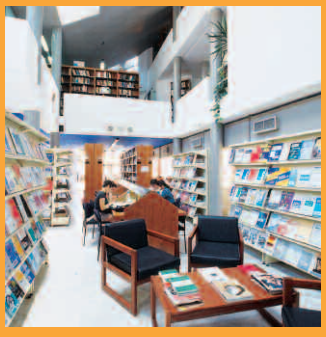
Department of Electronic and Computer Engineering

TECHNICAL UNIVERSITY OF CRETE

UNDERGRADUATE PROGRAM GUIDE 2008–2009









www.ece.tuc.gr

Undergraduate Program Guide 2008–2009

TECHNICAL UNIVERSITY OF CRETE
Department of Electronic and Computer Engineering

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Designed by Typorama
Photos by I. Milonakis

ΕΛΛΑΔΑ 2008 ΚΟΙΝΟΤΙΚΟ ΠΛΑΙΣΙΟ ΣΤΗΡΙΞΗΣ
Ανάπτυξη παντού. Ανάπτυξη για όλους.

ΥΠΟΥΡΓΕΙΟ ΕΘΝΙΚΗΣ ΠΑΙΔΕΙΑΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ ΕΠΕΑΕΚ

ΕΥΡΩΠΑΪΚΗ ΕΝΩΣΗ
ΣΥΓΧΡΗΜΑΤΟΔΟΤΗΣΗ
ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Η ΠΑΙΔΕΙΑ ΣΤΗΝ ΚΟΡΥΦΗ
Επιχειρησιακό Πρόγραμμα
Εκπαίδευσης και Αρχικής
Επαγγελματικής Κατάρτισης

Dear reader,

The Department of Electronic and Computer Engineering (ECE) of the Technical University of Crete (TUC) was founded towards the end of the 1980's and admitted its first incoming class of 30 freshmen in 1990. Since then the Department has grown substantially; the incoming freshman class currently exceeds 115 students per year, there are 29 full–time faculty members (22 serving and 7 under appointment), and a total of 472 engineers have graduated from the ECE Department so far.

The ECE Department offers high–level engineering education with emphasis in the four Divisions it is organized in: Electronics and Computer Architecture, Computer Science, Systems, and Telecommunications. The undergraduate program aims at building a solid theoretical background, as well as providing hands–on training through laboratory exercises and projects in almost all courses. The course descriptions and the curriculum are constantly updated according to the latest scientific developments, trends, and practical applications, so that students are prepared in the best possible way for their professional career after graduation.

Many graduates of the Department have pursued graduates studies in Greece or abroad and currently they serve as faculty members at Universities, researchers at academic or industrial research laboratories, and professional engineers in Greece, Europe, and the U.S.A.

The departmental personnel is well–trained and highly–qualified. The majority of the faculty members have earned their Ph.D. degrees from top universities around the world and many have pursued careers as faculty members abroad before joining the ECE Department. The current high level of scientific activity, peer–reviewed publications, and competitive research funding of the ECE Department are due to the unrelenting efforts and the talent of the faculty and their close collaboration with the staff and the students of the Department. The international recognition, which has been bestowed to the Department, can be attested by the numerous publications in top scientific journals and international conferences, several best paper awards, participation in top journal editorial boards and top international conference program committees, etc.

The present Undergraduate Program Guide provides accurate and complete information about all aspects of the undergraduate program of studies in the ECE Department. Further information may be found on the website of the ECE Department (www.ece.tuc.gr). For further inquiries you may contact the Secretariat of the Department (Vicky Grigoraki, 28210 37218, vicky@ece.tuc.gr) or the Chairman of the Department (Associate Professor Dionisios Pnevmatikatos, 28210 37344, pnevmati@mhl.tuc.gr).

Dionisios Pnevmatikatos
Associate Professor and Chairman

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The Technical University of Crete

The Technical University of Crete is Greece's second technical university, devoted to engineering education. It was established in 1977 and admitted its first students ever at the Department of Production Engineering and Management in 1984. The mission of the Technical University of Crete is to advance education and research in new technologies, as well as the establishment of a high–quality scientific and technological institution which is in close cooperation with the production forces of the country.

There are six departments at the Technical University of Crete:

- Department of Production Engineering and Management
- Department of Electronic and Computer Engineering
- Department of Mineral Resources Engineering
- Department of Environmental Engineering
- Department of Architectural Engineering
- Department of Sciences

To this list soon will be added the newly founded Department of Civil Engineering and the School of Fine Arts.

Mission Statement

The curriculum of the ECE Department of the Technical University of Crete aims at in–depth education and high–quality practical training of engineers in current technologies in the areas of electronics, computer science, telecommunications, and systems. The goal is for the students to develop a sound theoretical background, which will enable them to understand the fundamentals of the new technologies in all of the above areas and applied thinking so that they can cope with the demands and the rapid pace of technology growth at an international level. The ECE Department strives to provide broad and modern education to its graduates so that they become competitive against their European colleagues.

Computer science is pivotal in all cutting–edge technological disciplines. According to the European Strategic Program for Research in Information Technology (ESPRIT), the installation of a new computing system entails far greater expenses for the development of the software rather than the hardware, which tends to become inexpensive. Graduates of the ECE Department acquire complete and deep knowledge of all principles related to software development and thus become able to not only work, but also assume leading roles, as software engineers within a company. Current market needs include electronic filing (payroll, merchandize cataloging, ordering automation, etc.), management of large volumes of data (banking, hotel and travel reservations, patient data handling, etc.), and automation of businesses (state offices, insurance companies, etc.). To efficiently deal with these tasks, it is necessary to know how to specifically design and manage large data bases and complex information systems, knowledge which is acquired by our Department's graduates. It is worth mentioning that the ECE Department puts emphasis on modern technologies such as object–oriented programming, distributed and parallel systems programming, medical data processing, computer graphics and virtual reality, development of Web applications, programming of autonomous robotic systems, and data management in sensor networks. Thus, ECE graduates may be employed in enterprises of the future doing business in areas, such as e–commerce, tele–education, tele–medicine, entertainment and information systems over the Internet, digital libraries, etc.




Modern applications in the industry require that electronic sensors and control systems work efficiently, continuously, and securely even under extreme conditions. The use of microprocessors and microcontrollers is particularly important in a variety of electric and electronic real–time devices in automobiles, factories, land and air traffic controllers, robotics, assembly lines, quality control, smart houses, greenhouses, etc. Our students are trained on new methods of analysis and design of electrical, electronic, and logic circuits. More specifically they learn the fundamentals of basic electronic components (e.g. diodes, transistors, integrated circuits), how to design circuits involving both analog and digital components, how to design power amplifiers and high frequency RF circuits, and how to design Very Large Scale Integration (VLSI) circuits. This knowledge is complemented with hands–on laboratory sessions where students practice on Computer Aided design (CAD) stations and on the workbench.

Telecommunications are rapidly expanding worldwide. The students of the ECE Department gain in–depth knowledge on subjects such as digital telecommunications (antennas, microwaves, wireless communications, satellite communications, wireless and wired telephony, mobile telephony, information and coding theory, computer networks), as well as on modern applications of telecommunications, based on automated voice recognition and speech processing and understanding (voice interfaces, automated dialogue systems) so that they can work with any telecommunications organization. Computer networks, nowadays, transport on only data, but also voice, images, and video streams between computers. Data networking is crucial for all companies due to the rapid growth of Internet usage in Europe and in Greece a shift towards high–performance distributed computing. In fact, many companies and organizations today build their own Virtual Private Networks (VPN) to cover their needs in an absolutely vital domain. Our graduates have solid foundations to cover all needs of the telecommunications market.

Integrated manufacturing systems are prevalent today in the industry, as well as support applications on using graphics for designing, simulating, and monitoring any process on the factory floor to achieve quality assurance. The installation of an integrated automated manufacturing system is a challenging task requiring expert knowledge engineers for designing and incorporating the knowledge base into the plant. Our graduates are trained adequately in factory automation (Computer Aided Design, Computer Aided Management, robotics, quality control, etc.) as well as in the design of control systems for complex processes.

In addition to the theoretical and applied education, which qualifies our graduates to work in the above areas, our undergraduate program prepares students for continuation of their studies at graduate level and for active participation in large research teams following their graduation. A crucial milestone of our undergraduate program is the requirement for completion of a diploma thesis by each student during the last semester of his or her studies under the close supervision of their faculty advisor. The thesis not only allows students to focus on their favorite topic of interest, it also challenges them in conducting independent and novel research responsibly in order to present a complete piece of work. Quite often results of diploma theses are published in international peer–reviewed journals or refereed conferences.

Professional Rights

The establishment of professional rights for the graduates of the ECE Department has been established with Presidential Amendment 372/1997, which states that:

The graduate of the Department, defined as "Diploma–holding Electronic Engineer and Computer Engineer", has the right to work on the study, design, analysis, implementation, supervision of construction, maintenance, research, supervision of operation, and expert appraisement reports for every kind of electronic and computer systems, their installations and their applications in general in the following scientific areas:

A) *Electronics,* and in particular electronic apparatuses and systems, such as the design of analog and digital circuits, sensors, electronics for power systems, integrated circuits, electroacoustic systems, measurement and data processing systems, optoelectronic apparatuses and the applications of the above.

B) *Telecommunications and Telecommunication Systems,* which include in particular wired and wireless communications, information communication or transmission, switch and routing centers, wired and wireless communication networks, multiplexing systems, mobile telephony, satellite systems and every kind of similar application thereof.

Γ) *Information Systems,* which includes electronic computers as means of data storage and information processing, their design or construction or application in production or operation or other process or the offer of services in industry, in office automation or agencies, in telecommunications, in publications and in electronic apparatuses. The areas of computer architecture, peripheral units, expert systems, software engineering, human–computer interfaces, telematics, and multimedia are considered to be included in the term Information Systems.

Δ) *Systems,* and in particular automation systems, signal processing, image processing and every kind of application thereof.

Administration of the Department

The Department is governed by the General Assembly and the Department Chairman who chairs the General Assembly. The General Assembly is comprised of the faculty, undergraduate and graduate student representatives, and representatives of the laboratory staff of the Department. The responsibilities of the General Assmbly are determined by the current Higher Education Law and its amendments.

Department Chairman

The current Department Chairman is Associate Professor Dionisios Pnevmatikatos and Associate Chairman is Professor Apostolos Dollas..

Department Secretary

Department Secretary (which is the official position of the supervisor of the administrative services of the Department) is Mrs. Vassiliki Grigoraki.

Departmental Structure

The Department is organized in four Divisions:

- **Division of Computer Science**
- **Division of Electronics and Computer Architecture**
- **Division of Systems**
- **Division of Telecommunications**

Faculty and Staff

The faculty and staff of the Department are in the following categories:

a. Faculty.
The tenure–track and tenured faculty members of the Department hold Ph.D. degrees and they fall under four seniority ranks: Professors, Associate Professors, Assistant Professors, and Lecturers. In addition to the tenure–track and tenured faculty, there are also several adjunct assistant professors and visiting faculty members charged mostly with teaching responsibilities.

b. Laboratory Teaching Staff.
The laboratory teaching staff members perform laboratory and applied educational duties,

which largely include the design, preparation, and administration of laboratory sessions and recitations for the courses taught in the Department. The laboratory teaching staff members hold university and/or graduate degrees.

c. Laboratory Technical Staff.
The laboratory technical staff members provide technical support to the Department by offering specialized technical services to the educational and research activities of the various laboratories in the Department. The laboratory technical staff members hold university and/or graduate degrees.

d. Contracted Staff.
The contracted staff members conduct research and/or administrative work under long–terms contracts with the goal of improving the educational and research activities of the Department. The contracted staff members hold university and/or graduate degrees.

e. Administrative Staff.
The administrative staff includes employees of various ranks reporting to the central administration of the Technical University of Crete. The administrative staff members support the administrative operations of the Department, such as management of student records, departmental archives, course registrations, grade reports, etc.

Faculty

DIVISION OF COMPUTER SCIENCE

Stavros Christodoulakis, Professor
B.Sc. National and Kapodistrian University of Athens, Greece, 1971. M.Sc. Queen's University, Kingston, Canada, 1977. Ph.D. University of Toronto, Canada, 1981.
Computer Science, Computing Systems, Databases, Distributed Computing and Information Systems, Office Automation, Computer Applications, Multimedia Systems, Parallel Computing, Electronic Publishing.

Antonios Deligiannakis, Assistant Professor
B.Sc. National Technical University of Athens, Greece, 1999. M.Sc. University of Maryland, USA, 2001. Ph.D. University of Maryland, USA, 2005.
Databases, Online Analytical Processing, Approximate Query Processing, Sensor Networks, Data Streams.

Michail Lagoudakis, Assistant Professor
B.Sc. University of Patras, Greece, 1995. M.Sc. University of Louisiana–Lafayette, USA, 1998. Ph.D. Duke University, USA, 2003.
Machine Learning, Artificial Intelligence, Decision Making under Uncertainty, Multi–Agent Systems, Robotics, Complex Systems.

Katerina Mania, Assistant Professor
B.Sc. University of Crete, Greece, 1994. M.Sc. University of Bristol, UK, 1996. Ph.D. University of Bristol, UK, 2001.
Three–Dimensional Computer Graphics, Virtual Reality, Simulator Accuracy Metrics, Human–Computer Interfaces, Optical Cognition.

Euripides Petrakis, Associate Professor
B.Sc. National and Kapodistrian University of Athens, Greece, 1984. Ph.D. University of Crete, Greece, 1993.
Information Systems, Multimedia Systems, Medical Information Systems, Semantic Web, Machine Vision Applications.

Vassilios Samoladas, Assistant Professor
B.Sc. Aristotle University of Thessaloniki, Greece, 1992. M.Sc. University of Texas at Austin, USA, 1995. Ph.D. University of Texas at Austin, USA, 2001.
Computational Geometry, Algorithmic Complexity in Multidimensional Problems, Database Complexity, Distributed Information Systems, Parallel Programming.

