UNIVERSITY of the PELOPONNESE
FACULTY of ECONOMICS, MANAGEMENT and INFORMATICS

DEPARTMENT of INFORMATICS and TELECOMMUNICATIONS
UNDERGRADUATE STUDIES GUIDE
2017–2018

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Department of Informatics and Telecommunications

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Contents

1 The University of the Peloponnese

1.1 Presentation

The University of the Peloponnese was officially founded in year 2000. The administration office of the University is located in Tripoli, while the departments of the University are developed in the five capitals of the Peloponnese prefecture (Corinthos, Kalamata, Nafplio, Tripoli, and Sparta).

Established in the 20th of September 2002, the University of the Peloponnese has managed to cooperate with prestigious academic staff and form an important network of European and international cooperation. Its human resources include 140 full/associate/assistant professors and lecturers, 100 technical and administrative employees, while there are more that 6000 undergraduate and postgraduate students enrolled in all the departments.

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, which correspond to the requirements of a modern university with national, european, and international range.

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 5 faculties and 9 departments, is as follows:

- **Faculty of Economics, Management and Informatics**, located in Tripoli.
  - Department of Informatics and Telecommunications
  - Department of Economics
- **Faculty of Humanities and Cultural Studies**, located in Kalamata.
  - Department of History, Archaeology and Cultural Resources Management
  - Department of Philology

- **Faculty of Social Sciences**, located in Corinthos.
  - Department of Social and Educational Policy
  - Department of Political Science and International Relations
- **Faculty of Fine Arts**, located in Nafplio.
  - Department of Theatre Studies
- **Faculty of Human Movement and Quality of Life Sciences**, located in Sparta.
  - Department of Sports Organisation and Management
  - Department of Nursing

1.3 Students' Services

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

1.3.1 Dining service

Students can dine in specially designed facilities of the University of the Peloponnese or in contracting restaurants in the cities where the various departments are located. The dining services are offered every day of the week during the whole academic year (1st of September–30th of June), with the exception of the Christmas and the Easter holidays (as the academic programme regulates them). In the case that the academic year is extended, the students' dining service is also extended for a corresponding period.

1.3.2 Healthcare

The provided healthcare services are as follows:

- All undergraduate and postgraduate students of the University (with Greek nationality, Greek expatriates, and foreigners) are entitled to free healthcare services, both medical and hospital. Especially for the undergraduate students, healthcare is provided for a period equal to the official studies' duration plus two extra years (six years in total). For the postgraduate students, healthcare is provided for a period equal to the official duration of the studies.
- For the last year of studies, healthcare provision is extended beyond the end of the academic year (until the 31st of December) for those students that have not received their qualification by then.
- In case of suspension of attendance, the provided healthcare is extended accordingly.

A healthcare booklet is issued to the interested student – upon request – by the Secretariat of his Department. The healthcare booklet is renewed at the beginning of each academic year (September) by the Secretariat.

1.3.3 Transportation

Every student is provided with a special Student Transportation Card (STC) that is valid for a period equal to the official studies' duration plus two extra years (six years in total). In case the STC is lost, the student can apply for and receive within a month a new card from the Secretariat of his Department. The STC provides the student with the following discounts:

- 25% for public local transportation in the city where the student's department is located, and for local transportation in the rest of the country.
- 25% for public long distance transportation linking the city where the student's department is located with the students's residence, and for public long distance transportation in the rest of the country.
- 25% for rail transport through the country.
- 25% for the total fare, when travelling in groups of at least 15 persons, in national flights with Olympic Air.

1.3.4 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.

The Department of Informatics and Telecommunications

2

2.1 Presentation

The Department of Informatics and Telecommunications, part of the Faculty of Economics, Management and Informatics 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 building of the former Faculty of Science 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:

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Faculty of Economics, Management and Informatics
University of the Peloponnese

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Fax: +30 2710 372160

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

2.2 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.

2.2.1 Classrooms

The Department mainly uses the eight classrooms of the housed building, each with a capacity of 40–90 seats, which are also equipped with personal computers and modern regulatory systems. One of the classrooms is a videoconference room that can also be used for distance learning activities. The Department may also use the facilities of the adjacent building housing the Department of Economics.

2.2.2 Library and reading room

The Library of the Faculty of Economics, Management and Informatics[1] is housed in the building of the Department of Economics since the academic year 2013–2014. The Library includes a large number of scientific 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 35 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.

2.2.3 PC laboratories

The Department is provided with 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.

[1] http://library.uop.gr/parartimata/2014-04-01-07-50-59, in Greek.

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.

2.2.4 Research and teaching laboratories

The following laboratories are available for the teaching and research needs of the Department of Informatics and Telecommunications.

Logic design and architecture laboratory

The laboratory is equipped with 23 workstations with VLSI designing software installed. Moreover, several laboratory courses teaching card kits are available along with PC-FPGA interconnection cards, micro-controllers, XILINX FPGA foundation express software, digital oscilloscopes, postscript printers, and scanners.

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 for Mentor Graphics, Synplicity, Impulse Accelerated Technologies, Xilinx and Altera vendors, 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.

Graphics and image processing laboratory

The laboratory is equipped with 20 high performance workstations, featuring advanced graphics cards with embedded OpenGL support and 21” monitors with high refresh rate. The computers are provided with software covering office applications, application development, mathematical modelling, 3D graphics creation, image processing, graphics creation and OpenGL libraries. The laboratory users have also access to printers, scanners, digital cameras, 3D scanners, while the PC services are supported by a central server.

Human-computer interaction and virtual reality laboratory

The primary goal of the laboratory is to cover the undergraduate and postgraduate teaching and research needs of the Department as well as of other departments of the University of the Peloponnese, regarding both generic and specific/special subjects on the analysis of the requirements, design, implementation and evaluation of systems and applications of human-machine communication and virtual reality. Moreover, the interconnection and cooperation with other research centers and academic institutions (domestic or foreign) are also pursued as long as their scientific goals align and interrelate with those of the laboratory group.

Software and database systems laboratory

The laboratory is equipped with 8 state-of-the-art workstations provided with software covering office applications, software development environments, management systems for databases, libraries for developing parallel and distributed applications, internet servers, as well as environments for distributed execution of programs. The services of the workstations are supported by a central server.

High performance workstation laboratory

The laboratory is equipped with 5 modern workstations running the Unix operating system. The computers are provided with VLSI, LPA Prolog design software, knowledge base development software, ILOG optimisation libraries, as well as an environment for developing software and programming language translators. The services of the workstations are supported by a central server.

Computational sciences laboratory

The laboratory is equipped with 5 high performance workstations with 64bit, 2,2Ghz processor, 8GB RAM, 2x320GB hard disks, 20” high refresh rate monitors and dual operating system environment (Windows/Linux). The computers are provided with the Mathematica and Matlab software packages for developing scientific software and applications and for teaching purposes. Moreover, the workstations are interconnected via the MPI protocol forming a virtual cluster used for educational purposes. A system for simulating and analysing complicated networks (Network Workbench and NetworkX) has also been installed at the laboratory, while a computing system for computing molecular and atomic orbitals is also in operation supporting relevant research requirements.

Mathematical modelling and complex systems laboratory

The laboratory is engaged with the development of mathematical and computational techniques for simulating natural systems, focusing on complex systems and especially on complex networks. More specifically, the laboratory team works on the discretisation of natural laws, the founding of discrete geometries for the arithmetic description of natural systems in a compatible manner (retaining the basic symmetries) and also on simulating and understanding critical phenomena regarding complex networks and dynamic and evolutionary processes that take place in them. The teaching and research activities of the laboratory team are supported by partners and affiliates in Greece and abroad.

Knowledge and uncertainty laboratory

The laboratory studies the role of the presence and the absence of knowledge on the theory and application of informatics. The main theoretical tools are fuzzy mathematics and the semantic web, while the fields of artificial intelligence, information search and retrieval, adaptive systems and social networks also play an important role regarding the team's research activities. Besides the research endeavors, the laboratory contributes to the undergraduate and postgraduate curriculum of the Department by undertaking the teaching of courses that are relevant to its field of study and by providing the students with theoretical and applied projects for study.

