UNIVERSITY of the PELOPONNESE
FACULTY of
ECONOMY and
TECHNOLOGY

DEPARTMENT of INFORMATICS and TELECOMMUNICATIONS

UNDERGRADUATE STUDIES GUIDE

2024–2025

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Department of Informatics and Telecommunications

Undergraduate Studies Guide

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1 The University of the Peloponnese

1.1 Presentation

The University of the Peloponnese (UoP) was founded in the year 2000. In 2019 the Technological Educational Institute (TEI) of the Peloponnese and some Departments of the TEI of Western Greece were integrated in the UoP and a restructuring took place. The headquarters of the University are located in Tripoli, while its departments are developed in the five capitals of the Peloponnese prefecture (Tripoli, Corinthos, Nafplio, Sparta, Kalamata) as well as in Patras.

The University was inaugurated on the 20th of September 2002. Since then, the University of the Peloponnese has managed to employ prestigious academic staff and to create an important network of European and international cooperations.

A central goal of the University of the Peloponnese is to contribute to the development of higher education in the prefecture of the Peloponnese, through the adoption of high quality standards regarding the content of education, the research and the teaching activities, corresponding to the requirements of a modern university of national, European and international scope.

1.2 Faculties and Departments

The departments are the fundamental academic units of the University of the Peloponnese, and groups of related departments are organised into faculties. The academic structure of the University of the Peloponnese, which contains 9 faculties and 22 departments, is as follows:

- **Faculty of Economy and Technology**
  - Department of Informatics and Telecommunications (Tripoli)
  - Department of Economics (Tripoli)
  - Department of Management Science and Technology (Tripoli)
  - Department of Digital Systems (Sparta)
- **Faculty of Humanities and Cultural Studies**
  - Department of Philology (Kalamata)
  - Department of History, Archaeology and Cultural Resources Management (Kalamata)

- **Faculty of Social Sciences**
  - Department of Social and Educational Policy (Corinthos)
  - Department of Political Science and International Relations (Corinthos)
- **Faculty of Fine Arts**
  - Department of Theatre Studies (Nafplio)
  - Department of Performing and Digital Arts (Nafplio)
- **Faculty of Human Movement and Quality of Life Sciences**
  - Department of Sports Organisation and Management (Sparta)
- **Faculty of Health Sciences**
  - Department of Nursing (Tripoli)
  - Department of Speech Therapy (Kalamata)
  - Department of Nutrition Science and Dietetics (Kalamata)
  - Department of Physiotherapy (Sparta)
- **Faculty of Γεωπονίας και Τροφίμων**
  - Department of Agricultural Technology (Kalamata)
  - Department of Food Science and Technology (Kalamata)
- **Faculty of Management**
  - Department of Business Administration (Kalamata)
  - Department of Accounting and Finance (Kalamata)
- **Faculty of Engineering**
  - Department of Electrical and Computer Engineering (Patras)
  - Department of Mechanical Engineering (Patras)
  - Department of Civil Engineering (Patras)

1.3 Student Services

Students have access to all the facilities and services offered by the University of the Peloponnese.

1.3.1 Dining services

Dining services are provided to students in specially designed facilities of the University of the Peloponnese or in dining areas of contracting entities in the cities where there Departments of the University are located. Dining services are provided to students every day of the week during the whole academic year (1st of September–30th of June), excluding the Christmas and Easter holidays. In case of extension of the academic year, students dining services are also extended correspondingly.

1.3.2 Counseling and Psychological Support Structure – WeCare

The Counseling and Psychological Support Structure – WeCare of the University of Peloponnese aims to provide free counseling and psychological support services to its students.

The Counseling and Psychological Support Structure – WeCare has been staffed with specialized scientific staff and provides its services to undergraduate, postgraduate and doctoral students in order to best meet their psychosocial needs.

The services offered include:

- Counseling and psychological support for students from sensitive social groups.
- Social counseling.
- Recording and monitoring of student requests and problems.
- Individual or group counseling for students experiencing occasional concerns about personal or developmental issues and adjustment problems.
- Support services that help students utilize their potential/skills in their academic and personal spaces.
- Support for students with special educational needs.

All services are provided free of charge and with absolute confidentiality, respecting the code of ethics for the protection of the personal data of the students served.

Meetings with students take place after a telephone appointment, or after a visit to the Student Counseling and Psychological Support Structure (office B0.16 on the ground floor of the upper building of the Faculty of Economy and Technology in Tripoli) from Monday to Friday, morning hours 09:00 to 14:00 and evening hours 15:00 to 19:00.

More information and ways of communication about the WeCare Structure can be found on its website, https://wecare.uop.gr/.

1.3.3 Healthcare

All students (undergraduate, postgraduate and doctoral) enrolled in Higher Education Institutions, who do not have other medical, pharmaceutical and hospital insurance, are entitled to full medical, pharmaceutical and hospital care in the Greek National Health System.

For these students, the issuance of the European Health Insurance Card, as well as the reimbursement of any costs that may arise, are carried out by their University.

1.3.4 Transportation

Students are entitled to reduced fares on public transport. Beneficiaries are:

- Full-time undergraduate students who do not already hold another degree, for the number of academic years required to obtain their degree according to the indicative study program increased by two (2) academic years.
- Part-time undergraduate students who do not already hold another degree, for twice as many academic years as are required to obtain a degree according to the indicative study program.

- Postgraduate students who do not already hold a master's degree, for the number of calendar years their studies last according to the respective indicative program of the second cycle of studies.
- Doctoral students who do not already hold a doctoral degree, for five (5) calendar years from the date of their registration.
- Foreign students who study in Greek universities within the framework of the "Erasmus+" programme, for the duration of their studies in Greece.

Reduced fares are available for unlimited journeys of public urban and long-distance, road and rail transport as follows:

- At most 50% on the price of the normal fare on urban transport in the city where the department the beneficiary is studying is located.
- At a maximum of 75% on the price of the normal fare on urban transport in the rest of the country.
- Up to 50% on the price of the regular fare for long-distance road transport connecting the city of the department where the beneficiary is studying with his place of permanent residence.
- At a maximum of 75% on the price of the normal fare on the rest of the country's long-distance road transport.
- At a maximum of 50% on the price of the normal fare on rail transport connecting the city of the department where the beneficiary is studying with his place of permanent residence. The discount also applies to the case in which the rail transport is part of the total route connecting the department headquarters with the student's place of permanent residence.
- At a maximum of 75% on the price of the normal fare on the rest of the country's railway transport.

The right to a reduced ticket is valid for the whole year from September 1st to August 31st and until the point in time when the student graduates or loses his student status for any reason. It is interrupted for as long as the beneficiary serves his military service, or suspends or interrupts his studies, or completes the upper limit of the duration of the reduced fee provision in accordance with the above.

1.3.5 Career Office

The mission of the Career Office is to ease the students of the University to enter the modern and highly-competitive educational and professional arena; it supports the students so that they can manage and plan their educational and professional route, as well as they can progress in a personal, professional, and social aspect. Specifically, the Career Office provides the students with the following services:

- Information on postgraduate programmes.

- Information about scholarships, seminars, and conferences.
- Information on professional issues and available jobs.
- Support in the drafting of a CV and the corresponding cover letter.
- Preparing for a job interview selection.
- Support for entrepreneurship and innovation issues.

Additionally, the career office organises events and conferences, and participates in exhibitions, aiming to act as a channel of communication between the students of the University, the market, and the society at large. Through these actions, the career office aspires to put into sight the scientific work of the University of the Peloponnese and the whole range of knowledge and skills acquired by its graduates.

2 The Department of Informatics and Telecommunications

2.1 Presentation

The Department of Informatics and Telecommunications, part of the Faculty of Economy and Technology of the University of the Peloponnese, was established in 2013 from the merging of the Department of Computer Science and Technology and the Department of Telecommunications Science and Technology. The Department of Informatics and Telecommunications accepted students for the first time in the academic year 2013–2014; the former departments were the first to run in the University of the Peloponnese and accepted their first students on the academic year 2002–2003.

Every year, the Department of Informatics and Telecommunications welcomes around 240 undergraduate and 50 postgraduate students, which follow a modern curriculum. An important objective is the active participation of the students in the activities of the Department, in order to acquire a sound scientific basis and a strong research and practical experience in the various areas of Informatics and Telecommunications. The professional rights of the graduates of the Department of Informatics and Telecommunications are equivalent to the rights of the graduates of the relevant Greek University departments.

The Department aims towards the development of intense research activity in various areas of Informatics and Telecommunications, and towards participating in national and European competitive research and development projects to attract external resources. The research staff of the Department have a large number of published papers in leading scientific journals, have developed important national cooperations with related departments abroad, and participate in scientific committees of prestigious international magazines and conferences.

The Department is housed in the buildings of the Faculty of Economy and Technology, located 2 km from the city center, near the St. George grove. A regular bus service links the Department with the city center and the main bus station.

The Department's contact details are:

Department of Informatics and Telecommunications
Faculty of Economy and Technology
University of the Peloponnese

Akadimaikou G. K. Vlachou Street
GR-221 31 Tripoli, Greece

Tel.: +30 2710 372292–94

WWW: https://dit.uop.gr/
Email: dit-secr@uop.gr

2.2 Personnel

2.2.1 Professors / Lecturers

Name	Rank	Phone	Email
Athanasiadou, Georgia	Associate Professor	2710 372217	gathanas@uop.gr
Vassilakis, Costas	Associate Professor	2710 372203	costas@uop.gr
Yiannopoulos, Konstantinos	Associate Professor	2710 372204	kyianno@uop.gr
Glentis, George-Othon	Professor *Head of the Department*	2710 372202	gglentis@uop.gr
Wallace, Manolis	Associate Professor	2710 230133	wallace@uop.gr
Kaloxylos, Alexandros	Professor	2710 372205	kaloxyl@uop.gr
Kolokotronis, Nicholas	Professor	2710 372231	nkolok@uop.gr
Lepouras, George	Professor	2710 372201	gl@uop.gr
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Tselikas, Nikolaos	Professor	2710 372216	ntsel@uop.gr
Tsoulos, George	Professor	2710 372267	gtsoulos@uop.gr

2.2.2 Laboratory teaching staff

Name	Phone	Email
Dimitroulakos, Grigoris	2710 372263	dhmhgre@uop.gr
Zarbouti, Dimitra	2710 372181	dzarb@uop.gr
Kapellaki, Sofia	–	skapellaki@go.uop.gr
Kostopoulos, Paris	2710 372241	parkost@uop.gr
Batistatos, Michael	2710 372282	mbatist@uop.gr
Raftopoulou, Paraskevi	2710 372262	praftop@uop.gr
Seklou, Kyriaki	2710 372268	kseklou@uop.gr

2.2.3 Adjunct Lecturers

Name	Email
Giannakopoulou, Georgia	g.giannakopoulou@go.uop.gr
Doumouras, Andreas	a.doumouras@go.uop.gr

2.2.4 Administrative and technical staff

Name	Position	Phone	Email
Kyriazi, Giota	Postgratuate secretary	2710 372292	giotak@uop.gr
Nekidou, Aggeliki	Undergraduate secretary	2710 372297	anenekidou@uop.gr
Talaganis, Nikolaos D.	Head secretary	2710 372293	ntalagan@uop.gr
Tsafara, Afroditi	Postgratuate secretary	2710 372299	atsafara@uop.gr

2.3 Infrastructure

The Department is equipped with modern facilities for teaching, research and training seminars, and research laboratories, as well as with laboratories for the training of the students.

2.3.1 Classrooms

The Department uses 9 classrooms and the auditorium in the two buildings of the Faculty of Economy and Technology. One of the classrooms is a videoconference room that can also be used for distance learning activities.

2.3.2 Library and reading room

The Library of the Faculty of Economy and Technology[1] is housed in the upper building of the Faculty since the academic year 2013–2014. The Library includes a large number of scientific

[1] http://library.uop.gr/vivliothikes/kentriki-vivliothiki/, in Greek.

books and journals, as well as copies of courses' textbooks. Students can borrow the library items at will.

In the area of the Library, there is also a 52 seat capacity reading room equipped with modern personal computers that can serve students' needs.

Finally, through the Association of Greek Academic Libraries, the academic community of the Department may have electronic access to full-text articles in more than 8,500 international journals.

2.3.3 PC and hardware laboratories

The Department possesses three PC laboratories, which students may use according to their studying requirements. These laboratories are also used for conducting the laboratory courses offered by the curriculum of the Department.

The PC laboratories are equipped with modern, up-to-date computers (75 workstations in total), while a central printer is also available for use by the students. The computers are provided with software that includes office applications, application development, web design, image processing, graphics design, system analysis and modelling, mathematical applications and programming languages.

Furthermore, the Department possesses laboratories equipped to support hardware-related courses (Electronics, Logic Design, Circuit design, etc.)

2.4 Research and teaching laboratories

The following laboratories have been established to cover the teaching and research needs of the Department of Informatics and Telecommunications.

Computing Systems Laboratory

The laboratory is equipped with 16 high performance workstations and 8 backup workstations. The computers are provided with the Matlab simulation and algorithm development software (including Simulink and the relevant toolboxes), hardware design software by Mentor Graphics, Synplicity, Impulse Accelerated Technologies, Xilinx and Altera, as well as software development environments for ARM, Texas Instruments and Intel processors. Furthermore, development boards with Xilinx, ARM926EJ-S FPGAs and TI C6455 processors are available. The laboratory also provides equipment for the implementation of digital circuits with the use of discrete embedded circuits, digital oscilloscopes, signal generators and power sources.

Members: S. Blionas, K. Masselos

Knowledge and Uncertainty Laboratory

ΓAB LAB - Knowledge and Uncertainty Research Laboratory is an interdisciplinary research team focusing on areas of applied informatics ranging from cultural, educational, and medical informatics to smart cities and applications for the environment. As far as basic research is concerned, focus is on data analytics, management of uncertainty, semantics, machine learning and fuzzy mathematics.

The lab comprises around 60 members, including professors, senior researchers, postdoctoral, doctoral, graduate and undergraduate students, external collaborators and volunteers.

The lab's social footprint includes Innovation ΓAB LAB, a non-for-profit organization it has founded in collaboration with municipalities from the Prefecture of Peloponnese with the aim to benefit society, with an emphasis on the younger generations.

Members: M. Wallace

https://gav.uop.gr/

Software and Database Systems Laboratory

The Software and Database Systems Laboratory (SoDa Lab) supports both research and teaching activities within the Department of Informatics and Telecommunications. More specifically, the SoDa lab:

- develops research activities in state-of-the-art areas related to software systems and databases, including information representation and management (in areas pertaining to information retrieval/filtering, knowledge bases, information semantics), distributed computing (mainly cloud, grid and multi-agent systems), databases with special features (such as NoSQL, graph, spatial, and temporal), big data and data streams, artificial intelligence, service-oriented computing as well as related applications (including, e-government, e-health, and digital libraries);
- coordinates and implements R&D projects funded under Greek/European funding bodies, or under private/public institutions, while its members participate in many national and international projects/collaborations with top research institutions;
- provides a workplace for PhD candidates, postgraduate students, and affiliated researchers who specialize on areas relevant to the laboratory's interests;
- provides the necessary infrastructure in terms of manpower and hardware/software for supporting a number of undergraduate (such as Databases, Big Data Management, Information Retrieval & Mining, Systems programming, Operating systems, Software Engineering, Data Management Systems, Programming) and postgraduate (such as Big Data Systems, Distributed/Web Information Management, Internet Programming, Netcentric Computing, Data/Knowledge Management) courses related to software and database systems;
- is equipped with state-of-the-art workstations provided with specialized software including software development environments, database management systems, libraries for developing parallel/distributed applications, an intra-grid and a private cloud environment, as well as environments for distributed execution of programs.

Members: C. Vassilakis, S. Skiadopoulos, C. Tryfonopoulos, P. Raftopoulou, G. Dimitroulakos

https://soda.dit.uop.gr/

sodaslab

soda-lab

sodasLab

Human-Computer Interaction and Virtual Reality Laboratory

The Human-Computer Interaction and Virtual Reality Lab aims to support the research and teaching requirements of the department in issues related to the analysis, design, development, and evaluation of HCI and VR systems and applications. The Lab participates in national and international research projects, in the development of applications for culture, cybersecurity and video games.

Members: G. Lepouras, N. Platis, S. Kapellaki

https://hci-vr.dit.uop.gr/

hci.uop

Signal and Image Processing Laboratory

The laboratory is equipped with 10 workstations comprising of DSP development suite for analysis and verification of algorithms and real-time applications on the field of digital signal processing and telecommunications (e.g., broadband xDSL applications, OFDM, 802.11 WLAN), for algorithm evaluation and requirement's assessment on digital processing applications, TMS320C6711 (DSP Starter Kit), TMS320C6701 (Evaluation Module-EVM), Code Composer Studio and Spectrum analyzer. The lab also includes workstations with MATLAB and System View software, as well as workstations for image and video processing, equipped with suitable peripherals (4 cameras, 1 video) and image and signal processing software (Matlab, Adobe Premiere).

Members: G.-O. Glentis

Wireless and Mobile Communications Laboratory

The research area of the Lab is the Wireless and Mobile Communications and the relevant scientific subjects, such as Measurements of wireless telecommunication systems and networks (Land and airborne with drones, Radiocoverage and radiolink quality (air-interface), Narrowband and Wideband Radiochannel, Electromagnetic radiation), Wireless transmission. Development of stochastic and deterministic models Ray Tracing, Antennas,Smart Antennas and (um)MIMO systems, Wireless digital transmission techniques, Mobile and wireless communications Systems and Networks, Performance-Design and Dimensioning of wireless communications networks, Wireless communications in sub-6GHz, mmWave, sub-THz, and THz band, Wireless communication systems with Drones and applications, IoT systems and applications, Smart power grids and (e)V2X communications.

The lab has modern specialized measurement equipment which is constantly updated through National and European projects and supports measurements in state-of-the-art wireless communication systems (5G-6G) with Drones/UAVs up to 25kg fully equipped with autonomous navigation capabilities, three NARDA portable frequency selective SRM3006 with 5G, two fixed NARDA broadband up to 40GHz and fixed frequency selective station up to 6GHz, two Scanners up to 5G and 6GHz, complete measurement system from Enhancell (Echo One/Plus/Studio) with eight 5G testmobiles, complete measurement system from Nemo/Keysight with Outdoor and Handy testmobiles, IoT platform with Raspberry pi4 και z-wave/zigbee/WiFi/4G sensors, as well as lab instruments like signal generators, spectrum analyzers, vector analyzer, antennas, servers, computers etc.

The Lab supports courses and final year projects at undergraduate and postgraduate level for the MSc program on Modern Wireless Communications. Furthermore the Lab participates in R&D projects both national (e.g. Thalis-INTENTION, NSRF-PANDORA) and European (H2020: BIMERR, MERLON, SYNERGIES, COREnect).

Members: G. Tsoulos, A. Kaloxylos, G. Athanasiadou, D. Zarbouti

- http://wmclab.uop.gr/
- wirelessuop
- wireless-uop

Optical communications laboratory

The laboratory provides 10 workstations equipped with optical communications training packages, several types of optic fibers, connectors, fiber cutting equipment, welding instrument, back-reflection meter, loss measuring instrument, OTDR instrument, laser diodes, current source/temperature stabilizer, optical power meter, optical spectrum analyser, optical amplifier, resonating filter, photodiodes, electronic components, oscilloscope, and simulation software.

Members: A. Stavdas, P. Kostopoulos

Communication Networks and Network Applications Laboratory

The Communication Networks and Network Applications Laboratory carries out research activities in the field of network applications and services, wireless networks and communications, performance analysis of network mechanisms and wireless optical networks. The members of the laboratory teach and support relevant courses at the Department of Informatics and Telecommunications of the University of the Peloponnese. The laboratory participates in relevant national and international research programs and publishes the results of its research in international scientific journals and conferences.

Members: K. Yiannopoulos, I. Moscholios, N. Tselikas, K. Seklou

- https://cnalab.uop.gr/

Cryptography and Security Laboratory

The Cryptography and Security Laboratory of the Department of Informatics and Telecommunications, University of the Peloponnese, was established in 2018. The Lab's mission is to support the Department's academic programs and perform high–quality research by combining theory with practice in cutting-edge areas, which include but are not limited to:

- Applied cryptography, post–quantum cryptography, lightweight cryptography, blockchain and distributed ledgers, homomorphic encryption;
- Systems and network security, intrusion detection/response, cyber-security, IoT security, cyber-ranges, cyber-security training, semantic/provable security;

- Risk/threat modelling, dynamic risk/trust management, vulnerability assessment, threat forecasting, cyber-security incident response, cyber-threat intelligence.

The CryptoSec Lab has 24 members, namely 1 faculty member, 3 senior researchers, 6 PhD candidates, 4 junior researchers, and 10 MSc/BSc students, participating in its research activities. The lab has developed a broad national and international collaboration network, with well-known cyber-security organizations, companies and research groups, that is evidenced by the number of projects. More precisely, the lab's members have been actively involved in more than 26 EU-funded and national projects by coordinating and technically managing the projects or by leading various research and innovation activities relevant to the team's broad expertise.

The CryptoSec Lab has an excellent technological infrastructure, which is constantly renewed; in particular, it owns and operates:

1. a high-performance rack-mounted server of 512GB total memory, with 64 execution cores (128 threads) and 16TB storage;
2. a fully equipped lab with 12 high-performance workstations and specialized in-house developed SW being at the team's disposal for various research and innovation activities;
3. a cyber-security training platform offering a large number of VMs for conducting hands-on exercises in various security domains.

Members: N. Kolokotronis

Digital Communications and Systems Laboratory

Digital Communications and Systems Lab utilizes state-of-the-art equipment, covering a wide scientific area in telecommunication systems. It is supported by experienced academic staff, offering high level educational services at undergraduate and postgraduate level, while conducting innovative research in hot scientific areas.