DIVISION OF ELECTRONICS AND COMPUTER ARCHITECTURE

Konstantinos Balas, Associate Professor
B.Sc. University of Patras, Greece, 1988.
Ph.D. University of Patras, Greece, 1992.
Optoelectronics, Optoelectronic Circuits, Optical Detectors and Imaging Systems, Superspectral Imaging, Non–Destructive Evaluation, Biophotonics, Tissue Spectroscopy, Optical Biopsy, Novel Optical Diagnostic Technologies and Systems for Cancer Diagnosis.

Matthias Bucher, Assistant Professor
B.Sc. Swiss Federal Institute of Technology–Lausanne, Switzerland, 1993. Ph.D. Swiss Federal Institute of Technology–Lausanne, Switzerland, 1999.
Analog Integrated Circuit Design Methods, Semiconductor Circuit Physics and CMOS Technology, Analysis, Characterization, and Modeling of Active and Passive Elements for High Frequencies, Computer Aided Design Tool Development.

Apostolos Dollas, Professor
B.Sc. University of Illinois at Urbana–Champaign, USA, 1982. M.Sc. University of Illinois at Urbana–Champaign, USA, 1984. Ph.D. University of Illinois at Urbana–Champaign, USA, 1987.
Computer Hardware, Reconfigurable Computing, Computer Architecture, Rapid System Prototyping, Special–Purpose Architectures.

Konstantinos Kalaitzakis, Professor
B.Sc. National Technical University of Athens, Greece, 1977. Ph.D. Democritus University of Thrace, Greece, 1983.
Electronic Circuits, Renewable Energy Sources, Power Electronics, Sensors and Computer Interfaces, Special–Purpose Microprocessor–Based Systems, Biomedical Applications.

Ioannis Papaefstathiou, Assistant Professor
B.Sc. University of Crete, Greece, 1996.
M.Sc. Harvard University, USA, 1997.
Ph.D. University of Cambridge, UK, 2001.
Design and Implementation of High–Speed Systems, Low Power Systems Design, Tools and Methods for System–on–a–Chip Design and Simulation.

Dionisios Pnevmatikatos, Associate Professor
B.Sc. University of Crete, Greece, 1989.
M.Sc. University of Wisconsin–Madison, USA, 1991.
Ph.D. University of Wisconsin–Madison, USA, 1995.
Computer Architecture, Instruction–Level and Task Parallelism, Design and Implementation of Computing and Telecommunication Systems.

George Stavrakakis, Professor
B.Sc. National Technical University of Athens, Greece, 1980. M.Sc. Institut National des Sciences Appliquees, Toulouse, France, 1981. Ph.D. Universite Paul Sabatier [Toulouse III], France, 1984.
Modeling and Electronic Control of Manufacturing Systems, Energy Systems, and Renewable Energy Sources, Reliability Analysis and Automatic Diagnosis of System Failures, Applications of Electronics and Computers in Industry.

DIVISION OF SYSTEMS

Emmanuel Christodoulou, Professor
B.Sc. National Technical University of Athens, Greece, 1978. M.Sc. University of Maryland, USA, 1979.
Ph.D. Democritus University of Thrace, Greece, 1984.
Automatic Control, Systems, Optimal Control, Stochastic Control, Control of Robotic Systems, Biomedical Applications.

Peter Stavroulakis, Professor
B.Sc. New York University, USA, 1969. M.Sc. California Institute of Technology, USA, 1970. Ph.D. New York University, USA, 1973.
Satellite Systems, Telecommunications, Control Systems, Distributed Systems.

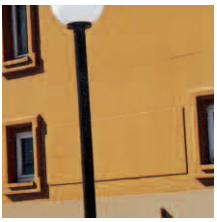
DIVISION OF TELECOMMUNICATIONS

Vassilios Digalakis, Professor
B.Sc. National Technical University of Athens, Greece, 1986. M.Sc. Northeastern University, USA, 1988. Ph.D. Boston University, USA, 1992.
Voice Recognition and Speech Processing, Digital Telecommunications.

George Karystinos, Assistant Professor
B.Sc. University of Patras, Greece, 1997. Ph.D. State University of New York at Buffalo, USA, 2003.
Wireless Communications Systems, Spreading Code and Signal Waveform Design, Interference Suppression and Receiver Adaptation with Short Data Records, Adaptive Antenna Arrays and Array Radar, Multiuser CDMA Detection, Neural Networks.

Athanasios Liavas, Associate Professor
B.Sc. University of Patras, Greece, 1989.
Ph.D. University of Patras, Greece, 1993.
Digital Communications, Signal Processing for Communications, Information Theory.

Michael Paterakis, Professor
B.Sc. National Technical University of Athens, Greece, 1984. M.Sc. University of Connecticut, USA, 1986. Ph.D. University of Virginia, USA, 1988.
Computer Communications, Communication Protocols, Modelling and Analysis of Protocols Performance, Modelling and Analysis of Systems Performance, Wireless Networks for Integrated Services to Mobile Users, Wideband Local and Metropolitan



Communication Networks, Packet Transmission Radionetworks.

Alexandros Potamianos, Associate Professor
B.Sc. National Technical University of Athens, Greece, 1990. M.Sc. Harvard University USA, 1991. Ph.D. Harvard University USA, 1995.
Voice Processing, Analysis, Synthesis and Recognition, Dialog and Multimodal Systems, Mobile Telephony Services, Nonlinear Signal Processing, Natural Language Processing, Artificial Intelligence, Multimodal Computational Systems for Children.

Nikos Sidiropoulos, Professor
B.Sc. Aristotle University of Thessaloniki, Greece, 1988. M.Sc. University of Maryland, USA, 1990. Ph.D. University of Maryland, USA, 1992.
Signal Processing for Telecommunications with Emphasis on Linear and Multi–way Linear Algebra, Theory and Algorithms of Non–Parametric Optimization with Applications to the so–called "Blind" CDMA Signal Detection, Multiple Antennas Systems, Random Access Networks and Coding in Systems with Multiple Transmission Antennas.

Michael Zervakis, Professor
B.Sc. Aristotle University of Thessaloniki, Greece, 1983. M.Sc. University of Toronto, Canada, 1985. Ph.D. University of Toronto, Canada, 1990.
Digital Image and Signal Processing, Biomedical Applications.

Laboratory Teaching Staff

Sotirios Bouros
B.Sc. in Computer Science and Engineering, University of Patras, Greece.

Emmanuel Doudounakis
B.Sc. in Electrical Engineering, National Technical University of Athens, Greece. M.Sc. in Production Engineering and Management, Technical University of Crete, Greece.

Markos Kimionis
B.Sc. in Electronic Engineering, Technological Education Institute of Crete, Greece.

George Markoulakis
B.Sc. in Electronic Engineering, Technological Education Institute of Crete, Greece.

Amalia Sergaki
B.Sc. in Electrical Engineering, Aristotle University of Thessaloniki, Greece. M.Sc. in Economics, International Centre for Advanced Mediterranean Agronomic Studies, France. Ph.D. Candidate in Electronic and Computer Engineering, Technical University of Crete, Greece.

Laboratory Technical Staff

Spyros Argyropoulos
B.Sc. in Computer Science and Engineering, University of Patras, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Eftichios Koutroulis
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. Ph.D. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Contracted Staff

Stamatis Andrianakis
B.Sc. in Electrical and Computer Engineering, Aristotle University of Thessaloniki, Greece.

George Anestis
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. M.Sc. in Production Engineering and Management, Technical University of Crete, Greece.

Polyxeni Arapi
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Vassilios Diakoloukas
B.Sc. in Physics, University of Crete, Greece. Ph.D. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Nektarios Gioldasis
B.Sc. in Applied Computer Science, University of Macedonia, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Fotis Kazasis
B.Sc. in Computer Science and Engineering, University of Patras, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Ioannis Maragoudakis
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. M.Sc. in Production Engineering and Management, Technical University of Crete, Greece.

Nektarios Moumoutzis
B.Sc. in Computer Science, University of Crete, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Kyprianos Papademetriou
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. Ph.D. candidate in Electronic and Computer Engineering, Technical University of Crete, Greece.

Nikolaos Pappas
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece.

Euripides Sotiriades
B.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. M.Sc. in Electronic and Computer Engineering, Technical University of Crete, Greece. Ph.D. candidate in Electronic and Computer Engineering, Technical University of Crete, Greece.

Administrative Staff

Vasiliki Grigoraki
Head Secretary.

Dimitra Athenaki
Coordinator of Undergraduate Studies.

Eleni Stamataki
Coordinator of Graduate Studies.

Agapi Karakatsani
Textbooks and Supplies Administrator.

Laboratory Infrastructure

The teaching and research activities within the Department of Electronic and Computer Engineering are supported by ten laboratories which are listed below.

1. Automation Laboratory
Director: Professor M. Zervakis

This laboratory operates under the Division of Systems and serves the educational and research needs in the discipline of Systems Theory and Automatic Control.

Research areas: Automatic Control Theory. Intelligent Control. Industrial Controllers. Neural Networks. Automated Fault Diagnosis and Repair. Diagnostic Systems in Medicine. Biomedical Systems. Robotics. Robotic Applications in Medicine. Industrial Control Processes. Production System Scheduling.

2. Digital Image and Signal Processing Laboratory
Director: Professor M. Zervakis

This laboratory operates under the Division of Telecommunications and conducts active research in applications related to the reception, identification, and diagnosis of operational problems in various signals used in Telecommunications, Industry, and Biomedicine.

Research areas: Biomedical image and signal processing. Machine vision and non–invasive diagnosis methods. Search methods in image and video archives. Video processing, analysis and compression. Non–linear systems modeling using artificial intelligence methods. Neural networks and fuzzy logic systems. Time series processing.

3. Distributed Multimedia Information Systems and Applications Laboratory
Director: Professor S. Christodoulakis

This laboratory was established in 1990 and operates under the Division of Computer Science. It is a centre of research and development in the areas of distributed information systems, multimedia, graphics, human–computer interaction, large–scale web information systems, and business applications on the Internet.

Research areas: Information retrieval systems. Internet search engines and agent technology. Digital libraries. Communication multimedia systems. Distributed collaborative environments and work flow management. Human–Computer Interaction. Applications in tourism and culture, electronic commerce, eLearning. Office automation, company automation. Distributed multimedia information

systems. Development of applications and services on the Internet. Information society. Databases.

4. Electric Circuits and Renewable Energy Sources Laboratory

Director: Professor K. Kalaitzakis

This laboratory operates under the Division of Electronics and Computer Architecture and is active in the field of electrical circuits and renewable energy. Its research equipment includes high–precision oscilloscopes, generators, and multimeters, electric power quality analyzer, meters for various quantities, and microprocessor, DSPs and FPGAs development systems, as well as a wind–generator, a photovoltaic array, and a meteorological station with data acquisition system for the measurement of related quantities.

Research areas: Sensors and measurement units. Development sensor, actuator, and computer networks. Development of electronic control systems based on fuzzy logic and neural networks. Decision support systems for industrial applications. Wind systems. Applications of photovoltaic units. Management and operation of electric power stations. Management in and optimization of systems with renewable energy sources. Intelligent energy management systems in buildings. Smart–card applications in health, security, billing, access, and energy saving. Biomedical and biomechanical units. Development of controlled inverters and electrical power converters.

5. Electronics Laboratory

Director: Professor K. Kalaitzakis

The laboratory operates under the Division of Electronics and Computer Architecture and its activities include research, development, education, and technology transfer in the fields of opto–electronics and micro–nano–electronics. The Electronics Laboratory is equipped with tools for design, simulation, layout, prototype development, characterization and control of opto–electronic and microelectronic systems and devices.

Research areas: System development and data analysis. Hyper–spectral imaging. Optical molecular imaging. Biophotonic medical diagnostic instruments. High–frequency microelectronics. Design and modeling of CMOS devices and circuits. Study, design, and evaluation of very large–scale integration (VLSI) circuits. Optoelectronic devices and applications. Development of optimal battery energy management, the voltage conversion, and uninterrupted power supply (UPS).

6. Information and Computer Networks Laboratory

Director: Professor V. Digalakis

This laboratory operates under the Division of Telecommunications and is active in the field of Information Theory and Coding with applications in Networks.

Research areas: Design, modeling, and performance analysis of computer networks. Universal mobile telecommunications systems. Multiple access telecommunications networks. Local and metropolitan broadband high–speed networks. ATM networks. Centralized and distributed systems for distribution of multimedia information. Scheduling for multimedia servers and information broadcasting over wireless networks. Voice Recognition. Voice coding. Acoustic and linguistic modeling. Robust and adaptive voice recognition. Telephone and Internet applications of speech recognition.

7. Intelligent Systems Laboratory

Director: Associate Professor E. Petrakis

This laboratory was founded in 2001 and operates under the Division of Computer Science. The current research activities cover various aspects of Artificial Intelligence, Intelligent Agents, Bioinformatics, Information Retrieval, Machine Learning, and Robotics. The robotic equipment of the laboratory includes quadrupedal Sony Aibo robots and bipedal humanoid Aldebaran Nao robots, which also form the robotic soccer team "Kouretes".

Research areas: Artificial Intelligence. Knowledge Representation. Constraint Satisfaction Problems. Logic Programming and Programming with Constraints. Multimedia Management. Web Information Systems. Information Retrieval. Electronic Commerce. Semantic Web. Autonomous Agents. Multi–Agent Systems. Machine Learning. Robotics. Bioinformatics. Machine Vision. Pattern Recognition. Image Understanding.

8. Microprocessor and Hardware Laboratory

Director: Professor A. Dollas

This laboratory was founded in 1990 and operates under the Division of Electronics and Computer Architecture. Its activities revolve around issues of computer architecture and hardware. The laboratory is a member of the academic and research consortium EUROPRACTICE.

Research areas: Computer architecture. Computer hardware. Design and implementation of digital microelectronic systems. Rapid System Prototyping. Very Large–Scale Integration Design (VLSI, FPGA's, PLD's, etc.). Development of tools for Computer–Aided Design (CAD).

9. Software Technology and Network Applications Laboratory

Director: Professor S. Christodoulakis

This laboratory operates under the Division of Computer Science and is a centre of research and teaching software systems' technology and network applications. The research and teaching activities of the laboratory include operating and distributed systems, sensor networks, continuous data streams, large and distributed databases, and topics in algorithms and complexity.