Electronics laboratory

The laboratory comprises of 10 workstations equipped with oscilloscope, high and low frequency generators, frequency meter, DC and AC power supply devices, multimeters, prefabricated exercise boards for wiring and measurements with discrete and/or embedded chips and/or cards and simulation packages for circuits, telecommunication functions and subsystems.

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.

Digital communications laboratory

The laboratory provides 10 workstations equipped with specialised hardware (prefabricated teaching boards by vendors like Degem, Feedback, LJ Technical Systems, Elettronica Veneta, Lucas-Nulle, etc.), measuring instruments (generators, oscilloscopes, multimeters), PCs that facilitate the simulation exercises, specialised educational software, and measuring instruments for digital links.

Wireless and mobile communications laboratory

The laboratory is equipped with hardware for conducting measurements on wireless and mobile communications. The equipment comprises of a NEMO TECHNOLOGIES system for measuring and analysing 2nd and 3rd generation radio links (GSM-GPRS-WCDMA), a network analyser (8,5GHz), spectrum analysers (22GHz and portable 3GHz), RF generators (1, 2 and 20GHz), a portable GPS system, an autonomous rechargeable battery and a petrol powered generator, several types of measured antennas (logarithmic, biconical, yagi, horn, dipole), a calibration kit, a power amplifier, LNA, attenuators, oscilloscopes, digital multimeters, and frequency meters. Furthermore, the laboratory is equipped with a complete system for RADAR teaching/training, computers with software for analysing/designing antennas, studying/designing wireless and mobile communication systems (network planning), ray tracing for studying propagation-radio coverage with digital maps, and Matlab.

VLSI circuit design laboratory

The laboratory is equipped with 10 workstations that include electronic circuit simulation programs, software for designing digital circuits in VHDL, along with the corresponding development circuit boards and other laboratory hardware equipment (boards, embedded circuits, electronic components).

Communication networks and informatics' applications laboratory

The laboratory is equipped with 10 workstations with 64-bit processor (quad core, 3,5 GHz), 8GB RAM, 320GB hard disk, 19" monitor and Windows 8 operating system. On each workstation access to Linux operating system is also possible via virtual machine software. The workstations are provided with software for network management, network hardware simulation, network protocol performance evaluation, and ntegrated environments and tools for the design and development of network applications and services. In addition, a suite is installed for the definition of protocols in SDL, the production of MSCs (Message Sequence Charts), protocol simulation and formal verification, code production and support of the process for executing compliance tests. The laboratory is also equipped with 3 high performance servers, hardware for certification, measuring and checking of wireline connections, patch-pannels, active routing and switching devices, telephone center, base stations and wireless access cards, a MCU device for teleconferences, and H.323 cards.

Digital image and signal 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) and for algorithm evaluation and requirement's assessment on digital processing applications. The TMS6713DSK, 642EVM and DaVinci series boards (DSP starter kits and evaluation modules) are also available, along with Xilinx Virtex5 FGPA boards, Ettus software defined radio platforms, a hand-held 3D scanner, a 3D printer, several peripheral devices (cameras, sound processing equipment, etc.), and related software (Matlab, System View, Code Composer studio). The laboratory is also equipped with 4 high performance computers with 6-core 3,6GHz processors, 32GB RAM and dual GPU configuration complying with the CUDA 3.0 requirements (there are also 8 backup PCs).

2.3 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 21 European universities[2] under the Erasmus+ programme.

Over the recent years, more than 22 students of the Department of Informatics and Telecommunications[3] accomplished part of their undergraduate studies in EU universities under the Erasmus and Erasmus + programmes. In addition, since the beginning of the internship programme, 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**[4] along with the **responsible moderators** of the Erasmus programme at the Department 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.

2.4 Personnel

2.4.1 Professors / Lecturers

Name	Rank	Phone	Email
Athanasiadou, Georgia	Assistant Professor	2710 372217	gathanas@uop.gr
Blionas, Spyros	Associate Professor	2710 372239	sbli@uop.gr
Boucouvalas, Anthony	Professor	2710 372240	acb@uop.gr
Glentis, George-Othon	Professor	2710 372202	gglentis@uop.gr
Kaloxylos, Alexandros	Assistant Professor	2710 372205	kaloxyl@uop.gr
Kolokotronis, Nicholas	Assistant Professor	2710 372231	nkolok@uop.gr
Koutras, Costas	Associate Professor	2710 372221	ckoutras@uop.gr
Lepouras, George	Professor	2710 372201	gl@uop.gr
Malamatos, Theocharis	Assistant Professor	2710 372229	tmalamat@uop.gr
Maras, Andreas	Professor	2710 372209	amaras@uop.gr
Masselos, Kostas	Professor	2710 372213	kmas@uop.gr
Moscholios, Ioannis	Assistant Professor	2710 372283	idm@uop.gr
Peppas, Kostas	Lecturer	2710 230134	peppas@uop.gr
Platis, Nikos	Assistant Professor	2710 230171	nplatis@uop.gr
Politi, Christina (Tanya)	Assistant Professor	2710 372222	tpoliti@uop.gr

[2] http://www.uop.gr/erasmus/index.php?option=com_content&view=article&id=36&Itemid=22
[3] Since 2011, where students of the former CST and TST departments are counted in.
[4] http://www.uop.gr/erasmus/

Name	Rank	Phone	Email
Sagias, Nikos	Associate Professor	2710 372274	nsagias@uop.gr
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Stavdas, Alexandros	Professor	2710 372207	astavdas@uop.gr
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Tselikas, Nikolaos	Assistant Professor	2710 372216	ntsel@uop.gr
Tsoulos, George	Professor	2710 372267	gtsoulos@uop.gr
Vassilakis, Costas	Associate Professor	2710 372203	costas@uop.gr
Vlachos, Dimitrios	Associate Professor Head of the Department	2710 230135	dvlachos@uop.gr
Wallace, Manolis	Assistant Professor	2710 230133	wallace@uop.gr
Yiannopoulos, Konstantinos	Assistant Professor	2710 372204	kyianno@uop.gr

2.4.2 Adjunct Lecturers

Name	Phone	Email
Argyropoulos, Savvas	–	–
Vergoulis, Thanasis	–	vergoulis@uop.gr

2.4.3 Laboratory teaching staff

Name	Phone	Email
Aggelopoulos, Kostas	2710 372281	kaggelop@uop.gr
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Batistatos, Michael	2710 372282	mbatist@uop.gr
Dimitroulakos, Grigoris	2710 372263	dhmhgre@uop.gr
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Nasiopoulos, Dimitrios	2710 372249	dimnas@uop.gr
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Seklou, Kyriaki	2710 372268	kseklou@uop.gr
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2.4.4 Administrative and technical staff

Name	Position	Phone	Email
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Kyriakopoulou, Sofia	Secretary	2710 372167	sofkiria@uop.gr
Kyriazi, Giota	Postgratuate secretary	2710 372162	giotak@uop.gr
Talaganis, Nikolaos D.	Head secretary	2710 372163	ntalagan@uop.gr
Tsafara, Afroditi	Postgratuate secretary	2710 372169	atsafara@uop.gr

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, i.e. those of ACM and IEEE. It has incorporated the accumulated experience of the faculty of the Department, as well as the 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

- Have acquired the necessary knowledge on working principles on the fields of information and telecommunication systems, networks, services and applications.
- 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.
- Understand the principles of economical and managerial aspects of running projects related to Informatics and Telecommunications.
- Understand issues related to social, legal, educational end ethical aspects of Informatics and Telecommunications.

Application of knowledge and understanding

- Be capable of applying their knowledge and understanding so as to become effective professionals
- Possess appropriate skills to develop sector-specific solutions.
- Have the ability to apply the theories of informatics and telecommunications in modern information & telecommunication systems, as well as in related research areas.
- 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.
- Be able to conduct experiments that involve tests and measurements, as well as analyze, interpret and present the produced results.
- Have the ability to undertake and successfully execute projects both as individuals and as members of a technical team.
- Be capable of working effectively in a team in order to manage, design, test certify the performance of ICT systems.