DCS Lab uses the following equipment:

- Desktop PCs and servers
- Microcomputers– Raspberry boards and components
- Microcontrollers - Arduino boards and components
- Satellite equipment
- Spectrum analyzers
- Digital Oscillators
- Electronics
- Specialized software for telecommunications and measurements
- Software defined radio (SDR)
- Quadqopters (UAVs/Drones)
- Fixed-Wing autonomous aircraft (UAV)
- Unmanned vehicles (UxVs) systems and applications

DCS lab conducts also research in hot scientific areas. The main research topics are:

- Digital communication systems
- Satellite systems and networks
- Current and future systems of mobile communications (4G, 5G, 6G)
- Sensors networks, IoT, smart cities
- Machine learning techniques for telocommunications
- Information theory focused on telecommunications
- Telecommunications theory, modulation techniques, signal estimation and detection
- Simulation of Telecommunication systems
- Digital communications for optical-wireless communication systems
- MIMO systems
- Multihop netowrks tranmsission techniques and cooperation protocols
- Physical layer security
- Digital communications based on electricity transfer lines
- Telecommunications embedded systems
- Molecular communications
- Green communications based on energy harvesting systems
- Unmanned automous vehicles (UAVs/DRONES): Systems and applications

Μέλη: N. Sagias, K. Peppas, M. Batistatos

https://telecom.uop.gr/

UOP.DCS.LAB

2.5 Participation in the Erasmus+ Programme

The Department of Informatics and Telecommunications encourages European academic cooperation and participates in LLP **Erasmus+** programme.

Under the Erasmus+ programme both undergraduate and postgraduate students can move (a) for studying at universities that have a bilateral agreement with the Department of Informatics and Telecommunications or (b) for internship at a cooperating institution or company. In the first case, students can enrol to courses or develop part of their final thesis in any of the EU countries, while in the second case students can deal with a topic that is associated with the object of their studies. Note finally, that the Department also cooperates with International higher education institutions in Asia, North Africa, and other areas.

Today the Department of Informatics and Telecommunications has bilateral agreements with 30 European universities[1] under the Erasmus+ programme.

Over the recent years, more than 36 students of the Department of Informatics and Telecommunications accomplished part of their undergraduate studies in EU universities under the Erasmus and Erasmus + programmes. In addition, since the beginning of the internship programme,

[1] https://erasmus.uop.gr/images/stories/files/dimereis/tmima-pliroforikis-kai-thlepikoinonion.xls

8 of them had the opportunity to work for a short period of time at European institutions and companies. The respective incoming students were 11.

The **Erasmus Office**[1] along with the **responsible moderators** of the Erasmus programme at the Department[2] are the ones advising the participants about the mobility programmes and helping them cope with both the substantive issues relating to academic topics and necessary formalities.

Under the Erasmus+ programme, there is also the opportunity for the research staff of the Department to move for short periods of time in European universities to teach and also, deepen in practice the relations of the University of the Peloponnese with universities around Europe.

Finally, in the context of bilateral agreements of the Erasmus+ programme, the Department of Informatics and Telecommunications welcomes teachers from various universities in Europe, who teach in the undergraduate and postgraduate courses.

2.6 Professional Rights of Graduates

The graduates of the Department, based on the general and specialized scientific knowledge they acquired during their studies, have a knowledge background related to computer hardware and software for the collection, classification, processing and transmission of information, and have the ability to engage in activities such as study, design, analysis, implementation, installation, supervision, operation, evaluation, and certification in the scientific fields:

1. computer hardware and software,
2. computer science,
3. communication systems and networks, telecommunications services and internet applications and
4. systems and applications, graphics, signal processing, image processing and speech processing,
5. telecommunication systems and networks.

In addition, they may engage in, for example:

1. teaching in Higher Education Institutions, secondary education and technical and professional training, public and private, at a theoretical, technological and applied level in the scientific fields of information technology and telecommunications listed above,
2. research in public and private research centers in the scientific fields listed above at a theoretical, technological and applied level,
3. offering services to IT, networks, computer and technical departments of ministries, public organizations, to electronic communications companies, in the banking, insurance, medical sector, in the mass media, in audiovisual production and processing companies, in transport, shipping, tourism, business consulting and high-tech companies.

[1] https://erasmus.uop.gr/

[2] For the current academic year, these are I. Moscholios, N. Tselikas and K. Peppas.

3

Curriculum Layout

3.1 Introduction

The Department of Informatics and Telecommunications offers a modern and competitive study programme, that incorporates the international developments of the respective fields. The curriculum aims to provide students with basic knowledge and skills on informatics and telecommunications, as well as with specialised knowledge so that they acquire a sound scientific background and be able to fully cope with the increasing demands of the associated industry.

3.1.1 Aims

The aims of the curriculum are, in more detail, the following:

- To inspire the students on the subjects they have chosen to study and to create an interesting and fruitful learning experience for them.
- To develop knowledge, understanding and abilities in informatics and telecommunications and related technologies.
- To provide the students with the knowledge and abilities necessary for them to evolve into competent professionals.
- To provide the students the opportunity to get in touch with the most recent and innovative scientific and technological advances in informatics and telecommunications.
- To provide education and learning through a multitude of educational activities, in order to develop abilities that will be applicable to the professional career.
- To prepare the students for further work and research in informatics and telecommunications.
- To provide the students with the knowledge and abilities necessary for them to be able to form scientifically sound solutions to problems pertaining to informatics and telecommunications.

3.1.2 Principles

The structure of the curriculum follows the guidelines of the main international scientific and professional associations on Informatics and Telecommunications, the ACM and IEEE. It incorporates the accumulated experience of the faculty of the Department, as well as the recommendations of the Accreditation Report of the Undergraduate Curriculum in 2019 and the earlier findings of the External Evaluation Report of the former Department of Computer Science and Technology, which was merged with the Department of Telecommunications Science and Technology to form the Department of Informatics and Telecommunications.

3.1.3 Learning Outcomes

Students of the Department of Informatics and Telecommunications that have successfully graduated will:

Knowledge and understanding

LO1.1. Have acquired the necessary knowledge on working principles on the fields of information and telecommunication systems, networks, services and applications.

LO1.2. Know the fundamental issues of the disciplinary fields of Informatics and Telecommunications and will be able to propose scientifically grounded and innovative solutions in the field of ICT applications, as well as to estimate the cost-benefit ratio of each solution.

LO1.3. Understand the principles of economical and managerial aspects of running projects related to Informatics and Telecommunications.

LO1.4. Understand issues related to social, legal, educational end ethical aspects of Informatics and Telecommunications.

Application of knowledge and understanding

LO2.1. Be capable of applying their knowledge and understanding so as to become effective professionals.

LO2.2. Possess appropriate skills to develop sector-specific solutions.

LO2.3. Have the ability to apply the theories of informatics and telecommunications in modern information & telecommunication systems, as well as in related research areas.

LO2.4. Have the potential to recognize the tools and techniques suitable for the problems at hand and apply them effectively, so as to successfully complete complex projects.

LO2.5. Be able to conduct experiments that involve tests and measurements, as well as analyze, interpret and present the produced results.

LO2.6. Have the ability to undertake and successfully execute projects both as individuals and as members of a technical team.

LO2.7. Be capable of working effectively in a team in order to manage, design, test certify the performance of ICT systems.

Judgement

LO3.1. Will be capable of recognizing, formulating and solving problems in the design, management and evolution of informatics and telecommunications systems.

LO3.2. Have the potential to carry out experimental testing and assess the performance of ICT hardware/software, as well as evaluate the extent to which an implemented system conforms to its specifications.

LO3.3. Understand scientific and technical publications and be able to formulate their personal opinion on their importance and implications.

LO3.4. Be able to retrieve and use bibliographical sources, standards and regulations concerning scientific issues, products and systems.

LO3.5. Have the capability to formulate holistic views, considering scientific, social and ethical aspects of the problem at hand, and be aware of the ethical aspects relevant to their professional, research and development activities.

LO3.6. Demonstrate insight into the potential limitations of technology, the role it plays in the society and the personal responsibility on its use, including social, economic, environmental and work aspects.

LO3.7. Be able to determine their needs to acquire new knowledge and continuously extend their knowledge and skills.

Communication

LO4.1. Be proficient in communicating problems, ideas, solutions, technical information effectively and efficiently, in writing and orally, to both specialist and non-specialist collocutors.

LO4.2. Have the capability produce technical reports on the activities carried out and present summaries of the key results in group discussions.

Learning

LO5.1. Be able to recognize and adapt to new methods, techniques and instruments used in all phases of ICT systems' and applications' lifecycle.

LO5.2. Have the capacity to follow scientific and technological developments in the ICT domain and determine needs for further knowledge acquisition and skill development.

LO5.3. Have the potential to continue further studies in all fields of informatics and telecommunications.

3.1.4 ECTS

The curriculum conforms with the specifications of the *European Credit Transfer and Accumulation System* (ECTS)[1]. In this framework, detailed courses specifications aligned with the

[1] https://education.ec.europa.eu/education-levels/higher-education/inclusive-and-connected-higher-education/european-credit-transfer-and-accumulation-system

ECTS standards are provided in Chapter 4. These specifications thoroughly describe the aims and the expected learning outcome of each course, along with the teaching and evaluation methods.

A vital component of the ECTS is the estimation of the workload (e.g., lecture attendance, dealing with projects, study, examinations) required by the students in order to achieve the expected learning outcome for the relevant course. This is measured using the *ECTS units*: 60 ECTS units represent the workload for one academic year, while 1 ECTS unit corresponds to 25–30 working hours.

3.1.5 Specializations

The elective courses of the programme are classified into two different specializations, the **Specialization in Informatics** and the **Specialization in Telecommunications**.

Students may choose among these two specializations by selecting more courses of the relevant specialization; they may also choose to not follow any of the two specializations, in which case they are free to select elective courses as they wish. The obligations for these two choices are described in detail in Section 3.3.

It should be noted that the degree of the Department of Informatics and Telecommunications is common for all its graduates, and any specialization chosen does not appear on the certificate. The relevant information is indicated on the final grade transcript and on the diploma supplement[1].

Specialization registration

The student is expected to choose a specialization when s/he has reached the 5th semester; the choice of the specialization is performed together with the enrolment to courses. The available options are:

- Specialization in Informatics
- Specialization in Telecommunications
- No Specialization

This choice can be changed only at the end of the studies, through student's application during the studies completion application procedure (please refer to the *Procedures Guide*).

It must be noted that the specialization choice (or the choice of not having a specialization) is compulsory in the 5th semester, but it only affects the characterisation of the courses appearing on the student's detailed transcript (i.e. which of the courses will be mentioned as specialization core courses or specialization elective courses). If the student later on decides to change his choice, s/he should succeed to courses according to his/her new choice and s/he will be able to declare the new choice on his/her studies completion application, so that it be indicated on the final degree transcript and the diploma supplement.

3.2 Course Categories

The courses of the programme are divided into the following categories:

[1] A document with detailed information on the studies undertaken, accompanying the diploma.

Core courses (C)

Core courses help the student to acquire basic knowledge on Informatics and Telecommunications, preparing the ground for the available topics of the degree. Core courses are offered in the first five (5) semesters and are common and compulsory for all the students. The indicative weight of each core course is 6 ECTS units.

The final thesis, which the student undertakes during the 7th and 8th semesters, is considered as a core course and is compulsory. The indicative weight of the final thesis is 25 ECTS units, reflecting the increased effort for its successful completion. For more information about the final thesis, please see the corresponding page at the site of the Department[1].

Specialization courses (S)

These courses provide specialised knowledge for the two different specializations offered by the Department (Specialization in Informatics/Specialization in Telecommunications).

Specialization courses are further divided into the *Specialization Core* courses (**SC**), which explore basic topics of the specialization, and the *Specialization Elective* courses (**SE**), which deal with other topics of Informatics and Telecommunications.

Specialization courses are offered to the students of the Department from the 5th semester and onwards, and the indicative weight of such a course is 5 ECTS units.

Free Elective courses (FE)

Free elective courses deal with topics from a wider scientific area and introduce the student to a variety of scientific fields.

Free elective courses are offered during the 7th and 8th semester and the indicative weight of such a course is 3 or 4 ECTS units.

Pedagogy and Didactics courses (PD)

Six relevant courses are offered (of which five are taught and the last one is a training placement at a school) which aim to provide the student with the basic knowledge and abilities required to teach a Computer Science course in primary and secondary schools.

These courses are offered from the 5th semester onwards and their indicative weight is 4 ECTS units.

3.3 Degree Requirements

A degree will be awarded to a student who meets the following academic requirements:

1. Successful completion of assessments in 21 core courses (**C**), with a total weight of 126 ECTS units.
2. Successful completion of the final thesis, with a weight of 25 ECTS units.

[1] https://dit.uop.gr/en/bachelor-thesis

3. Successful completion of assessments in other courses, with a minimum of total weight of 89 ECTS units. These courses may include:
    (a) At minimum 4 specialization core courses (**SC**).
    (b) At minimum 13 other specialization courses (**SC** or **SE**).
    (c) At maximum 2 free elective courses (**FE**) or pedagogy and didactics courses (**PD**).

A student may establish one of the specializations of the degree if s/he succeeds in 4 specialization core courses (**SC**) and 8 other specialization courses (**SC** or **SE**) of this specialization (courses belonging to both specializations included). This specialization is then shown on his detailed academic transcript.

A course assessment is considered successful if the student achieves at minimum of 5 out of 10 points, according to the requirements of the course (see Chapter 4) specified by the tutor.

Degree grade calculation

The degree grade is calculated by the following formula:

$$\text{Grade} = \frac{\sum_{i=1}^{N} G_i \cdot ECTS_i}{\sum_{i=1}^{N} ECTS_i}$$

where

- N is the total number of the courses that are taken into account for the degree completion,
- G_i is the grade of the i^{th} course,
- $ECTS_i$ are the ECTS units of the i^{th} course.

If the student has successfully completed courses whose weights sum up to more than 240 ECTS units, then s/he may (but is not obliged to) select which of these courses will be taken into consideration for the degree grade calculation, even if they correspond to more than 240 ECTS units, provided that the remaining courses satisfy the above requirements for the degree. All successfully completed courses are mentioned in the student's academic transcript.

The degree grade has the following classification:

- **First class honours**, for grades 8.50–10.00.
- **Second class honours**, for grades 6.50–8.49.
- **Third class honours**, for grades 5.00–6.49.

3.4 Course Registration Requirements

At the beginning of every semester, the student is enrolled to the courses that s/he desires to undertake during the semester; the student will only be eligible to participate in the exams of the courses that s/he has enrolled to for the respective semester. For more information about the enrolment procedure, please refer to the *Procedures Guide*[1] of the Department.

In order a student to be eligible to enroll in a course, the following requirements and limitations must be met:

[1] https://dit.uop.gr/odigos-diadikasion-tmimatos, in Greek.

- The semester of the course should not be higher than the semester that the student is registered.
- The student should have enrolled to all the core courses (C) offered in the previous semesters.
- The student should have successfully completed the assessment to all of the prerequisite courses of the specific course (for more information please refer to Chapter 3.7).
- The student should not have successfully completed the assessment of the course.

Every semester, the student can enroll to courses of which the total ECTS units are not more than 49.

Exemption from course registration requirements

A student may be exempted from the above requirement to enroll only to courses offered at most at the semester they are attending (included the BSc Thesis), as well as the maximum total of 49 ECTS units per semester, provided that the following conditions hold:

- They are registering for the 3rd up to the 6th semester.
- They have succeeded to all the courses of the previous semesters if they are registering for the 3rd or 4th semester, at least to 19 courses if they are registering for the 5th semester or at least to 24 courses if they are registering for the 6th semester.
- Has a total grade (according to the rules for degree grade calculation) of at least 6.5/10.

To be exempted from these limitations, the student must make a suitable application to the Departmental Assembly, attaching a degree transcript as well as the **full list of courses** that they wish to be enrolled to.

The Departmental Assembly checks if the above conditions hold and in this case the Secretary enrolls the student to the courses approved by the Assembly.

This procedure must be repeated on every semester that the student wishes to be exempted from the limitations for course registration.

3.5 Educational Procedure

Through the educational procedure applied at the Department of Informatics and Telecommunications, students learn to analyse scientific problems and find solutions to them, work individually and in groups, and effectively coordinate working groups. Lectures, laboratory activities and projects are basic elements of the educational procedure.

In-class and laboratory activities are an extremely important part of the unique educational experience of the student. Through these activities students and tutors share their knowledge and experience and advance their educational level both individually and collectively. Concerning the importance of these activities, students must systematically attend the lectures and the laboratory activities, be at the classroom before the beginning of the lecture, attend the lecture to the very end, and engage in the educational procedure. Students must follow the educational procedure, respect their colleagues and the university staff, and try to accomplish their personal educational goals.

However, the physical presence in the classroom is just a part of the educational procedure. Furthermore, students must study the lecture material to work on their projects and to be ready and willing to share their thoughts and questions with their colleagues and tutors.

The Department of Informatics and Telecommunications uses modern e-learning tools, such as online lecture notes, online project submission tools, announcement lists, additional educational material, etc. However, these tools cannot substitute under any circumstances the lectures and the laboratory exercises or any other activity that requires the student's physical presence, including the procedure of the exams (e.g., the assessment of the laboratory exercises). Students are expected to participate in the activities of the courses according to the course timetable and the tutors' directions.

3.6 Course List

This section summarises the courses of the programme; courses are grouped according to their category and some basic information about them is listed. Appendix A summarises the courses by semester for the students' convenience.

In the electronic version of this guide, the titles of the courses are hyperlinks to their descriptions according to the ECTS standard that are presented in Chapter 4.

Please note that the teaching hours listed in the table for theory, laboratory and tutorial exercises are indicative of the total weekly course load. During the semester, the exact allocation of these hours is the responsibility of the course instructor.

3.6.1 Core courses

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Introduction to Informatics and Telecommunications	1	6	4		2	C
Logic Design	1	6	4	2	2	C
Mathematics I	1	6	6			C
Programming I	1	6	4	2		C
Physics	1	6	4		2	C
Computer Architecture I	2	6	4	2		C
Discrete Mathematics	2	6	4		2	C
Mathematics II	2	6	6			C
Probability and Statistics	2	6	4		2	C
Programming II	2	6	4	2		C
Object-Oriented Programming	3	6	4	2		C
Data Structures	3	6	4		2	C
Electromagnetic Fields	3	6	4		4	C
Mathematics III	3	6	4			C
Signals and Systems	3	6	3	2	1	C
Algorithms and Complexity	4	6	4		2	C
Principles of Telecommunication Systems	4	6	6	2		C

Course Title	Semester	ECTS Units	Teaching hours Lectures	Lab	Tutorials	Category
Communication Networks I	4	6	4	1	1	C
Electronics	4	6	4	2	2	C
Operating Systems	4	6	4		2	C
Databases	5	6	5	1		C
Undergraduate Thesis	7 / 8	12 / 12				C

3.6.2 Specialization courses

The abbreviations that are used at the following table are:

SC-I Core course of the Informatics specialization
SC-T Core course of the Telecommunications specialization
SE-I Elective course of the Informatics specialization
SE-T Elective course of the Telecommunications specialization
SE-I/T Elective course of the Informatics and the Telecommunications specialization

Specialization core courses on Informatics

Course Title	Semester	ECTS Units	Teaching hours Lectures	Lab	Tutorials	Category
Systems Security	5	5	3			SC-I
Compilers I	5	5	2	2		SC-I
Human Computer Interaction	6	5	3	2	1	SC-I
Artificial Intelligence	6	5	3	1		SC-I
Information Retrieval and Mining	7	5	3		2	SC-I
Software Engineering	7	5	3	1		SC-I

Specialization core courses on Telecommunications

Course Title	Semester	ECTS Units	Teaching hours Lectures	Lab	Tutorials	Category
Wireless and Mobile Communications I	5	5	3		1	SC-T
Communication Networks II	5	5	3	1		SC-T
Introduction to Optical Communications	5	5	3			SC-T
Digital Communications	5	5	2	2	1	SC-T
Digital Signal Processing	6	5	3	1		SC-T

Specialization elective courses on Informatics

Course Title	Semester	ECTS Units	Teaching hours Lectures	Lab	Tutorials	Category
Systems Programming	5	5	3	1		SE-I
Computability and Complexity Theory	5	5	4			SE-I
Computer Architecture II	6	5	4			SE-I
Computer Graphics	6	5	3	1		SE-I
Educational Informatics	6	5	3			SE-I
Cultural Informatics	6	5	3			SE-I
Advanced Programming Topics	6	5	3			SE-I
Big data management	7	5	3		2	SE-I
Distributed Information Management	7	5	3	1		SE-I
Cryptography	7 [1]	5	3			SE-I
Compilers II	7	5	2	2		SE-I
Parallel Algorithms	7	5	4			SE-I
Advanced User Interfaces - Virtual Reality	7	5	2	2		SE-I
Data Management Systems	7	5	4			SE-I
Computational Geometry	7	5	3			SE-I
Computer Games Development	8	5	3	2		SE-I
Special Topics in Algorithms	8	5	3			SE-I
Topics on Data and Information Management	8	5	3	1		SE-I
Logic for Computer Science	8	5	3			SE-I
Machine Learning	8	5	2	2		SE-I
Software Engineering II	8	5	2	2		SE-I

Specialization elective courses on Telecommunications

Course Title	Semester	ECTS Units	Teaching hours Lectures	Lab	Tutorials	Category
Telecommunication Systems Measurements	5	5	3	1		SE-T
Wireless Links	6	5	3	1		SE-T
Antennas	6	5	3	1		SE-T
Optical Wireless Communications	6	5	4			SE-T
Optoelectronics	6	5	3		1	SE-T
Telephone Networks	6	5	4			SE-T
Satellite Communications	7 [1]	5	2	2	1	SE-T
Microwaves and Waveguides	7	5	4			SE-T
Advanced Topics in Digital Communications	7	5	3			SE-T
Optical Communication Systems	7 [1]	5	3			SE-T
Core and Metropolitan Networks	8 [1]	5	3			SE-T

[1] Students may also enroll to the course in semester 5.
[1] Students may also enroll to the course in semester 6.