Research areas: Collection and distribution of content on the Internet. Internet Video Streaming. Collaborative Web Proxy Caching. Peer–to–peer architectures for large–scale storage and distribution of content. Intelligent information storage systems. System performance modeling. Caching and fetching in hierarchical servers. Access request scheduling. Distributed information management systems (caching, prefetching, replication, fault tolerance, recovery, etc.). File management systems. Database systems. Development of applications for electronic commerce.

10. Telecommunications Laboratory

Director: Professor N. Sidiropoulos

This laboratory operates under the Division of Telecommunications and is active in the field of Telecommunications.

Research areas: Signal processing using convex optimization techniques and particle filters. Signal processing with a time–varying spectral analysis. Blind channel equalization. Subspace techniques, sensitivity analysis. Parameter estimation of multi–dimensional harmonics, estimation of direction and beamforming for multi–antenna reception and transmission. Localization in sensor networks. Admission protocols, waiting queue interaction, stability. Unique composition theory. Design of transmitter–receivers, decoding, modeling, and characterization of cross–interference systems in multi–line digital subscriber loop. Channel capacity. Capacity reduction due to incorrect channel assessment. Design of DS–CDMA codes using Welch bounds. Design of DS–CDMA receivers. Channel estimation and equalization.

The current laboratory infrastructure was funded in part with the amount of 66,757€ by the European Program EPEAEK II (ETPA).

University Research Institutes

The Telecommunication Systems Research Institute (T.S.I.) *[www.tsi.gr]* is a Greek Government–sponsored independent Research Institute established by the Greek Ministry of National Education in 1995. Among the objectives of the Institute is to promote graduate education, research and development in the broad areas of Telecommunications and Telecommunication Systems.

The Institute provides technical support, space, research infrastructure, and access to cooperating faculty members and highly qualified R&D engineers with experience in project planning, execution, and management.

Incoming Student Registration

The means of acceptance to the ECE program of the Technical University of Crete, the size of the incoming freshman class, and the dates of enrollment and initial registration are determined by the Greek Ministry of National Education and the related legislation.

The enrollment and initial registration must be done in person or an by authorized person with appropriate notarized authorization document at the Secretariat of the Department.

Notarized authorization documents may be obtained at police stations or Citizen Service Centers, which verify the authenticity of the new student's signature. The documents needed for initial registration and enrollment in the ECE Department are:

- Enrollment application (provided by the Secretariat of the Department)
- Secondary Education Certificate: Original or certified photocopy of the high school diploma
- Personal Statement of Liability (provided by the Secretariat of the Department), where the new student states that he/she is not enrolled in any other university program
- Photocopy of the personal identification document or a birth certificate
- Six (6) passport–type photographs
- Confirmation of access (certificate provided by the high school of graduation)

Issue of Student ID Card, Transportation Pass and Certificates

Each student, immediately after their initial registration and enrollment in the Department, is issued a Student Identification Card and a Transportation Pass – the latter qualifies the student for reduced fares in public transportation.

Upon request of a student, the Secretariat of the Department can issue registration and enrollment certificates for any legal use. These include the Certificate of Student Status (certifies that the student is indeed enrolled at the Technical University of Crete), the Certificate of Studies (required by the tax office and the army office), the Grade Transcript (detailed list of all courses completed by the student and the corresponding grades received in each one of them), and the Certificate of Completion of Studies (certifies that the student has completed all graduation requirements).

Student Status

The student status is earned upon initial registration and enrollment in the ECE Department and is lost upon graduation. The duration of study in the undergraduate program cannot exceed twenty (20) semesters, that is, twice the nominal duration of the program of study in the ECE Department. In exceptional cases, it is possible to extend the duration of study by two (2) additional semesters, following an application of the student justifying the extension request and subsequent approval by the General Assembly of the Department and the Senate of the Technical University of Crete. Student status is automatically lost upon expiration of the maximum duration of study.

Students are allowed to suspend their studies for up to ten (10) semesters in total by submitting a written request to the Secretariat of the Department. These semesters are counted towards the maximum duration of study. Students suspending their studies loose temporarily their student status for the period of suspension. Student status is restored immediately upon return from suspension.

After the completion of fourteen (14) semesters of study, the student retains the student status, however all student benefits are lost.

Student Benefits

All students are entitled to complete medical insurance by the University.

In case a student is entitled to direct or indirect medical coverage from another organization, he or she can choose the preferred medical insurance carrier by submitting a personal statement of liability to the Secretariat of the Department.

The Department offers a student support service aiming at providing advise for facilitating the transition of students from secondary to higher education and to supporting disabled students and students facing problems in their efforts to complete their studies successfully.

Student advising duties are assigned by the General Assembly to faculty members of the department for at least one academic year.

It is the responsibility of the Faculty Advisors to guide the students towards the successful completion of their studies.

Students can apply for various scholarships and interest–free loans, as shown below:

- *Scholarships from the Greek Scholarship Foundation:* The Greek Scholarship Foundation grants scholarships to the top students of each student class in the Department.

- ***Merit scholarships:*** **The merit scholarships are granted exclusively on academic excellence criteria. The nomination conditions and the selection process are determined by the Senate of the Technical University of Crete.**

- ***Campus Service Scholarships:*** **The campus service scholarships are granted in return of on–campus part–time work provided by the student to various services of the university up to forty (40) hours per month.**

  The details of the nomination and award process are determined by the Senate and the Bylaws of the Technical University of Crete.

- ***Interest–Free Loans:*** **Students facing serious financial difficulties are entitled to receive interest–free student loans from various credit agencies, provided they have received passing grades in all mandatory courses of their most recent semester of study and they have not exceeded the maximum duration of study. The loan is paid in installments at the end of each semester, assuming that the progress criterion in each semester is met.**

  The loan is paid off in installments under concessional terms after five (5) years of professional occupation following graduation, but in any case within a maximum of fifteen (15) years from the date of the last loan installment. The procedure and the details of awarding student loans are determined jointly by the Greek Ministry of Economics and the Greek Ministry of National Education.

Placement Examinations

Graduates holding university–level degrees from other disciplines wishing to enroll in the ECE Department may do so, after passing successfully the written placement examinations in a small number of courses announced at the end of the spring semester of each academic year.

Applications for participation to these placement examinations are taken during the first half of November and the examinations are held at the beginning of December each year.

Each contestant is examined on the content listed in the corresponding courses in the ECE curriculum.

Program Structure

The academic year begins on September 1st of each year and ends on August 31st of the following year.

The educational program of studies for each academic year is divided in two semesters. The courses offered by the ECE Department are semester–long and they include:

- lectures in class
- tutorials and recitations
- laboratory exercises
- practical training of the students
- seminars or other activities which are deemed necessary for the better coverage of the material

Undergraduate studies in the ECE Department last for ten (10) semesters including the submission of a complete diploma thesis during the last semester.

Regarding registration, transfers, placement, etc. to the ECE Department, the 1st and 2nd semesters are considered to be the 1st year of study, the 3rd and 4th semesters are considered to be the 2nd year of study, and so on up to the 10th semester.

Academic Semesters

The Fall Semester begins in the second half of September and the Spring Semester ends during the first half of June. The exact dates are determined by the Senate of the Technical University of Crete. Each semester includes at least thirteen (13) weeks of classes and two (2) weeks for examinations.

If, for any reason, the class hours completed in any course is less than the nominal number of hours for the working days of that semester, then the corresponding course becomes and is considered equivalent to not having been offered.

The holidays in the academic year are:

a. Fall Semester

- October 28 (anniversary of Greece's entry into the WWII)
- November 17 (anniversary of the 1973 student unrest in Athens)
- November 21 (the annunciation of Virgin Mary – patron Saint of Chania)
- December 24 to January 6 (Christmas and New Year's Holidays – 2 weeks)
- January 30 (feast day of the Three Hierarchs – patron Saints of education)

b. Spring Semester

- Lenten Monday (the beginning of the Great Lent before Easter)
- March 25 (Greece's Independence Day)
- The Holy Week and the Bright Week (Easter vacation – 2 weeks)
- May 1 (Labor Day)
- Student elections day (determined by the federation of student unions)

Curriculum Development

The detailed curriculum of the ECE Department is updated as needed at the end of the spring semester of each academic year and applies as of the following academic year. The curriculum entails:

- the titles of all courses
- the organization of courses in semesters of study
- the number of credit hours for each course
- the number of hours per week for lectures, tutorials, and laboratories for each course
- the recommended prerequisites for each course
- a detailed description of topics covered in each course

Coursework is divided in two categories: (a) core or mandatory courses, and (b) elective or optional courses.

The first category includes courses that provide the fundamental core knowledge to the students; all of them must be completed successfully.

The second category includes a large number of courses on specialized topics; the student must choose and complete successfully a sufficient number of elective courses to meet the graduation requirements.

The recommended ordering of courses given in the curriculum and their organization in semesters is indicative and not mandated. Nonetheless, it corresponds to a nominal flow under normal study conditions, it accounts for the minimum number of

semesters towards graduation, and it takes into account the recommended prerequisite courses for each course. This ordering constitutes the Nominal Curriculum in the ECE Department, and it secures the most natural and recommended schedule of course registration that facilitates the completion of the entire program of studies in the ECE Department within the nominal duration of five (5) years.

Course Registration

Each student must register for the courses he/she wants to attend in a semester during the three–week registration period at the dates determined and announced by the Department. The completed course registration form is submitted to the Registrar's Office of the Department and includes the student's choices for textbooks in each course. Each student may add/drop courses within two weeks from the end of the registration period.

The Registrar's Office checks for the validity of the registrations and finalizes the course enrollment lists and the textbook lists for each course. The student enrollment lists are distributed to the course instructors and the textbook lists are given to the service handling the supply and distribution of the free textbooks. Students cannot attend nor be examined in a course in which they are not officially enrolled.

There is a quota to the number of courses in which a student can enroll (from the current, earlier, or later semesters), which differs depending on the student's current semester of study:

- up to nine (9) courses, for students in the 1st – 4th semesters of study
- up to eleven (11) courses, for students in the 5th – 8th semesters of study
- up to fifteen (15) courses, for students in the 9th semester of study or beyond

It is noted that students cannot enroll to more than two (2) courses from later semesters in each enrollment period. In addition, it is not allowed to enroll into the core courses of a semester without first completing successfully all those core courses from previous semesters which are considered prerequisites for later core courses, according to the Nominal Curriculum.

Undergraduate students who satisfy certain criteria may enroll in graduate courses (if they are offered during that semester) with the instructor's consent. In these cases, upon successful completion of the graduate course and with the approval by the Department's General Assembly, the course may be taken into account as an elective course towards meeting the graduation requirement.

In case a student enrolled in a course, but did not successfully complete it, and this course
(a) is eliminated from the curriculum,
(b) is replaced with an equivalent course, or
(c) is not offered for some time,
the student has to complete this course requirement by taking another (core or elective) course from the same area of concentration with the approval of the Department's General Assembly.

Very good knowledge of the English language is necessary for making progress in the Department's curriculum, given that the largest part of relevant literature is in English, and also that there is no standardized Greek terminology for a significant fraction of the material.

Field Trips

Within the scope of core courses of the 3rd, 4th and 5th years of study field trips are organized to foster practical training. The field trips last up to one week and they include visits to industrial facilities and research centers.

The field trips take place during the second week after Easter vacations and they are held only if attendance exceeds 70% of the corresponding year's student population.

Course Grading

The progress of a student during the semester and his/her performance are evaluated according to the compliance of the student with the course obligations in the aspects of class attendance, homework completion and submission, laboratory attendance and submission of laboratory reports, possible oral examination in laboratory exercises, mid–term exams, etc., depending on the educational requirements of each course.

The grading method for each class is determined by the instructor who is charged to arrange for written and/or oral examinations, according to his judgment, and/or give homework and projects and/or laboratory exercises.

Students have the opportunity to participate in two (2) examination periods for each semester.

For the Fall Semester the first examination period takes place in January, whereas the second examination period takes place in September.

For the Spring Semester the first examination period takes place in June, whereas the second examination period takes place in September as well.

Students who do not satisfy the requirements for successful completion of a course even after the second examination period have to enroll again in that course in a subsequent semester and perform all required duties regarding attendance and examination for that class.

The grading scale in all courses is expressed in a 0–10 scale, including a fractional part (multiples of half point – 0.5), and the minimum passing grade for each class is five (5.0). The performance of the student according to the grades received is categorized as follows:

STUDENT PERFORMANCE	
POOR	from 0 to 3 (not including 3)
AVERAGE	from 3 to 5 (not including 5)
GOOD	from 5 to 6.5 (not including 6,5)
VERY GOOD	from 6.5 to 8.5 (not including 8,5)
EXCELLENT	from 8.5 to 10

Diploma Thesis

All students are required to complete a Diploma Thesis, which includes a substantial amount of work and a final written report on a well–defined project related to the subjects of the Divisions of the ECE Department. The diploma thesis is completed under the supervision of one or more faculty

members of the Department, who acts as the student's advisor. The General Assembly of the Department has determined that:

- All Divisions of the Department announce topics and offer diploma thesis options to all students. Topics may be taken from a different Department, with the approval of the Department's General Assembly. Each faculty member of the Department announces topics for Diploma Thesis in each academic year. Students desiring to pursue a particular topic ought to get in touch with the desired advisor and fill out the appropriate form for diploma thesis assignment distributed by the Secretariat of the Department.
- The three–member examination committee of the thesis is appointed by the General Assembly after a recommendation by the faculty advisor of a diploma thesis topic.
- The chair of the three–member examination committee is the faculty supervisor of the thesis and must be a faculty member of the ECE Department. It is permissible to include at most one faculty member, or adjunct assistant professor, or visiting professor, or researcher of another recognized academic or research institution in the committee, as long as this person is a Ph.D. holder.
- The assignment of diploma thesis topics is done during the last two semesters of studies. The assignment of a topic is allowed only if a student has two (2) or fewer courses left to complete the course requirements. The oral examination of a student on his/her diploma thesis is allowed only after the completion of all coursework required by the curriculum of the Department.