Judgement

- Will be capable of recognizing, formulating and solving problems in the design, management and evolution of informatics and telecommunications systems.
- 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.
- Understand scientific and technical publications and be able to formulate their personal opinion on their importance and implications.
- Be able to retrieve and use bibliographical sources, standards and regulations concerning scientific issues, products and systems.
- 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.
- 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.
- Be able to determine their needs to acquire new knowledge and continuously extend their knowledge and skills.

Communication

- Be proficient in communicating problems, ideas, solutions, technical information effectively and efficiently, in writing and orally, to both specialist and non-specialist collocutors;
- Have the capability produce technical reports on the activities carried out and present summaries of the key results in group discussions;

Learning

- Be able to recognize and adapt to new methods, techniques and instruments used in all phases of ICT systems' and applications' lifecycle.
- Have the capacity to follow scientific and technological developments in the ICT domain and determine needs for further knowledge acquisition and skill development
- 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 ECTS standards are provided in Chapter 4. These specifications thoroughly describe the aims

[1] http://ec.europa.eu/education/tools/ects_en.htm

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.

3.2 Course Categories

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

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 24 ECTS units, reflecting the increased effort for its successful completion. For more information about the final thesis, please follow the link[2].

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.

[2] http://dit.uop.gr/undergrad-thesis, in Greek.

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 5 ECTS units.

3.3 Degree Requirements

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

- Successful completion of assessments in 21 core courses (**C**), with a total weight of 126 ECTS units.
- Successful completion of the final thesis, with a weight of 24 ECTS units.
- Successful completion of assessments in other courses, with a minimum of total weight of 90 ECTS units. These courses should include:
  - At minimum four specialization core courses (**SC**).
  - Specialization elective courses (**SE**).
  - At maximum two free elective courses (**FE**) or pedagogy and didactics courses (**PD**).

A student successfully completes a specialization when s/he has successfully completed the assessments in four (4) specialization core courses (SC) and eight (8) specialization elective courses (SE), all included in a specific specialization. This specialization is then included in 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:

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

where

- N is the total number of the courses that are taken into account for the degree completion,

- B_i is the grade of the ith course,
- $ECTS_i$ are the ECTS units of the ith course.

When the student has successfully completed the assessment of courses of a total weight larger than 240 ECTS units, then s/he can choose which of these courses will be taken into consideration for the degree grade calculation, with the restriction that all the above requirements are followed. The extra 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 in the respective semester. For more information about the enrolment procedure, please refer to the *procedure guide*[3] of the Department.

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

- 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.

The student can enrol to additional courses every semester, provided that the total ECTS weight does not be higher than

- 49 ECTS units for the semesters 1–6,
- 55 ECTS units for all the following semesters.

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

[3] http://dit.uop.gr/images/docs/bsc/dit-procedure-guide.pdf, in Greek.

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 *procedure 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, he may be registered to the other specialization (or not having a specialization) during the procedure of studies completion and if he has successfully completed the assessments in all the courses that are required according to his new choice. His final choice will be then mentioned on his final detailed degree transcript.

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 Courses 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.

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	6	2		C
Mathematics I	1	6	4		2	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		4	C
Probability and Statistics	2	6	4		2	C
Programming II	2	6	4	2	2	C
Object-Oriented Programming	3	6	4	2		C
Data Structures	3	6	4	1	1	C
Electromagnetic Fields	3	6	4		4	C
Mathematics III	3	6	6		4	C
Signals and Systems	3	6	6	2		C
Algorithms and Complexity	4	6	6			C
Principles of Telecommunication Systems	4	6	4	2	4	C
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	4	2	2	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		1	SC-I
Compilers I	5	5	2	2		SC-I
Human Computer Interaction	6	5	2		2	SC-I
Software Engineering	7	5	4			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	4		1	SC-T
Introduction to Optical Communications	5	5	3			SC-T
Digital Communications	5	5	4	2		SC-T
Digital Signal Processing	5	5	3	2		SC-T

Specialization elective courses on Informatics

Course Title	Semester	ECTS Units	Teaching hours Lectures	Lab	Tutorials	Category
Systems Programming	5	5	4			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
Advanced Programming Topics	6	5	3	1		SE-I
Semantic Web	6	5	4			SE-I
Information Retrieval	7	5	3		2	SE-I
Big data management	7	5	3	1		SE-I
Distributed Information Management	7	5	3	1		SE-I
Logic for Computer Science	7	5	4			SE-I
Compilers II	7	5	2	2		SE-I
Parallel Algorithms	7	5	4			SE-I
Data Management Systems	7	5	4			SE-I
Artificial Intelligence	7	5	4			SE-I
Computational Geometry	7	5	4			SE-I
Special Topics in Algorithms	8	5	4			SE-I
Topics on Data and Information Management	8	5	3	1		SE-I
Cryptography	8 [4]	5	3		1	SE-I
Advanced User Interfaces - Virtual Reality	8	5	2	2		SE-I
Machine learning and data mining techniques	8	5	3	1		SE-I

[4] During the current academic year, the course will be offered in semester 7 instead.

Specialization elective courses on Telecommunications

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Communication Networks II	5	5	3	1		SE-T
Antennas	5	5	3	1		SE-T
Wireless Links	6	5	3	1		SE-T
Satellite Communications	6	5	3	1		SE-T
Telecommunication Systems Measurements	6	5	2	2		SE-T
Optoelectronics	6	5	3		1	SE-T
Stochastic Signal Processing and Applications	6	5	3	2		SE-T
Telephone Networks	6	5	4			SE-T
Microwaves and Waveguides	7	5	4			SE-T
Optical Wireless Communications	7	5	4			SE-T
Advanced Topics in Digital Communications	7	5	4			SE-T
Optical Communication Systems	7	5	3			SE-T
Modern Cellular Communication Systems	7	5	4			SE-T
Core and Metropolitan Networks	8	5	3			SE-T
Introduction to Radars	8	5	4			SE-T
Applications of Optical Fiber Systems and Networks	8	5		3		SE-T
Adaptive Signal Processing	8	5	3	2		SE-T
Simulation of Telecommunications Systems	8	5	2	2		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		1	SE-I/T
Introduction to Information Theory and Coding	6	5	3			SE-I/T
Image Processing: principles, algorithms and applications	6	5	2	2		SE-I/T
Business Procedures. Modeling and Simulation	6	5	4			SE-I/T
Decision making systems	6	5	4			SE-I/T
Internet Applications and Web Services Development	6	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
Mathematical Modeling and Complex Networks	7	5	4			SE-I/T
Management Information Systems	7	5	3	1		SE-I/T

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Stochastic Network Modeling and Performance Analysis	7	5	3		1	SE-I/T
Digital Systems and Circuits Design	7	5	3	1		SE-I/T
Switch and Router Architectures	8	5	4			SE-I/T
Sensor Networks	8	5	3	1		SE-I/T
Group Projects on Informatics and Telecommunications	8	5	4			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	5	4			SE-I/T
Specification of Communication Protocols	8	5	2	1		SE-I/T
Communication Networks Simulation Techniques	8	5	4			SE-I/T
Implementation of digital circuits and systems with FPGAs	8	5	3	1		SE-I/T

3.6.3 Free elective courses

Course Title	Semester	ECTS	Teaching hours			Category
		Units	Lectures	Lab	Tutorials	
Introduction to Economic Science	5	4	3			FE
Development of New IT products	6	3	3			FE
Project Management in Informatics and Telecommunications	6	3	3			FE
Game Theory	6	4	3			FE
Research Methodology and Scientific Writing	6	3	3			FE
Traineeships	6 / 7 / 8	3				FE
Erasmus Traineeships	6 / 7 / 8	6				FE
Legal Issues of Informatics and Telecommunications	7	3	3			FE
Entrepreneurship in IT	8	3	3			FE

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	–

Course Title	**Category**	**Prerequisites**
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 **or** Communication Networks II
Compilers I	SC-I	Programming II
Wireless and Mobile Communications I	SC-T	–
Introduction to Optical Communications	SC-T	Physics **or** Principles of Telecommunication Systems
Digital Communications	SC-T	–
Digital Signal Processing	SC-T	–
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** Logic Design
Communication Networks II	SE-T	–
Antennas	SE-T	Electromagnetic Fields **or** Physics
Introduction to Economic Science	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
Computer Architecture II	SE-I	Computer Architecture I
Computer Graphics	SE-I	**(**Programming II **or** Object-Oriented Programming**)** **and** Mathematics I
Advanced Programming Topics	SE-I	Object-Oriented Programming **and** Data Structures
Semantic Web	SE-I	Data Structures **or** Object-Oriented Programming
Numerical Analysis	SE-I/T	–