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Introduction to Radars	8	5	2	1	1	SE-T
Applications of Optical Fiber Systems and Networks	8 [1]	5		3	1	SE-T
Adaptive Signal Processing	8	5	3	2		SE-T
Simulation of Telecommunications Systems	8 [1]	5	2	2		SE-T
Stochastic Signal Processing and Applications	8	5	3	1		SE-T
Modern Cellular Communication Systems	8 [1]	5	3			SE-T

Specialization elective courses on Informatics and Telecommunications

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Introduction to Embedded Systems	5	5	3	1		SE-I/T
Numerical Analysis	6	5	3			SE-I/T
Wireless and Mobile Communications II	6	5	3			SE-I/T
Image Processing: principles, algorithms and applications	6	5	2	2		SE-I/T
Coding and Information Theory	6	5	2	1	2	SE-I/T
Decision Making Systems	6	5	4			SE-I/T
Internet Applications and Web Services Development	6	5	3	2		SE-I/T
Internet of Things	7	5	3	1		SE-I/T
Multimedia Signal Processing	7	5	3	1		SE-I/T
Theory and Applications of Speech Processing	7	5	2	2		SE-I/T
Stochastic Network Modeling and Performance Analysis	7 [1]	5	3		1	SE-I/T
Digital Systems and Circuits Design	7	5	3	1		SE-I/T
Implementation of digital circuits and systems with FPGAs	7	5	3	1		SE-I/T
Sensor Networks	8 [1]	5	3	1		SE-I/T
Distributed Systems Programming	8	5	3	1		SE-I/T
Advanced Topics in Coding Theory	8	5	4			SE-I/T
Combinatorial Optimization	8 [1]	5	3			SE-I/T
Specification of Communication Protocols	8 [1]	5	2	1		SE-I/T
Communication Networks Simulation Techniques	8	5	4			SE-I/T

[1] Students may also enroll to the course in semester 6.
[1] Students may also enroll to the course in semester 5.

3.6.3 Free elective courses

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Introduction to Economic Science	5	6	3			FE
Traineeships	5 / 6 / 7 / 8	24				FE
Entrepreneurship in IT	6	3	3			FE
Game Theory	6	6	3			FE
Research Methodology and Scientific Writing	6	3	3			FE
Erasmus Traineeships	6 / 7 / 8	20				FE
Legal Issues of Informatics and Telecommunications	7	3	3			FE

3.6.4 Pedagogy and didactics courses

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Methods of development and evaluation of educational content	5	4	3	1		PD
Pedagogical ICT issues in education	5	4	3	1		PD
Pedagogy and Psychology in Education	5	4	3	1		PD
Practical training for pedagogical and teaching experience	5 / 6	4	2	2		PD
Cognitive Psychology and Educational Practice	6	4	3	1		PD
Didactics of Informatics	6	4	2	2		PD

3.7 Prerequisite Courses

The majority of the courses of the undergraduate programme offered on the 3rd semester and onwards, demand the successful completion of *prerequisite courses*.

Prerequisite courses reflect the necessary knowledge a student must have in order to attend a course without difficulties and fulfill its requirements. Prerequisite courses aim to better organize the sequence of attendance of the courses and to help students select the courses they should focus on in order to complete their studies on time.

The following tables list all the prerequisite courses. It is important to mention that the successful completion of the prerequisite courses **is not** required when the courses belong to the same academic year as the main course, even if they are listed in the following tables. For example, if a course in the 6th semester requires a prerequisite course that is offered in the 5th semester, then this requirement is not enforced. This especially applies in the case of a temporary change (i.e., in the semester that a course is offered).

3.7.1 1st semester

Course Title	Category	Prerequisites
Introduction to Informatics and Telecommunications	C	–
Logic Design	C	–
Mathematics I	C	–
Programming I	C	–
Physics	C	–

3.7.2 2nd semester

Course Title	Category	Prerequisites
Computer Architecture I	C	Logic Design
Discrete Mathematics	C	–
Mathematics II	C	–
Probability and Statistics	C	–
Programming II	C	–

3.7.3 3rd semester

Course Title	Category	Prerequisites
Object-Oriented Programming	C	Programming I **or** Programming II
Data Structures	C	Programming I **or** Programming II
Electromagnetic Fields	C	Physics **or** Mathematics I **or** Mathematics II
Mathematics III	C	–
Signals and Systems	C	Mathematics I **or** Mathematics II

3.7.4 4th semester

Course Title	Category	Prerequisites
Algorithms and Complexity	C	(Programming I **or** Programming II) **and** (Discrete Mathematics **or** Data Structures)
Principles of Telecommunication Systems	C	–
Communication Networks I	C	–
Electronics	C	–
Operating Systems	C	Programming I **or** Programming II

3.7.5 5th semester

Course Title	Category	Prerequisites
Databases	C	**(**Programming II **or** Object-Oriented Programming**)** **and** Discrete Mathematics
Systems Security	SC-I	Communication Networks I
Compilers I	SC-I	Programming II
Wireless and Mobile Communications I	SC-T	–
Communication Networks II	SC-T	Communication Networks I
Introduction to Optical Communications	SC-T	Physics **or** Principles of Telecommunication Systems
Digital Communications	SC-T	Signals and Systems **or** Principles of Telecommunication Systems
Systems Programming	SE-I	Programming II **and** Operating Systems
Computability and Complexity Theory	SE-I	Mathematics II **or** Discrete Mathematics
Introduction to Embedded Systems	SE-I/T	**(**Programming I **or** Programming II**)** **and** Electronics **and** Logic Design
Telecommunication Systems Measurements	SE-T	–
Introduction to Economic Science	FE	–
Traineeships	FE	–
Methods of development and evaluation of educational content	PD	–
Pedagogical ICT issues in education	PD	–
Pedagogy and Psychology in Education	PD	–
Practical training for pedagogical and teaching experience	PD	–

3.7.6 6th semester

Course Title	Category	Prerequisites
Human Computer Interaction	SC-I	Programming I **or** Programming II
Artificial Intelligence	SC-I	**(**Programming II **or** Object-Oriented Programming**)** **and** Discrete Mathematics
Digital Signal Processing	SC-T	Signals and Systems
Computer Architecture II	SE-I	Computer Architecture I
Computer Graphics	SE-I	**(**Programming II **or** Object-Oriented Programming**)** **and** Mathematics I
Educational Informatics	SE-I	–
Cultural Informatics	SE-I	–
Advanced Programming Topics	SE-I	Object-Oriented Programming **and** Data Structures
Numerical Analysis	SE-I/T	–
Wireless and Mobile Communications II	SE-I/T	Communication Networks I

Course Title	Category	Prerequisites
Image Processing: principles, algorithms and applications	SE-I/T	–
Coding and Information Theory	SE-I/T	Probability and Statistics
Decision Making Systems	SE-I/T	–
Internet Applications and Web Services Development	SE-I/T	Programming I **or** Programming II
Wireless Links	SE-T	Electromagnetic Fields **or** Physics
Antennas	SE-T	Electromagnetic Fields **or** Physics
Optical Wireless Communications	SE-T	–
Optoelectronics	SE-T	Physics
Telephone Networks	SE-T	–
Entrepreneurship in IT	FE	–
Game Theory	FE	–
Research Methodology and Scientific Writing	FE	–
Traineeships	FE	–
Erasmus Traineeships	FE	–
Cognitive Psychology and Educational Practice	PD	–
Didactics of Informatics	PD	–
Practical training for pedagogical and teaching experience	PD	–

3.7.7 7th semester

Course Title	Category	Prerequisites
Undergraduate Thesis	C	–
Information Retrieval and Mining	SC-I	Programming II **or** Object-Oriented Programming
Software Engineering	SC-I	Object-Oriented Programming
Big data management	SE-I	Object-Oriented Programming **or** Databases
Distributed Information Management	SE-I	–
Cryptography	SE-I	Discrete Mathematics
Compilers II	SE-I	Compilers I
Parallel Algorithms	SE-I	Programming I **or** Programming II
Advanced User Interfaces - Virtual Reality	SE-I	Human Computer Interaction
Data Management Systems	SE-I	Data Structures **and** Databases
Computational Geometry	SE-I	Data Structures **or** Algorithms and Complexity
Internet of Things	SE-I/T	Introduction to Embedded Systems **and** Electronics **and** Logic Design
Multimedia Signal Processing	SE-I/T	Signals and Systems
Theory and Applications of Speech Processing	SE-I/T	–
Stochastic Network Modeling and Performance Analysis	SE-I/T	Probability and Statistics

Course Title	Category	Prerequisites
Digital Systems and Circuits Design	SE-I/T	Logic Design
Implementation of digital circuits and systems with FPGAs	SE-I/T	Logic Design
Satellite Communications	SE-T	–
Microwaves and Waveguides	SE-T	–
Advanced Topics in Digital Communications	SE-T	Digital Communications
Optical Communication Systems	SE-T	–
Legal Issues of Informatics and Telecommunications	FE	–
Traineeships	FE	–
Erasmus Traineeships	FE	–

3.7.8 8th semester

Course Title	Category	Prerequisites
Undergraduate Thesis	C	–
Computer Games Development	SE-I	Computer Graphics
Special Topics in Algorithms	SE-I	Data Structures **or** Algorithms and Complexity
Topics on Data and Information Management	SE-I	Databases
Logic for Computer Science	SE-I	–
Machine Learning	SE-I	Mathematics I **and** Programming II **and** Probability and Statistics
Software Engineering II	SE-I	Object-Oriented Programming **and** Software Engineering
Sensor Networks	SE-I/T	Communication Networks I **or** Wireless and Mobile Communications I
Distributed Systems Programming	SE-I/T	Object-Oriented Programming
Advanced Topics in Coding Theory	SE-I/T	Coding and Information Theory
Combinatorial Optimization	SE-I/T	–
Specification of Communication Protocols	SE-I/T	–
Communication Networks Simulation Techniques	SE-I/T	–
Core and Metropolitan Networks	SE-T	–
Introduction to Radars	SE-T	Antennas
Applications of Optical Fiber Systems and Networks	SE-T	–
Adaptive Signal Processing	SE-T	Signals and Systems **or** Digital Signal Processing
Simulation of Telecommunications Systems	SE-T	Programming I **or** Digital Communications **or** Digital Signal Processing
Stochastic Signal Processing and Applications	SE-T	Signals and Systems **or** Digital Signal Processing
Modern Cellular Communication Systems	SE-T	Wireless and Mobile Communications I **or** Wireless Links

Course Title	Category	Prerequisites
Traineeships	FE	–
Erasmus Traineeships	FE	–

Course Descriptions

4

4.1 Core Courses

Introduction to Informatics and Telecommunications

Category: Core

ECTS Credits: 6 ***Semester:*** 1

Prerequisites: –

Teaching: 4 hours lectures and 2 hours labs (during some of which an introduction to the UNIX operating system will be presented) per week.

Learning outcomes: At the end of the course the student will be able to:

- Convert numbers between decimal, binary and hexadecimal and be able to perform simple numerical operations in binary
- Use gates to design simple circuits
- Recognize basic components of computer architecture
- Develop simple programs in a low-level language
- Explain functions of an Operating System and select suitable commands in UNIX
- Describe the basic operating principles of networks and Internet and be able to write a simple page in HTML
- Structure problems using tools such as Turing machines
- Compute the complexity of algorithms
- Design algorithms to solve problems

Course contents: Basic of data encoding and storage, machine architecture and machine languages, operating systems, networking and the Internet, algorithms and algorithm design, programming languages, software engineering, data abstractions.

Assessment: Optional exercises counting for 25% of the final grade, and written exam for 75% of the final grade. In case a mid-term exam is given, the final grade is computed as: 25% exercises + 25% mid-term exam + 50% final exam. September re-sits for 100% of the grade (other grades such as exercises or mid-term exam are discarded).

Logic Design

Category: Core

ECTS Credits: 6 ***Semester:*** 1

Prerequisites: –

Teaching: 4 hours lectures, 2 hours lab, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic principles of binary numbers, Boolean Algebra and logic gates
- explain the basic principles of binary functions and simplify binary functions
- design and reduce combinatioal circuits given specific requirements
- explain the notion of memory in the context of logic circuits,
- list the characteristic tables of flip flop types D,T and JK
- read and reduce state diagrams
- design sequential circuits

Course contents: Numeral systems and codes, digital circuits, principles and practices for combinatorial logic design, basic combinatorial digital circuits, PLAs, decoders, coders, multiplexers, comparators, adders, subtractors, ALUs, principles and practices for sequential digital design, latches, flip flops, counters, shift registers, memory.

Assessment: This is a compound course, with its total grade comprising theory (70%) and applied part (30%). Success in the applied part of the course must coincide or predate participation in the final theory exam. The applied part is graded through with laboratory exercises and written reports. Theory is graded through a written midterm exam (20%), a written examination at the end of the course (50%) and an optional semester project (40%). In case of success to the applied part of the course and failure to the theoretical part, the grades of the applied part may be retained for one year.

Mathematics I

Category: Core

ECTS Credits: 6 ***Semester:*** 1

Prerequisites: –

Teaching: 6 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic topological concepts and use them to solve problems
- describe the basic principles of calculus of single variable functions and use them to solve problems
- describe the concepts of continuity, sequences and series, differentiation and integration of functions, be able to present the related mathematical proofs and use these concepts to solve problems
- describe the basic concepts of vector spaces and matrices and use them to solve linear systems and other problems
- describe the basic concepts of polynomials and use them to solve problems

Course contents: Part A, Mathematical Analysis: Basic topology concepts, Real numbers, Sequences, Series, Functions of one variable (limit, continuity etc), Derivatives, Definite and indefinite integral, Power series, Taylor expansions.

Part B, Algebra and Linear Algebra: vectors, matrices, characteristic polynomials, linear system solving, vector spaces, bases, inner product, orthogonal spaces, eigenvectors. Algebraic structures, polynomials, finite fields and extensions, irreducible and primitive polynomials, polynomial factorization, trace and norm functions.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 25% and 30%.

Programming I

Category: Core

ECTS Credits: 6 ***Semester:*** 1

Prerequisites: –

Teaching: 4 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- edit, compile and run a C program.
- recognize and use C data types, to declare variables and assign values to them, to write C statements by using C operators, as well as to read input data from keyboard and display output data in screen by using scanf() and printf() functions, respectively.
- control the flow of C programs by using either if-else and switch statements or the conditional (ternary) operator and create and execute iterations (loops) by using for, while and do-while statements.
- create and handle one-dimensional and two-dimensional arrays, to use pointers and handle arrays with pointer notation, to handle the char data type and create and use strings with either array or pointer notation.
- declare and implement functions and use the most popular C library functions, to distinguish call-by-value and call-by-reference function calls and use them.
- execute, use and implement basic searching (linear/binary search) and sorting (selection-sort, insertion-sort and bubble-sort) algorithms in arrays and use the dynamic memory management functions, e.g., malloc(), free(), memcpy(), memmove(), memcmp().
- recognize the difference between structs and unions, to define and handle structs and unions, to create their own data types, to recognize the difference between text and binary files and to write C programs that open, close, read, write and append both text and binary files.

Course contents: Introduction, data types and variables in C, data input and output, operators, program flow control statements, iterations (loops), arrays, strings, pointers, functions, searching and sorting arrays algorithms, structures and unions, dynamic memory management, text and binary files.

Assessment: Written exams at the end of the semester. Lab assignments every week (or every second week) contributing to the final grade with a percentage ranging between 10% and 20%. It is possible that home assignments will be given and/or intermediate written exams will take place, while each of the above will contribute to the final grade with a percentage ranging between 10% and 20%.

Physics

Category: Core

ECTS Credits: 6 ***Semester:*** 1

Prerequisites: –

Teaching: 4 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe and explain the basic principles of mechanics, wave physics and modern physics
- Correlate physical and mathematical models for the description of physical phenomena
- Analyze and solve basic problems in physics by applying suitable techniques
- Apply description models to real-world problems of Informatics and telecommunications

Course contents: Mechanics: velocity and acceleration, Newton's laws, work, energy, power, conservation of energy, trajectories, circular motion, momentum, angular momentum, conservation of momentum, torque, oscillations, universal gravitation.Waves: wave equation, harmonic waves, acoustic waves, nature and propagation of light, Compton effect, geometrical optics, reflection, refraction, mirrors, thin lenses.Modern physics: special theory of relativity, speed of light, time dilation, length contraction, structure of matter, structure of atomic nucleus, radioactivity, elementary particles, Heisenberg's uncertainty principle, Schrödinger's equation.

Assessment: Written exams at the end of the semester.

Computer Architecture I

Category: Core

ECTS Credits: 6 ***Semester:*** 2

Prerequisites: Logic Design

Teaching: 4 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe the characteristics of CISC and RISC architectures
- Describe the maing addressing modes and their classification in CISC and RISC architectures
- Describe the basic characteristics and structure of RISC and CISC instruction repertoire
- Describe the principles and the functionality of the memory hierarchy (Cache, Scratch Pad)
- Describe the different design options of the memory hierarchy
- Describe the functionality and the characteristics of static and dynamic RAMs
- Describe the design principles of Input/Output
- Descrbe the segmentation and paging techniques for memory management
- Describe the characteristics and the structure of the X86 processor family architecture
- Design, compile debug and execute applications written in the x86 assembly language

Course contents: Introduction, Segmentation, Paging, CISC & RISC processors, Addressing Modes, Instruction Sets, Memory Hierarchies: Cache and Scratch-Pad, Memory Technologies: SRAM and SDRAM, Computer IO Interface, Buses, x86 Assembly,

Assessment: The final grade for the course will be the average of theory and laboratory grades (50% theory + 50% laboratory). The course's theory has 2 sections. The first concerns the assembly x86 language and the second the basic principles of computer architecture.

Laboratory performance is assessed on the basis of examinations (oral or written) during specific laboratory exercises set by the teacher. The final grade of the laboratory will be determined by the average performance in the examined laboratory exercises.

The course exams grades are considered promotable when the grade of both written theoretical sections are at least 50/100 and the average of the laboratory and theoretical exams must be at least 50/100. The grades in the laboratory or in the theory examination cannot be maintained for the following years.

Discrete Mathematics

Category: Core

ECTS Credits: 6 ***Semester:*** 2

Prerequisites: –

Teaching: 4 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- recognize and employ fundamental mathematical notions (sets, functions, relations, etc,) for defining and solving computational problems
- understand complex combinatorial problems and employ the combinatorial strategies introduced in the course
- understand problems in Graph Theory and devise solving strategies and techniques
- state and analyze correct proofs, using the fundamental techniques reviewed in the course (mathematical induction, reductio ad absurdum, etc.)

- understand and solve problems in elementary Number Theory and its applications

Course contents: **Rudiments of Mathematical Logic & Set Theory:** propositional logic, elements of first-order logic, the algebra of sets, finite and infinite sets, cardinality and Cantor's diagonal methods. **Proof methods:** mathematical induction (strong induction and wellordering principle), diagonalization, reductio ad absurdum. **Relations and Functions:** Cartesian product, binary and *n*-ary relations, functions, lattices and partial orders, equivalence and congruence relations. **Combinatorics:** rules of sum and product, combinations and permutations (with/without repetition), balls in urns, inclusion/exclusion principle, pigeonhole principle. **Rudiments of Graph Theory:** graph species, Euler & Hamilton graphs and trails, planar graphs, graph coloring, matching theorems, elements of Ramsey Theory. **Trees:** trees and rooted trees, applications, Huffman codes. Depending on the progress, **number theory** and the basics of **algorithm analysis** can be touched upon.

Assessment: Written exams (70%) at the end of the semester and exercises (30%), where the weights may be changed by ±10%.

Mathematics II

Category: Core

ECTS Credits: 6 ***Semester:*** 2

Prerequisites: –

Teaching: 6 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- Analyze and solve problems with complex numbers and complex functions
- Computes Taylor and McLaurin series
- Computes Fourier transforms as well as their inverses
- Analyze and solve problems with functions of many variables, and calculate partial derivatives
- Analyze and solve problems with vector functions
- Computes curvilinear, surface and spatial integrals

Course contents: Complex analysis: complex numbers, complex functions, analytic functions, sequences, series of complex functions, integration, calculus of integral balances. Fourier analysis: periodic functions, harmonic functions, trigonometric series, Fourier series, exponential form of Fourier series, derivative and integration of Fourier series. Taylor and McLaurin series, approximate calculations. Functions of several variables: vector analysis, curve theory, partial derivatives, Green's, Stokes and divergence theorems, multiple integrals.

Assessment: 3 hours written exams. Mid-exams are possible with weight 40%.

Probability and Statistics

Category: Core

ECTS Credits: 6 ***Semester:*** 2

Prerequisites: –

Teaching: 4 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic principles of probabilities and statistics
- infer the distribution modeling the behavior of a random variable
- apply and combine probabilistic tools and methods
- solve probabilistic problems in computer science, communications, and in general

Course contents: Sample Space and Probability. Sets. Conditional Probability. Total Probability Theorem. Bayes' Rule. Independence. Counting. Discrete Random Variables. Probability Mass Functions. Functions of Random Variables. Expectation, Mean and Variance. General Random Variables. Cumulative Distribution Functions. Normal Random Variables. Limit Theorems. Markov and Chebyshev Inequalities. The Weak Law and the Strong Law of Large Numbers. The Central Limit Theorem. The Bernoulli and Poisson Processes. Bayesian Statistical Inference. Classical Statistical Inference.