- Following its completion, the diploma thesis is presented to an open audience and is graded by the three–member examination committee. The presentation of a diploma thesis can be done anytime throughout the academic year, except for the vacation periods.
  Nevertheless, the presentations of the thesis must take place within twenty (20) days of the completion of some examination period for receiving the diploma degree in the graduation that follows that examination period. The exact date and time of the oral presentation is determined in cooperation with the members of the three–member examination committee.

- Each diploma thesis is graded in the 0–10 scale by taking the average of the grades given by the three committee members to each of the following three criteria with the corresponding percentages: quality of technical content (50%), quality of written report (30%), and quality of oral presentation (20%).

In case of collaborative work among two or more students, which is allowed only following the approval of the Department's General Assembly, each student is graded separately for his/her contribution to the diploma thesis and his/her oral presentation.

Graduation Requirements

The requirements for graduating with the diploma in Electronic and Computer Engineering are:

- Registration in the Department and enrollment in classes for at least nine (9) of the ten (10) semesters, for regularly enrolled students.

- Successful completion of forty–nine (49) courses in total, that is, all of the thirty–five (35) core courses and a selection of fourteen (14) elective courses (under some restrictions explained below).

- Successful collection of at least 176 credit hours from successfully completed courses.

- Successful completion of a diploma thesis.

Diploma Grade and Characterization

The final grade of the diploma is computed using the average grade over all courses required for graduation weighted by 80% and the grade of the diploma thesis weighted by 20%.

For computing the average grade over courses, the grade in each course is multiplied by a weight coefficient which depends on its credit hours and the sum of these partial products is divided by the sum of the weight coefficients of all courses.

English I, II, and III are not taken into account in computing the average grade over courses.

The weight coefficients of each course are determined according to their credit hours, as shown in the table below.

CREDIT HOURS	WEIGHT COEFFICIENT
1 –2	1,0
3– 4	1,5
5	2,0

If a student has completed successfully more courses than those required for graduation, the elective courses with the lowest grades are excluded from the calculation of the average grade over courses, provided that the remaining courses satisfy the coursework requirement. Nevertheless, all courses completed successfully appear on the grade transcript of the student.

The diploma is characterized depending on the final grade, as follows:

DIPLOMA CHARACTERIZATION	
GOOD	from 5.0 to 6.5 (not including 6.5)
VERY GOOD	from 6.5 to 8.5 (not including 8.5)
EXCELLENT	from 8.5 to 10.0

The ranking of each graduating class is determined each September, following the second examination period, and includes all students who graduated either in the fall or in the spring semester of the past academic year.

The ranking is according to the students' final diploma grade, regardless of their initial registration and enrollment date. This ranking is used for the award of scholarships, honors, etc.

Annual Grade and Ranking

The annual grade of a student is the average grade over the courses he/she completed successfully in the past academic year. The annual grade is calculated only for student who have completed successfully all courses of the nominal curriculum in the two semesters of the past academic year.

The calculation is similar to the one for the final grade of the diploma (multiplication of each course grade with the corresponding weight coefficient, summation of the partial products, and division by the sum of all weight coefficients), however only the core and elective courses of the nominal curriculum in the past academic year are taken into account.

Additional courses, which may have been completed, successfully by the student, as well as English I, II, and II are not taken into account.

The annual rankings are determined each September, following the second examination period, separately for the students of each of the five (5) years of studies who successfully completed all coursework in the nominal curriculum up to their year of study.

For the first four (4) years in the program, following a student's initial registration, the year of studies is considered to be the corresponding academic year.

Beyond the fourth year, all students are considered to be in the fifth year of studies.

The annual rankings are used for the award of scholarships, honors, etc.

Transfer of Coursework

It is possible only for students enrolled in the ECE Department's undergraduate program through transfer from another university or placement examinations to transfer coursework performed in other universities and count it towards their graduation from the ECE Department. In order to do so, the following conditions must be met:

- The student must have successfully completed the course he/she wants to transfer in a different Department of the Technical University of Crete or in another university in Greece or abroad.
- The Undergraduate Studies Committee, in cooperation with the corresponding instructor, determines the equivalence of the course material of the requested course to the material of the corresponding course in the ECE curriculum, as described in the Undergraduate Studies Guide.
- In case of equivalence, the credit hours of the equivalent ECE course are credited to the student. If this course was taken at a Greek university the grade is transferred as well. However, if the recognized course was taken at a university abroad, the student gets credited with the corresponding credit hours, but the grade is not transferred. In such cases, the annual grade and the final diploma grade of the student are calculated only from courses with grades.
- In cases of non–equivalence, the Undergraduate Studies Committee makes a recommendation to the General Assembly, which takes a final decision for the recognition or not of the requested course.

Regarding the first two English courses (English I and II), students who are certified at C2 level according to the Common European Framework of Reference for Languages may bring a certified copy of their diploma at the beginning of the semester at the Language Research and Resources Center to receive automatically a grade of 8,0 without examination.

Areas of Concentration

All courses of the ECE Department fall under six (6) areas of concentration:

1. ARCHITECTURE, CIRCUITS AND ELECTRONICS [ACE]

This area covers subjects related to analysis and design of analog and digital electric and electronic systems, computer hardware, computer architecture, real–time microprocessor systems, implementation of digital systems, and CAD tools. It is covered by the Division of the Electronics and Computer Architecture.

2. SYSTEMS [SYS]

This area covers subjects related to systems theory, automatic control, optimal control, neural networks, fuzzy logic, biomedical applications, and quality assurance. It is covered by the Division of Systems.

3. TELECOMMUNICATIONS [TEL]

This area covers subjects related to telecommunications systems, telephony systems, antennas, microwaves, information and coding theory, computer networks, wireless communication systems, voice and image processing, speech recognition, and natural language processing. It is covered by the Division of Telecommunications.

4. COMPUTER SCIENCE [COMP]

This area covers subjects related to programming principles, algorithms, data structures, programming languages, compilers, operating systems, artificial intelligence, agents, graphics, and software engineering. It is covered by the Division of Computer Science.

5. APPLICATIONS OF THE INFORMATION SOCIETY [AIS]

This area covers subjects related to modern applications of computer science, office automation, human–computer interaction, design and development of information systems, and user satisfaction. It is covered by the Division of Computer Science.

6. POWER ENERGY SYSTEMS [POW]

This area covers subjects related to power systems, electrical engines, power generation, electric power distribution networks. It is covered by the Division of Electronics and Computer Architecture.

Courses offered by other departments fall under the following scientific areas:

1. MATHEMATICS [MATH]

This area covers subjects in basic and advanced mathematics for engineers, differential and integral calculus, differential equations, probability, linear algebra, and applied mathematics. It is covered by the Division of Mathematics of the Department of Sciences.

2. PHYSICS [PHYS]

This area covers subjects in physics for engineers. It is covered by the Division of Physics of the Department of Sciences.

3. CHEMISTRY [CHEM]

This area covers subjects in chemistry for engineers. It is covered by the Division of Chemistry of the Department of Sciences.

4. SOCIETY, SCIENCE, CULTURE [SSC]

This area covers subjects in humanities, sociology, philosophy, history of science, public policy, and law. It is covered by the Division of Humanities of the Department of Sciences.

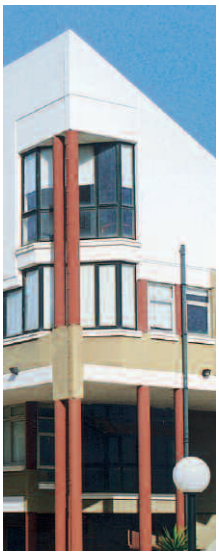
5. PRODUCTION AND MANAGEMENT [PMA]

This area covers subjects in production, management, industrial design, and computer–aided design. It is covered by the Department of Production Engineering and Management.

6. LANGUAGE [LANG]

This area covers the use of foreign languages. It is covered by the Languages Research and Resources Center.






Course Numbering

For easy reference to the courses of the ECE Department, their codes are developed as follows:

- the code begins with a three– or four–letter code declaring the area of concentration of the course
- the code ends with a three–digit numeric code
- the first digit is the year of study to which the course belongs nominally
- the second digit is 0 for fall semester courses and 1 for spring semester courses
- the third digit is an index to the course in the corresponding area of concentration

Nominal Curriculum

The concise tables below show the organization of all courses in the curriculum in academic semesters. For each course, the title, the code, the credit hours (Cre), the lecture hours per week (Lec), the tutorial hours per week (Tut), the laboratory hours per week (Lab), and the recommended prerequisite courses are given.

The last table lists all the elective courses offered by the ECE and other Departments from which students are free choose to complement their program of study, along with some constraints these choices must satisfy.

1st Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Introduction to Computer Science	COMP 101	4	3	2	1	–
Logic Design	ACE 101	4	4	1	2	–
Differential and Integral Calculus I	MATH 101	4	3	1	–	–
Linear Algebra	MATH 201	3	3	1	–	–
Physics I	PHYS 101	3	2	1	2	–
English I	LANG 101	2	4	–	–	–
Elective courses						
Discrete Mathematics	MATH 208	3	3	–	–	–
General Chemistry	CHEM 101	3	3	–	–	–

2nd Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Structured Programming	COMP 111	4	3	2	1	COMP 101
Differential and Integral Calculus II	MATH 102	4	3	1	–	MATH 101
Ordinary Differential Equations and Difference Equations	MATH 203	3	2	1	–	MATH 201
Probability Theory – Statistics	MATH 107	3	2	1	–	–
Physics II	PHYS 102	3	2	1	2	MATH 101
English II	LANG 102	2	4	–	–	LANG 101
Elective courses						
Symbolic and Discrete Structures	COMP 112	4	3	1	–	–
Numerical Analysis	MATH 202	4	3	1	–	MATH 201
Applied Mathematics	MATH 302	3	3	–	–	MATH 101, MATH 201

3rd Semester

ΟΝΟΜΑ	ΚΩΔΙΚΟΣ	ΔΜ	ΔΙ	ΦΡ	ΕΡ	ΣΥΝΙΣΤ. ΠΡΟΑΠΑΙΤ.
Object–Oriented Programming	COMP 201	4	3	2	1	COMP 111
Signals and Systems	TEL 201	4	3	2	1	MATH 101, MATH 102, MATH 201, COMP 111
Digital Computers	ACE 201	4	2	2	2	ACE 101, COMP 111
Basic Circuit Theory	ACE 202	4	2	2	2	MATH 101, MATH 201
English III	LANG 201	2	4	–	–	LANG 102
Elective courses						
Software Development Tools and Systems Programming	COMP 202	4	3	1	2	COMP 111
Electromagnetic Signals and Antennas	TEL 202	4	3	1	2	MATH 102, PHYS 102

4th Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Data and File Structures	COMP 211	4	3	2	1	COMP 201
Probability and Random Signals	TEL 211	4	3	2	1	MATH 107, TEL 201
Advanced Logic Design	ACE 211	4	3	2	2	ACE 101
Electric Circuits Analysis	ACE 212	4	2	2	2	ACE 202, MATH 201
English IV	LANG 202	2	4	–	–	LANG 201
Elective courses						
Introduction to Energy Technology I	POW 211	4	3	1	2	MATH 102, PHYS 102
Computer–Aided Design	PMA 423	4	3	–	2	–

5th Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Operating Systems	COMP 301	4	3	1	2	COMP 211
Telecommunication Systems I	TEL 301	4	3	2	1	MATH 102, TEL 201, TEL 211
Digital Signal Processing	TEL 302	4	3	1	3	TEL 201
Electronics I	ACE 301	4	3	2	2	ACE 212
Elective courses						
Statistical Modelling and Pattern Recognition	TEL 303	4	3	2	1	MATH 102
Introduction to Energy Technology II	POW 301	4	3	1	2	POW 211
Simulation	PMA 501	4	3	–	2	–
Sociology	SSC 101	3	3	–	–	–
Art and Technology	SSC 301	3	3	–	–	–
Philosophy and History of Science	SSC 203	3	3	–	–	–

6th Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Databases	COMP 311	4	3	2	1	COMP 211, COMP 301
Telecommunication Systems II	TEL 311	4	3	1	2	TEL 201, TEL 211, TEL 301
Electronics II	ACE 311	4	3	2	2	ACE 101, ACE 301
Computer Organization	ACE 312	4	3	2	2	ACE 201, ACE 211
Elective courses						
Digital Image Processing	TEL 312	4	3	1	3	TEL 302
Political Economy	SSC 102	3	3	–	–	–
Introduction to Philosophy	SSC 104	3	3	–	–	–
History of Civilization	SSC 202	3	3	–	–	–

7th Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Linear Systems	SYS 401	4	3	2	3	TEL 201
Algorithms and Complexity	COMP 401	4	3	3	–	COMP 211
Computer Networks I	TEL 401	4	3	1	2	TEL 211, MATH 107
Elective courses						
Introduction to Speech Processing	TEL 402	4	3	1	2	TEL 201, TEL 211, TEL 302
Wireless Communications	TEL 403	4	3	2	–	TEL 301
Principles of Programming Languages	COMP 402	4	3	1	2	COMP 211
Web Information Systems	AIS 403	4	3	1	2	COMP 311

7th Semester (cont.)