Course Title	Category	Prerequisites
Wireless and Mobile Communications II	SE-I/T	Communication Networks I
Introduction to Information Theory and Coding	SE-I/T	Probability and Statistics
Image Processing: principles, algorithms and applications	SE-I/T	–
Business Procedures. Modeling and Simulation	SE-I/T	–
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
Satellite Communications	SE-T	–
Telecommunication Systems Measurements	SE-T	–
Optoelectronics	SE-T	Physics
Stochastic Signal Processing and Applications	SE-T	Signals and Systems **or** Digital Signal Processing
Telephone Networks	SE-T	–
Development of New IT products	FE	–
Project Management in Informatics and Telecommunications	FE	–
Game Theory	FE	Probability and Statistics
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	–
Software Engineering	SC-I	Object-Oriented Programming
Information Retrieval	SE-I	**(**Programming II **or** Object-Oriented Programming **or** Advanced Programming Topics**)** **and** Data Structures
Big data management	SE-I	–
Distributed Information Management	SE-I	–
Logic for Computer Science	SE-I	–
Compilers II	SE-I	Compilers I
Parallel Algorithms	SE-I	Programming I **or** Programming II
Data Management Systems	SE-I	Data Structures **and** Databases
Artificial Intelligence	SE-I	**(**Programming II **or** Object-Oriented Programming**)** **and** Discrete Mathematics

Course Title	Category	Prerequisites
Computational Geometry	SE-I	Data Structures **or** Algorithms and Complexity
Multimedia Signal Processing	SE-I/T	Signals and Systems
Theory and Applications of Speech Processing	SE-I/T	–
Mathematical Modeling and Complex Networks	SE-I/T	–
Management Information Systems	SE-I/T	–
Stochastic Network Modeling and Performance Analysis	SE-I/T	–
Digital Systems and Circuits Design	SE-I/T	Logic Design
Microwaves and Waveguides	SE-T	–
Optical Wireless Communications	SE-T	–
Advanced Topics in Digital Communications	SE-T	Digital Communications
Optical Communication Systems	SE-T	–
Modern Cellular Communication Systems	SE-T	Wireless and Mobile Communications I **or** Wireless Links
Legal Issues of Informatics and Telecommunications	FE	–
Traineeships	FE	–
Erasmus Traineeships	FE	–

3.7.8 8th semester

Course Title	Category	Prerequisites
Undergraduate Thesis	C	–
Special Topics in Algorithms	SE-I	Data Structures **or** Algorithms and Complexity
Topics on Data and Information Management	SE-I	Databases
Cryptography	SE-I	Probability and Statistics **or** Discrete Mathematics
Advanced User Interfaces - Virtual Reality	SE-I	Human Computer Interaction
Machine learning and data mining techniques	SE-I	Databases
Switch and Router Architectures	SE-I/T	–
Sensor Networks	SE-I/T	Communication Networks I **or** Wireless and Mobile Communications I
Group Projects on Informatics and Telecommunications	SE-I/T	–
Distributed Systems Programming	SE-I/T	Object-Oriented Programming
Advanced Topics in Coding Theory	SE-I/T	Introduction to Information Theory and Coding
Combinatorial Optimization	SE-I/T	–
Specification of Communication Protocols	SE-I/T	–
Communication Networks Simulation Techniques	SE-I/T	–
Implementation of digital circuits and systems with FPGAs	SE-I/T	Logic Design **or** Digital Systems and Circuits Design

Course Title	Category	Prerequisites
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** Programming II **or** Digital Communications **or** Signals and Systems
Entrepreneurship in IT	FE	–
Traineeships	FE	–
Erasmus Traineeships	FE	–

4

Course Descriptions

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

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: 6 hours lectures, 2 hours lab (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 (30%), a written examination at the end of the course (70%) and an optional semester project(40%).

Mathematics I

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 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 and wave 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: introduction, measurements, vectors, one and two dimensional motion, laws of motion, energy and work, circular motion, oscillation.

Wave physics: wave motion, wave definition, transverse and longitudinal waves, travelling harmonic waves, harmonic wave energy/intensity/velocity, acoustics, wave superposition, standing waves.

Optics: refractive index, reflection, refraction, interference, diffraction.

Modern physics - applications to telecommunications (optical fibers, lenses, semiconductors, antennas, interferometers).

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 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. A passing grade at either the laboratory exams or the theory exams may be retained for subsequent 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 at the end of the semester

Mathematics II

Category: Core

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

Prerequisites: –

Teaching: 6 hours lectures, 4 hours tutorials (per week).

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

- handle functions of many variables and calculate their partial derivatives
- handle vector valued functions
- calculate line, surface and volume integrals
- handle complex functions
- calculate Taylor and Laurent series
- calculate closed line integrals using the Cauchy residue theorem
- handle conformal mappings
- calculate the Fourier and Laplace transforms and their inverses

Course contents: Vectors and polar functions in 2 and 3 dimensions, Functions of many variables, Derivations, Multiple integrals, Integration of vector fields, Complex numbers and elementary functions, Analytic functions and integration, Linear integrals and the residue theorem, Complex transforms, Asymptotic integration, Riemann-Hilbert problems, Integral transforms.

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, 2 hours tutorials (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).

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, 1 hour lab, 1 hour 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 = 40% and written exam, weight = 60% (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, 4 hours 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: 6 hours lectures, 4 hours tutorials (per week).

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

- solve ordinary differential equations of the 1st degree by using the method o separation of variables
- solve ordinary differential equations with constant coefficients using Laplace transform or the method of the characteristic polynomial
- solve ordinary differential equations of the 2nd degree using power series
- solve systems of linear differential equations of the 1st degree
- analyse the stability of ordinary differential equations
- apply the method of separation of variables in order to solve partial differential equations
- apply the Fourier transform in order to solve boundary problems

Course contents: Ordinary differential equations (ODE), modeling physical phenomena using ODE, ODE's of the 1st order, ODE's with constant coefficients, the method of power series for the solution of ODE's, linear systems of ODE's, bifurcation theory, partial differential equations (PDE), solution of PDE's using separation of variables, solution of boundary value problems, Fourier transform.

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

Signals and Systems

Category: Core

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

Prerequisites: Mathematics I **or** Mathematics II

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

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

- describe the structure and interpretation of signals and of (mainly, linear) systems.describe the mathematical modeling of systems and also learn their basic properties such as linearity, causality, stability and time-invariance with particular emphasis given on linear and timeinvariant (LTI) systems.
- describe the various signal categories, their main properties and also the fundamental classes of signals such real and complex exponentials, the Heaviside unit step pulse, the unit impulse functional and also the unit ramp function in both continuous-time and discrete-time form.
- explain the convolution sum representation for discrete time LTI systems and also the convolution integral representation for continuous time (analog) systems.
- interpret LTI continuous-time and discrete-time systems through their impulse response and also their step response.
- describe the Fourier integral analysis for continuous-time signals and LTI systems, and also analyze LTI continuous-time LTI systems through their Fourier integral representation.

- explain the Fourier series (both in complex exponential form and real trigonometric form) analysis for discrete-time periodic signals.
- apply Fourier transform analysis to the modelling of simple communication systems such as an AM radio system and the AC/DC conversion.
- assess the importance of Laplace transform and Z-transform methods in the analysis of more general signals and systems in continuous time for the former case and discrete time for the latter case.

Course contents: Introduction. Overview of signals and systems concepts.

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: 6 hours lectures (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: 4 hours lectures, 2 hours lab, 4 hours tutorials (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.

- Implement modulated and demodulated signals (e.g. voice) and sampled signals using laboratory equipment and Matlab-Simulink.

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 along with problem sets during the semester, which contribute 70% to the final grade. Laboratory reports followed by written or oral examination, which contribute 30% to the final grade.