Assessment: Written exams at the end of the semester.

Programming II

Category: Core

ECTS Credits: 6 ***Semester:*** 2

Prerequisites: –

Teaching: 4 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- design algorithmic solutions for demanding problems
- solve problems by utilizing advanced features of the C language (e.g., complex data types, input and output streams, direct access to main memory through pointers, modular programming, bit manipulation)
- implement and test solutions to medium-sized real-world problems using C,
- describe algorithmic alternatives (present algorithmic thinking and modular software design skills) that will be useful in solving large-sized problems in other programming languages.

Course contents: Pointers and pointer arithmetic. Call by value/reference. Pointers to functions. Dynamic memory allocation. Structs and arrays of structs. Simple data structures (single and double linked lists, circular lists, stacks, queues) and associated functions. Debugging. Recursion. Handling of characters and strings. Random number generation. Command line arguments. Bitwise operations. File I/O (text and binary). Modular programming. The C preprocessor. Useful programs (makefile, profiling, etc). Introduction to network programming using sockets.

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or programming exercises that will jointly account for 50% of the final grade, and a 3-hour written examination that will account for the remaining 50% of the final grade. These percentages may vary (+/-10%) each year. To succeed in this course, a mark of 5 or higher is required in the written exam and in the final grade.

Object-Oriented Programming

Category: Core

ECTS Credits: 6 ***Semester:*** 3

Prerequisites: Programming I **or** Programming II

Teaching: 4 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- develop simple and more complex classes in Java, using all the basic elements of object-oriented programming (fields, methods, access control)
- use object references in Java
- describe and use inheritance and polymorphism, as well as abstract methods and classes and interfaces

- describe the error-handling mechanism of exceptions, catch exceptions, throw exceptions and write his own exception classes
- use file-handling classes for text and binary, serial and random-access files
- use basic elements of the Java library (String, Math, ArrayList)
- develop complete programs of medium complexity in Java , following the principles of object-oriented programming and making use of all the tools mentioned above

Course contents: Introduction to object-oriented programming and to Java. Classes, objects, fields, methods. Access modifiers: public, private, protected; package access. Static and final modifiers. Inheritance, polymorphism, abstract methods and classes, interfaces. Generic classes, Java collections – ArrayList. Exceptions. Enumerations. File handling. Elements of the Java library.

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or programming exercises that will jointly account for 30% of the final grade, and a 3-hour written examination that will account for the remaining 70% of the final grade. These percentages may vary (+/-10%) each year. In order to pass the course, the student must have a mark higher than 4.5/10 in the programming projects, higher than 4.5/10 in the final exam, and a total mark higher than 5/10.

Data Structures

Category: Core

ECTS Credits: 6 ***Semester:*** 3

Prerequisites: Programming I **or** Programming II

Teaching: 4 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic data structures and the operations that they support.
- describe the algorithms that allow the execution of the above operations and the computational resources that they require.
- implement data structures in C.
- select the appropriate data structures depending on the computational problem.

Course contents: Introduction. Lists. Tables. Queues. Trees. Tree traversals. Priority queues. Binary search trees. AVL trees. Hashing. Sorting. Graphs. Skip lists. Union-find structures.

Assessment: Assignments, weight = 30% and written exam, weight = 70% (can vary ± 10% per year).

Electromagnetic Fields

Category: Core

ECTS Credits: 6 ***Semester:*** 3

Prerequisites: Physics **or** Mathematics I **or** Mathematics II

Teaching: 4 hours lectures, 2 hours tutorials, 2 hours background tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- Verify the feasibility of an electromagnetic field.
- Determine the electromagnetic field produced by simple charge and current distributions.
- Calculate the charge and current distributions given the electromagnetic field.
- Solve boundary problems.
- Analyze time variant electromagnetic problems by employing phasors and/or time domain equations.

- Determine electromagnetic energy and power

Course contents: Maxwell's equations (integral equations, differential equations, Boundary conditions). State equations. Charge distribution, current distribution, charge conservation law. Electrostatic Field. Magnetostatic Field. Wave equation. Time harmonic waves. Phasors. Electromagnetic potentials. Plane Waves. Electromagnetic Energy and Power (Poynting Vector, Energy conservation law). Wave Polarization. Reflection and Transmission of Plane Waves. Standing waves. Introduction to transmission lines.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given and/or a written interim examination will be held, which will contribute to the final grade with a percentage ranging between 10% and 20%.

Mathematics III

Category: Core

ECTS Credits: 6 ***Semester:*** 3

Prerequisites: –

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- solve first order differential equations (separable, homogeneous, linear)
- solve linear differential equations with constant coefficients using the characteristic polynomial and Laplace transforms
- solve linear systems of ordinary differential equations
- apply the separation of variables for the solution of partial differential equations

Course contents: Introduction to differential equations, modeling of physical systems with differential equations, first order differential equations, linear differential equations with constant coefficients, the Laplace transform, linear systems of differential equations, partial differential equations and the method of separation of variables.

Assessment: 3 hours written exams. A mid-term exam with weight 40% is also possible.

Signals and Systems

Category: Core

ECTS Credits: 6 ***Semester:*** 3

Prerequisites: Mathematics I **or** Mathematics II

Teaching: 3 hours lectures, 2 hours lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the differences between causal and stochastic signals as well as describe the basic properties of continuous time signals.
- describe the modeling of systems through the fundamental concepts of linearity, causality, temporal variability and bounded input bounded output (BIBO) stability.
- describe the relationship between input and output of a linear and time-invariant (LTI) continuous time system through the convolution integral
- analyze periodic signals through the complex Fourier exponential series and also the Fourier trigonometric series.
- describe and applie the Fourier and Laplace transforms to describe the input-output relationship of continuous time linear systems.

- calculate the frequency response and transmission function of continuous time systems
- solve linear differential equations describing linear systems of continuous time, with examples from the theory of mechanical oscillators, electrical filters, and simple telecommunication systems.

Course contents: Introduction to Signals and Systems. Elementary signals. Linear and Time Invariant Systems. Mechanical and electrical systems. Convolution. Fourier series. Fourier Transform. Laplace Transform. Applications of the Fourier and Laplace transform. Electric circuits. Analog Filters.

Assessment: Written exam at the end of the semester. Laboratory exercises count for 20% of the overall final examination mark.

Algorithms and Complexity

Category: Core

ECTS Credits: 6 ***Semester:*** 4

Prerequisites: **(**Programming I **or** Programming II**) and (**Discrete Mathematics **or** Data Structures**)**

Teaching: 4 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe algorithms for a series of classical computational problems and show their execution on typical instances.
- apply algorithm design techniques and construct efficient algorithms.
- describe algorithms with clarity in words and in pseudocode.
- analyze the complexity of an algorithm and prove its correctness.
- recognize basic notions of NP-completeness theory.

Course contents: Algorithms and computational problems, Analysis of algorithms, Asymptotic notations, Recurrence relations. Design techniques: Divide-and-Conquer, Greedy algorithms, Dynamic programming. Graph algorithms: Breadth first search, Depth first search, Topological sorting, Minimum spanning trees, Shortest paths. Introduction to complexity theory: P, NP, and NP-complete problems, Polynomial-time reductions. Special topics: Approximation algorithms, Randomized algorithms and Computational geometry.

Assessment: Assignments with weight 30%-40% and written exam.

Principles of Telecommunication Systems

Category: Core

ECTS Credits: 6 ***Semester:*** 4

Prerequisites: –

Teaching: 6 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Calculate the spectrum of simple analogue signals.
- Analyze and describe simple block diagrams of communication systems.
- Apply analogue modulations for signal transmission and select the appropriate detector according to the modulation.
- Analyze bandpass signals into orthogonal lowpass components.
- Calculate the Signal to Noise Ratio at the end of simple analogue systems.
- Analyze the PCM technique for signal transmission.
- Analyze the operation of basic transceivers with the use of specialized software

Course contents: Fourier transform. Spectral density. Bandpass signals and systems. Complex and physical envelope. Analogue transmission. Modulation and demodulation AM, DSB-SC, SSB, VSB. Quadrature Amplitude Modulation (QAM). Frequency Division Multiplexing (FDM). Transmission bandwidth, Generation of AM and FM waveforms and detectors. Introduction to Noise theory. Impact of Channel Noise. Signal to noise ratio. Performance comparison of analog modulation to Noise. Sampling Theorem, quantization, Pulse-code modulation (PCM).

Assessment: Written exams at the end of the semester (100% of the final grade). (Optionally) Students of the 4th semester have the option to participate in Lab exercises and in the relevant lab examination (maximum grade 2.0/10.0). Lab grade is added to the grade of written exams.

Communication Networks I

Category: Core

ECTS Credits: 6 ***Semester:*** 4

Prerequisites: –

Teaching: 4 hours lectures, 1 hour lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe several protocols and technologies (e.g., HTTP, TCP/IP and Ethernet), as well as related network applications (e.g., mail, web, file transfer, peer-to-peer)
- implement simple network applications
- explain the functions that are executed in every layer of the protocol stack (i.e., physical, data link, network, transport, application layers)
- design local area networks
- use commands to configure end terminals and network devices and analyze any network malfunction
- analyze the information located in a transmitted packet
- evaluate the efficiency of well-known network protocols

Course contents: Computer Networks and the Internet. Application Layer. Transport Layer. Network Layer. Link Layer and Local Area Networks.

Assessment: Written exams at the end of the semester 80% and lab exercises 20%.

Electronics

Category: Core

ECTS Credits: 6 ***Semester:*** 4

Prerequisites: –

Teaching: 4 hours lectures, 2 hours lab, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe the physical operation and calculate the currents and voltages of semiconductor components in diode applications
- Calculate the currents and voltages of components in circuits that include diodes.
- Describe the physical operation and calculate the currents and voltages of semiconductor components in Bipolar Junction Transistors applications also of amplifiers
- Calculate, the currents and voltages of components in amplifier circuits that include Bipolar Junction Transistors, as well as the characteristics of an amplifier
- Describe the physical operation and calculate the currents and voltages of semiconductor components in applications of MOSFET transistors also of amplifiers

- Calculate, the currents and voltages of components in amplifier circuits that include MOSFET Transistors, as well as the characteristics of an amplifier
- Describe the functionality of operation amplifiers (OPAMPs)
- Calculate, the currents and voltages of components in operational amplifier circuits at various configurations
- Realize a circuit and use of multimeter, oscilloscope, Function Generator, and power supply to perform measurements and make characteristic curves of circuits, particularly of amplifiers with Bipolar Junction Transistors or MOSFETs.

Course contents: The objective of this course is to introduce students to the basic concepts and technologies of Electronics and particularly for semiconductor devices. Through this course a student will acquire an understanding about the structure and purpose of the basic electronic semiconductor components i.e. diodes, bipolar transistors, MOSFET, CMOS, and operational amplifier. Analytically:

Devices and Basic Circuits: Signals, Frequency Spectrum of Signals, Analog and Digital Signals, Amplifiers, Circuit Models for Amplifiers, Frequency Response of Amplifiers, Operational Amplifiers (Op Amps): The Ideal Op Amp, The Inverting Configuration, The Noninverting Configuration, Difference Amplifiers, Integrators and Differentiators, DC Imperfections, Effect of Finite Open-Loop Gain and Bandwidth on Circuit Performance, Large-Signal Operation of Op Amps, Semiconductors : Intrinsic Semiconductors, Doped Semiconductors, Current Flow in Semiconductors, The pn Junction with Open-Circuit Terminals (Equilibrium), The pn Junction with Applied Voltage, Capacitive Effects in the pn Junction, Diodes: The Ideal Diode, Terminal Characteristics of Junction Diodes, Modelling the Diode Forward Characteristic, Operation in the Reverse Breakdown Region—Zener Diodes, Rectifier Circuits, Limiting and Clamping Circuits, Special Diode Types, MOS Field-Effect Transistors (MOSFETs): Device Structure and Physical Operation, Current-Voltage Characteristics, MOSFET Circuits at DC, Applying the MOSFET in Amplifier Design, Small-Signal Operation and Models, Basic MOSFET Amplifier Configurations, Biasing in MOS Amplifier Circuits, Discrete-Circuit MOS Amplifiers, The Body Effect and Other Topics, Bipolar Junction Transistors (BJTs), Device Structure and Physical Operation, Current-Voltage Characteristics, BJT Circuits at DC: Applying the BJT in Amplifier Design, Small-Signal Operation and Models, Basic BJT Amplifier Configurations, Biasing in BJT Amplifier Circuits, Discrete-Circuit BJT Amplifier, Transistor Breakdown and Temperature Effects.

Lab Exercises: use of multimeter, oscilloscope, Function Generator and power supply and measurements. Implementation on Breadboard of circuits like amplifier using Operational Amplifier, rectifier with diodes, amplifiers with με Bipolar Junction Transistors or MOSFETs, RC, Filters, and LC resonance circuits.

Assessment: Written exams on theory at the end of the semester (70-80% of the final grade) and written/oral exams on the lab (20-30% of the final grade). It is possible to have theory or/and lab exercises, and/or have an intermediate oral or/and written exam, with weight 30-50% of their corresponding weight (theory and lab), of the final grade. All three grades (written exam, lab, possible intermediate exam) must be at least 5. A passing grade of either the coursework or the lab may be retained for subsequent years.

Operating Systems

Category: Core

ECTS Credits: 6 ***Semester:*** 4

Prerequisites: Programming I **or** Programming II

Teaching: 4 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the goals of the operating system and its structure as well as the main types of operating systems, and explain the differences between them.

- describe the concepts of processes, scheduling, deadlocks, memory management and input/output, describe and explain the basic algorithms and mechanisms that operating systems employ in these areas, assess the different options and choose between them.
- describe the implementation of the basic algorithms and mechanisms in the aforementioned areas and implement solutions to related problems.

Course contents: Introduction. Overview of operating systems concepts and elements of computer architecture. Operating system structure. Processes: states, synchronization and scheduling. Deadlocks and deadlock handling. Memory management. Input-output management. Disk devices and file systems. Security.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%.

Databases

Category: Core

ECTS Credits: 6 ***Semester:*** 5

Prerequisites: **(**Programming II **or** Object-Oriented Programming**) and** Discrete Mathematics

Teaching: 5 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- design all stages of a database
- express simple queries
- express complex and aggregate queries
- implement applications using database management systems

Course contents: Introduction. The entity relation model (E/R). The relational model, relational algebra and other query languages (relational calculus, Datalog, QBE). SQL. Data constraints, functional dependencies, relational database design, canonical forms. Algorithms for database design, moving from E/R to relational model. Query evaluation.

Assessment: Written exercises and implementation of a project during semester, and written exams at the end of the semester. The final grade is computer by taking into account the respective marks of the exercises (10-20%), the project (30-40%) and the final examination (50-80%). It is required to have a passing grade on the project and the final examination.

Undergraduate Thesis

Category: Core

ECTS Credits: 10 ***Semester:*** 7

Prerequisites: –

Teaching: Guidance and progress assessment meetings with the supervisor, as well as work at home.

Learning outcomes: At the end of the course the student will be able to:
- choose the theories, methods and tools from earlier courses in the programme in order to solve a given problem.
- apply the chosen theories, methods and tools in order to formulate the required solution.
- justify the choice of theories, methods and tools and to defend and justify the outcomes and conclusions of the project they carried out.
- independently be able to recognize when further knowledge and study is necessary and to take responsibility for his/her further knowledge development, through locating, assessing and studying relevant literature or other learning resources.

- synthesize an extensive, structured and coherent scientific document in which they describe the problem, analyze the methodology they followed, present and document the results of their project and defend their conclusions.
- defend their thesis in front of the examination committee and other audience.

Course contents: Completion of a written bachelor thesis on a topic set by the supervisor.

Assessment: A committee of three members grades the student, after studying the thesis text, and attending the student's defense of his/her thesis.

4.2 Specialization Courses

Systems Security

Category: Specialization in Informatics - Core

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Communication Networks I

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:
- describe basic principles of services and mechanisms to ensure confidentiality and integrity
- apply ways of protecting information in most layers of OSI model
- evaluate the impact in the security of mechanisms of certain parameter choices
- describe well-known attacks and the weaknesses that they exploit

Course contents: Introduction (threats, security services and measures), topics in cryptography (symmetric cryptography, public–key cryptography, hash functions), public–key infrastructures (digital signatures, certificates, trusted third parties, architectures, technologies), identity authentication, code security, internet resource protection, internet security, operating systems security, database security, viruses, intrusion detection systems.

Assessment: Written exams (70%) at the end of the semester and projects (30%), where the percentages may vary up to ±10%.

Compilers I

Category: Specialization in Informatics - Core

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Programming II

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- describe the purpose and the internal structure of a compiler
- describe the purpose and individual stages of lexical analysis
- apply manually the algorithms relevant to lexical analysis
- write regular expressions and create a lexical analyzer with the flex tool.
- describe the purpose, the individual stages and the different algorithmic strategies of syntax analysis
- apply manually the algorithms relevant to syntax analysis
- express languages in terms of BNF grammars and build basic syntax analyzers using the bison tool
- describe the structure and purpose of compiler intermediate representation.
- practically produce and visualize an intermediate representation with the bison tool for a given grammar
- describe the purpose of semantic analysis and the two basic strategies: (1) syntax directed definition and (2) syntax directed translation

Course contents: Introduction. Compiler Structure and Phases. Lexical Analysis. Syntax Analysis. Intermediate Representations. Semantic Analysis. Compiler Back-End.

Assessment: The result grade will be the mean (50% theory exams + 50% laboratory exams) performance of theory and laboratory exams.Student's performance in the laboratory will be assessed by two means (attendance in the laboratory is optional):

1. Students attending the laboratory will be assessed by in-the-class exams (oral or written) during each laboratory session
2. Students not attending the laboratory will have to give separate exams for the laboratory in the course's regular exam period

To pass the course the theory exams grade should be no less than 50/100.

Human Computer Interaction

Category: Specialization in Informatics - Core

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Programming I **or** Programming II

Teaching: 3 hours lectures, 2 hours lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:
- Describe the stages of User Interface development lifecycle
- Identify User Groups
- Analyze user requirements and synthesize specifications
- Design a usable interface
- Select and apply the most prominent UI evaluation technique

Course contents: Introduction to Human Computer Interaction. The User, the Computer, their Interaction. Basic principles of usability. Development life cycle. User requirements capture. UI design. User modelling. Tools for UI development. UI evaluation. Help and documentation.

Assessment: 50% of the labs results and 50% of the final exam. Passing grade: a student has to get at least 4.5/10 at each assessment method (labs total, final exam) and the total mark should be at least 5/10.

Artificial Intelligence

Category: Specialization in Informatics - Core

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: **(**Programming II **or** Object-Oriented Programming**) and** Discrete Mathematics

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- represent complex problems as search problems
- solve these problems using several searching strategies
- represent complex problems as constraint satisfaction problems
- represent knowledge using first order logic
- design knowledge bases

Course contents: Solving problems by searching. Problem-solving agents. Search strategies: breadth-first search, uniform-cost search, depth-first search, depth-limited search, iterative deepening depth-first search, bi-directional search. Heuristic search strategies: greedy best-first search, A*-search. Local search algorithms. Constraint satisfaction problems, solution of constraint satisfaction problems with various variations of backtracking search. Adversarial search and zero-sum games. Search algorithms: minimax algorithm, alpha-beta pruning. Stochastic games. Monte Carlo tree search. Knowledge-based agents. Propositional logic and first-order logic. Using propositional and first-order logic to represent knowledge. Design of knowledge bases, ontologies, examples from various applications. Inference: modus ponens, unification, forward and backward chaining, resolution. Introduction to logic programming and the Prolog language. Probabilistic reasoning. Bayesian networks. Exact inference in Bayesian networks: inference by enumeration, variable elimination algorithm. Approximate inference in Bayesian networks. Sampling methods: rejection sampling, importance sampling. Inference by Markov chain simulation.

Assessment: Written exercises and implementation of a project during semester and written exams at the end of the semester. The final grade results in by taking into account the respective marks of exercises (10-20%), project (30-40%) and final examination (50-80%).

Information Retrieval and Mining

Category: Specialization in Informatics - Core

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Programming II **or** Object-Oriented Programming

Teaching: 3 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe fundamental concepts in the area of Information Retrieval and Mining
- implement fundamental Information Retrieval and Mining algorithms
- evaluate the performance of Information Retrieval and Mining algorithms
- design new algorithms and techniques related to Information Retrieval and Mining

Course contents: Web search basics. Document preprocessing, analysis, storage and indexing. Retrieval models (Boolean/Vector Space/Probabilistic). Tolerant retrieval. Evaluation measures and standard test collections. Document clustering (flat/hierarchical). Document classification (Naïve Bayes and vector space). Link analysis. Frequent itemset mining. Language models.

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or exercises (in-class or homework) that will jointly account for 50% of the final grade, and a 3-hour written final examination that will account for the remaining 50% of the course grade. These percentages may vary (+/-10%) each year. In order for a student to successfully complete the course, s/he must score at least 50% in the written exams, and the student's weighted average should be 50% or higher.

Software Engineering

Category: Specialization in Informatics - Core

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Object-Oriented Programming

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the goals of software engineering, the basic concepts, the methodologies used and the tools supporting them; additionally, describe the aspects that should be taken into account while developing software (usability, performance, human and organizational factors etc.) as well as the impact of each aspect
- describe the software life cycle, the phases it comprises of and the activities taking place in each phase and be able to shape the life cycle of a small scale software development project
- describe and create/use the most commonly used UML diagrams (use case diagrams, class diagrams, sequence diagrams, state machine diagrams, deployment diagrams)
- explain the processes of requirement elicitation and analysis and the tools they use and be able to perform these processes

- explain the design processes, the tools and the criteria used therein, and be able to design a system
- explain and carry out the processes and techniques of writing code according to the design and testing the code
- explain how a software development project is organized and the structure of communication among the project participants

Course contents: Introduction. Software development paradigms – software life cycle models. Requirements – analysis, specification and validation. Design. Software architecture. Detailed design. Implementation and testing. Project organization and phases, team organization and communication.