Multimedia Management Methods	AIS 404	4	3	1	2	COMP 211, COMP 311
Machine Vision	AIS 405	4	3	1	2	TEL 312
Advanced Issues in Databases	COMP 406	4	3	2	–	COMP 311
Fuzzy Logic Technology and Applications	SYS 402	4	3	1	3	–
Embedded Computer Systems	ACE 401	4	3	2	2	ACE 312, COMP 301
Electric Measurements and Sensors	ACE 402	4	3	1	2	ACE 311, ACE 312
Biomedical Electronics	ACE 403	4	3	–	3	ACE 301
Introduction to the Legal System and to the Technical Legislation	SSC 204	4	3	–	–	–
Micro– and Macro– Economic Analysis	SSC 201	3	3	–	–	–

8th Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Theory of Computation	COMP 411	4	3	2	1	COMP 401
Theory and Applications of Automatic Control	SYS 411	4	3	2	3	SYS 401
Elective courses						
Information, Semantics, and Services in the Web	AIS 412	4	3	1	2	COMP 311, AIS 403
Agent–Based Internet Computing	AIS 413	4	3	1	2	AIS 403
Principles of Distributed Software Systems	COMP 414	4	3	1	2	COMP 301
Information Technology in Education	COMP 415	4	3	1	2	–
Multidimensional Data Management	COMP 416	4	3	1	2	COMP 211, COMP 311, COMP 401
Artificial Intelligence	COMP 417	4	3	1	2	COMP 211, COMP 401
Computer Graphics	COMP 418	4	3	2	1	COMP 201, COMP 211
Compilers	COMP 419	4	3	1	2	COMP 211, COMP 402, COMP 402
Computer Networks II	TEL 411	4	3	1	2	TEL 401
Information Theory and Coding	TEL 412	4	3	2	1	MATH 107, TEL 211, TEL 301
Natural Language Processing	TEL 413	4	3	1	2	TEL 402
Introduction to Modeling and Performance Evaluation of Communication Networks	TEL 414	4	3	1	2	ΤΗΛ 211, TEL 401
Statistical Signal Processing for Communications	TEL 415	4	3	1	2	MATH 201
Modern Topics in Automatic Control	SYS 412	4	3	1	2	SYS 411, SYS 401
Industrial Control Systems	SYS 413	4	3	1	2	SYS 411
Neural Networks and Applications	SYS 414	4	3	1	2	SYS 411
Computer Architecture	ACE 411	4	3	2	2	ACE 312, COMP 301
Microelectronic System Implementation	ACE 412	4	3	1	2	ACE 312

8th Semester (cont.)

Parallel and Distributed Computer System Architecture	ACE 413	4	3	1	2	ACE 411, COMP 301
Optoelectronics	ACE 414	4	3	–	3	ACE 311
Power Electronics	ACE 415	4	3	1	2	ACE 311
Renewable Energy Sources	ACE 416	4	2	2	2	ACE 311
Computer–Aided Manufacturing	PMA 421	4	4	–	2	–
Industrial Sociology	SSC 302	3	3	–	–	–

9th Semester

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Elective courses						
Software Engineering	COMP 501	4	3	1	2	COMP 201, COMP 211
Human–Computer Interaction	AIS 502	4	3	1	2	COMP 201
Autonomous Agents	COMP 503	4	3	1	2	MATH 107, COMP 417
Economy of the Information Society	AIS 504	4	3	1	2	–
Society and Information Technology	AIS 505	4	3	1	2	–
Data Management and Processing in Sensor Networks	COMP 506	4	3	1	–	COMP 311
Modern Topics in Computer Science	COMP 52x	4	3	2	1	–
Wireless Telecommunication Systems and Networks	TEL 501	4	3	1	2	TEL 301, TEL 401
Modern Topics in Telecommunications	TEL 52x	4	3	1	2	–
Principles of Biomedical Systems	SYS 501	4	3	2	1	SYS 411, TEL 312, SYS 412
Robotics	SYS 502 PMA 502	4	3	2	3	SYS 401
Control Systems Design	SYS 503	4	3	1	2	SYS 411, SYS 402, SYS 413, SYS 401, SYS 414
Applications of Neuro–Fuzzy Logic in Control Systems	SYS 504	4	3	1	2	SYS 401, SYS 412
Optimal Control	SYS 505	4	3	1	3	SYS 411
VLSI and ASIC System Design	ACE 501	4	3	2	2	ACE 312
Electronic System Testing	ACE 502	4	3	2	2	ACE 312
Analog CMOS Design	HPY 503	4	3	1	2	ACE 301, ACE 311
Modern Topics in Electronics and Computer Architecture	HPY 52x	4	3	1	2	–

10th Semester

DIPLOMA THESIS

Notes

Students are required to complete successfully at least fourteen (14) elective courses subject to the following constraints:

- At least eight (8) courses from the ECE Department:

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Symbolic and Discrete Structures	COMP 112	4	3	1	–	–
Software Development Tools and Systems Programming	COMP 202	4	3	1	2	COMP 111
Electromagnetic Signals and Antennas	TEL 202	4	3	1	2	MATH 102, PHYS 102
Introduction to Energy Technology I	POW 211	4	3	1	2	MATH 102, PHYS 102
Statistical Modelling and Pattern Recognition	TEL 303	4	3	2	1	MATH 102
Introduction to Energy Technology II	POW 301	4	3	1	2	POW 211
Digital Image Processing	TEL 312	4	3	1	3	TEL 302
Introduction to Speech Processing	TEL 402	4	3	1	2	TEL 201, TEL 211, TEL 302
Wireless Communications	TEL 403	4	3	2	–	TEL 301
Principles of Programming Languages	COMP 402	4	3	1	2	COMP 211
Web Information Systems	AIS 403	4	3	1	2	COMP 311
Multimedia Management Methods	AIS 404	4	3	1	2	COMP 211, COMP 311
Machine Vision	AIS 405	4	3	1	2	TEL 312
Advanced Issues in Databases	COMP 406	4	3	2	–	COMP 311
Fuzzy Logic Technology and Applications	ΣΥΣ 402	4	3	1	3	–
Embedded Computer Systems	ACE 401	4	3	2	2	ACE 312, COMP 301
Electric Measurements and Sensors	ACE 402	4	3	1	2	ACE 311, ACE 312
Biomedical Electronics	ACE 403	4	3	–	3	ACE 301
Information, Semantics, and Services in the Web	AIS 412	4	3	1	2	COMP 311, AIS 403
Agent–Based Internet Computing	AIS 413	4	3	1	2	AIS 403
Principles of Distributed Software Systems	COMP 414	4	3	1	2	COMP 301
Information Technology in Education	COMP 415	4	3	1	2	–
Multidimensional Data Management	COMP 416	4	3	1	2	COMP 211,COMP 311, COMP 401
Artificial Intelligence	COMP 417	4	3	1	2	COMP 211, COMP 401
Computer Graphics	COMP 418	4	3	2	1	COMP 201, COMP 211
Compilers	COMP 419	4	3	1	2	COMP 211, COMP 402, COMP 402
Computer Networks II	TEL 411	4	3	1	2	TEL 401
Information Theory and Coding	TEL 412	4	3	2	1	MATH 107, TEL 211, TEL 301

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Natural Language Processing	TEL 413	4	3	1	2	TEL 402
Introduction to Modelling and Performance Evaluation of Communication Networks	TEL 414	4	3	1	2	ΤΗΛ 211, TEL 401
Statistical Signal Processing for Communications	TEL 415	4	3	1	2	MATH 201
Modern Topics in Automatic Control	SYS 412	4	3	1	2	SYS 411, SYS 401
Industrial Control Systems	SYS 413	4	3	1	2	SYS 411
Neural Networks and Applications	SYS 414	4	3	1	2	SYS 411
Computer Architecture	ACE 411	4	3	2	2	ACE 312, COMP 301
Microelectronic System Implementation	ACE 412	4	3	1	2	ACE 312
Parallel and Distributed Computer System Architecture	ACE 413	4	3	1	2	ACE 411, COMP 301
Optoelectronics	ACE 414	4	3	–	3	ACE 311
Power Electronics	ACE 415	4	3	1	2	ACE 311
Renewable Energy Sources	ACE 416	4	2	2	2	ACE 311
Software Engineering	COMP 501	4	3	1	2	COMP 201, COMP 211
Human–Computer Interaction	AIS 502	4	3	1	2	COMP 201
Autonomous Agents	COMP 503	4	3	1	2	MATH 107, COMP 417
Economy of the Information Society	AIS 504	4	3	1	2	–
Society and Information Technology	AIS 505	4	3	1	2	–
Data Management and Processing in Sensor Networks	COMP 506	4	3	1	–	COMP 311
Modern Topics in Computer Science	COMP 52x	4	3	2	1	–
Wireless Telecommunication Systems and Networks	TEL 501	4	3	1	2	TEL 301, TEL 401
Modern Topics in Telecommunications	TEL 52x	4	3	1	2	–
Principles of Biomedical Systems	SYS 501	4	3	2	1	SYS 411, TEL 312, SYS 412
Robotics	SYS 502 PMA 502	4	3	2	3	SYS 401
Control Systems Design	SYS 503	4	3	1	2	SYS 411, SYS 402, SYS 413, SYS 401, SYS 414
Applications of Neuro–Fuzzy Logic in Control Systems	SYS 504	4	3	1	2	SYS 401, SYS 412
Optimal Control	SYS 505	4	3	1	3	SYS 411
VLSI and ASIC System Design	ACE 501	4	3	2	2	ACE 312
Electronic System Testing	ACE 502	4	3	2	2	ACE 312
Analog CMOS Design	HPY 503	4	3	1	2	ACE 301, ACE 311
Modern Topics in Electronics and Computer Architecture	HPY 52x	4	3	1	2	–

- At most three (3) courses from the Department of Sciences and the Department of Production Engineering and Management:

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
General Chemistry	CHEM 101	3	3	–	–	–
Discrete Mathematics	MATH 208	3	3	1	–	–
Numerical Analysis	MATH 202	4	3	1	–	MATH 201
Applied Mathematics	MATH 302	3	3	–	–	MATH 101, MATH 201
Computer–Aided Design	PMA 423	4	3	–	2	–
Simulation	PMA 501	4	3	–	2	–
Computer–Aided Manufacturing	PMA 421	4	4	–	2	–
Robotics	PMA 502	4	3	2	3	–

- At most three (3) courses from the following humanities courses:

TITLE	CODE	Cre	Lec	Tut	Lab	PREREQUISITES
Sociology	SSC 101	3	3	–	–	–
Political Economy	SSC 102	3	3	–	–	–
Introduction to Philosophy	SSC 104	3	3	–	–	–
Micro– and Macro– Economic Analysis	SSC 201	3	3	–	–	–
History of Civilization	SSC 202	3	3	–	–	–
Philosophy and History of Science	SSC 203	3	3	–	–	–
Introduction to the Legal System and to the Technical Legislation	SSC 204	4	3	–	–	–
Art and Technology	SSC 301	3	3	–	–	–
Industrial Sociology	SSC 302	3	3	–	–	–

Students are advised to pay particular attention in choosing their elective courses to meet the required number of credit hours for graduation.

Detailed Course Descriptions

The pages below list detailed descriptions of all courses in the curriculum. The ordering of the listing follows the ordering of the courses in the nominal curriculum of the ECE Department.

1st Semester

Introduction to Computer Science — COMP 101

Introduction to computer science. Introduction to algorithms and computer programming, Structured programming, development of accurate and fast algorithms, characteristics of advanced programming languages. Introduction to procedural programming utilizing the C programming language. Programming cycle execution. Syntax and grammar of C. Generic data types. Definition of variables and constants. Operators and expressions. Conditional operators and advanced program control. Input and output functions. Programmer–defined functions. Arrays. Structures. Pointers. Using disk files.

Logic Design — ACE 101

Binary number representation, binary/octal/hexadecimal representation systems, representation codes. Boole algebra, logic gates, 2–level combinational logic. Single– and multi–variable function simplification, Karnaugh maps, McCluskey minimization. Arithmetic circuits, adders/subtractors. Combinational logic circuit design with TTL IC chips, multiplexers, decoders, comparators. Sequential logic, latches, flip–flops, counters, design and analysis of sequential logic, Finite State Machines (FSMs). Programmable logic devices: PLA, PAL, GAL, introduction to Hardware Description Languages (HDL).

Differential and Integral Calculus I — MATH 101

Functions of a single variable. Limits and continuity of functions. Derivatives. Geometric interpretation of derivatives. Function differentials. Applications of derivatives to analysis of functions (monotony, convexity, extremes). Mean value theorem. Rule De L' Hopital. Integrals of single variable functions. Definite integrals. Fundamental theorems of integral calculus. Calculation of areas and volumes. Applications to Physics. Exponential functions. Inverse functions. Hyperbolic functions. Integration methods. Improper integrals. Sequences and series (convergence conditions). Power series and Taylor series.

Linear Algebra — MATH 201

Linear spaces, base and dimension of a linear space, inner product spaces, orthogonality, matrices, matrix rank, column and row spaces, fundamental problems in linear algebra, systems of linear equations, determinants, linear mappings, linear mapping matrices, eigenvalues and eigenvectors, eigenspaces, quadratic forms, positive definite matrices, case–studies and applications of linear algebra.

Physics I — PHYS 101

Linear motion, motion on the plane, vectors, Newton's laws, gravitational forces, estimation of the acceleration of gravity from free fall, friction forces, estimation of the friction factor of surfaces in contact. Momentum, conservation of momentum, centre of mass. Kinetic and dynamic energy, law of energy conservation, work, power, conservative forces, relation between force and dynamic energy. Circular motion of a particle, rotation of a rigid body, estimation of angular acceleration, torque, and frictional torque, general condition of mechanical equilibrium. Angular momentum of particles and rigid bodies, angular momentum conservation law. Simple harmonic oscillator, simple, compound, and torsional pendulum, estimation of the spring constant and estimation the acceleration of gravity using a simple pendulum, estimation of the torque of a body using a doubly–supported pendulum. Restricted motion, generalized coordinates, Hamilton's equations of motion. Electric field, Coulomb's Law, motion of a charge in an electric field. Gauss' Law and applications. Electric potential, electric potential difference, electric dipole, electric dynamic energy, estimation of electrostatic field from potential measurements. Simple electric circuits, Kirchhoff's rules, charging and discharging effect of a capacitor.

English I — LANG 101

English grammar and development of writing and oral skills in English at B2 level.

Discrete Mathematics — MATH 208

Elementary combinatorics. Elements of mathematical logic. Set theory. Number theory and mathematical induction. Relations and functions. Recurrence relations. Languages and finite state automata (deterministic and non–deterministic). Basic concepts of graph theory.