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 100%. It is possible that students can participate to lab exercises, which will contribute to the final grade with a percentage of 40%. In the latter case the written exams contribute to the final grade with a percentage of 60%.

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: Compulsory coursework and written exam at the end of the semester. During and at the end of the semester oral examination of the lab coursework. The final grade is computed by the grades of the written exam (weight 30-50%), the coursework (weight 30-50%) and the oral examination of the coursework (20-30%). All three grades (written exam, coursework, oral examination) must be at least 5. A passing grade of either the coursework or the written exam 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, its structure and the main types of operating systems.
- describe the modeling of processes, their switching on the CPU, the mechanisms for accomplishing interprocess communication and synchronization and the basic algorithms for process scheduling; apply the related algorithms and solve related problems.
- describe the concept of deadlock, the related problems, the mitigation strategies and the algorithms used to this end. The student will be also able to apply the related algorithms.
- describe the goals of memory management, the main techniques for managing memory and the related algorithms. The student will be also able to apply the related algorithms.
- describe the basic elements and the functionality of file systems, their structures, their implementation methods and the related techniques and algorithms and solve related problems.
- describe the principles and structure of input/output software, and the way that input/output software handles the main device categories.
- describe the concepts of security related to the operating system, the existing threats and the mitigation methods and mechanisms, and additionally choose and apply the related algorithms.

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: 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:

- 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

Undergraduate Thesis

Category: Core

ECTS Credits: 12 ***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 **or** Communication Networks II

Teaching: 3 hours lectures, 1 hour tutorials (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 percentage 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: 4 hours lectures per week. About half of them will take the form of an obligatory lab and exam. The course is divided in parts of theory, followed by labs and each set of labs is concluded with an exam.

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.

Software Engineering

Category: Specialization in Informatics - Core

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

Prerequisites: Object-Oriented Programming

Teaching: 4 hours lectures (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: 4 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%.

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: –

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

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

- explain the sampling process
- identify the differences between ideal and practical sampling process
- explain quantization techniques and encoding methods
- design of PCM systems of specific characteristics
- identify baseband modulation techniques and waveforms
- design the optimum receiver
- identify passband modulations (ASK, PSK, FSK)

Course contents: Digital transmission, baseband systems, binary and multilevel PAM and PPM systems, bit error probability calculation, performance analysis, digital signals spectra, signals geometric representation, matched filters, correlators, detectors, intersymbol interference (ISI, equalisers) and noise. Digital data transmission through carrier modulation, binary and multilevel ASK, FSK, PSK and DPSK modulations, ideal receivers and performance comparison, power and bandwidth requirements. Elements of sampling theory, quantization methods and coding. PCM, DPCM and delta modulation systems, TDM multiplexing. Noise theory. Impact of quantization and channel noise on the Signal-to-Noise-Ratio. Comparison of analog and digital signal transmission methods. For the lab of the course, the Simulink software of Matlab is used.

Assessment: Written exams at the end of the semester in both theory and laboratory with a percentage 70% and 30%, respectively.

Digital Signal Processing

Category: Specialization in Telecommunications - Core

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

Prerequisites: –

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 discrete time signals and systems
- Describe elementary applications on digital signal processing
- Perform theoretical analysis as well as a practical implementation of signal processing algorithms
- Describe the role of signal processing in modern applications
- Design digital filters

- Design discrete time signal processing architectures
- Apply the z-transform for the solution of digital signal processing problems

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: 4 hours lectures (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). 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%.

Advanced Programming Topics

Category: Specialization in Informatics - Elective

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

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

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

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

- create a mid-size application with a graphical user interface by selecting the appropriate graphical controls for the user interface of his application (text field, button, combo box, check box, radio button, list, etc)
- use appropriate layout managers (Border, Flow, Grid, Box layout) for the effective setup of the content of the GUI.
- implement event listeners for various kinds of events of the UI elements of Swing, selecting the most appropriate implementation (as a regular class, as an inner class, or as an anonymous class)
- use secondary windows (dialogs) in his application
- 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.)
- traverse the collections in multiple ways (for-each, iterator)
- write a basic client-server application for network communication

Course contents: (a) Swing programming: basic elements of a graphical user interface (text field, button, combo box, check box, radio button, list, etc), layout managers (Border layout, Flow layout, Grid layout, Box layout), event listeners, menus, dialogs. Inner classes, anonymous classes. Use of graphical editors (Netbeans) for GUI creation.(b) 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). 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.

Semantic Web

Category: Specialization in Informatics - Elective

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

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

Teaching: 4 hours lectures (per week).

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

- explain the notion of the semantic web
- identify application fields for semantic web technology
- create XML documents
- read and explain RDF/OWL documents
- design and develop simple ontologies
- list the different forms of uncertainty and explain their differences

Course contents: Introduction to the vision of the Semantic Web, structured web documents: XML, resource description framework: RDF, web ontology language: OWL, logic and inference: rules, ontology engineering, uncertainty, representation of uncertain knowledge, applications

Assessment: The overall course grade is calculated as a weighted sum of grades for written reports (30%), written examination at the end of the course (40%) and semester project (100%). Students can accumulate grades through any combination of the above.

Information Retrieval

Category: Specialization in Informatics - Elective

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

Prerequisites: **(**Programming II **or** Object-Oriented Programming **or** Advanced Programming Topics**) and** Data Structures

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 and theory in the area of Information Retrieval,
- describe fundamental algorithms and methods used to index, search, cluster, browse, rank and filter information,
- implement and evaluate Information Retrieval algorithms,
- design, develop, and evaluate novel algorithms and techniques for performing Information Retrieval and Data Management on the Web.

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). Link analysis. Frequent itemset mining. XML retrieval. Relevance feedback and query expansion. Latent semantic indexing.

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.

Big data 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:
- understand the peculiarities induced by massive volumes of data.
- understand the limitations of older approaches.
- understand the benefits and limitations of parallel and distributed processing.
- model, store, retrieve and handle very large volumes of data.

Course contents: This course focuses on the manipulation and management of vast amounts of data and discusses technologies such as: architectures of distributed systems, cluster, grid and cloud computing, distributed file systems (e.g., Google File System/Facebook Cassandra/HBase), parallel/distributed data computations (Map/Reduce, Hadoop), parallel/distributed graph processing (Pregel, Hama), parallel databases and parallel query execution, key-value stores and NoSQL databases, distributed stream processing, graph databases, column-stores, data cleaning and data analysis, knowledge extraction and data mining.

Assessment: The course grade will be based on programming projects (possibly involving a personal examination) and/or programming exercises that will jointly account for 40% of the final grade, litterature review exercises and class presentations that will account for 30% of the 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. To succeed in this course, a mark of 5 or higher is required in the written exam and in the final grade.

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.

Logic for Computer Science

Category: Specialization in Informatics - 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:

- 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.

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%).

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.

Artificial Intelligence

Category: Specialization in Informatics - Elective

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

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

Teaching: 4 hours lectures (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 with search agents. Searching strategies: breadth-first search, uniform-cost search, depth-first search, depth-limited search, iterative deepening depth-first search, bi-directional search. Heuristic functions: greedy best-first search, A*-search. Local search. Constraint satisfaction problems. Agents for knowledge representation and reasoning. Propositional and first order logics. Knowledge base design. Reasoning systems: modus ponens, unification, forward and backward chaining, resolution. Introduction to logic programming and Prolog.

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%).

Computational Geometry

Category: Specialization in Informatics - Elective

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

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

Teaching: 4 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.

Special Topics in Algorithms

Category: Specialization in Informatics - Elective

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

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

Teaching: 4 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: Distributed databases. Databases and XML. OLAP. Object relational databases. Spatial and spatiotemporal data management. Constraint databases. Semantic web. RDF and SPARQL. Data models and query languages for linked data. Anonymity and privacy.

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

Cryptography

Category: Specialization in Informatics - Elective

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

Prerequisites: Probability and Statistics **or** Discrete Mathematics

Teaching: 3 hours lectures, 1 hour tutorials (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

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%.

Advanced User Interfaces - Virtual Reality

Category: Specialization in Informatics - Elective

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

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.