Assessment: Mandatory home assignments with a weight ranging from 30% to 50% and written exams, with a weight ranging from 70% to 50%. In order for a student to succeed in the course, s/he must meet the threshold of 40% in both home assignments and written exams, and the student's weighted average should be 5 or more.

Wireless and Mobile Communications I

Category: Specialization in Telecommunications - Core

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: –

Teaching: 3 hours lectures, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the different types of cell structures.
- describe the different types of interference in cellular systems
- describe how cellular systems can accommodate large number of users in a limited radio spectrum using the trunking concept
- calculate the performance of a wireless communication system
- describe how mobility affects performance
- describe how radio resources can be assigned to users
- describe ways to improve performance and calculate the improvement

Course contents: Introduction to wireless and mobile communication systems. Principles of cellular systems. Frequency reuse. Co-channel and adjacent channel interference and system capacity. Trunking and grade of service. Channel assignment strategies. Improving coverage and capacity in cellular systems.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%.

Communication Networks II

Category: Specialization in Telecommunications - Core

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Communication Networks I

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic physical layer technologies PDH, SDH/SONET
- describe the ATM and Frame Relay technologies and the corresponding QoS support mechanisms
- describe the basic protocols PPP, HDLC, OSPF, ISIS, BGP
- describe the protocol TCP and congestion control mechanisms

- describe the routing fundamentals in MPLS networks
- describe the basic concepts of IPv6

Course contents: Physical layer technologies for high speed networks (PDH, SDH). Virtual circuit network technology. Frame-Relay, Asynchronous Transfer Mode (ATM). Point-to-point link protocols (PPP, HDLC). Routing protocols: OSPF and ISIS. Routing architecture on the internet and BGP routing protocol. Multicast. P-NNI for ATM networks. TCP protocol: bottleneck and flow control mechanisms. Network quality of service support: ATM categories, quality of service mechanisms for TCP/IP networks. MPLS technology: services and applications. Introduction to IPv6.

Assessment: Written exams at the end of the semester 80% and lab exercises 20%.

Introduction to Optical Communications

Category: Specialization in Telecommunications - Core

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Physics **or** Principles of Telecommunication Systems

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the essentials of propagation in an optical fibre and the physical layer properties, at system and sub-system level, of a point-to-point link.
- quantify by means of appropriate mathematical formalism these physical layer properties.
- explain the physical effects contributing to signal deterioration within an optical links.
- describe the basic principles of physical layer modeling for design optical links.

Course contents: Why optical fibres are needed. Transmission, transportation and switching. What are the building blocks for a point-to-point link. BER, Q-factor, EOP. Optical fibre and propagation in it. Dispersion, losses, power budget; modeling of dispersion and dispersion compensation. Lasers and their principle of operation, single mode semiconductor laser, rate equations. Optical amplifiers and their noise. Optical receivers . Optical filters and multiplexers.WDM systems and their design principles. Non-linear effects and their impact.

Assessment: Written exams at the end of the semester.

Digital Communications

Category: Specialization in Telecommunications - Core

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Signals and Systems **or** Principles of Telecommunication Systems

Teaching: 2 hours lectures, 2 hours lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- Recognize the most well-known line codes and plot corresponding spectra.
- Calculate the signal space dimension and design the optimal detector.
- Be aware of basic digital modulation techniques with (ASK, PSK, DPSK, FSK) and without (PAM, PPM, on/off) carrier and recognize their waveforms.
- Design optimum filters to eliminate intersymbol interference.
- Be able to calculate bandwidth and power requirements for optimal operation of digital communication systems.
- Calculate and compare the performance of basic modulation techniques in the presence of AWGN noise

Course contents: Introduction, AWGN noise, line codes and spectra, baseband modulation techniques (PAM, PPM), signal algebra, constellation diagram, Nyquist filters, correlator and matched filter, intersymbol interference, probability of error and bandwidth requirements, optimum receiver design, maximum likelihood detectors, eye pattern, carrier modulation, coherent demodulation (ASK, PSK, FSK), noncoherent demodulation (DPSK, NCFSK), performance comparison.

Assessment: Written exams at the end of the semester in both theoretical and laboratory parts with a percentage 70% and 30%, respectively. Optional midterm exams are also possible for the theoretical part with a weight of 30%-40%.

Digital Signal Processing

Category: Specialization in Telecommunications - Core

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Signals and Systems

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe basic concepts and properties related to distinctive signals and systems time
- describe basic applications of digital signal processing
- apply the theoretical analysis of issues related to digital signal processing, with the computer simulation and actual implementation
- describe the role of signal processing in modern technological applications
- design digital filters
- designs digital system architectures with distinct elements
- applies the Discrete Time Fourier transform and the Z transform to describe the input – output of discrete time linear systems.
- calculate the frequency response and transmission function of discs of discrete time systems
- solve linear difference equations describing discrete linear time systems
- apply the Discrete Fourier Transform to troubleshooting digital signals and systems

Course contents: Introduction. Discrete time signals and systems. Sampling and quantization. Linear time invariant discrete time systems. Convolution. Z-transform. Frequency domain representation. Digital filters. Discrete orthogonal transforms.

Assessment: Examination for both theory (70%) and laboratory practice (30%). Theory: written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%. Laboratory practice: Written exams at the end of the semester or home assignments or both.

Systems Programming

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Programming II **and** Operating Systems

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the most important Unix standards and implementations and write code that can be compiled and run without changes on any system
- use library and system calls to query and set resource limits for processes

- use tools to statically check program correctness
- use library and system calls to read, write and manage files and directories
- use library and system calls to manage processes and their environment, manage signals and use dynamically linked libraries; additionally use tools to create dynamically linked libraries
- use pipes, named pipes, semaphores, shared memory, message queues and sockets for interprocess communication and synchronization
- write multi-threaded programmes and use library and system calls to manage and synchronize threads

Course contents: Introduction. Basic concepts. Standards and implementations. Limits management. Input-output for files and directories. Processes. Signals. Interprocess communications. Threads.

Assessment: Mandatory home assignments with a weight ranging from 30% to 40% and written exams, with a weight ranging from 70% to 60%. In order for a student to succeed in the course, s/he must meet the threshold of 40% in both home assignments and written exams, and the student's weighted average should be 5 or more.

Computability and Complexity Theory

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: Mathematics II **or** Discrete Mathematics

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- define and use the abstract computational models introduced along with their relation to the notion of algorithmic computation (Church-Turing thesis)
- state and describe the notion of Turing computability and the fundamental recursive unsolvability results
- analyze the classification of computational problems with respect to the resources needed for their computation (complexity classes)
- explain the fundamentals of the theory of NP-completeness along with the importance of the P vs NP problem for Theoretical Computer Science and Mathematics
- state and analyze proofs of NP-completeness

Course contents: Problems as languages (decision vs search problems). Finite automata. Models of computation – Turing Machines and variants of TMs. Decidable and Undecidable Problems, Recursively Enumerable Languages and beyond.

Complexity classes and known relations, hierarchy theorems. The class NP, NP-complete problems, Cook and Karp reductions. PSPACE completeness, Polynomial Hierarchy.

Time permitting, a quick review on the structural aspects and the inherent difficulties of the P vs NP problem up to the Baker-Gill-Solovay Theorem. Alternatively, a quick view of approximability of NP-hard problems.

Assessment: Written exams at the end of the semester

Computer Architecture II

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Computer Architecture I

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic techniques of instruction level parallelism for enhancing performance in general purpose processors
- describe the basic techniques of data level parallelism in SIMD (Single Instruction Multiple Data), Vector and GPU (Graphics Processing Units) architectures
- describe the basic techniques to exploit thread level parallelism in parallel systems with distributed or shared memory architectures
- apply the algorithms of memory coherency protocols for shared and distributed memory architectures
- describe the structure and models of warehouse scale computers and describe the algorithms for exploiting request-level and data level parallelism.
- apply existing techniques for memory hierarchy design
- assess performance of parallel computer systems

Course contents: Introduction. Instruction Level Parallelism. Pipeline Hazards. Static & Dynamic Scheduling. Hardware Speculation. Multithreading. Vector Architectures. Graphics extensions in SIMDs. GPUs. Data level parallelism. Shared Memory Architectures. Distributed Memory Architectures. Multicore Performance Issues. Warehouse Scale Computing.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 50%.

Computer Graphics

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: **(**Programming II **or** Object-Oriented Programming**) and** Mathematics I

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic steps of the graphics pipeline for direct rendering (primitive rasterization, clipping, hidden-surface removal, projection, lighting, texture mapping, shadow generation) and corresponding algorithms.
- compose basic 2D and 3D transformations in order to perform complex transformations
- apply basic graphics algorithms (eg. Back-face culling) by performing the relevant computations on 2D and 3D geometry
- describe the process of texture mapping on a surface
- describe the basics of ray tracing
- optionally, compose a simple 3D scene with animation and simple user interaction using the OpenGL library

Course contents: Introduction: elements of linear algebra and geometry, image and color representation, graphics hardware technologies. Algorithms for drawing simple primitives: line segments, circles, polygon filling, antialiasing. Clipping of simple primitives. 2D and 3D transformations, homogeneous coordinates. Projections, perspective, parallel, viewing transformation. 3D model representation. Scene graph. Back-face culling, hidden-surface removal, the z-buffer. Lighting, the Phong illumination model, algorithms based on the Phong model (constant, Gouraud, Phong shading). Texture mapping: types of texture, texture coordinates, texture coordinate generation functions, antialiasing and texture filtering, environment mapping and bump mapping. Shadow generation: shadow volumes, shadow maps. Ray-tracing basics. OpenGL lab.

Assessment: Written exam, and optional coursework with weight 15%-20%.

Educational Informatics

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the educational informatics domain
- list the areas of application of educational informatics
- discriminate between mere reporting of information, training and teaching
- explain the differences between synchronous and asynchronous education
- explain the differences between generic software, educational software, plagiarism checking software and learning assessment software
- list the motives and criteria for the application of informatics in education

Course contents: Education and teaching. School system, formal education, informal education, life-long learning. Introduction to educational informatics and educational technology. Beyond Scratch and robotics. The use of technology in teaching, training, assessment, teacher support and in supporting autonomous learning. The role of LLMs. Good practices

Assessment: Through projects

Cultural Informatics

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the cultural informatics domain
- list the areas of application of cultural informatics
- discriminate between tangible and intangible heritage
- explain the differences between preservation, documentation, organization, study, exploitation and presentation of cultural heritage
- identify areas where cultural informatics is applied and areas where it could be applied
- list the motives and criteria for the application of informatics in culture

Course contents: Culture and cultural heritage. Tangible and intangible heritage. Introduction to cultural informatics. The use of informatics in (i) preservation, (ii) recording, (iii) organization, (iv) study, (v) exploitation and (vi) presentation of culture. Good Practices.

Assessment: Through projects

Advanced Programming Topics

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Object-Oriented Programming **and** Data Structures

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- use source control systems and specifically git
- create a mid-size application with a graphical user interface in JavaFX by selecting the appropriate graphical controls for the user interface of the application (text field, button, combo box, check box, radio button, list, etc)
- use appropriate layout managers (Stack, Border, Flow, Grid, HBox, VBox panes, etc.) for the effective setup of the content of the GUI.
- implement event handlers for various kinds of events of the UI elements of JavaFX, selecting the most appropriate implementation (as a regular class, as an inner class, as an anonymous class, or with lambda expressions)
- use secondary windows (dialogs) in his application with the help of the Alert class
- select among the various data structures available in the Java library, depending on the requirements of his application, and traverse the data structures in multiple ways (for-each, iterator)
- make use of the algorithms available in the Java library (sorting, searching, etc.)
- write a basic client-server application for network communication

Course contents: (a) Usage of git for source control: basic commands, branching, use of remote repositories (github).(b) JavaFX programming: basic elements of a graphical user interface (text field, button, combo box, check box, radio button, list, etc), layout managers (Stack, Border, Flow, Grid, HBox, VBox panes, etc.), event handlers, menus, dialogs. Inner classes, anonymous classes, basic elements of lambda expressions.(c) Elements of the Java library: Collections (List, Set Queue, Map and their implementations). Algorithms (Arrays, Collections). Equals methods. Object comparison (Comparable, Comparator). Data structure traversal (for-each, iterators). Java Streams. Network programming (simple client-server applications).

Assessment: The course grade will be based on a large programming project (possibly involving a personal examination) and/or programming exercises that will jointly account for 30% of the final grade, and a final examination (on a computer, possibly split in two parts) that will account for the remaining 70% of the final grade. These percentages may vary (+/-10%) each year. In order to pass the course, the student must have a mark higher than 4.5/10 in each part (and exam) of the course and a total mark higher than 5/10.

Big data management

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Object-Oriented Programming **or** Databases

Teaching: 3 hours lectures, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:
- dentify the specifics, problems and ethical issues that arise from big data management,
- explain the limitations of older approaches,
- distinguish the benefits and the limitations of parallel / distributed big data processing, as well as of no-SQL databases,
- model big data, and
- use modern applications / technologies to manage big data.

Course contents: The course focuses on distributed system architectures, cluster computing systems, grids and cloud technologies, distributed file systems (e.g., Google file system, Hadoop, Facebook Cassandra), search of distributed data (Chord), models of parallel/distributed computations for relational data (Map/Reduce) and graphs (Pregel), NoSQL databases (e.g., Elasticsearch, MongoDB, Neo4j), big data visualization (e.g., Kibana), big data streams, and big data mining. Additionally, the course discusses issues concerning the use of big data in the context of different everyday applications (e.g., social networks, e-health, e-government, etc.), as well as the related ethical/private issues raised.

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or exercises (in-class or homework) and/or oral presentation that will jointly account for 50% of the final grade, and a 3-hour written final examination that will account for the remaining 50% of the course grade. These percentages may vary (+/-10%) each year. In order for a student to successfully complete the course, s/he must score at least 50% in the written exams, and the student's weighted average should be 50% or higher.

Distributed Information Management

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: –

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe fundamental concepts and algorithms as applied in areas such as the Web, peer-to-peer and distributed/parallel systems,
- design, develop, and evaluate fundamental algorithms and systems in the area of Distributed Information Management
- identify and record important research questions in the area of Distributed Information Management,
- combine solutions from existing technologies to solve new/interesting Distributed Information Management problems.

Course contents: Distributed Information Retrieval (crawling, distributed indexes, link analysis). Distributed/peer-to-peer data and information management (in unstructured, structured, and self-organising environments). (Distributed) Information Filtering. Social data/information management. (Distributed) Digital libraries, Distributed/Palallel data computation (Map/Reduce, Hadoop, Pregel, Cassandra). Personalisation (user profiles, collaborative information filtering).

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or exercises (in-class or homework) that will jointly account for 40% of the final grade, survey and presentation of topics related to the course that will account for 30% of the final grade, and a 3-hour written examination that will account for the remaining 30% of the final grade. These percentages may vary (+/-10%) each year.

Cryptography

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7 [1]

Prerequisites: Discrete Mathematics

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe basic principles in using cryptographic algorithms in order to provide confidentiality and integrity
- apply main design methodologies to develop own ciphers
- evaluate the strength cryptographic algorithms based on design building blocks
- apply well-known cryptanalytic techniques

[1] Students may also enroll to the course in semester 5.

Course contents: Introduction (applications, algorithms classification, attack models), classical ciphers (permutation, mono– & poly–alphabetic substitution, perfect secrecy, classical cryptanalysis), stream ciphers (generator models, Golomb's postulates, Berlekamp–Massey algorithm, linear complexity, cryptanalysis), block ciphers (Feistel structure, substitution–permutation networks, modes of operation, differential and linear cryptanalysis), public–key cryptography (principles, RSA algorithm and Rabin, ElGamal, McEliece systems, probabilistic algorithms, attacks), digital signatures (Fiat-Shamir, Feige-Fiat-Shamir, Schnorr and others, one-time signatures, attacks), hash functions.

Assessment: Written exams (70%) at the end of the semester and projects (30%), where the percentage may vary up to ±10%.

Compilers II

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Compilers I

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the characteristics and purpose of intermediate representations
- describe the characteristics of computer languages' type systems
- describe the algorithms and techniques from high to medium level intermediate representation
- describe the characteristics and functionality of runtime environments
- describe the purpose of dependence checking and apply the Delta dependence test
- describe the purpose and apply the basic algorithms of data flow analysis
- describe and apply the algorithms of the basic stages of code generation (instruction selection, scheduling and register allocation)
- describe and apply optimizing loop transformations
- describe and apply the basic design patterns for compiler construction
- design syntax analyzers with the ANTLR tool
- design compiler passes using the visitor and listener design patterns
- calcualte the dependency graph using Delta Test
- apply loop transformations in loop nests to expose parallelism

Course contents: Introduction. Intermediate Representations. Languages' Type Systems characteristics. Medium Level Intermediate Representation generation. Dependence Analysis. Data Flow Analysis. Instruction Selection. Scheduling. Register Allocation. Optimizing Loop Transformations. Design Patterns for Compilers.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage between 10% and 50%.

Parallel Algorithms

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Programming I **or** Programming II

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- analyse and design parallel algorithms based on the channel/task model

- implement a parallel algorithm using the MPI interface
- characterize the efficiency of a parallel algorithm
- describe basic parallel algorithms especially in the field of array calculations and searching

Course contents: The task/channel model, Foster's design methodology, the n-body problem, Message Passing Programming, benchmarking parallel performance, Floyd's algorithm, performance analysis, Amdahls law, the Karp-Flatt metric, matrix-vector multiplication, matrix multiplication, sorting, combinatorial search, divide and conquer, parallel alpha-beta search.

Assessment: Five sets of homework with total weight 25% and 3 hours written exams with weight 75%.The relevant weights can be changed (+/-10%).

Advanced User Interfaces - Virtual Reality

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Human Computer Interaction

Teaching: 4 hours lectures per week. About half of them will take the form of an **obligatory** lab and exam. The first half of the course is mainly theoretical and prepares for the second half, which is mainly lab-based.

Learning outcomes: At the end of the course the student will be able to:

- describe the peculiarities of VR technologies
- describe the Virtual Reality Systems' development life-cycle
- use basic content development tools
- design and implement a Virtual Reality application

Course contents: Introduction to Virtual Reality, Human Factors, Virtual Reality I/O technologies, Content development tools and techniques, User interaction design and development, System intergration.

Assessment: 50% of the labs results and 50% of the final exam. Passing grade: a student has to get at least 4.5/10 at each assessment method (labs total, final exam) and the total mark should be at least 5/10.

Data Management Systems

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Data Structures **and** Databases

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe fundamental concepts and theory related to the architecture and functionality of a Data Management System,
- describe, analyse, and implement fundamental tools and techniques used in Data Management Systems,
- evaluate proposed solutions for Data Management Systems and select the most appropriate one based on the constraints and nature of the given problem,
- design and develop novel algorithms and techniques related to the area of data management.

Course contents: Architecture of database systems. Disks and files (memory hierarchy, RAID, file organization – heap/ordered/hash/clustered files). System catalogs and record storage. Tree-structured

(ISAM, B-trees, B+ trees) and hash-based (static/extendible/linear) indexing. Query processing and optimization (selection, projection, join, groupby). Transaction processing and management (schedules and serializability). Concurrency control and crash recovery. Parallel and distributed databases. Special types of databases.

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or exercises (in-class or homework) that will jointly account for 50% of the final grade, and a 3-hour written examination that will account for the remaining 50% of the final grade. These percentages may vary (+/-10%) each year. To succeed in this course, a mark of 5 or higher is required in the written exam and in the final grade.

Computational Geometry

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Data Structures **or** Algorithms and Complexity

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- recognize basic notions of computational geometry.
- describe fundamental geometric algorithms.
- design efficient algorithms for computational geometry problems.
- analyze the complexity of geometric algorithms and prove their correctness.

Course contents: Convex hulls. Segment intersection. Polygon triangulation. Halfplane intersection. Lower envelopes and Duality. Orthogonal range searching. Point location. Voronoi diagrams. Delaunay triangulations. Line arrangements. Linear programming.

Assessment: Assignments with weight 50% and written exam.

Computer Games Development

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Computer Graphics

Teaching: 3 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- know the methodology for the development of an electronic game
- distinguish the elements that make a game fun
- create the game design document
- create a game prototype

Course contents: The development cycle of a game, player profiles, the elements of a game, the MDA framework, the concept/design document, storytelling techniques, player decisions and dilemmas, basic development tools.

Assessment: 60% Game Design Document, 20% prototype, 20% presentation

Special Topics in Algorithms

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Data Structures **or** Algorithms and Complexity

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:
- describe the algorithmic methods of the presented topics
- apply these methods to related problems

Course contents: Selected topics in one or more areas of Algorithms such as Graph Algorithms. Geometric Algorithms. Approximation Algorithms. Advanced Data Structures. Randomized Algorithms. Combinatorial Algorithms. Algorithms on Strings.

Assessment: Assignments

Topics on Data and Information Management

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Databases

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- describe the functionality of modern systems managing information and data
- explain their techniques and algorithms
- analyze the design choices and the computational complexity ogf the systems
- use the systems to address real-world information and data management problems

Course contents: Introduction. Object relational databases. Knowledge representation. Representation of complex data. Queries for complex data and knowledge. Time series. Constraint databases. Anonymity and privacy.

Assessment: Written exercises and implementation of a project during semester and exams at the end of the semester. The final grade results in by taking into account the respective marks of exercises (up to 60%), project (up to 40%) and final examination (up to 60%).

