Arithmetic of elliptic curves. Torsion points of an elliptic curve. Computing discrete logarithm. Implementation of elliptic curves in cryptography. Cryptanalysis of cryptosystems based on elliptic curves.

Labs:

- choosing of an “cryptographically strong” elliptic curve
- counting of group order
- basic operations: adding and doubling
- complexity of algorithms of counting discrete logarithms on elliptic curve
- building of cryptosystems and cryptographic protocols with the use of elliptic curves.

Introduction to Computer Networking

ECTS: 8

Lectures: 16h

Exercises: 8h

Laboratories: 16h

Project: 20h

Exam/Pass/Pass/Pass

Computer Networks and the Internet

- Internet and Networks Protocols
- The Network Edge: End Systems, Clients, and Servers

- The Network Core: Switching and Routing
 - Internet Backbones: NAPs and ISPs
- Application Layer
- Application Layer Protocols
 - WWW and HTTP
 - File Transfer: FTP
 - SMTP
 - DNS – The Internet’s Directory Service
 - Socket Programming with TCP & UDP
- Transport Layer
- Services and Principles
 - UDP & TCP
- Network Layer and Routing
- Routing Principles
 - IP - Internet Protocol
 - Routing in the Internet
 - IPv4 vs. IPv6
 - Multicast Routing
- Link Layer and LAN
- Services
 - LAN Addresses
 - Ethernet
 - Bridges and Switches
 - 802.11 LANs
 - PPP: Point-to-Point Protocol
 - ATM
- Multimedia Networking
- Real Time Streaming Protocol (RTSP)
 - QoS
 - RSVP
- Security in Computer Networks
- Network Management

Introduction to the Cryptography

ECTS: 4

Lectures: 16h

Laboratories: 14h

Exam/Pass

Introduction to the cryptology and basic terms. Definition of cryptography and cryptanalysis. Shannon’s theory of information. Modern cryptosystems: stream ciphers, block ciphers, hash functions. Basic cryptanalysis. Public key cryptography: Diffie-Hellmann scheme, the RSA cryptosystem. Cryptographic protocols: confidentiality, integrity, non-repudiation, key exchange. Digital signatures. Contemporary cryptology and its applications: electronic cash, GSM, PINs and more.

Labs:

- implementation of cryptosystems:
 - simple substitution/permutation ciphers
 - stream ciphers
 - block ciphers
 - hash function
 - public key cryptosystems
 - cryptographic protocols
- basic cryptanalysis.

Introduction to Stochastic Processes

ECTS: 3

Lectures: 15 h

Laboratories: 15 h

Pass/Pass

Content:

The basics of probability theory. Discrete and continuous time Markov chains. First step analysis: gambler's ruin and successful runs. Branching processes. Poisson processes. Birth-and-death process. Queueing processes. Applications of the standard concepts and methods of stochastic modeling: choosing appropriate stochastic process for specific situation; applying stochastic analysis to realistic problems.

Probabilistic Analysis

ECTS: 3

Lectures: 15h;

Laboratories: 15h;

Exam /Pass

Content:

Probability space as a model for phenomena with statistical regularity.
Naive and axiomatic definition of probability.
Conditional probability; Bayes' Theorem, independence of events and Simpson's paradox.
Bernoulli, Binomial, Hypergeometric, Poisson distributions.
Indicator r.v.s, continuous random variables and exponential distribution.
Inequalities of: Cauchy-Schwarz, Jensen, Markov, Chebyshev and Chernoff.
Analysis of problems under uncertainty; the structuring, processing, and presentation of probabilistic information.
Applying the probability methods to quantify uncertainty and update beliefs given the appropriate models. Using of discrete and continuous distributions as models for real-world phenomena.

Robotics and Computer Vision Systems

ECTS: 8

Lectures: 28h

Exercises: 16h

Laboratories: 16h

Exam/Pass/Pass

Introduction to Computer Vision

- General overview of computer vision systems (pre-processing, feature extraction, segmentation, classification, interpretation and description)
- Image processing, analysis and understanding
- Segmentation techniques
- Regular and irregular patterns identification methods
- Computer monitoring work-station for robots

Computer Vision Applications (non robotics)

- Regular and irregular objects recognition
- Handwriting recognition, postal codes recognition
- Biometrics identification

Introduction to Robotics

- Positions, orientations, and 3D frames
- Denavit-Hartenburg convention
- Forward kinematic solution
- Inverse kinematic solutions

- Velocities and static forces
- Trajectory generation in Cartesian space
- Robot languages & task planning
- Overview of Example robotic systems

Computer Vision Applications to Robotics

- Robot programming language
- Object recognition (scene analysis) and manipulation tasks
- Analysis of Example computer monitoring robot's work-stations
- Applications of selected computer vision methods to robotics

Trends in computer technology

ECTS: 2

Lectures: 20h

Exercises: 10h

Pass/Pass

The origins and history of computer engineering

- Early calculating tools
- Mechanical solutions
- Electro-mechanical computers
- Electronic digital computers
- Turing machine and Von Neumann architecture

Modern personal computers and servers

- PC architecture
- Servers architecture
- Data centres and HPC systems

Obsolete and modern computer buses in details

- ISA, PCI, and PCI-E buses
- QPI and Infinity Fabric
- PATA and SATA standards, m.2 expansion
- RS-232, USB, and Thunderbolt

Development trends in:

- Microprocessors
- Memory and storage devices
- Graphics processing units and cards
- Motherboards and I/O devices

IT market and new trends in computer technology

Statistics

ECTS 6

Lectures: 30h

Laboratories: 30h

Exam/Pass

Content:

Subject of statistics:

Data classification and graphic presentation. Frequency distributions. Measures of central tendency and variation. Dynamical analysis of phenomena. Analysis of correlation. Analysis of regression. Elements of probability. Random variable. Parameter's of random variable. Correlation and covariance. Fundamental distributions of random variables. Normal Distribution. Basic statistics. Distributions of selected statistics. Interval estimation. Verification of parametric hypotheses. Verification of nonparametric hypotheses.