General Chemistry — CHEM 101

Atomic Structure. Introduction to Quantum Chemistry. Elementary particles. Atomic orbitals. Electronic config-

uration of elements. The Periodic Table and properties of elements. Ionic bonding. Covalent bonding. Molecular geometry. Theory of valence bonding. Hybridization of atomic orbitals. Theory of molecular orbitals. Bimolecular forces. Metal bonding metal properties, pure silicon semiconductors, doped semiconductors, semiconductor applications, photosensitive elements, p–n diodes). Elements of physical chemistry (classes of chemical reactions, chemical reactions equilibrium, chemical kinematics). Solutions. Acids. Bases. Salts. Oxidation reduction. Electrochemistry. Modern methods of surface and structural analysis of microelectronic material. Diffraction technique of X–rays (XRD). Photoelectron spectroscopy (XPS). Electron spectroscopy Auger (AES). X–ray fluorescent spectroscopy (XRF). Infrared spectroscopy (IR).

2nd Semester

Structured Programming — COMP 111

Complex applications of pointers in the C language. Pointers to pointers. Recursion. Introduction to Java and abstraction in object–oriented programming. The notion of a class and an object. Input/output, parameter passing in methods, access levels of member variables/methods/classes, overloading, inheritance, polymorphism, abstract classes. Abstract data types. Examples of abstract data types. Lists and their versions (single/double linked lists, circular lists). Queues and stacks. Divide and conquer strategies. Binary search trees. Hash–based structures. Simple sorting and search algorithms.

Differential and Integral Calculus II — MATH 102

Functions of many variables. Second–order surfaces. Polar, cylindrical, and spherical coordinates. Parametric equations of curves and elements of differential geometry. Inner and outer vector product. Partial derivates of multi–variable functions, div, grad, curl, and elementary theory of vector fields. Lagrange multipliers and criteria for extremes of multi–variable functions. Line integrals. Double and triple integrals. Surface integrals. Applications in fluid mechanics. Green's Theorem, vector analog of Green's theorem. Stokes' Theorem. Gauss' Theorem. Applications in Physics.

Ordinary Differential Equations and Difference Equations — MATH 203

First–order differential equations. Higher–order differential equations. Systems of differential equations. Laplace transforms. Difference equations. Stability theory.

Probability Theory – Statistics — MATH 107

Discrete space of elementary events. Conditional probability, independence. Random variable. Chebyshev inequality, law of large numbers. Hypothesis checking. Distribution of random variable. Central limit theorem. Estimation.

Physics II — PHYS 102

Magnetic induction B, charges in electrical and magnetic fields, torque on current loop. Sources of magnetic fields, Ampere's law, current–carrying conductors, solenoid, Biot–Savart law. Induction phenomena, time–varying magnetic flux, Faraday's law, Lenz's law, LR circuit, estimation of self–inductance L of a solenoid. Energy in an electric and magnetic field, LC system, dumped and forced electromagnetic oscillations, resonance, estimation of natural frequency, dumping and resonance of electromagnetic oscillations in an LCR circuit. Electromagnetic waves, principles of generation and wave intensity, Poynting's vector, induced magnetic fields, displacement current, Maxwell equations. Properties and behavior of light, superposition principle, Huygens' principle, reflection, refraction, Snell's law, total reflection, polarization, estimation of refraction index and Brewster angle of plexiglass. Geometric optics, Fermat's principle, image formation from refraction, ray diagrams for lenses. Wave Optics, wave interference, Young's experiment, diffraction from a single slit, limits of resolution, diffraction from a double slit, bounds, estimation of CD capacity using light diffraction. Introduction to modern physics, duality of waves and particles, photoelectric effect, photon properties, materials waves, de Broglie wavelength. Electrical conductivity of solids, free and almost free electrons, energy zones, metals, insulators, semiconductors, estimation of photoelectric phenomenon in a semiconductor. Applications of semiconductors, pure and doped semiconductors (type–n, type–p), p–n junction diode, LED diode, estimation of energy gap in LED.

English II — LANG 102

Development of writing and oral skills in English at C2 level with emphasis on reading and writing academic texts.

Symbolic and Discrete Structures — COMP 112

Basic set theory: algebra, finite and infinite sets, countable and uncountable infinite sets, power sets, diagonalisation. Relations and functions: properties of binary relations, equivalence relations and partitions,

partial–order relations, chains and counter–chains, functions, and the pigeon–hole principle. Logic: propositional logic, first–order predicate logic, axiomatic systems, semantic models, tautologies, inference rules, proofs, soundness and completeness, proof techniques. Combinatorics: the rule of sum and the rule of product, orderings, combinations, generation of orderings and combinations, inclusion–exclusion principle. Sequences: asymptotic behavior of sequences, generating functions, recurrence relations, linear recurrence relations with constant coefficients, homogeneous solutions, special–case solutions, global solutions, solution using generating functions, summations.

Numerical Analysis MATH 202

Floating point numbers, machine numbers, rounding errors in calculations. Solution of algebraic equations: dichotomy method, modified bracket method (Illinois, hybrid), iterative fixed–point method, Newton–Raphson method, Aitken acceleration, Steffensen method, Muller method. Systems of non–linear equations. Polynomial interpolation: Lagrange interpolation, Newton polynomials and divided differences, Hermite interpolation, uniform partitions and the phenomenon Runge, Chebyshev nodes. Interpolation with splines: linear splines, cubic splines, cubic Hermite splines and extended divided differences. Discrete Least–Squares: the line of least–squares, the m–degree least–squares polynomial, the general problem of least–squares, normal equations, non–linear least–squares, linearization. Numerical differentiation: front and rear first–order finite differences, central second–order finite differences, Richardson extrapolation for high–order finite differences. Numerical integration: Riemann summations, Newton–Cotes rules, trapezoid and Simpson rules, composite rules, Romberg integration, Gauss–Legendre integration. Initial value problems: Euler method, convergence and stability, Heun method, Taylor methods, Runge–Kutta methods.

Applied Mathematics MATH 302

Complex functions of one variable. Derivatives. The Cauchy–Riemann conditions. Analytic functions. Harmonic functions. Exponential, trigonometric, hyperbolic functions and transformations. Linear and Moebius transformations. Conferral mappings. Line integrals. Cauchy/Goursat theorem. The Cauchy integral formulas. Taylor series. Laurent series. Calculation of improper integrals. Integration around junction point. Applications in Fourier and Laplace transforms. Linear spaces of complex functions. Bases, orthogonality, completeness.

3rd Semester

Object–Oriented Programming COMP 201

In depth study of the object–oriented model, object oriented design patterns and requirements analysis and modeling of large object oriented applications. Classes, interfaces, privileges. Special topics of object management (creation and destruction of objects). Code re–usability: inheritance, polymorphism of objects) encapsulation, overloading, exception management, multi–threading. Introduction to object oriented design patterns. The basic principles of a design pattern, composition, decoupling. Pattern categories for generating objects, for organization of objects and classes, for task oriented support. Introduction to Requirements Analysis and Design in large object oriented applications using UML. Use Cases, Class Diagrams, Robustness Diagrams, Sequence Diagrams.

Signals and Systems TEL 201

Signals, systems, signal processing, continuous and discrete time signals, periodic and aperiodic signals, energy and power signals. Continuous and discrete time systems, analysis of linear time–invariant systems, convolution, input–output stability (BIBO). Study of signals and systems with the use of MATLAB. Sinusoidal signals, harmonically related signals, Fourier series of a periodic signal. Continuous–time Fourier transform, properties and applications of Fourier transform, Fourier transform of a periodic continuous–time signal, discrete–time Fourier transform, Nyquist sampling theorem. Amplitude modulation, frequency multiplexing, angle modulation, applications of modulation in telecommunications systems, AM and FM. Laplace transform, region of convergence, inverse Laplace transform, properties and applications of Laplace transform.

Digital Computers ACE 201

Basic computer organization: processor, memory and peripherals, machine code, assembly language, assembly programming. Processor programming model, instructions, instruction sets, addressing modes, interrupts and traps. Binary number representation (integer and floating point), arithmetic operations: addition/subtraction, multiplication, division. Computer memory systems, stack. Laboratory exercises using microprocessors or simulators.

Basic Circuit Theory ACE 202

Lumped electric elements and circuits, Kirchhoff's cur-

rent (KCL) and voltage law's (KVL), Tellegen theorem, basic circuit elements (resistors, capacitors, inductors, transformers, independent sources, two–terminal elements), waveforms, small–signal analysis, introduction to Linear Time–invariant Circuits, analysis of first order, second order and higher order linear circuits (differential equations, zero input response, zero state response, complete response, transient and steady state response, impulse response, step response), basic principles of the node and mesh analysis methods for linear circuits analysis, state equations, Laplace Transforms(definition, fundamental properties, solutions of simple circuits, solution of linear differential equations and of general networks, state equations solution, applications), network (transfer) functions (poles, zeros and frequency response, impulse response, natural frequencies of a network, Bode diagram, application to oscillator and filter design).

English III — LANG 201

Self–learning program at the Language Research and Resources Center using educational material designed to improve oral, writing, and comprehension skills.

Software Development Tools and Systems Programming — COMP 202

Basic software development tools: compilation, linking, loading. Management and version control of source code. Automation of compilation (build management). Tools for debugging, unit testing, and profiling. Code refactoring. Unix environment programming: shells and utilities, file system, redirection of input/output and piping, job control. Shell programming. System programming. Scripting programming: introduction to Python, data types and code organization. Text editor applications: basic operations, regular expressions, basic theory of regular language, implementation of text editors in Python, examples and applications.

Electromagnetic Signals and Antennas — TEL 202

Time–Varying Fields (Maxwell equations, wave equation, scalar and vector potentials, Poynting theorem). Electromagnetic wave plane (transmission of wave plane on non–conducting media, polarization of wave plane, transmission of wave plane in non–perfect insulation media, field within conducting media, diffusion equation, transmission of wave plane in random direction, team velocity, theorem of reciprocity). Reflection and refraction of wave plane (Laws, Fresnel equations, total reflection, reflection and refraction energy coefficients, vertical and lateral encounter with lossy means, static wave encounter in dielectric plate, radiation pressure, scattering of electromagnetic wave). Bipolar linear antennas, directional and gain antennas, example applications. Uniform and non–uniform antenna arrays, Yagi–Uda antenna array, example applications. Surface antennas and receiving antennas (antenna as receiver, active surface antenna). Friis equation, Radar equation, antenna temperature. Transmission in earth space (tropospheric transmission and refraction, interruption phenomena, ionospheric transmission, example applications).

4th Semester

Data and File Structures — COMP 211

Abstract Data Types, implementation in Java, algorithm complexity, performance analysis of algorithms. Sorting in main and external memory, sorting algorithms: bubble sort, exchange sort, insertion sort, selection sort, quick sort, merge sort, k–way merge sort, radix sort. Stacks, queues, linked lists. Implementation of one–dimensional arrays and dynamic memory allocation. Trees, tree traversal, binary search trees, operations research in binary trees (search, insert, delete data). Implementation using arrays and dynamic memory allocation. Applications, Huffman codes. Graphs, graph traversal. Operations on graphs (search, insertion, deletion). Implementation of graphs and applications (minimum spanning tree, shortest path). Searching in main or external memory. Sequential search (binary search, interpolation search, self–adjusting search), Indexed sequential search, ISAM. Performance analysis of search. Hierarchical search trees, trees in main memory (binary search trees, AVL trees, optimal trees, splay trees), analysis of performance. Trees on the secondary memory (multi–way search trees, B–trees, B +-trees), VSAM. Tries, digital search trees, text tries, Patricia tries, Ziv–Lembel coding. Searching in text (KMP, BMH algorithms). Non–hierarchical search, hashing in the main memory, collision resolution, open addressing, separate chaining. Complexity of search. Hashing in external memory (dynamic hashing, extendible hashing, linear hashing). Performance analysis of search.

Probability and Random Signals — TEL 211

Random variables, random vectors and stochastic processes. Functions of a random variable. Normal distribution. Correlation and covariance functions. Basic inequalities and the central limit theorem. Introduction

to parameter estimation. Normal random vectors. Ergodicity and stationarity of random processes. Power spectral density of random signals. Linear transformations of random vectors and linear filtering of random signals. Noise modeling in telecommunication systems.

Advanced Logic Design — ACE 211

Introduction to Hardware Description Languages (HDL). Structural and behavioural models, schematic capture, simulation, correct operation verification, circuit timing analysis. Advanced logic design, one–hot encoding, algorithmic design methods. Circuit fan–in and fan–out, critical path. Spatial and timing complexity, O( ) complexity for logic circuits. Data path and control path design. Finite State Machines, state minimization. Fast arithmetic circuits: carry look–ahead, carry select and carry–save adders, multipliers, dividers. Fixed and floating–point arithmetic. Synthesis of logic circuits.

Electric Circuits Analysis — ACE 212

Fundamental circuit elements (resistors, capacitors, inductors, independent voltage and current sources), ideal elements, approximations, parasitic effects, equivalent circuits, associated reference direction, passive and active elements, linearity, variables – parameters – instantaneous values, characteristic curves, power and energy. Simple circuits, Kirchhoff's laws, basic connections, resistor bridge, ladder network, sensitivity analysis. Sinusoidal Steady State, complex numbers, theorems and lemmas for SSS, phasors, sinusoidal excitation (partial solution and complete response), impedance – admittance, parallel and series RLC resonant circuits, resonance frequency, overcurrent and overvoltage, quality factor, network functions, the decibels, frequency response, filters, real or average power, complex power, reactive power, power factor, effective or root mean square values, maximum power transfer theorem. Coupled inductors, transformers, coefficient of coupling, multi–winding transformers, ideal transformer, transformer equivalent, controlled or dependent voltage and current sources, coupled branches, power of transformer and dependent source. Network graphs, subgraph, oriented graph, connected graph, incidence matrix, cut–set, loop. Node and mesh analysis, equations by inspection, sources and branches transformations, planar graph, mesh, outer mesh, dual graphs and dual networks. Network theorems, substitution theorem, superposition theorem, Thevenin – Norton theorem, reciprocity theorem. Two–ports, two–poles or one–ports, four–poles, terminated two–ports, open–circuit or impedance or Z parameters, short–circuit or admittance or Y parameters, hybrid H parameters, hybrid G parameters, transmission or ABCD parameters, reverse transmission parameters, small–signal analysis.

English IV — LANG 202

Study of text and vocabulary using technical material for engineers.