Logic for Computer Science

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:
- discern and recognize the basic tools of Mathematical Logic, having been acquainted with the fundamentals of this area and its well-known metamathematical results (syntax and semantics for propositional and first-order logic, elements of proof theory, elements of model theory, logic programming)
- design and develop applications of Logic in problems of Computer Science, starting from simple applications in Theoretical Informatics

- design and develop applications of Logic in Knowledge Representation and Reasoning in AI
- compare and sort logics with respect to their expressive power and usefulness for specific problems

Course contents: Propositional and First-Order Logic (Syntax, Semantics, proof Theory, Soundness, Completeness). Elements of Proof Theory and automated deduction (Hilbert systems, tableaux, Gentzen systems). Elements of Logic programming. Non-classical logics (modal, temporal, non-monotonic logic) and applications in AI.

Assessment: Written exam at the end of the semester. Optional coursework may be assigned.

Machine Learning

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Mathematics I **and** Programming II **and** Probability and Statistics

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic concepts of machine learning (classes of machine learning problems, training methods, etc.).
- explain what kinds of problems can be solved using machine learning, as well as the limitations of machine learning.
- recognize and address frequent problems of machine learning methods (e.g. overfitting).
- choose the most appropriate machine learning model/methodology based on the task at hand.
- use modern tools (e.g. NumPy, scikit-learn, Tensorflow, PyTorch) to develop algorithms and solve machine learning problems.
- evaluate the quality of a machine learning system, as well as compare different machine learning systems with each other

Course contents: Introduction to machine learning, the cross validation method, introduction to probability theory and probabilistic models, linear regression and logistic regression models, nonlinear models, neural networks and deep learning, deep learning architectures, introduction to large language models, k-nearest neighbors, descriptive probabilistic classification models, naive Bayes, support vector machines, decision trees and information gain, ensemble methods, clustering methods, k-means algorithm, dimensionality reduction methods, reinforcement learning.

Assessment: The final course grade is based on three criteria: (1) Performance on the first assignment (20%); (2) Performance on the second assignment (20%); (3) Final written exams (60%). A prerequisite for the exam to be considered successful is that at least a grade equal to 5 is achieved in each category of grading criteria (ie, Assignments and Final Exam).

Software Engineering II

Category: Specialization in Informatics - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Object-Oriented Programming **and** Software Engineering

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe and apply the basic principles for the description, design and development of object-oriented software, under the agile methodology

- describe and apply the different phases of application design, according to the agile methodology
- describe the GRASP and SOLID SOLID Principles, and apply them in software design and implementation
- describe the object-oriented architectural design patterns (Gang of Four -GoF- patterns) and the related criteria for their application; select the most appropriate design pattern considering the functionalities to be implemented and apply the selected design patterns
- apply effectively the software development techniques for object-oriented software blueprints, in the context of modern programming languages and software development environments.

Course contents:

1. Overview of the object-oriented features of modern programming languages
   (a) classes / abstract classes / interfaces
   (b) Extension Methods
   (c) Anonymous Methods / Lambda Expressions
   (d) Delegates / functional interfaces / Events
   (e) Generics
2. The agile methodology and the iterative development paradigm
   (a) Requirements phase
   (b) Design phase
   (c) Implementation phase
3. GRASP and SOLID principles
   (a) GRASP principles: Information Expert, Creator, Low Coupling, Protected Variations, Indirection, Polymorphism, High Cohesion, Pure Fabrication, Controller
   (b) SOLID principles: S - Single-responsibility Principle, O - Open-closed Principle, L - Liskov Substitution Principle, I - Interface Segregation Principle, D - Dependency Inversion Principle
4. Design patterns - Gang Of Four Patterns
   (a) Creation patterns (Abstract Factory, Builder, Factory Method, Prototype, Singleton)
   (b) Structural patterns (Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy)
   (c) Behavioral patterns (Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State , Template Method, Visitor)

Assessment: Compulsory final project with weight 60%-70%. Lab exercises with weight 30%-40%.

Introduction to Embedded Systems

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: **(**Programming I **or** Programming II**) and** Electronics **and** Logic Design

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Explain and describe the architecture of embedded systems
- Explain and describe the way embedded systems work and communicate with their peripherals
- Apply methods and techniques for specification, desing and implementation of embedded systems
- Extend the already existing programming knowledge to the embedded systems programming
- Combine already existing knowlegde from obtained both Hardware and Software courses
- Utilize both electronic components and software for implementation of practical embedded systems

Course contents: Overview of embedded systems and their practical applications. Basic principles of microprocessors.

Embedded systems software: Embedded systems programming , programmable input/output, interrupts, the shared data problem. Basic software architectures for embedded systems. Real time operating systems, tasks, the shared data problem in embedded systems implemented with real time operating systems. Embedded systemsdesign with real time operating systems.

Embedded systems hardware: Overview of digital electronics, technical characteristics of logic gates, RAM/ROM memories. Implementation of input/output, handshaking, serial and parallel communications, UARTs, FIFOs, DMA. Analog electronic devices for embedded systems, timers, oscillators, signal generators and circuits.

Laboratory: Laboratory exercises in Arduino and/or Raspberry-Pi based embedded systems. Students are requested to design and implement an embedded system for an application of their choice.

Assessment: Written exams at the end of the semester 70% and lab exercises or project 30%.

Numerical Analysis

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic principles of Numerical Analysis.
- describe the way of constructing and analyzing numerical methods
- describe how to modify methods in order to solve specific real-world problems
- program methods of Numerical Analysis in a MATLAB environment

Course contents: Introduction to Numerical Analysis. Errors: Errors in calculations. Interpolation: Introduction, Lagrange Interpolation, Newton Interpolation, Difference Quotient, Finite Differences, Newton-Gregory Polynomials, Correction in Interpolation. Approximation Theory: Introduction, Polynomial Approximation, Least Squares Theory, Chebyshev Technique. Numerical Differentiation: Introduction, Method of Undetermined Coefficients. Numerical Integration: Introduction, Newton-Cotes Methods, Method of Undetermined Coefficients. Numerical Solution of Nonlinear Equations: Introduction, Bisection Method (Bolzano), Fixed Point Iteration Method, Method of Newton-Raphson.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 15% and 25%.

Wireless and Mobile Communications II

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Communication Networks I

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe the fundamental operation principles in all cellular and wireless communication networks
- Evaluate the performance of the mechanisms used for a number of tasks (e.g., handover, location management)
- Explain the main issues for the integration of different access systems and how these can be tackled
- Identify the problems of mobile and wireless systems that arise in different deployment environments and how these can be solved

Course contents: Cellular Systems Architecture, management of radiochannels, mobility management, communication management, systems integration, network management for cellular networks, QoS Support in mobile and wireless networks.

Assessment: Written exams at the end of the semester 100%, or optional coursework 20% and written exams 80%.

Image Processing: principles, algorithms and applications

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- Identify the characteristics and properties of 2D signals (continuous and discrete variable signals)
- Use digital signal processing tools (DFT, filters, etc.) in a 2D signal environment
- Conduct typical measurements and modifications on several properties and metrics of digital images (e.g. size, brightness, histogram etc.)
- Apply techniques for enhancing, de-noising, restoring/reconstructing, segmenting etc. digital images
- Apply methods for detecting edges and points/areas of interest
- Draft processing algorithms and deploy them in software (prototyping) tools (e.g. MatLab)

Course contents: Digital image - digitizing two-dimensional signals (2D). Two-dimensional transforms (Fourier, Z, DFT, etc.) and 2D filters. Image analysis and processing, size modification, contrast/brightness modification, histogram and equalization. Techniques and methods for image segmentation, edge detection, contour and point of interest detection. Tools for image restoration, de-noising, color enhancement, reconstruction. Applications using software (e.g. MatLab).

Assessment: Written exams at the end of the semester which will contribute 60% to the final grade. Laboratory reports and/or oral examination which will contribute 40% to the final grade. The aforementioned percentages may vary by ±10% depending on the requirements of the laboratory work each academic year.

Coding and Information Theory

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Probability and Statistics

Teaching: 2 hours lectures, 1 hour lab, 2 hours tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:
- Evaluate the discrete source entropy
- Explain 1st and 2nd Shannon coding theorem
- Recognize and categorize source codes
- Perform data compression
- Evaluate the mutual information and the discrete channel capacity
- Explain the motivation for source and channel coding
- Encode and decode linear block codes and cyclic codes

Course contents: Introduction, entropy, joint entropy, mutual information, information rate, redundancy, discrete message sources, memoryless sources, Markov sources, source coding, Huffman coding, communication channels, discrete channel capacity, continuous channel capacity, Galois field GF(2), linear block codes, Hamming codes, cyclic codes, systematic codes, BCH and CRC codes, burst error correcting codes.

Assessment: Written exam at the end of the semester. Given projects have 30%-40% weight on the total course grade.

Decision Making Systems

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- identify the decision-making processes and manage to solve complex problems.
- design a system to support semi structured and unstructured decisions.
- analyze the sensitivity of the systems by studying their function.
- make the decision with respect to the effectiveness and efficiency of the system.
- create systems that can be tested in different strategies in different circumstances to produce results quickly and objectively.
- select and combine the appropriate parameters required, in order to extract reliable and useful conclusions during the processes that occur in unforeseen situations (frequent changes in complex scenarios).
- understand the basic theories for taking simple and sequential decisions.
- achieve interaction with the data management to recover data, to run models and store the results for further processing.
- separate decision sequences (Decision Trees, Markov Decision Processes, Dynamic Programming).

Course contents: Data, Information, Knowledge Management. Strategic Role of Information Systems. Decisions, analysis in all phases of the decision making process. Multicriteria decision analysis, multicriteria analysis applications. Group decision making process. Decision support systems - architectures. Communication Systems. Structured modeling - modeling strategy. Structured Modeling & Model Base Management Systems. Dynamic Simulation Modelling - Fuzzy logic. Dynamic Simulation Modelling - AnyLogic. Intelligent decision support systems. Multicriteria decision support systems. Decision support systems Applications.

Assessment: Written examination at the end of the semester. Assignment which will contribute 30% – 50% to the final grade.

Internet Applications and Web Services Development

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Programming I **or** Programming II

Teaching: 3 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- recognize the functionality of common application protocols (e.g., FTP, SMTP, POP, IMAP, DNS), as well as to recognize the common request and response messages of HTTP and their meaning.
- use and configure open source web servers (e.g., Apache, Tomcat, etc) and relational databases (e.g. MySQL, PostgreSQL, etc).
- use HTML5 to implement static web pages and CSS3 for web design.
- adapt the content of a web application based on the visitor's screen characteristics, by using CSS3 media queries and mobile first techniques or responsive web design.
- use Javascript to implement client-side dynamic web pages and applications, as well as PHP/Node.js to implement server-side dynamic ones.
- connect to MySQL Server with PHP or Node.js in order to implement 3-tier internet applications.
- edit, serialize/deserialize, validate and handle XML/JSON document, to use XML Schema (XSD)/JSON schema in order to define the structure of XML/JSON documents and to use basic AJAX (Asynchronous Javascript and XML) techniques.
- use open APIs, like Google Maps API or Chart.js, in order to be able to design and implement mash up applications.
- design and implement Web Services by using either SOAP over HTTP or RESTful architecture.

Course contents: Application layer protocols (e.g., FTP, SMTP, POP, IMAP, DNS), HTTP, HTML, CSS, client side scripting (Javascript), server side scripting (PHP/Node.js), PHP/Node.js and MySQL scripting, XML, XML Schema, JSON, JSON Schema and Asynchronous Javascript and XML (AJAX), Google Maps/Chart.js API and mash up applications, SOAP/REST Web Services.

Assessment: Written exams at the end of the semester. Project assignment will be given, which will contribute to the final grade with a percentage ranging between 20% and 40%.

Internet of Things

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Introduction to Embedded Systems **and** Electronics **and** Logic Design

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- describe basic applications of the Internet of Things systems
- explain and describe the architecture of Internet of Things systems
- explain and describe how Internet of Things systems function and communicate
- explain and describes the ways of processing the data produced by the Internet of Things systems
- design IoT embedded systems
- implement elementary IoT embedded systems

Course contents: The purpose of the course is for students to understand the basic concepts in the systems called “Internet of Thing” (IoT), such as the technologies used in them (e.g. communication, programming and processing of the data that they collect and transmit). In the laboratory, students will be trained in the use and programming of the most common and commercially available IoT systems. This course bridges the 5th semester Introduction to “Embedded Systems” prerequisite course and the 8th semester “Sensor Networks” which specializes in the details of embedded sensor networking which is a subcategory of IoT systems. The contents of the course are the following:

Introduction to Internet of Things systems; purpose, benefits and practical applications. Fundamentals of designing, developing and operating an IoT system. Communication protocols and their comparison. Comparison of Operating systems for Internet of Things systems in their applications. Programming IoT systems. IoT processing units and processing methods of IoT systems' data. Study of IoT sensors/actuators and data communication channels through I/Os. Design and implementation of elementary IoT devices.

Assessment: Assessment will be by written exams at the end of the semester or by assignments, or by written exams and assignments.Written exams will be a combination of problem solving, multiple choice and short answer questions.Assignments include problem solving, and/or presentations, and/or report writing.The assignments, if combined with exams, will contribute to the final grade with a percentage ranging between 40% and 60%.

Multimedia Signal Processing

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Signals and Systems

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe the basic elements and properties of multimedia signals and systems
- Describe elementary applications on multimedia signal processing
- Perform theoretical analysis as well as a practical implementation of multimedia signal processing methods and algorithms for compression and coding of voice, music, image and video signals
- Describe the role of multimedia in modern computer and telecommunication applications
- Describe multimedia signal coding standards
- Describe and apply techniques for the transmission of multimedia signals over the internet and communication systems.

Course contents: Multimedia signals and systems. Voice, music, image and video signals. Analog to digital conversion. Compression and coding. Entropy encoding. Compression of voice, music, image and video signals. Transmission of multimedia signals. Applications of multimedia in informatics and telecommunications.

Assessment: Examination for both theory (70%) and laboratory practice (30%). Theory: written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%. Laboratory practice: Written exams at the end of the semester or home assignments or both.

Theory and Applications of Speech Processing

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: –

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Understand the general principles of the speech production models
- Understand the fundamental concepts regarding the acoustic perception of the speech signal and of the sound in general
- Conduct (in software environment) recordings and pre-processing of the speech signal (recording, initial filtering, pre-amplifying, etc.)
- Process the speech signal - in software platforms - utilizing signal processing tools (e.g. spectral estimation, harmonic analysis, etc.) in order to extract the main characteristics of the signal (e.g. pitch, formants, voiced/unvoiced sections etc.)

- Understand the main parameters of the speech synthesis process and deploy in software various parts of the synthesis techniques (speech diphone concatenation, overlap-add method, LPC coding, harmonics plus noise synthesis, etc.)
- Devise methods for modifying the speech signal (e.g. speech or speaker modification)
- Describe the components of an end-to-end Text-to-Speech synthesis system
- Describe the main problems of the (automatic) speech recognition process and the individual processing parts that comprise a speech recognition model

Course contents: Main characteristics of the speech signal. Speech production models. Acoustic perception of speech and sound. Techniques and tools for digital processing of the speech signal. Linear prediction in speech processing, harmonic models and typical coding methods of the speech signal. Speech synthesis and Text-to-Speech systems. Speech recognition. Algorithm deployment in software platforms (e.g. MatLab).

Assessment: Written exams at the end of the semester which will contribute 50% to the final grade. Laboratory reports and/or oral examination and/or semester project presentation which will contribute 50% to the final grade. The aforementioned percentages may vary by ±10% depending on the requirements of the laboratory work each academic year.

Stochastic Network Modeling and Performance Analysis

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7 [1]

Prerequisites: Probability and Statistics

Teaching: 3 hours lectures, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the concept of traffic load and its properties
- describe Little’s Law
- describe basic loss and queueing models
- solve problems by using the classical formulas of Erlang B, Erlang C, Engset and Pollaczek–Khinchine
- describe and design multirate loss models
- solve problems by using the recursive formulas of Kaufman-Roberts and Roberts in the case of the complete sharing and bandwidth reservation policies
- describe the basic principles of overflow systems and solve problems according to the Equivalent Random Theory

Course contents: The basic characteristics of teletraffic systems. Traffic load – Traffic load properties. Little’s Law. Analysis of Markovian loss models: M/M/s – M(n)/M/s. The Erlang B formula. The Engset formula for a small number of traffic sources. Analysis of Markovian queueing models: M/M/1, M/M/s/k, M/G/1. The Erlang C formula. The Pollaczek–Khinchine formula. Multirate Loss Models. The complete sharing policy of the available link bandwidth. The Kaufman-Roberts recursive formula. The bandwidth reservation policy. The Roberts’ recursive formula. Overflow systems: The Equivalent Random Theory – ERT.

Assessment: Written exams at the end of the semester.

Digital Systems and Circuits Design

Category: Specialization in Informatics or Telecommunications - Elective

[1] Students may also enroll to the course in semester 5.

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Logic Design

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Define the design flow of a digital system and according to the specifications to define the design targets for the implementation and the architectures
- Use VHDL for the description of a digital system
- Apply methods and techniques for the implementation of algorithms in digital systems

Course contents: Introduction to Digital systems: Principles and terminology, Digital systems design flow. System level design: Design objectives, System architecture alternatives (Application Specific Integrated Circuits –ASIC- or processor).Digital design using VHDL code: Design flow, Data Types and Operators, Concurrent code and description of combinational circuits, Sequential circuits and Code, Signals and Variables, State Machines, System Design, Parametric design, Data flow and behavioural description, Design using existing subsystems (Intelectual .property –IP- cores).From specifications to architecture and verification of a digital system: Definition of functional specifications, Development of formal verification methods, Validation, Data handlers and control unit design, Interconnectionunits, Register Transfer Level design.Digital signal processing system design, Application specific processor design.

Assessment: Compulsory coursework and oral-written exam at the end of the semester. The final grade is computed from the grades of the oral-written exam (with weight 50-70%) and the coursework (with weight 30-50%). The grades of both the oral-written exam and the coursework must be at least 5.

Implementation of digital circuits and systems with FPGAs

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Logic Design

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- choose the appropriate type of FPGA to implement a developed digital design/system
- use the FPGA manufacturer tools to place & route the digital design/system on the chosen FPGA and verify the design
- program the FPGA with the developed digital design/system and debug-verify the circuit

Course contents: Introduction to FPGAs (Field Programmable Gate Arrays), Available FPGA technologies, Implementation, Place & Route and interconnections of the design on the FPGA, Timing constraints definition,Analysis of timing, Timing verification with simulation,FPGA resources utilization and performance evaluation, FPGA pin allocation, FPGA programming, FPGA verification, Circuit debugging, System verification.

Assessment: Compulsory coursework and oral-written exam at the end of the semester. The final grade is computed from the grades of the oral-written exam (with weight 50-70%) and the coursework (with weight 30-50%). The grades of both the oral-written exam and the coursework must be at least 5.

Sensor Networks

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [1]

[1] Students may also enroll to the course in semester 6.

Prerequisites: Communication Networks I **or** Wireless and Mobile Communications I

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the most important sensor technologies.
- design sensor systems that are implemented on embedded systems.
- operate the corresponding software (operating system, applications).
- describe the architecture of sensor networks.
- analyze the operation of communication protocols at the MAC and network layers.
- describe, explain and design applications of sensor networks.
- assess dynamic energy management techniques.

Course contents: Introduction. Applications, Node architecture, operating system, MAC protocol, Routing Protocols,Dynamic Power management, Embedded Systems, Synchronization, Localisation, Programming environments.

Assessment: Written exams at the end of the semester.

Distributed Systems Programming

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Object-Oriented Programming

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- recognize the differences between different distributed architectural models (e.g., client-server, n-tier, peer-to-peer, publish-subscribe).
- use Eclipse and/or NetBeans IDE for distributed Java programming development and implement Java applications by using threads, TCP and UDP sockets, multithreaded sockets and use the remote-procedure-call (RPC) technique.
- define and implement Java remote interfaces and implement Java-based distributed services and applications by using Java Remote Method Invocation (Java RMI).
- define and implement IDL (Interface Definition Language) interfaces and implement distributed services by using CORBA middleware and distributed objects technologies.
- define and implement WSDL (Web-Services Definition Language) interfaces and distinguish the differences between the dominant Web Service Architectures (i.e., SOAP RPC over HTTP and RESTful Web Services).
- use Glassfish or Tomcat Application Server and Apache AXIS SOAP engine to implement SOAP Web Services, to edit, serialize/deserialize and handle JSON (Javascript Simple Object Notation) documents and to use Glassfish Application Server and Jersey API implementing JAX-RS specifications to implement RESTful Web Services.
- use the RESTClient plug-in in Firefox or DEV HTTP Client plug-in in Chrome, for RESTful Web Services debugging.

Course contents: Architectural models (client-server, n-tier, peer-to peer, publish-subscribe), sockets, processes, threads, single threaded programming, multi threaded programming, distributed services and applications, remote procedure call, distributed objects technologies and middleware, Java Remote Method Invocation (Java RMI), CORBA architecture, Microsoft DCOM, SOAP RPC over HTTP Web Services, RESTful Web Services.

Assessment: Written exams at the end of the semester. Home assignments will be given (every week or every two weeks), which will contribute to the final grade with a percentage ranging between 20% and 50%.