Machine learning and data mining techniques

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 machine learning and data mining processes
- describe the algorithms and the methods used in machine learning
- use different machine learning and data mining tools

- apply machine learning and data mining algorithms to solve problems, e.g., financial problems.
- describe successful machine learning and data mining use-cases

Course contents: Introduction to data mining techniques (data, problems, applications). General data analysis and management techniques. Data categorization (decision trees, statistical methods). Categorization of multidimensional data. Clustering techniques. Techniques for relation and knowledge extraction. Applications of data mining techniques to searching.

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

Introduction to Embedded Systems

Category: Specialization in Informatics or Telecommunications - Elective

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

Prerequisites: **(**Programming I **or** Programming II**) 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:
- Understand fundamental differences between conventional computing systems and embedded systems.
- 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: Applications of embedded systems in informatics and telecommunications (wireless sensors), signal processing (e.g. smart cards), automata automotives, Biomedical etc.

Models for the description of embedded systems: computation models, High level Programming languages.

Analysis and design of an application/program: program models high level transformations, Compilers for embedded systems Optimisation of code Design Platforms, Partitioning of hardware and software, Performance analysis, Hardware-Software co-synthesis algorithms, Firmware development, Procedures and their time schedule Αλγόριθμοι, OS kernels of real time systems Hardware-Software co-design, Prototyping technologies of embedded systems, multi-processors architectures. (MPSOC), Processing units, Interconnection networks and topologies, Memory hierarchies, Memory management units.

Embedded Systems Hardware: Building components of embedded systems: Microcontrollers, IP cores, Memory systems, Bridges, Peripherals, Embedded Systems implementation technologies, Low power consumption systems, Systems on Chip.

Embedded Systems Software: Embedded real time OS kernels, time schedule of real time systems. Implementation of embedded systems

Verification: Verification of hybrid systems, Simulation and emulation, Testing, Fault simulation, Risk analysis, Reliability.

Lab Exercises: Implementation of applications in hardware and firmware on FPGA development boards.

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, 1 hour tutorials (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%.

Introduction to Information Theory and Coding

Category: Specialization in Informatics or Telecommunications - Elective

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

Prerequisites: Probability and Statistics

Teaching: 3 hours lectures (per week).

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

- assess the importance of entropy in defining the information content of sources and capacity for channels.
- apply probabilistic modeling for describing the information content of simple sources such as those used for transmitting voice or data, or even both and also learn how to describe them via the notion of entropy.
- describe the various measures of entropy for discrete-time memoryless sources, i.e., conditional and joint, as well as its equivalent forms for analog memoryless information sources.
- describe the information channel via its various matrix representations such as the channel matrix, input-output information system matrix, mutual information and most importantly, its capacity.
- describe the capacity of simple information channels such the Binary Symmetric Channel and the Binary Erasure Channel.
- describe the famous Shannon's channel coding and its application to data processing and coding.
- describe the importance of the data processing theorem in obtaining the capacity of practical every day telecommunication systems.
- describe the basic geometric notions of coding theory and the important properties of codes such as the error detecting capability and error correcting capability.
- describe the definition of linear error correcting binary codes via two alternative definitions using well known results from linear algebra.
- utilize linear algebra to obtain the Hamming minimum distance and further utilize it to define the error-correcting radius of any binary linear code.
- describe the limits of error correcting codes through the Hamming upper bound and also Plotkin's bound as well as the Gilbert-Varshamov bound of binary linear error-correcting codes .
- describe the family of Hamming's binary linear error correcting codes and decode them via Slepian's algebraic method.

Course contents: Introduction. The concept of entropy as Shannon's information measure. Joint, mutual and conditional entropy. The memoryless discrete as well as analog information source. Capacity of noisy channels and coding for discrete memoryless channels. The data processing theorem (Cascading of channels). Introduction to error correcting codes. Linear block codes. Binary Hamming codes.

Assessment: Written exam at the end of the semester.

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.

Business Procedures. Modeling and Simulation

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:

- define the notions of modeling and simulation procedures, which take place during the creation, development and promotion of a product and/or service in the IT sector.
- describe the modern dynamic systems, in relation to the entrepreneurship trends in information technology, competitiveness and strategic planning of innovative actions.
- combine the modeling of optimization processes of existing systems and to develop new ones.
- conduct a sensitivity analysis and study their function.
- select and combine the appropriate parameters required, in order to extract reliable and useful conclusions by the processes involved in innovative business processes.
- recognize all those actions that may contribute to a business development strategy focusing on innovation, which can derive from the use of dynamic simulation models in Informatics.
- describe and design Dynamic Simulation Models) with the use of modern software, such as iThink of isee Systems and AnyLogic.

Course contents: Entrepreneurship & Innovation of IT products and services. Modeling procedures. Simulation of procedures. Business Process Model και Notation (BPMN). Modeling Strategy. Computational decision-making systems. Development of simulation programs. Competitiveness Modeling.

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

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. 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

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, 1 hour 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 HTML to implement static web pages and CSS for web design.
- use Javascript to implement client-side dynamic web pages and applications, as well as PHP to implement server-side dynamic ones.
- connect to MySQL Server with PHP scripting in order to implement 3-tier internet applications.
- edit, serialize/deserialize, validate and handle XML document, to use XML Schema (XSD) in order to define the structure of XML documents and to use basic AJAX (Asynchronous Javascript and XML) techniques.
- use open APIs, like Google Maps API, in order to be able to design and implement mash up applications.
- design and implement Java-based 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), PHP/MySQL scripting, XML, XML Schema and Asynchronous Javascript and XML (AJAX), Google Maps 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%.

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.

Mathematical Modeling and Complex Networks

Category: Specialization in Informatics or 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 the complexity theory and the theory of critical phenomena
- describe the structural parameters of complex networks
- apply dynamical and evolutionary processes in complex networks
- describe the structure and architecture of important networks found in nature and the environment

Course contents: Introduction to the theory of complexity, critical phenomena, percolation, fractals. Complex networks, network evolution models, correlations, communities and modularity, clusters, centrality, self-similarities. Dynamical process in complex systems, information spreading, epidemics, evolutionary processes in complex networks. Study of the Internet (physical layer), Web, social and economic networks, biological networks, discrete geometries.

Assessment: Five sets of homework with total weight 40% and 3 hours written exams with weight 60%.The relevant weights can be changed (+/-10%).

Management Information Systems

Category: Specialization in Informatics or Telecommunications - 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:

Course contents:

Assessment:

Stochastic Network Modeling and Performance Analysis

Category: Specialization in Informatics or Telecommunications - Elective

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

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 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

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.

Switch and Router Architectures

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:
- Explain and appreciate the fundamental role of switching in all kinds of networking schemes, independently from the context/transport mode in which they operate while deriving and reducing switching functions to simplify circuits used to realize them.
- Design two classes of blocking networks, namely banyan networks and sorting networks, as well as re-arrangable networks based on given criteria and design strict-sense non-blocking.
- Apply all the above to the high level design of packet and circuit switched networks
- Understand the high level node architecture of all telecom and data networks with respect to switching and other functions (technology specific design)
- Explain and apply fundamental characteristics of relevant electronic and optical technologies, such as propagation delay, power dissipation and noise margin to the switch design

Course contents: Introduction - Motivation of hierarchical networks - Topology - Telephone Networks - General Concepts. Switching principles - Model switch. Blocking properties - Accessibility / Accessibility. Networks and Switches - Topologies and equivalent topologies - Cost and switch size. Monitoring and switch control algorithms. Blocking Conditions - Architecture (banyan, sorting). Non-Blocking Conditions - Architectures. Examples network architectures with many stages. Circuit switched architectures-SONET / SDH. Packet switching nodes- ATM switches. IP Routers - General principles and examples of architectures. Materials and switching technologies. Optical circuit switched networks.

Assessment: Compulsory written exams at the end of the semester. Home assignments will be given, which will contribute to the final grade with a percentage of 20%. Mini project will be given that will contribute to the final grade by 20%.

Sensor Networks

Category: Specialization in Informatics or Telecommunications - Elective

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

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.

Group Projects on Informatics and Telecommunications

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:

- cooperate within study groups over topics relevant to communication networks.
- study independently research literature (conference and journal papers).
- assemble technical documents and/or scientific papers.
- present research results in scientific conferences.