Introduction to Energy Technology I — POW 211

Basic concepts, ac circuits, power, triphase systems, symmetrical components, the system unit (per–unit). Historical development of electric power systems, power plants, the transmission system, and the distribution system. The Greek electricity system, quantitative data. Synchronous generators, principle of operation, structural components, circuit model of turbine generator, power relations, operational limits of turbine generators. The power transformer, circuit model, triphase joints of windings, voltage–current relation in triphase transformers. Inductive engines, operating principles, structural components, circuit model, relation of torque and power. Operation of engines, generators, and brakes, starting and adjusting the speed of induction engines.

Computer–Aided Design — PMA 423

Design using computers, role in the process of studying a product, applications – design systems, three–dimensional modeling systems, wire models, surface models, solid models, representation of curves and surfaces using Ferguson, Bezeir, B–Splines, and Nurbs methods. Solid modelling systems, constructive solid geometry, Limited representation (B–Rep).

5th Semester

Operating Systems — COMP 301

History and evolution of operating systems. Review of computer organization: CPU, registers, MMU, interrupts, stack–based execution. Processes: definition, process state, threads, resources. Unix process control. Process table, PCBs. POSIX threads. Multiprogramming: definitions. Monitors, concepts and implementation. Semaphores, reader–writer locks, producer/consumer and buffers. Deadlocks. Process scheduling. Memory management: Memory hierarchies, locality, caching and prefetching, fragmentation. Memory allocation. Program loading. Segmentation, paging. The i386 paging model. Memory mapping, copy–on–write. Virtual memory, replacement policies. Input/output and interprocess communication: Streams and stream I/O. Pipes, sock-

ets. Terminals. Network and block devices. Device drivers, driver architecture. I/O programming using polling, threads, event–driven programming. External memory: file systems. File and directory management. Magnetic disks, performance model, formatting, I/O scheduling. RAID. File system organization. Metadata management, journalled file systems. Backups. Security: authorization in Unix, ACLs. User authentication. Cryptography, symmetric and asymmetric ciphers, RSA.

Telecommunication Systems I — TEL 301

Benefits of digital transmission and storage. The AWGN channel and Shannon's capacity formula – ramifications. Analog to digital conversion. Sampling theorem, uniform quantization, optimal quantization and the Lloyd–Max algorithm. Companders, PCM, DPCM, Delta modulation, adaptive Delta modulation. Elements of digital transmission. Geometrical view of signal space: modulation, signal dimension, basis functions. The demodulation process: matched filtering, correlation receiver front–end. Principles of detection, minimum probability of error detection. Specific modulation formats: PAM, PSK, QAM, orthogonal modulation. Analytical computation of symbol and bit error rates, Monte–Carlo simulation, comparisons; energy– versus bandwidth–limited communication, and the Shannon limit.

Digital Signal Processing — TEL 302

Discrete–time signals and systems. Sampling and Quantization effects. Fourier Transform: properties and applications. Z–Transform: properties and applications. Sampling and reconstruction of analog signals. Changing sampling frequency: downsampling and upsampling. Power spectrum estimation. Processing of analog signals with digital filters. Transform analysis of linear time–invariant systems. Minimum phase systems. Structures for discrete–time and digital filters. Design and implementation of infinite impulse response (IIR) and finite impulse response (FIR) filters. Transform and windowing methods.

Electronics I — ACE 301

Semiconductor physics, p–n diode, special diodes (LED diode, Schottky diode, variable capacitance diode, zener diode), applications of diodes (voltage rectifier–regulator–multiplier, logic gates), bipolar transistors (BJT), common emitter–base–collector configurations, hybrid transistor models, transistor characteristics and bias, amplifiers, JFET, MOSFET transistors, integrated circuit development technologies.

Statistical Modeling and Pattern Recognition — TEL 303

Basic definitions: estimation, classification, recognition, clustering. Bayes classifier, probability of error, decision boundaries. Detection. Estimation: maximum likelihood estimation, Bayesian estimation, expectation maximization algorithm. Modeling class dependencies: Bayesian networks, Markov models, hidden Markov models. Model selection and sufficient statistics. Feature selection: independence and correlation. Non–parametric classification methods: Parzen windows, nearest neighbor classifiers. Linear classifiers. Perceptron. Support vector machines. Unsupervised Training. Mixture of Gaussians. K–means clustering. Non–linear classifiers. Decision trees, classification and regression trees. String matching. Principal component analysis. Boosting. Applications in Speech Recognition and Optical Character Recognition.

Introduction to Energy Technology II — POW 301

The transmission system, electric power cables, components and specifications. The short transmission line, circuit model, power relations, voltage regulation. Control of voltage drop, offsetting unused power. Electricity conservation, system loads, costing and pricing of electricity, electricity market liberalization. Power electronics, AC/DC converters, applications. Electrical installations for buildings and industrial facilities, regulations and safety of people and equipment of low and medium voltage, specifications of installations, means of implementation, planning and sizing.

Simulation — PMA 501

Simulation of production systems and waiting lines, modeling of discrete event systems, statistical estimation techniques for measuring performance and comparing systems, variance reduction techniques, introduction to perturbation analysis, optimization, simulation software.

Sociology — SSC 101

Introduction to Sociology. Analytic and synthetic study of concepts related to the social framework in which of production activity of people takes place: society, social position and role, social changes, social stratification and mobility, social classes, socio–political institutions, socio–economic institutions and societal transformations.

Art and Technology — SSC 301

Technology and Art in the social structure. Technology as objectification, as a framework for the human impact on nature and for the relations among people, as a fore-

running conception–knowledge and as an instrument implicating upon Nature. The particularity of the aesthetic moment. The aesthetic moment as a specific activity in the division of labor (Art). Art and technology in the history of civilization. Metaphysical discourse on "Appollonean" and "Dionysean" elements.

Philosophy and History of Science — SSC 203

Science as a social–cultural phenomenon. The role of science in the social structure. Theoretical issues concerning knowledge, logic and the methodology of scientific research. Sciences in History. Differentiation, integration and interdisciplinarity of science. Traditions and innovations in the development of science. The subject of scientific activity. Theories, orientations and approaches in the philosophy of science.

6th Semester

Databases — COMP 311

Conceptual modelling. Entities, relationships between entities, modelling constraints, cardinality and integrity constraints, functional dependencies. The Entity–Relationship model. The Entity–Relationship model for user requirements analysis and representation. Logical data models. The Relational model. Conversion of the Entity–Relationship to the Relational model. Language support for the Relational model. Relational database design issues. Functional dependencies. Relational database Normalization and Normal Forms. The SQL–92, SQL–99 standards. Views support. Embedded SQL. Graphical Query languages, Query by Example. Database performance issues. Secondary storage costs. Data transfer units and block size selection. Access paths and the index selection problem. Other performance optimization methods: vertical partitioning, vertical clustering, horizontal partitioning, horizontal clustering, etc. Query optimization in relational databases. Heuristic methods for query optimization. Statistical query optimization and access path selection. Concurrency problems. Anomalies of concurrent access (lost updates, dirty reads, etc.). Concurrency control management. Transactions, interleaving the execution of instructions, serializability. Concurrency control protocols. Database recovery from failures. Recovery Management. The course is more oriented to the design and the development of database applications, as well as to the performance optimization, and less oriented to the database system implementation issues. A project that includes the analysis, design and implementation of a large database application is carried out during the course.

Telecommunication Systems II — TEL 311

Elements of Probability Theory (brief presentation). Stochastic processes, mean, autocorrelation function. Stationary stochastic processes, power spectral density, sampling. Stationary stochastic processes and linear time invariant systems. Cyclostationary processes. Power spectral density of cyclostationary processes. Signal transmission through a bandlimited channel, intersymbol interference, Nyquist pulses. Optimal receivers for ideal bandlimited channels, square root raised cosine pulses. Least squares, channel estimation. Linear Equalization, equalization Viterbi. Adaptive algorithms, adaptive equalization, LMS algorithm. Phase synchronization (Phase–Locked–Loop, PLL). Symbol synchronization. Frame synchronization. Low-pass equivalent representation of signals and channels. Elements of information theory (entropy, mutual information), channel capacity. Link budget

Electronics II — ACE 311

Differential amplifiers, operational amplifiers with transistors (characteristics, frequency response, speed, power), operational amplifiers with FET (characteristics, frequency response, speed, power), analysis and design of amplifiers (feedback, frequency compensation, input and output impedance), operational amplifier based circuits (power amplifiers, logarithmic amplifiers, video amplifiers, oscillators, multi–vibrators, timing circuits, comparators, voltage and current regulators, voltage followers, adders, multipliers, dividers, differentiators, integrators, filters, modulators, de–modulators, phase detectors, VCOs, PLLs, analog switches, sample and hold circuits). Special–purpose integrated circuits.

Computer Organization — ACE 312

Survey of addressing modes, MIPS addressing modes and the corresponding formats in assembly language and object code, Design of the datapath and control of a processor that executes a subset of the full MIPS instruction set single–clock–cycle processor datapath, multiple–clock–cycle processor datapath, Exceptions and interrupts Pipelining, Data hazards, Branch hazards, Performance of pipelined systems, Hierarchical memory systems, Interleaved memory, Caches, Virtual memory

Digital Image Processing — TEL 312

General principles and modeling of digital images. Image Perception. Color representation and transformations. 2–D Sampling, 2–D Fourier and other trans-

forms. Image description and processing using vectors and matrix operators. Image enhancement: Histogram equalization and mapping, contrast enhancement, low–pass and highpass filters in two dimensions. Image restoration: Deterministic and stochastic methods. Optimization for the design of image restoration filters, comparisons and applications. Image coding and compression: JPEG, MPEG. Image analysis and segmentation methods.

Political Economy SSC 102

Brief review of economic history with particular reference on the succession of different modes of production and on the contemporary development trends. The development of economic theory up to day is also examined, as well as certain elements of micro– and macro– economics.

Introduction to Philosophy SSC 104

A brief overview of the history of philosophy. Main categories and laws of dialectic in the areas of knowledge. Theory of ontology and logic (formal and dialectical). Elements of social philosophy. The social structure as an organic whole, social consciousness and its forms.

History of Civilization SSC 202

Introduction to the basic concepts of civilization from a variety of viewpoints (sociology, anthropology, philosophy, history). Analytic and synthetic approach of issues related to the history of civilization, particularly in some critical time periods: eastern territories, ancient Greece, Western Europe in Middle Ages, Renaissance, etc. Critical review of theories which attempt to explain the modern civilization: behaviorism, metamodernism, etc.

7th Semester

Linear Systems SYS 401

Introduction to linear systems, study and modeling of linear systems, state space, examples from signal processing, images, etc. Application in continuous and discrete time systems, analysis, controllability and observability, minimal realizations, linear systems design. Modeling of dynamical systems, transient response analysis, basic control actions and response of control systems. Root locus, analysis and design, frequency domain methods analysis and design, Bode plots.

Algorithms and Complexity COMP 401

Models and concepts of complexity. Introduction to discrete mathematics for algorithm analysis. Asymptotic cost. Recursion and recurrences, solution by induction, master theorem. Fundamental recursive algorithms: multiplication, Karatruba's algorithm, FFT. Order statistics. Dynamic programming, memoization. Knapsack problem. Non–determinism, Cook's theorem, the classes P and NP, NP–completeness. Amortized complexity analysis, amortized costs in basic dynamic data structures. Range search over ordered keys, data structures for multidimensional range search. Introduction to graph theory. Data structures for graph representation. Graph traversals, depth and breadth first search, traversing DAGs, topological sorting. Connected components. Weighted graphs. Minimum spanning trees, Prim's algorithm, Kruskal's algorithm. The Union–Find problem. Ackerman's function. Shortest paths and distance metrics. Triangle inequality. Representing single–source and all–pairs shortest paths. The algorithm of Bellman–Ford. Dijkstra's algorithm. Transitive closure. Johnson's algorithm. Floyd–Warshall algorithm.

Computer Networks I TEL 401

Introduction to the operating principles of computer communication networks (shared Ethernet: hubs and collisions, interconnecting Ethernets: switches and routers, the Internet: routing and the Transmission Control Protocol, Asynchronous Transfer Mode: main features, Quality of Service control), Design principles for computer communication networks: switching and multiplexing, the OSI reference model. Physical layer: error control and information digitization. Data Link layer: the Alternating Bit, GO BACK N and Selective Repeat protocols and their performance evaluation. Medium Access Control layer: ALOHA protocol, tree and stack–based packet contention resolution algorithms. Local Area Networks: Ethernet, Token Ring, FDDI, wireless LANs. Third generation wireless communication networks: voice, data and compressed video transmission protocols and their performance analysis. Network layer: routing, congestion control. The Internet: architecture, naming and addressing, the Internet Protocol (IP), TCP and UDP. Introduction to computer network modeling and simulation. The course includes a project in computer communication protocol simulation.

Introduction to Speech Processing TEL 402

Speech analysis. Digital speech–production model. Short–time Fourier transform. Linear prediction analysis. Speech coding techniques and standards. Speech synthesis. Introduction to speech recognition and hidden Markov models. Statistical language modeling. Applications of speech recognition and synthesis and

the VoiceXML language.

Wireless Communications TEL 403

History of mobile communications. Wireless channel models: free–space propagation, 2–ray models, M–ray models, empirical path loss models (Okumura, Hata), shadowing, time–varying linear system model, narrow–band flat–fading model (Rayleigh, Rice), wide–band (frequency selective) channel model. Mean probability of error for fading channels. Diversity in time, space, frequency, mean probability of error. Elements of CDMA. Elements of OFDM. GSM, IS–95.

Principles of Programming Languages COMP 402

Development of programming languages. Syntax specification, type systems, type interface, exception handling, information hiding, structural recursion, run–time program data storage management. Non–structured programming, such as functional programming with Lisp, Scheme, ML, and logic programming with Prolog.