Advanced Topics in Coding Theory

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Coding and Information Theory

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the encoding and decoding processes of linear algebraic binary and more importantly, non-binary codes defined on finite fields using modular polynomial arithmetic.
- describe the advantages of cyclic codes over non-cyclic codes such as elegant description, implementation using shift register encoders and syndrome units, error trapping and random error correction by solving polynomial equations.
- familiarize with the basic properties of the simple algebraic structure of groups, rings and fields.
- learn the algebra of finite fields of order 2, $GF(2)$, and its higher-order extension to $GF(2m)$, m being a positive integer. In particular, learn the primitive roots of irreducible polynomials defined over $GF(2m)$ and the importance of minimal polynomials.
- describe cyclic codes through their generator polynomials using modular arithmetic and compute their error control polynomials.
- obtain the cyclic counterpart of the already familiar binary Hamming codes.
- describe the important family of binary cyclic BCH codes, compute their syndromes and decode them via simple equations in the cases of single or, at most, double errors.
- obtain the extension of the binary cyclic BCH codes to the more general case namely, the non-binary $BCH(n,k)$ codes.
- describe the Gorenstein-Zierler (or, Peterson) algorithm for decoding non-binary $BCH(n,k)$ codes with error decoding capability greater than or equal to three.
- obtain the famous non-binary cyclic Reed-Solomon codes, $RS(n,k)$, in their systematic (or, canonical) form.
- decode the $RS(n,k)$ codes for both random errors and erasures by using the famous Berlekamp-Massey and Forney algorithms.

Course contents: Introduction. Groups, rings and finite fields. Cyclic (linear) codes. Binary cyclic Hamming codes. Modular polynomial arithmetic of Galois fields. Binary cyclic BCH (n, k) codes. Non-binary BCH (n, k) codes. The Gorenstein-Zierler decoding algorithm. Systematic Reed-Solomon codes. Random error correction and erasure correction using the modified Berlekamp-Massey algorithm.

Assessment: Written exam at the end of the semester.

Combinatorial Optimization

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [1]

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the mathematical model of a problem.
- describe how a combinatorial optimization problem can be solved
- explain and substantiate how fast a combinatorial optimization problem can be solved
- find feasible or optimal solutions of a problem
- use the Octave software for solving computationally combinatorial optimization problems

[1] Students may also enroll to the course in semester 6.

Course contents: Introduction to optimization. Introduction to mathematical modeling. Graphical method. Simplex method. Duality theory. Robustness analysis. Extensions of linear programming (network, game and transportation problems). Computer applications.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 35% and 50%.

Specification of Communication Protocols

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [1]

Prerequisites: –

Teaching: 2 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- explain the fundamental principles for the description, modeling and the verification of telecommunication protocols
- use finite state machines to describe simple protocols
- identify the problems that arise during the specification of a protocol and how to deal with them
- create simulation and verification models

Course contents: Protocols Structure. Specification and modelling. Correctness requirements finite state machines. Validation of protocols.

Assessment: Student project (100%).

Communication Networks Simulation Techniques

Category: Specialization in Informatics or Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: –

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the concept of simulation and the basic simulation techniques.
- simulate basic loss and queueing systems with the aid of the simulation language SIMSCRIPT III
- simulate circuit-switched networks that support one or more service-classes with the aid of the simulation language SIMSCRIPT III
- compare simulation results with those obtained by analytical models

Course contents: Simulation as a means of communication networks analysis and design. Simulation for the purposes of: performance analysis, stability analysis, availability analysis, design and planning, etc. Overview of basic simulation techniques (discrete events, rare events, etc.). Simulation time scale of a communication network (packet arrival scale, connections arrival scale, etc.). Communication network modelling for simulation: node models, line models, source models, random variable generation. Simulation languages and environments. Practice on simple programming for discrete events simulation. The SIMSCRIPT III simulation environment for networks. Performance analysis of network simulation through SIMSCRIPT III. Comparison to other methods of performance analysis: methods based on analytical models, methods based on measurements.

Assessment: Written exams at the end of the semester.

[1] Students may also enroll to the course in semester 6.

Telecommunication Systems Measurements

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 5

Prerequisites: –

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- calculate the uncertainty and error of measurements
- describe the operation of non-linear components
- understand the datasheet of measurement equipment systems
- describe the theory of operation and the functionality of spectrum analyzers
- describe the basic parts of an RF measurement set-up
- conduct power measurements
- describe and model the impact of noise on RF receivers
- measure the noise level of RF receivers

Course contents: Basic measurement quantities (E, P, V, I, Noise, SNR). Measurable units and conversions (dB, dBW, dBV). Time and frequency domain, transforms. Transceiver brock diagram (modulators, filters, amplifiers, mixers). Non-linearities. Basic measurement equipment (oscilloscope, generator, spectrum analyzer, vector analyzer etc.). Datasheet. Error analysis (random and systematic errors, accuracy, calibration, error propagation, uncertainty). Power measurements. Noise for RF receivers.

Assessment: Written exams at the end of the semester which will contribute up to 60% to the final grade. Measurement project which will contribute up to 20% to the final grade. Laboratory reports and/or oral examination which will contribute 25% to the final grade.

Wireless Links

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Electromagnetic Fields **or** Physics

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Identify the basic propagation mechanisms.
- Produce the statistical characteristics of the wireless channel from the impulse response.
- Select the appropriate path loss model according to the propagation environment.
- Estimate the outage probability of a system in different propagation environment based on link budget calculations.
- Characterize the wireless channel according to the small scale fading (flat/frequency selective fading, fast/slow fading).
- Describe the measurement principles of wideband channel sounders.

Course contents: Free Space Transmission and wireless links (Friis equation). Transmission over Irregular Terrain (Huygen principle, Uniform Theory of Diffraction, Fresnel Zones), path loss for line- and non-line of sight transmission, shadowing, attenuation models (Okumura-Hatta, Walfisch-Bertoni, COST231, etc. Characterization of multi-path effects (time and space characteristics, mechanisms and models), Doppler shift. Transmission characteristics in operational environments (indoor-outdoor, pico-, micro-cells, statistical and empirical and deterministic channels). Coverage calculations. Calculation and modeling methods for EM waves transmissions. Application and practice.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given which will contribute to the final grade with a percentage ranging between 10% and 20%.

Antennas

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Electromagnetic Fields **or** Physics

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the radiation mechanism
- describe the antenna characteristics
- calculate the directivity and gain
- calculate the radiation pattern
- calculate the circuit elements of an antenna
- calculate the characteristics of a linear/loop/array antenna
- measure and simulate in Matlab antenna characteristics

Course contents: Introduction. Radiation mechanism, pattern and regions. Isotropic antenna. Radiation intensity. Directivity and calculation methods. Gain and efficiency factor. Antenna as a circuit element and aperture. Friis transmission equation. Application in radar. Antenna temperature. Linear antennas. Infinitesimal dipole or Hertz dipole. Analysis of linear random length dipole antenna. Half wavelength dipole: radiation pattern, directivity, gain. Active height. Antennas over perfect ground. General analysis of antenna radiation field – applications. Arrays: introduction, linear arrays, uniform linear arrays.

Assessment: Written exams at the end of the semester. Lab assignments every week (or every second week) contributing to the final grade with a percentage ranging between 20% and 35%. It is possible that home assignments will be given and/or intermediate written exams will take place, while each of the above will contribute to the final grade with a percentage ranging between 10% and 20%.

Optical Wireless Communications

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- explain the basic application difference between optical fibre and optical wireless communications.
- be describe the model of indoor and outdoor optical wireless channel and describe mathematically the channel model.
- design basic links and understand the compromises of the various link parameters.
- design using various sources and detectors suitable for the link purpose.
- describe and assess the impact of the ambient noise on the design of links.
- explain the various applications which make the use of such links necessary.
- describe modulation formats suitable for optical wireless links.

Course contents: Introduction. Overview of optical wireless communication systems. Optical components: optical sources (LEDs and lasers), optical detectors (PIN and APD). Receiver modelling: shot noise, thermal noise, Q factor, error probability. Indoor optical wireless channel: intersymbol interference, link budget, artificial light interference. Outdoor optical wireless channel: transmission losses, fading, link budget, outage probability, average probability of error. Personal communication standards (IrDA). Visible light communication standard (IEEE 802.15.7).

Assessment: Written exams at the end of the semester.

Optoelectronics

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: Physics

Teaching: 3 hours lectures, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- Understand the nature/characteristics of light by investigating how light is generated and master interactions between light and matter (electrons)
- Describe, clarify and interpret the particular natural phenomena in the field of optoelectronics and integrated optics
- Describe sources, detectors and transmission media for optoelectronics i.e. understand principles of semiconductor laser action, modulation, amplification and photo detection combined with the basic principles of dielectric optical waveguides
- Apply and relate optoelectronic parameters with fiber optics components, devices and systems operation
- Design at high level optoelectronic components for specific application to meet performance criteria and select suitable components for the subsystem realization
- Calculate performance characteristics on semiconductor devices including light emitting and laser diodes, modulators, amplifiers and photodetectors and on fibre devices including amplifiers and passive devices for WDM
- Illustrate obtained knowledge in solving practical optoelectronic system design problems

Course contents: This course is designed to expose students to optoelectronics with emphasis on the functions of optoelectronic devices for fiber optic systems. Specifically it investigates devices used for the transmission, modulation, transmitting and detecting light. Specifically, the contents are as follows: Introduction - Optoelectronic devices. Optics and the nature of light - Elements of linear and non -linear optics. Electronics - Elements of Solid State Physics - Crystalline structures - Heterostructures - Semiconductor properties - pn junction. Light emission - Elements of laser theory- Lasers for telecommunications (DBR, DFB, FP, tunable wavelength lasers) - Einstein Relations - Fibre lasers - semiconductor Lasers - semiconductor and organic LED. Light Modulation - Electrooptic phenomenon, acousto-optic effect - modulator circuits. Light detection, photo - detectors , thermal detectors , photonic devices and circuits. optical amplification and optical amplifiers theory. Optical fiber amplifiers - semiconductor optical amplifiers. Optical switching and wavelength conversion. Principles of optical filter and examples - optical multiplexers - Passive devices. optoelectronic devices for Optical Communications.

Assessment: Written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%.

Telephone Networks

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 6

Prerequisites: –

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe and explain the basic operation of the public switched τelephone network (PSTN)
- describe and explain the basic operation of phone devices
- describe and explain the process of voice digitization (sampling and quantization)
- describe and explain the concepts of multiplexing, switching and routing in a telephone network

- describe and explain plesiosynchronous and synchronous digital hierarchies
- Describe and explain analogue and digital signaling, with emphasis given on signaling system 7
- describe and explain the requirements and operation of intelligent networks
- describe and explain the basic operation of end-user access technologies (mainly xDSL)
- solve basic and advanced problems on voice digitization, switching, routing, multiplexing and signaling in telephone networks

Course contents: Introduction to Telephone Networks: Network Architecture and Telephone Exchange Hierarchy, Voice Requirements, Signaling. Analogue Local Loop and User End: Telephones (Microphone, Speaker, Bell, Dialer), Local Loop Architecture (Twisted Pair, Box, SLIC), Analogue Local Loop Signaling. Digital Telephone Networks: Analogue (FDM) vs Digital (TDM) Telephony, Digital Transmission Hierarchies (ITU Standards). Voice Digitization: Voice Spectrum, PAM and PCM Systems, Voice Sampling, Voice Quantization (A-Law, μ-Law, Quantization Noise), Voice Compression (DPCM and Delta Modulation). Digital Switching: Space Switching, Crossbar Switch, Clos 3-Stage Non-Blocking Switch and Clos Theorem, Blocking Probability, Time-Domain Switching, Combined Space-Time Switching, Digital Cross-connects, Digital Switching Hierarchies. Voice in SONET/SDH and ATM Networks: SONET Frame Architecture and Rates, Virtual Tributaries, Voice Capacity of SONET Networks, SDH Frame Architecture and Rates, Virtual Containers, Voice Capacity of SDH Networks, ATM Layer Architecture, Description of AAL-1 and AAL-2, Voice Transport in AAL-1 and AAL-2. Signaling in Telephone Networks: Channel Associated Signaling in FDM and TDM Systems (CCITT-R1, CCITT-R2, CCITT #5), Common Channel Signaling (SS6, SS7), Signaling System 7 Architecture (SSPs, SCPs, STPs) and Layers (MTP 1-3, TUP, ISUP, SSCP, TCAP). Intelligent Networks: Intelligent Network Architecture, Formal Call Model, Applications (Portability, Call Forwarding, Toll Free Calls, 800- Calls and Number Translation, Time-of-Day Routing, Private Virtual Network). Access Networks: xDSL basics (multiplexing modulation/demodulation), access architecture, protocol stack (PPPoE, PPPoA), equipment (DSLAMs, BRAS), technologies (ADSL, SDSL, VDSL).

Assessment: Written exams at the end of the semester.

Satellite Communications

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7 [1]

Prerequisites: –

Teaching: 2 hours lectures, 2 hours lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:

- explain the need for satellite communications
- acquire an understanding on orbital mechanics of LEO, MEO, HEO and GEO satellites
- define and explain propagation impairments
- design uplink/downlink satellite link using the power link budget
- explain the analog and digital modulation techniques
- explain the synchronization and multiple-access techniques, such as FDMA, TDMA, CDMA, Aloha
- design and simulate satellite orbits with specific characteristics using STK software of AGI

Course contents: Satellite orbit types and characteristics, orbital mechanics and orbits LEO, MEO, HEO, GEO, calculation methods for link budget, transponders, propagation impairments (free space loss, atmospheric, rain attenuation, shadowing), effects of noise, noise figure, antennas, transmission/reception techniques, multiple access techniques, random access, multibeam systems, simulation on orbit planning and link budget with STK software by Analytical Graphics (AGI). Exercises based on the STK and GNU Octave software packages.

[1] Students may also enroll to the course in semester 5.

Assessment: Written exams at the end of the semester. Assignments may be given during the semester with weight 30% (in which case the weight of the written exams will be 70%).

Microwaves and Waveguides

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: –

Teaching: 4 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic principles of operating at Microwave frequencies and waveguiding.
- explain the important properties of waveguides for communications, and how they affect the system
- describe mathematically the waveguide properties such as dispersion, attenuation and cutoff frequencies.
- explain the differences between copper and fibre optic waveguides and their uses.
- explain transmission lines theory.

Course contents: Introduction. Overview of microwave and optical wireless systems concepts, sources, LEDs and Lasers, detectors pin and APD and components elements. E-M theory and waveguides, Boundary conditions, propagation constants and cutoffs, modes of propagation, dispersion, optical fibre components such as couplers WDM, isolators, Transmission line theory, Smith Charts, Optical fibre system design WDM transmission.

Assessment: Written exams at the end of the semester.

Advanced Topics in Digital Communications

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7

Prerequisites: Digital Communications

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe the impact of the finite channel bandwidth on the performance of digital communication systems.
- Describe the concept of inter-symbol interference, the related problems, the mitigation strategies and the algorithms used to this end.
- Design pulse-shaping filters for base-band data transmission.
- Describe the principles of equalization and design basic equalizers.
- Describe the principles and structure of multi-carrier communication systems.
- Describe the impact of fading on wireless digital communication systems.

Course contents: Introduction. Overview of digital communication systems. Digital communication over finite-bandwidth channels. Intersymbol interference, the Nyquist criterion. Raised cosine filters equalization techniques. Multi-carrier communication systems. Digital communication over fading channels.

Assessment: Written exam

Optical Communication Systems

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 7 [1]

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- understand the essentials of propagation in an optical fibre and the physical layer properties, at system and sub-system level, of a point-to-point link.
- Quantify by means of appropriate mathematical formalism these physical layer properties.
- Comprehend the physical effects contributing to signal deterioration within an optical link.
- Comprehend the basic principles of physical layer modeling for design optical links.

Course contents: Why optical fibres are needed. Transmission, transportation and switching. What are the building blocks for a point-to-point link. BER, Q-factor, EOP. Optical fibre and propagation in it. Dispersion, losses, power budget; modeling of dispersion and dispersion compensation. Lasers and their principle of operation, single mode semiconductor laser, rate equations. Optical amplifiers and their noise. Optical receivers . Optical filters and multiplexers. WDM systems and their design principles. Non-linear effects and their impact.

Assessment: Written exams at the end of the semester.

Core and Metropolitan Networks

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [2]

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the essential of synchronous Metro and Core networks, the reasons for the introductions and their essential aspects as well as the relations between data-plane and control-plane.
- explain the evolution of synchronous networking towards NG-SONET/OTN.
- describe the basic features of NG-SONET like GFP, VCAT, LCAS.
- describe the principles of protection and restoration.

Course contents: Current trends in core and metropolitan networks. Introduction to PDH and to SONET/SDH, reasons for their introduction and network evolution; principles of operation. SONET/SDH networks, main building blocks, topologies, examples. Protection/restoration. NG SONET/SDH and packet-over-SONET/SDH. Efficient packet transportation mechanisms, GFP, VCAT, LCAS. OTN; ASON;MPLS, MPλS, GMPLS.

Assessment: Written exams at the end of the semester.

Introduction to Radars

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8

[1] Students may also enroll to the course in semester 5.

[2] Students may also enroll to the course in semester 6.

Prerequisites: Antennas

Teaching: 2 hours lectures, 1 hour lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:
- describe a pulsed radar
- describe ways to reduce radar cross section
- calculate the radar range
- describe a continuous wave radar
- describe a moving target radar
- describe a synthetic aperture radar
- describe different surveillance and radiometry techniques

Course contents: Introduction to RADAR systems. Radar cross-section. Radar equation. Signal detection under noise presence. Scattering theory. Moving target RADAR, continuous wave RADAR, FM modulated RADAR. Synthetic aperture RADAR. Introduction to Radio surveillance and radiometry. Control mechanisms of antenna radiation patterns. Adaptive antennas study and analysis. Examples and applications.

Assessment: Written exams at the end of the semester. Lab assignments every second week contributing to the final grade with a percentage ranging between 20% and 35%. It is possible that home assignments will be given and/or intermediate written exams will take place, while each of the above will contribute to the final grade with a percentage ranging between 10% and 20%.

Applications of Optical Fiber Systems and Networks

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [1]

Prerequisites: –

Teaching: 3 hours lab, 1 hour tutorials (per week).

Learning outcomes: At the end of the course the student will be able to:
- explain the operation of basic optical fiber based arrangements and subsystems.
- perform and explain experiments related to optical fiber networks.
- operate optical fiber network simulation software.
- describe the operation of optical fiber network subsystems and assess their performance.
- correlate the theoretical analysis with the practical application.

Course contents: The student will familiarize with important building blocks of optical communications by means of commercially available platforms.

Assessment: On-site examination, upon completion of each exercise.

Adaptive Signal Processing

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Signals and Systems **or** Digital Signal Processing

Teaching: 3 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- Describe the basic elements and properties of adaptive signal processing

[1] Students may also enroll to the course in semester 6.

- Describe elementary applications on adaptive signal processing
- Perform theoretical analysis as well as a practical implementation of adaptive signal processing methods and algorithms
- Describe the role of adaptive signal processing in modern applications
- Design, implement and apply Wiener filtering and evaluate their performance.
- Design, implement and apply LMS and RLS adaptive algorithms.

Course contents: Fundamentals for adaptive systems; mean-square estimation, Wiener filters. Introduction to adaptive structures and the least squares method. Optimization techniques: Gradient and Newton methods. LMS (least mean squares), RLS (recursive least squares). Analysis of adaptive algorithms: Learning curve, convergence, stability, excess mean square error, misadjustment. Applications in telecommunication systems (channel equalization, echo cancellation).

Assessment: Examination for both theory (70%) and laboratory practice (30%). Theory: written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%. Laboratory practice: Written exams at the end of the semester or home assignments or both.

Simulation of Telecommunications Systems

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [1]

Prerequisites: Programming I **or** Digital Communications **or** Digital Signal Processing

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- generate random numbers having specific properties
- simulate the most well-known modulation formats
- design and simulate the optimum receiver
- identify the differences in system performance between theory and simulation
- evaluate the bit and symbol error probability
- describe the software-defined radio architecture
- develop communication systems based on SDR and GNU Radio

Course contents: Telecommunication system design by using methods and techniques based on random process, fundamental computer simulation techniques, fading channel, error probability simulation, spectral analysis, Monte Carlo simulation, thermal noise, Rayleigh fading, software defined radio systems, simulation system development in GNU Octave and GNU Radio.

Assessment: Compulsory assignments during the semester.

Stochastic Signal Processing and Applications

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8

Prerequisites: Signals and Systems **or** Digital Signal Processing

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe basic concepts and properties related to stochastic signals.

[1] Students may also enroll to the course in semester 6.

- describe basic applications of stochastic signal processing.
- apply the theoretical analysis of issues related to stochastic signal processing, with computer simulation and actual implementation.
- analyze and calculate second-order statistics (autocorrelation-crosscorrelation) and power spectral density for stochastic signals of continuous and discrete time signals
- analyze systems that are excited by stochastic signals of continuous or discrete time
- design optimal estimators for communication systems and information processing applications

Course contents: Foundations of the theory of probability. Discrete and continuous probability distributions. Random variables. Moments. Transformation of random variables. Stochastic processes. Stationarity, Wide-Sense Stationarity, Ergodicity. Power density spectrum. Filtering of WSS processes. Gaussian function and white noise. Parameter estimation. Spectral estimation

Assessment: Examination for both theory (70%) and laboratory practice (30%). Theory: written exams at the end of the semester. It is possible that home assignments will be given, which will contribute to the final grade with a percentage ranging between 10% and 20%. Laboratory practice: Written exams at the end of the semester or home assignments or both.

Modern Cellular Communication Systems

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***Semester:*** 8 [1]

Prerequisites: Wireless and Mobile Communications I **or** Wireless Links

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe and analyze spread spectrum modulation
- describe key elements of a CDMA system
- describe factors that affect CDMA performance
- describe and analyze OFDM and an OFDMA system
- calculate the performance of an OFDMA system
- describe different diversity techniques, calculate their performance and implementation complexity
- describe the network planning methodology for a cellular system and key performance indicators

Course contents: Introduction to the design and analysis of cellular communication systems (fixed, wireless and mobile). Multiplexing methods and modern cellular systems. Physical layer techniques (OFDM and spread spectrum, RAKE receiver), logical channels and control mechanisms. Diversity methods (frequency, polarization, time, space) and performance improvement techniques. Radio resource management. WCDMA-OFDMA, 3G-4G system characteristics. Network planning methodologies and examples.