Course contents: Introduction. Working in groups, Advantages and disadvantages, leading a team. Introduction to topics of interest. Writing a publication. Team grouping on advanced topics on telecoms or informatics projects. Manage the process.

Assessment: Demonstration of the project, presentation of work, publish a peer reviewed conference paper.

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: Introduction to Information Theory and Coding

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

Prerequisites: –

Teaching: 4 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

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

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: Written exams at the end of the semester 100%. It is possible that students can participate in a project, which will contribute to the final grade with a percentage of 50%. In the latter case the written exams contribute to the final grade with a percentage of 50%.

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.

Implementation of digital circuits and systems with FPGAs

Category: Specialization in Informatics or Telecommunications - Elective

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

Prerequisites: Logic Design **or** Digital Systems and Circuits 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.

Communication Networks II

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:
- 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.

Antennas

Category: Specialization in Telecommunications - Elective

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

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%.

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%.

Satellite Communications

Category: Specialization in Telecommunications - Elective

ECTS Credits: 5 ***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:

- acquire an understanding on basic concepts on satellite communications
- acquire an understanding on orbital mechanics of LEO, MEO, HEO και GEO satellites
- define and explain propagation impairments
- calculate and evaluate the characteristics of the uplink/downlink satellite 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: Introduction to satellite communications: Definitions, satellite types, orbital mechanics and orbits (low & medium earth orbits (LEO & MEO), high elliptical orbit (HEO), geosynchronous earth orbit (GEO)), coordinates transformations. Calculation methods for link budget, propagation impairments (free space loss, atmospheric, rain attenuation, shadowing), effects of noise on various receiver parts (antenna, absorptive network, amplifier), definitions of various parameters (EIRP, cross-polar isolation and discrimination (XPI and XPD), G/T figure, transponder input/output backoff). Description of multiple access networks and multibeam systems. Study on contemporary satellite systems (DVB-S, Iridium, GPS, Inmarsat, VSAT). Simulation studies on orbit planning and link budget with STK software by Analytical Graphics (AGI). Exercises using the STK software and analyses of link budget using Excel.

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

Telecommunication Systems Measurements

Category: Specialization in 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:

- understand and use the datasheet of measurement equipment systems
- describe the functionality of basic measurement instruments (oscilloscope, generator, spectrum analyzer, vector analyzer)
- draw the block diagram of a spectrum analyzer
- understand, model and minimize common types of disturbances that can occur in any measurement system setup
- calculate the statistics properties of electrical measurements
- calculate measurements uncertainty
- describe the structure of any RF measurement setup
- conduct RF power measurements

Course contents: Basic measurement quantities (E, P, V, I, Noise, SNR, SINR, BER). Measurable units and conversions (dB, dBW, dBV). Time and frequency domain, transforms. Transceiver brock diagram (ADC/DAC, modulators, filters, amplifiers). Measurement equipment (oscilloscope, generator, spectrum analyzer, vector analyzer etc.). Datasheet. Error analysis (random and systematic errors, accuracy, calibration, mean value, deviation, error propagation, linear interpolation, uncertainty). RF power measurement systems. Power measurements.

Assessment: Written exams at the end of the semester which will contribute 50% to the final grade. Laboratory reports and/or oral examination which will contribute 50% to the final grade.

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%.

Stochastic Signal Processing and Applications

Category: Specialization in Telecommunications - Elective

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

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 stochastic signal processing
- Describe elementary applications on stochastic signal processing
- Perform theoretical analysis as well as a practical implementation of stochastic signal processing methods and algorithms

- Describe the role of stochastic signal processing in modern applications
- Apply filtering on WSS processes
- Apply spectral estimation algorithms
- Apply parameters estimation algorithms

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.

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 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 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.

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.

Optical Wireless Communications

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:

- 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 systems concepts, sources, LEDs and Lasers, detectors pin and APD and components elements. Indoor optical wireless channel, noise system design, outdoor channel applications, outdoor channel and system design.

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: 4 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

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.

Modern Cellular Communication Systems

Category: Specialization in Telecommunications - Elective

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

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

Teaching: 4 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 4G 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. 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%.

Core and Metropolitan Networks

Category: Specialization in Telecommunications - 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:

- 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

Prerequisites: Antennas

Teaching: 4 hours lectures (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

Prerequisites: –

Teaching: 3 hours lab (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
- 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

Prerequisites: Programming I **or** Programming II **or** Digital Communications **or** Signals and Systems

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

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

- describe fundamental issues regarding random numbers generation
- generate random numbers having specific properties
- simulate advanced modulation formats
- design and simulate the optimum receiver
- identify the differences in system performance between theory and practice and explain any differences
- evaluate the bit and symbol error probability

Course contents: Line codes NRZ, RZ, AMI, Manchester, coherent and non-coherent modulation techniques PSK, FSK, QAM, advanced modulation techniques OFDM και CDMA. Random number generation, Monte Carlo simulation, bit and symbol error rate calculation, performance analysis, digital signals spectra, signals geometric representation, maximum likelihood detectors, matched filters, correlators, intersymbol interference, pulse shaping, simulation of digital communication systems. During the course, Matlab is used extensively for the implementation of simulation systems.

Assessment: Written exams at the end of the semester with weight 60% and assignments during the semester with weight 40%.

4.3 Free Elective Courses

Introduction to Economic Science

Category: Free Elective

ECTS Credits: 4 ***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.

Development of New IT products

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:

- identify problems and to combine solutions for developing new IT products.
- distinguish the problems that arise and to generate ideas that will translate into IT products .
- apply the methodology of combination and differentiation of existing solutions in products and IT services.
- assess the resulting solutions with the help of dynamic simulation models, in order to determine the most advantageous business.

Course contents: Birth of Ideas, Comparative Evaluation of Ideas, New Product/Service Concept Development, Marketing Analysis, Business Analysis, Product/Service Control and Testing, Manufacturing Product/Service, Merchandising.

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.

Project Management in Informatics and Telecommunications

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:

- identify and analyze the basic principles that govern the administrative planning of the development of an IT project, consisting of the cooperative framework of management, the project planning, the time and cost planning of IT projects and the breakdown and categorization of subprojects (Work Breakdown Structure).
- apply methods for the organization of work groups and job scheduling,
- analyze personnel selection issues, matters relating to the conduct of an individual / a group in the process of developing an IT project, the construction of the project plan (with the use of programming Language "Business Process Management Notation")
- describe the processes of drafting, evaluation, as well as selection of offers
- leverage the role of IT in project management.

Course contents: Starting a project. Planning a project. Cooperation with management. Create project budget. Organization of a project team. Creating a project plan. The course places emphasis on the application and analysis of all the actions that will contribute to a sales development strategy, focusing on innovation that may derive from the Informatics. The implementation of the problem is organized using the method of Simulation and Modeling of all actions of the IT Projects Administration, with the aid of Dynamic Simulation Models (Dynamic Simulation Models).

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.

Game Theory

Category: Free Elective

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

Prerequisites: Probability and Statistics

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:

- describe the structure of a scientific paper
- describe the way to create a bibliography review and re-create it
- create a bibliography list
- follow specific text formatting guidelines
- describe different scientific research methods (e.g. observations, experiments) and the different methods of results analysis (i.e. qualitative, quantitative)
- describe research and scientific ethics
- design observational studies
- design experiments
- conclude on research data

Course contents: Introduction to research methodology, experiment and observations, scientific paper structure, bibliography and use of sources, scientific code of ethics, data collection methods - questionnaires, qualitative and quantitative data analysis methods.

Assessment: Written exams at the end of the semester.

Traineeships

Category: Free Elective

ECTS Credits: 3 ***Semester:*** 6 / 7 / 8

Prerequisites: –

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

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

- describe the practices employed by the company or organization he has been working with
- apply knowledge and skills he has acquired during his studies in the operational environment of the host institutions
- combine knowledge from different scientific areas for efficient problem solving
- 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 or a test can also be used by the supervising professor.

Erasmus Traineeships

Category: Free Elective

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

Prerequisites: –

Teaching: Four 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:

- describe the practices employed by the company or organization he has been working with
- apply knowledge and skills he has acquired during his studies in the operational environment of the host institutions
- combine knowledge from different scientific areas for efficient problem solving
- 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 or a test 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.