Assessment: Written exams at the end of the semester. Group project with weight up to 20% which is added to the grade of thw written exam.

[1] Students may also enroll to the course in semester 6.

4.3 Free Elective Courses

Introduction to Economic Science

Category: Free Elective

ECTS Credits: 6 ***Semester:*** 5

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- define the main concepts and describe the models and methods used in economic analysis
- describe and use mechanisms for setting product prices
- apply and use the main economic models used in economic analysis to solve problems
- describe the various forms of markets
- identify equilibrium income.

Course contents: History of economic thought. Fundamental concepts of political economy. Mechanism of setting product prices, production factors. Introduction to various forms of markets. Identification of equilibrium income.

Assessment: Written exam at the end of the semester.

Traineeships

Category: Free Elective

ECTS Credits: 24 ***Semester:*** 5 / 6 / 7 / 8

Prerequisites: –

Teaching: Two to six months work in the premises of the cooperating business/organization.

Learning outcomes: At the end of the course the student will be able to:

- apply knowledge and skills he has acquired during his studies in a work environment,
- combine knowledge from different scientific areas for efficient problem solving,
- take part effectively in teams, co-operating with different scientific and professional disciplines,
- develop initiatives in the work environment,
- describe the practices employed by the company or organization he has been working with,
- develop professional awareness,
- evaluate and compare methodologies based on scientific criteria.

Course contents: Students are given the chance to apply the theoretical knowledge and the skills acquired to specific tasks under industrial/office conditions.

Assessment: The work of the student during the traineeships is supervised by a business/organization manager, who provides the Department with an assessment of the student's performance. The supervising professor grades the student, based on this assessment; an interview can also be used by the supervising professor.

Entrepreneurship in IT

Category: Free Elective

ECTS Credits: 3 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe and design current trends of enterpreuneuship in IT, in competitiveness and in strategic planning of innovative actions.
- analyze and apply all actions that contribute to a growing sales strategy with empasis on the innovation that stems from IT.
- organize with the method of simulation and modeling all the actions of Enterpreneurship in IT with Dynamic Simulation Models.

Course contents: Entrepreneurship. Entrepreneurship and Innovation. Competitive Positioning, Market Analysis. Marketing. Merchandising. Franchising. Business Communications. Strategic planning. Sales. Organization of the sales department. Customer Centric Strategy. Sales Techniques

Assessment: Written examination at the end of the semester. Project which will contribute 40% to the final score.

Game Theory

Category: Free Elective

ECTS Credits: 6 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- describe the basic concepts and results concerning games and identify games as strategic behavior
- explain the importance of informational limitations
- describe and apply techniques for finding equilibrium points (e.g. Nash) of systems
- describe and apply extensions related to selfish behavior
- explain the effect of repetition on a game's outcome
- illustrate the essence of bargaining situations
- use game-theoretic thinking to explain events / outcomes in the economy and society.

Course contents: Decision making by strategically interdependent factors. Static and dynamic games having perfect information. Static and dynamic games having imperfect information. Applications of game theory: negotiations, auctions, mechanism design, signaling, reputation.

Assessment: Written exam at the end of the semester.

Research Methodology and Scientific Writing

Category: Free Elective

ECTS Credits: 3 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- understand what research methodology is
- choose a research topic and define the goals of their research
- describe the structure of a scientific paper
- understand the main steps in writing a technical report
- search effectively the bibliography

- structure the material and the flow of information in a technical report (no matter if it concerns a 2-page report or a PhD dissertation)
- use LaTeX for the production of technical reports
- present (complex) experimental data in a logical, clear and concise manner making optimal use of graphs, charts and tables
- introduce the bibliography in the technical report
- write a clear and meaningful executive summary / abstract
- use specialized software for producing graphs and charts
- describe research and scientific ethics

Course contents: Report writing is often viewed as a tedious and difficult task. This leads to poorly written documents that fail to communicate their content to the reader, meaning confusion, mistakes, wasted time and additional costs. This course approaches report writing in a more effective and efficient way. It starts from the structure of a technical report and the bibliography search and reaches up the production of technical reports with the use of LaTeX. By using examples from actual reports and demonstrating the value and methods of good writing, contrasting "good" and "bad", to indicate which writing styles work, which don't and why, participants will understand key elements of a good report. They will learn how to produce clear, unambiguous, and concise technical texts that will increase the value and professionalism of their reports.

Assessment: Weekly assignments and literature review of a research area

Erasmus Traineeships

Category: Free Elective

ECTS Credits: 20 ***Semester:*** 6 / 7 / 8

Prerequisites: –

Teaching: Three months full-time work in the premises of the cooperating business/organization.

Learning outcomes: At the end of the course the student will be able to:

- apply knowledge and skills he has acquired during his studies in a work environment,
- combine knowledge from different scientific areas for efficient problem solving,
- take part effectively in teams, co-operating with different scientific and professional disciplines,
- develop initiatives in the work environment,
- describe the practices employed by the company or organization he has been working with,
- develop professional awareness,
- evaluate and compare methodologies based on scientific criteria.

Course contents: Students are given the chance to apply the theoretical knowledge and the skills acquired to specific tasks under industrial/office conditions.

Assessment: The work of the student during the traineeships is supervised by a business/organization manager, who provides the Department with an assessment of the student's performance. The supervising professor grades the student, based on this assessment; an interview can also be used by the supervising professor.

Legal Issues of Informatics and Telecommunications

Category: Free Elective

ECTS Credits: 3 ***Semester:*** 7

Prerequisites: –

Teaching: 3 hours lectures (per week).

Learning outcomes: At the end of the course the student will be able to:

- analyze issues related to the impact of new information and communication technologies in Law, in terms, not only of the current legislation, but also of the regulatory system.
- identify, recognize and assess the application of Information Technology, within the legal environment and law, related to organizations and the state.

Course contents: The Information Society. The impact of new information and communication technologies on the law. The intervention of legal system. New regulatory models. The role of the state and the law in the Information Society. Implementation and analysis of the legal issues that arise in various fields of Information Technology (e-banking, Blogs, etc).

Assessment: Written examination at the end of the semester. Test that will contribute 20% to the final score. Tasks that will contribute 30% to the final score.

4.4 Pedagogy and Didactics Courses

Methods of development and evaluation of educational content

Category: Pedagogy and Didactics

ECTS Credits: 4 ***Semester:*** 5

Prerequisites: –

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Identify educational content design requirements
- Synthesize knowledge in order to evaluate educational content
- Design research protocols
- Create original educational content

Course contents: Requirements for designing educational content for different groups of learners, creativity enhancement techniques, creative content creation, creative and interactive storytelling, qualitative and quantitative methods for evaluating educational material.

Assessment: Written and/or oral exam at the end of the semester

Pedagogical ICT issues in education

Category: Pedagogy and Didactics

ECTS Credits: 4 ***Semester:*** 5

Prerequisites: –

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe scientific articles on ICT in education.
- Explain the key points of a relevant scientific article and be able to draw conclusions.
- Create presentations of relevant articles where they reorganize the information to make it suitable for classroom presentation
- Evaluate presentations and judge their completeness

Course contents: Students will be invited to study and present a series of scientific articles on ICT in education and to present these articles to their fellow students. The use of specialized presentation software will be necessary. Students will also need to evaluate their fellow students for presentations through a peer assessment process.

Assessment: Assessment for this course examines both the presentations given to fellow students as well as the log of evaluations kept through the course.

Pedagogy and Psychology in Education

Category: Pedagogy and Didactics

ECTS Credits: 4 ***Semester:*** 5

Prerequisites: –

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe the basic pedagogic theories and psychology theories in education.

- Create lesson plans using methods and tools for different educational purposes.
- Compare and evaluate different pedagogical practices.
- Analyze and explain factors that influence the educational process.

Course contents: The nature of learning and theories of knowledge and learning, basic principles of pedagogy, curricula and lesson plans, learning evaluation, evolutionary psychology and relation to education system, social psychology and relation to education, personal learning characteristics and special abilities, sociology of education.

Assessment: Written and/or oral exams

Practical training for pedagogical and teaching experience

Category: Pedagogy and Didactics

ECTS Credits: 4 ***Semester:*** 5 / 6

Prerequisites: –

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- Identify educational objectives and needs per educational condition and select appropriate teaching tools and techniques
- Explain in depth the subject matter to the learners.
- Organize educational material for different educational conditions.
- Evaluate both their own teaching performance and learners' learning outcomes.

Course contents: After a few introductory lectures, students will go to schools where they will observe the computing classes and complete observational calendars. Students will be required to do at least one full-time teaching at a school under the supervision of the class teacher. The teacher will complete a student assessment form. Throughout the semester, there will be workshops for the students to prepare their class presentations.

Assessment: Students will deliver calendars of attendance lessons, lesson plans, course reports and assessments by teachers in classrooms.

Cognitive Psychology and Educational Practice

Category: Pedagogy and Didactics

ECTS Credits: 4 ***Semester:*** 6

Prerequisites: –

Teaching: 3 hours lectures, 1 hour lab (per week).

Learning outcomes: At the end of the course the student will be able to:
- Describe the basic principles of human cognitive structure and brain structures.
- Examine the cognitive requirements of different educational processes.
- Synthesize knowledge about the cognitive background of a person and to propose appropriate educational planning.
- Evaluate educational material according to different students' cognitive requirements.

Course contents: The course presents the basic cognitive structures of the human, such as memory, perception, problem solving procedures, etc., as well as the basic brain structures involved in learning (lobes, etc.) and the way they are related to educational acts. The course examines ways in which the educational design of both the material and its presentation will be compatible with the cognitive abilities of learners. Finally, optimal ways of evaluating the learning processes based on the cognitive preferences of the stakeholders are considered.

Assessment: Written coursework with in-class presentation, for 50% of the final grade. Written exam, in which only students who pass the coursework will be allow to sit, for 50% of the final grade.

Didactics of Informatics

Category: Pedagogy and Didactics

ECTS Credits: 4 ***Semester:*** 6

Prerequisites: –

Teaching: 2 hours lectures, 2 hours lab (per week).

Learning outcomes: At the end of the course the student will be able to:

- Describe basic IT teaching principles
- Explain introductory programming (eg Logo), script creation environments (eg Scratch, Alice), educational robotics, etc.
- Combine his / her knowledge to create educational workshops
- Evaluate the educational process of the workshops he/she organized.
- Produce detailed lesson plans.

Course contents: Integration of Informatics in education, the specificity of Informatics in the curriculum, computer science in primary and secondary education, teaching transformation of concepts of Informatics, mental models and representations of informatics, learning processes and teaching of Informatics, programming as a teaching subject, Didactics of science, Dicactics of informatics, Pedagogy, lesson plans.

Assessment: The course is evaluated via a combination of theoretical examination and practical application. For the theoretical part, a written theory exam at the end of the semester is used. For the practical part, students are asked to put into practice the skills cultivated by the lesson, indicatively by developing lesson plans or organizing student workshops.

Courses offered in the academic year 2024–2025

A

Below are given the courses offered in the academic year 2024–2025 and the respective lecturers; courses not assigned to any lecturer will not be offered this academic year.

1st semester

Course Title	Category	ECTS	Lecturer
Introduction to Informatics and Telecommunications	C	6	Kaloxylos
Logic Design	C	6	Wallace, Kostopoulos
Mathematics I	C	6	Nikolentzos
Programming I	C	6	Tselikas, Seklou, Batistatos
Physics	C	6	Kapellaki

2nd semester

Course Title	Category	ECTS	Lecturer
Computer Architecture I	C	6	Dimitroulakos
Discrete Mathematics	C	6	Kolokotronis
Mathematics II	C	6	[Adjunct lecturer]
Probability and Statistics	C	6	Moscholios
Programming II	C	6	Tryfonopoulos, Raftopoulou, Doumouras

3rd semester

Course Title	Category	ECTS	Lecturer
Object-Oriented Programming	C	6	Platis, Raftopoulou, Doumouras
Data Structures	C	6	Lepouras, Yiannopoulos
Electromagnetic Fields	C	6	Athanasiadou, Zarbouti
Mathematics III	C	6	Peppas

Course Title	Category	ECTS	Lecturer
Signals and Systems	C	6	Glentis

4th semester

Course Title	Category	ECTS	Lecturer
Algorithms and Complexity	C	6	[Adjunct lecturer]
Principles of Telecommunication Systems	C	6	Tsoulos, Zarbouti, Athanasiadou
Communication Networks I	C	6	Yiannopoulos, Seklou
Electronics	C	6	Blionas, Kostopoulos, Batistatos
Operating Systems	C	6	Vassilakis

5th semester

Course Title	Category	ECTS	Lecturer
Databases	C	6	Skiadopoulos, Raftopoulou, Doumouras
Systems Security	SC-I	5	Kolokotronis
Compilers I	SC-I	5	Dimitroulakos
Wireless and Mobile Communications I	SC-T	5	Tsoulos, Zarbouti
Communication Networks II	SC-T	5	Moscholios, Seklou
Introduction to Optical Communications	SC-T	5	Stavdas
Digital Communications	SC-T	5	Sagias, Batistatos
Systems Programming	SE-I	5	
Computability and Complexity Theory	SE-I	5	
Introduction to Embedded Systems	SE-I/T	5	Blionas
Telecommunication Systems Measurements	SE-T	5	Zarbouti
Introduction to Economic Science	FE	6	[Offered by the Department of Economics]
Traineeships	FE	24	–
Methods of development and evaluation of educational content	PD	4	Lepouras, Giannakopoulou
Pedagogical ICT issues in education	PD	4	
Pedagogy and Psychology in Education	PD	4	Wallace, Giannakopoulou
Practical training for pedagogical and teaching experience	PD	4	Platis, Giannakopoulou

6th semester

Course Title	Category	ECTS	Lecturer
Human Computer Interaction	SC-I	5	Lepouras, Kapellaki
Artificial Intelligence	SC-I	5	Nikolentzos, Doumouras
Digital Signal Processing	SC-T	5	Glentis
Computer Architecture II	SE-I	5	
Computer Graphics	SE-I	5	Platis
Educational Informatics	SE-I	5	Wallace
Cultural Informatics	SE-I	5	
Advanced Programming Topics	SE-I	5	Platis
Numerical Analysis	SE-I/T	5	
Wireless and Mobile Communications II	SE-I/T	5	Kaloxylos
Image Processing: principles, algorithms and applications	SE-I/T	5	
Coding and Information Theory	SE-I/T	5	Sagias
Decision Making Systems	SE-I/T	5	
Internet Applications and Web Services Development	SE-I/T	5	Tselikas, Kapellaki
Wireless Links	SE-T	5	Athanasiadou, Zarbouti
Antennas	SE-T	5	
Optical Wireless Communications	SE-T	5	Yiannopoulos
Optoelectronics	SE-T	5	
Telephone Networks	SE-T	5	
Entrepreneurship in IT	FE	3	
Game Theory	FE	6	[Offered by the Department of Economics]
Research Methodology and Scientific Writing	FE	3	Raftopoulou
Traineeships	FE	24	–
Erasmus Traineeships	FE	20	–
Cognitive Psychology and Educational Practice	PD	4	Lepouras, Giannakopoulou
Didactics of Informatics	PD	4	
Practical training for pedagogical and teaching experience	PD	4	Platis, Giannakopoulou

7th semester

Course Title	Category	ECTS	Lecturer
Undergraduate Thesis	C	10	–
Information Retrieval and Mining	SC-I	5	Tryfonopoulos, Raftopoulou
Software Engineering	SC-I	5	Vassilakis
Big data management	SE-I	5	Raftopoulou

Course Title	Category	ECTS	Lecturer
Distributed Information Management	SE-I	5	
Cryptography [1]	SE-I	5	Kolokotronis
Compilers II	SE-I	5	Dimitroulakos
Parallel Algorithms	SE-I	5	
Advanced User Interfaces - Virtual Reality	SE-I	5	Lepouras, Kapellaki
Data Management Systems	SE-I	5	
Computational Geometry	SE-I	5	
Internet of Things	SE-I/T	5	Blionas
Multimedia Signal Processing	SE-I/T	5	
Theory and Applications of Speech Processing	SE-I/T	5	
Stochastic Network Modeling and Performance Analysis [1]	SE-I/T	5	Moscholios
Digital Systems and Circuits Design	SE-I/T	5	
Implementation of digital circuits and systems with FPGAs	SE-I/T	5	
Satellite Communications [1]	SE-T	5	Sagias, Batistatos
Microwaves and Waveguides	SE-T	5	
Advanced Topics in Digital Communications	SE-T	5	
Optical Communication Systems [1]	SE-T	5	Stavdas
Legal Issues of Informatics and Telecommunications	FE	3	
Traineeships	FE	24	–
Erasmus Traineeships	FE	20	–

8th semester

Course Title	Category	ECTS	Lecturer
Undergraduate Thesis	C	15	–
Computer Games Development	SE-I	5	
Special Topics in Algorithms	SE-I	5	
Topics on Data and Information Management	SE-I	5	Skiadopoulos
Logic for Computer Science	SE-I	5	
Machine Learning	SE-I	5	
Software Engineering II	SE-I	5	Dimitroulakos
Sensor Networks [2]	SE-I/T	5	Peppas, Seklou
Distributed Systems Programming	SE-I/T	5	
Advanced Topics in Coding Theory	SE-I/T	5	
Combinatorial Optimization [2]	SE-I/T	5	

[1] Students may also enroll to the course in semester 5.
[2] Students may also enroll to the course in semester 6.

Course Title	Category	ECTS	Lecturer
Specification of Communication Protocols [1]	SE-I/T	5	Kaloxylos
Communication Networks Simulation Techniques	SE-I/T	5	
Core and Metropolitan Networks [1]	SE-T	5	Stavdas
Introduction to Radars	SE-T	5	
Applications of Optical Fiber Systems and Networks [1]	SE-T	5	Stavdas, Kostopoulos
Adaptive Signal Processing	SE-T	5	
Simulation of Telecommunications Systems [1]	SE-T	5	Sagias, Batistatos
Stochastic Signal Processing and Applications	SE-T	5	Glentis
Modern Cellular Communication Systems [1]	SE-T	5	Tsoulos
Traineeships	FE	24	–
Erasmus Traineeships	FE	20	–

[1] Students may also enroll to the course in semester 6.

Courses offered to Erasmus Students

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Below are given the courses offered in the academic year 2024–2025 **to Erasmus Students**; all courses are offered in English.

Fall Semester

Course Title	Semester	Category	ECTS	Lecturer
Compilers I	5	SC-I	5	Dimitroulakos
Wireless and Mobile Communications I	5	SC-T	5	Tsoulos, Zarbouti
Communication Networks II	5	SC-T	5	Moscholios, Seklou
Introduction to Optical Communications	5	SC-T	5	Stavdas
Digital Communications	5	SC-T	5	Sagias, Batistatos
Introduction to Embedded Systems	5	SE-I/T	5	Blionas
Methods of development and evaluation of educational content	5	PD	4	Lepouras, Giannakopoulou
Pedagogy and Psychology in Education	5	PD	4	Wallace, Giannakopoulou
Information Retrieval and Mining	7	SC-I	5	Tryfonopoulos, Raftopoulou
Software Engineering	7	SC-I	5	Vassilakis
Big data management	7	SE-I	5	Raftopoulou
Compilers II	7	SE-I	5	Dimitroulakos
Advanced User Interfaces - Virtual Reality	7	SE-I	5	Lepouras, Kapellaki
Internet of Things	7	SE-I/T	5	Blionas
Stochastic Network Modeling and Performance Analysis	7	SE-I/T	5	Moscholios
Satellite Communications	7	SE-T	5	Sagias, Batistatos
Optical Communication Systems	7	SE-T	5	Stavdas

Spring Semester

Course Title	Semester	Category	ECTS	Lecturer
Human Computer Interaction	6	SC-I	5	Lepouras, Kapellaki
Artificial Intelligence	6	SC-I	5	Nikolentzos, Doumouras

Course Title	Semester	Category	ECTS	Lecturer
Digital Signal Processing	6	SC-T	5	Glentis
Computer Graphics	6	SE-I	5	Platis
Educational Informatics	6	SE-I	5	Wallace
Advanced Programming Topics	6	SE-I	5	Platis
Wireless and Mobile Communications II	6	SE-I/T	5	Kaloxylos
Coding and Information Theory	6	SE-I/T	5	Sagias
Internet Applications and Web Services Development	6	SE-I/T	5	Tselikas, Kapellaki
Wireless Links	6	SE-T	5	Athanasiadou, Zarbouti
Optical Wireless Communications	6	SE-T	5	Yiannopoulos
Game Theory	6	FE	6	[Offered by the Department of Economics]
Research Methodology and Scientific Writing	6	FE	3	Raftopoulou
Cognitive Psychology and Educational Practice	6	PD	4	Lepouras, Giannakopoulou
Topics on Data and Information Management	8	SE-I	5	Skiadopoulos
Software Engineering II	8	SE-I	5	Dimitroulakos
Sensor Networks	8	SE-I/T	5	Peppas, Seklou
Specification of Communication Protocols	8	SE-I/T	5	Kaloxylos
Core and Metropolitan Networks	8	SE-T	5	Stavdas
Applications of Optical Fiber Systems and Networks	8	SE-T	5	Stavdas, Kostopoulos
Simulation of Telecommunications Systems	8	SE-T	5	Sagias, Batistatos
Stochastic Signal Processing and Applications	8	SE-T	5	Glentis
Modern Cellular Communication Systems	8	SE-T	5	Tsoulos