Entrepreneurship in IT

Category: Free Elective

ECTS Credits: 3 ***Semester:*** 8

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. Market. Marketing. Communications. Strategic planning. Sales. Organization of the sales department.

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: 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:

- 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: 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:

- 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: 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:

- 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: 5 ***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: 5 ***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: 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:

- 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.

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.

Assessment: Obligatory organization and execution of workshops by students in topics related to teaching computer science, such as introductory programming (eg Logo), scenarios (eg Scratch, Alice), educational robotics, etc. Workshops (organization and execution) will be done by groups of students. Students should also provide a workshop report. The course will be evaluated solely by the workshop grades.

Courses offered in the academic year 2017–2018

A

Below are given the courses offered in the academic year 2017–2018and 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, Nasiopoulos
Mathematics I	C	6	Vlachos, Batistatos
Programming I	C	6	Tselikas, Lepouras, Seklou
Physics	C	6	Yiannopoulos, Zarbouti

2nd semester

Course Title	Category	ECTS	Lecturer
Computer Architecture I	C	6	Peppas, Dimitroulakos
Discrete Mathematics	C	6	Kolokotronis
Mathematics II	C	6	Vlachos
Probability and Statistics	C	6	Moscholios
Programming II	C	6	Tryfonopoulos, Raftopoulou

3rd semester

Course Title	Category	ECTS	Lecturer
Object-Oriented Programming	C	6	Platis
Data Structures	C	6	Malamatos, Yiannopoulos
Electromagnetic Fields	C	6	Athanasiadou, Zarbouti
Mathematics III	C	6	Vlachos, Aggelopoulos

Course Title	Category	ECTS	Lecturer
Signals and Systems	C	6	Maras, Sagias, Aggelopoulos, Batistatos

4th semester

Course Title	Category	ECTS	Lecturer
Algorithms and Complexity	C	6	Malamatos
Principles of Telecommunication Systems	C	6	Tsoulos, Zarbouti, Batistatos, Aggelopoulos
Communication Networks I	C	6	Yiannopoulos, Boucouvalas, Seklou
Electronics	C	6	Blionas, Kostopoulos, Nasiopoulos
Operating Systems	C	6	Vassilakis

5th semester

Course Title	Category	ECTS	Lecturer
Databases	C	6	Skiadopoulos, Raftopoulou
Systems Security	SC-I	5	Kolokotronis
Compilers I	SC-I	5	Dimitroulakos
Wireless and Mobile Communications I	SC-T	5	Tsoulos, Zarbouti
Introduction to Optical Communications	SC-T	5	Stavdas
Digital Communications	SC-T	5	Sagias, Batistatos
Digital Signal Processing	SC-T	5	Glentis, Aggelopoulos
Systems Programming	SE-I	5	
Computability and Complexity Theory	SE-I	5	
Introduction to Embedded Systems	SE-I/T	5	Peppas, Dimitroulakos
Communication Networks II	SE-T	5	Moscholios, Seklou
Antennas	SE-T	5	Tsoulos, Zarbouti
Introduction to Economic Science	FE	4	[Offered by the Department of Economics]
Methods of development and evaluation of educational content	PD	5	Antoniou
Pedagogical ICT issues in education	PD	5	Antoniou
Pedagogy and Psychology in Education	PD	5	Antoniou
Practical training for pedagogical and teaching experience	PD	5	Antoniou

6th semester

Course Title	Category	ECTS	Lecturer
Human Computer Interaction	SC-I	5	Lepouras, Antoniou
Computer Architecture II	SE-I	5	
Computer Graphics	SE-I	5	Platis
Advanced Programming Topics	SE-I	5	Platis
Semantic Web	SE-I	5	Wallace
Numerical Analysis	SE-I/T	5	
Wireless and Mobile Communications II	SE-I/T	5	Kaloxylos
Introduction to Information Theory and Coding	SE-I/T	5	Maras
Image Processing: principles, algorithms and applications	SE-I/T	5	Aggelopoulos
Business Procedures. Modeling and Simulation	SE-I/T	5	Sakas
Decision making systems	SE-I/T	5	Nasiopoulos
Internet Applications and Web Services Development	SE-I/T	5	Tselikas, Seklou
Wireless Links	SE-T	5	Athanasiadou, Zarbouti
Satellite Communications	SE-T	5	Sagias
Telecommunication Systems Measurements	SE-T	5	Zarbouti
Optoelectronics	SE-T	5	
Stochastic Signal Processing and Applications	SE-T	5	Glentis, Aggelopoulos
Telephone Networks	SE-T	5	Yiannopoulos
Development of New IT products	FE	3	Sakas
Project Management in Informatics and Telecommunications	FE	3	Sakas
Game Theory	FE	4	
Research Methodology and Scientific Writing	FE	3	
Traineeships	FE	3	–
Erasmus Traineeships	FE	6	–
Cognitive Psychology and Educational Practice	PD	5	Antoniou
Didactics of Informatics	PD	5	Antoniou
Practical training for pedagogical and teaching experience	PD	5	Antoniou

7th semester

Course Title	Category	ECTS	Lecturer
Undergraduate Thesis	C	12	–
Software Engineering	SC-I	5	Vassilakis
Information Retrieval	SE-I	5	Tryfonopoulos, Raftopoulou
Big data management	SE-I	5	Raftopoulou
Distributed Information Management	SE-I	5	

Course Title	Category	ECTS	Lecturer
Cryptography	SE-I	5	Kolokotronis
Logic for Computer Science	SE-I	5	
Compilers II	SE-I	5	Dimitroulakos
Parallel Algorithms	SE-I	5	
Data Management Systems	SE-I	5	
Artificial Intelligence	SE-I	5	Vergoulis
Computational Geometry	SE-I	5	Malamatos
Multimedia Signal Processing	SE-I/T	5	Argyropoulos
Theory and Applications of Speech Processing	SE-I/T	5	
Mathematical Modeling and Complex Networks	SE-I/T	5	
Management Information Systems	SE-I/T	5	Sakas
Stochastic Network Modeling and Performance Analysis	SE-I/T	5	Moscholios
Digital Systems and Circuits Design	SE-I/T	5	Blionas
Microwaves and Waveguides	SE-T	5	Boucouvalas
Optical Wireless Communications	SE-T	5	Boucouvalas
Advanced Topics in Digital Communications	SE-T	5	Peppas
Optical Communication Systems	SE-T	5	Stavdas
Modern Cellular Communication Systems	SE-T	5	Zarbouti
Legal Issues of Informatics and Telecommunications	FE	3	
Traineeships	FE	3	–
Erasmus Traineeships	FE	6	–

8th semester

Course Title	Category	ECTS	Lecturer
Undergraduate Thesis	C	12	–
Special Topics in Algorithms	SE-I	5	
Topics on Data and Information Management	SE-I	5	Skiadopoulos, Raftopoulou
Advanced User Interfaces - Virtual Reality	SE-I	5	Lepouras, Sakas
Machine learning and data mining techniques	SE-I	5	
Switch and Router Architectures	SE-I/T	5	
Sensor Networks	SE-I/T	5	Peppas, Seklou
Group Projects on Informatics and Telecommunications	SE-I/T	5	Boucouvalas
Distributed Systems Programming	SE-I/T	5	
Advanced Topics in Coding Theory	SE-I/T	5	
Combinatorial Optimization	SE-I/T	5	
Specification of Communication Protocols	SE-I/T	5	Kaloxylos, Seklou
Communication Networks Simulation Techniques	SE-I/T	5	

Course Title	Category	ECTS	Lecturer
Implementation of digital circuits and systems with FPGAs	SE-I/T	5	Blionas
Core and Metropolitan Networks	SE-T	5	Stavdas
Introduction to Radars	SE-T	5	
Applications of Optical Fiber Systems and Networks	SE-T	5	Stavdas, Kostopoulos
Adaptive Signal Processing	SE-T	5	Glentis, Aggelopoulos
Simulation of Telecommunications Systems	SE-T	5	Sagias
Entrepreneurship in IT	FE	3	Nasiopoulos
Traineeships	FE	3	–
Erasmus Traineeships	FE	6	–