Web Information Systems AIS 403

Analysis, design, and implementation of large scale information systems. State of the Art. The role of international standards in the web. HTML, XML, HTTP, Web Browsers, Web Servers, J2EE. The importance of accessing databases from web applications. Architectural principles of web applications: data layer, business logic layer, interface layer. Single tier, client–server, multi–tier architectures. Basic technologies of web application development: dynamic HTML, Java Scripts, Java Server Pages. Advanced techniques for developing interactive web applications using Ajax. Technologies for Web 2.0. Methodologies for analysis, design, and implementation of applications using the object–oriented model: use cases, CRC cards. UML: Class, Sequence, Collaboration, State, Activity, Component, Deployment Diagrams, Stereotypes, Constraints, OCL. Development of structured applications using web application design patterns. BCED patterns, Control layer patterns, Data Access Object, CRUD framework. Design and development of user interfaces in the web. Information structuring and presentation in the web: Document Object Model (DOM), Cascading Style Sheets (CSS). Principles and guidelines for User Interface design. User Interface design rules, design and implementation of special User Interface components (menus, forms, etc.). Color selection, help. Main mistakes in designing user interfaces in the web. Usability analysis methodologies: Interface mock–ups, prototypes, interface flow diagrams. Usability analysis from experts with usability evaluation techniques. Methodologies for usability improvement of web applications. Usability engineering. Methodologies for mapping UML object oriented models into relational models. Methodologies for complete application development and their application in web applications: Waterfall Model, unified process, ICONIX methodology. Tools for collaborative development of user interfaces.

Multimedia Management Methods AIS 404

Processing, archiving, and searching multimedia information including documents, one–dimensional signals, still and moving images (video) in information systems and the Internet. Classic models of information retrieval (binary, relational, probabilistic), information clustering and clustering algorithms (partitional, hierarchical, hybrid algorithms), clustering applications grouping in document collections. Visualization of one–dimensional signals and images in multimedia systems. Feature extraction (color, texture, shape, and spatial relationships) from images. Retrieval methods for one–dimensional signals and images. Indexing techniques in information systems for documents and multimedia information (inverted files, k–d trees, grid files, R–trees). Design of information systems on the Internet, management and analysis of information on the Internet (PageRank and HITS methods). Basic processing techniques and analysis of still and moving images (video) in information systems. Compression techniques, JPEG, MPEG–1, 2, 4, 7 standards.

Machine Vision AIS 405

Basic principles and methodology of machine vision with emphasis on algorithms and applications of machine vision. Image formation, mathematical, geometric, colour, frequentist, discrete models. Basic image processing techniques (filtering, enhancement, normalization). Edge detection, first and second derivative operators. Image segmentation, methods for segmenting or enhancing regions and edges, thresholding techniques. Advanced segmentation techniques (merging and splitting regions and edges, relaxed ordering, Hough technique). Techniques for processing binary images, distance transforms, morphological operators, and region labeling. Analysis, representation, and recognition of images. Representation of edges and regions, representation and recognition of shapes, representation and recognition of structural content. Texture analysis and recognition, structural and statistical methods. Dynamic vision, estimation of motion, optical flow, and trajectory.

Advanced Issues in Databases COMP 406

Coordination and recovery in the operation of database management systems. Distributed databases and operational problems. New SQL–3 standard. Database engines. Advanced database systems and applications (object–oriented, temporal, active, spatial databases, data warehouses). Correlation between mathematical logic and data warehouses (inductive databases).

Fuzzy Logic Technology and Applications SYS 402

Introduction to Fuzzy set theory, fuzzy relations, approximate reasoning, systems based on fuzzy rules, inference engines, applications of fuzzy logic in pattern recognition and control systems.

Embedded Computer Systems ACE 401

Hardware/software systems and codesign, models of computation for embedded systems. Behavioral design, architecture selection, partitioning, scheduling, and communication. Simulation, synthesis, and verification, hardware/software implementation. Performance analysis and optimization, design methodologies and tools. Design examples and case studies.

Electric Measurements and Sensors ACE 402

Electric measurements principles. Analog signal processing (amplification, scaling, filtering, linearization, level shifting, correlation, common mode rejection, isolation, sampling, holding, compression, etc.). Elimination of influences (temperature, humidity, noise, thermoelectric effect, electromagnetic, inductive, capacitive, ground loop, etc.). Digital to analog signal conversion (D/A), analog to digital signal conversion (A/D). Processing of digital signal with µP, PC or DSP). Transducers (displacement, force, speed, acceleration, power, magnetic field strength, frequency, liquid level, liquid flow, pressure, etc.). Sensors (temperature, wind speed, wind direction, humidity, barometric pressure, etc.). Detectors (proximity, microwave, light, smoke, fire, etc.). Actuators. Biomedical transducers, microsensors, sensor arrays, sensor networks, smart sensors. Interfacing sensors to computer, parallel and serial interfaces, USB interface, DMA, the IEEE488 (GPIB) standard, the I2C standard, the CAN standard, modem interfacing, Ethernet interface, Internet interface. Analog and digital multiplexers. Data acquisition. Automated measurements. Control systems with sensors. Measurements error theory.

Biomedical Electronics ACE 403

Introduction: elements of human physiology, biosignal production mechanisms, electrical, magnetic, and optical properties of biological tissues and systems, interaction–electromagnetic radiation with tissues. Biomedical sensors: biodynamic electrodes, electrochemical sensors, photonic sensors, bio–analytical sensors, new technologies (implantable micro–sensors). Electronic Imaging: scanners from gamma–rays to ultrasound, imaging using gamma–Camera, X–ray, nuclear magnetic resonance, ultrasound. New technologies: confocal microscopy, optical tomography, imaging spectroscopy. Electronic therapeutic instrumentation: electric surgical and electric stimulating instruments, radioactive sources, particle accelerators, lasers, lithotripsy, new technologies (photodynamic therapy, robotics). Regulations safety and suitability of medicine electronic technology: biological effects and protection from electric currents, radiation, laser, non–ionized electromagnetic fields, regulations FDA–CE. Special topics and applications: non–invasive diagnosis and monitoring, optical trapping, modeling of normal systems (cardiovascular, respiratory), agitation and control, departmental models and identification of normal systems.

Introduction to the Legal System and to the Technical Legislation SSC 204

Introduction to the legal system. Basic law classification. Elements of public and European law. Elements of civil law (general principles of civil law, contract law, property law). Elements of labour law (individual contract of employment, collective bargaining, labour accidents), commercial law, industrial property (trade–mark, patent), intellectual property, elements of environmental law. Elements of public works law (undertaking and elaboration of public works projects, undertaking and construction of public works, contractor's counter value, procedures to receive a public work, contractual liability, procedures to resolve conflicts in public works, organization of public works contractors).

Micro– and Macro–Economic Analysis SSC 201

Analysis of the supply–and–demand commodity, the theory of the consumer and the firm. Macroeconomic topics for the income and employment determination, the role of investment, and the impact of international exchange.

8th Semester

Theory of Computation COMP 411

Sets, relations, alphabets, languages. Finite state automata, regular expressions, regular languages. Equivalence of finite automata and regular expressions. State minimization. Lexical analysis. Pushdown automata, context–free grammar, context–free languages. Equivalence of pushdown automata and context–free grammars. Syntactic parsing. Turing machines and extensions, unrestricted grammars, recursive languages. Non–determinism, non–deterministic Turing machines, recursive enumerable languages. The language hierarchy. Decidability, computability, non–computability. Church–Turing thesis. Universal Turing machines, reductions. Rice's theorem. Computational complexity and complexity classes. Cook's theorem. Application to compiler construction and laboratory instruction of the tools flex, bison, JavaCC.

Theory and Applications of Automatic Control SYS 411

Introduction and study of classical control systems, modeling of systems based on transfer function, analysis and synthesis of systems using conventional methods, application of Bode, Nyquist, and Nichols diagrams for the design of regulators, examples of applications in control of ships, aircraft, etc. Usage of software packages developed for controlling systems. The PID controller and an introduction to robust control. Analysis of control systems in the state space. Design of systems in the state space.

Information, Semantic, and Services in the Web AIS 412

Information models for the web, information integration from independent enterprises. XML, XML Schema, XSL, XQUERY. Web Information Management: Exchanging, Parsing, Storage, Indexing, Querying: XML Processing Technologies, and XML Databases. Web Services. Concepts and Applications: Basic service standards: XML, SOAP, WSDL, UDDI, REST–Full Web Services and the Web 2.0. Web Service Integration Models: Orchestration, Composition, Choreography. Service Management, Service Oriented Architectures (SOA), Event Based Architectures. Business processes and the B2B scenario in the Web. Business Process Engineering, Workflow Modeling, and Implementation: BPMN, WS–BPEL, BPEL4People, WS–CDL. Business Process Management: Long–Living Processes, B2B Transactions. Semantic Web. Ontologies and ontology languages: Introduction to Description Logics and relationship with conceptual modeling and data bases. RDF, RDFS, OWL, SPARQL. Categorization of ontologies, top level, linguistic, domain. Ontological engineering, ontology learning, ontology reconciliation, mapping and merging ontologies. Implementation of large Semantic Web Applications on databases. Web applications, standards and ontologies; semantic models for multimedia, e–learning, digital libraries, telecommunication applications.

Agent–Based Internet Computing AIS 413

Agents and multi–agent systems. Languages and protocols for communication. Distributed problem solving. Mobile agents. Methodologies for developing multi–agent systems. Personal agents. Information agents. Internet applications (information retrieval, filtering and dissemination). Economic agents and electronic commerce. Applications (business process management, network management).

Principles of Distributed Software Systems COMP 414

Models and methods for interprocess communication. Sockets, shared memory, group communication, remote procedure calls, distributed objects. Basic network programming. Sessions. Protocols. Distributed system architectures: client–server, multi–tier architecture, mediators, code migration, agent systems, peer–to–peer networks. Overview of CORBA, using CORBA IDL. Naming and addressing: names, physical and logical addresses, name services, DNS. Directory services, LDAP. Service oriented architecture. Distributed algorithms: Models, algorithms with coordinator. Time in distributed systems. Causality. Lamport's theorem. Lamport clocks, vector clocks. Global state and snapshots. Basic algorithms without coordinator: leader election, mutual exclusion, byzantine agreement. Search algorithms: distributed data structures, search in peer–to–peer networks, distributed hash tables. Reliability: fault–tolerance, backups, replication. Distributed transactions, two and three–phase commit protocols. Security: Authentication and authorization. Elements of cryptography. Symmetric and asymmetric ciphers. Digital signatures and PKI. The SSL protocol. The Kerberos system.

Information Technology in Education COMP 415

Information technology in education. Politics and degree of integration of information technology in education in Greece and other European countries.

Detailed information technology curricula in secondary education. General concepts and applications in teaching science. Objectives and content of information technology courses. Preparing course material. Evaluation methodologies. Design and evaluation of written exercises. Design and evaluation of laboratory exercises. The use of new technologies in teaching computer programming (educational software, websites, multimedia). Learning from distance. Teaching computer science to adults and persons with disabilities.

Multidimensional Data Management COMP 416

Multidimensional data: raster and vector representations, abstract data types, standard formats. Management of large datasets, performance issues. Storage and retrieval of data in main memory and hard disks. Main applications: GIS, CAD, graphics. Introduction to spatio–temporal databases, data models, languages for spatial, topological and temporal queries. Basic 2–d and 3–d geometry, coordinate systems, elements of cartography. Computational geometry, convex hull algorithms, triangulation, data structures for point location and segment intersection. Geometric data structures, range search, nearest neighbors, special cases, external data structures, distributed data structures. Query processing algorithms. High–dimensional data processing, metric spaces, similarity metrics, optimization problems, linear programming.

Artificial Intelligence COMP 417

Foundation and history of Artificial Intelligence. Intelligent agents and environments. Systematic search methods: uninformed, informed, heuristic. Local search methods. Constraint satisfaction problems and algorithms. Basic game theory and adversarial search. Propositional logic, first–order logic, reasoning, inference algorithms. Knowledge representation and knowledge bases. Reasoning systems, theorem provers, logic programming. Planning problems and algorithms. Planning in the real world and multi–agent planning.

Computer Graphics COMP 418

Computer graphics methods. Useful mathematics. Transformations (translation, rotation, change of co–ordinate system). Rendering equations. Local and global models of diffuse and specular radiant energy. Photorealistic algorithms. Colour theory and displays. Input and output devices and virtual reality systems. Visibility and shadow techniques. Ray tracing, radiosity, antialising, animation, visualization. Optimizations of algorithms based on perception models. Computational image quality metrics.

Compilers COMP 419

Introduction to compilers. Implementation of a simple compiler in C. Lexical analysis, regular expressions and languages, implementation of lexical analyzers using lex/flex. Syntactic analysis, top–down and bottom–up parsing, implementation of parsers using yacc/bison. Semantic analysis. Production of intermediate code. Memory organization and run–time environment of the program. Production and optimization of the final executable code. Implementation of a compiler for a simple programming language.

Computer Networks II TEL 411

Introduction to computer networks and the Internet. Application layer: network application principles, examples of network applications and their protocols (the Web and HTTP, file transfer and FTP, electronic mail and SMTP, the Internet's directory service and DNS), content distribution (web caching, content distribution networks, peer–to–peer systems). Transport Layer: principles and services, connectionless transport and UDP, principles of reliable data transfer, connection–oriented transport and TCP, principles of congestion control, TCP congestion control. Network layer: network service models, routing principles, hierarchical routing, the Internet Protocol (IP), routing in the Internet, router architecture, multicast routing, mobility support and Mobile IP. Multimedia networking: networking applications, streaming stored audio and video, limitations of Internet's best–effort service, protocols for real–time interactive applications (RTP, SIP and H.323), principles for providing Quality of Service guarantees, scheduling and policing mechanisms, integrated and differentiated services, RSVP. Security in computer networks: definition, principles of cryptography (symmetric key and public key cryptography), authentication, data integrity, key distribution and certification, access control (firewalls), attacks and countermeasures, secure E–mail and PGP, transport layer security, network layer security and IPsec. Introduction to computer network management: infrastructure for network management, the Internet–standard management framework and SNMP.

Information Theory and Coding TEL 412

Review of probability theory and random variables. Source coding, memoryless source, entropy, joint and conditional entropy, source with memory, entropy rate, source coding theorem. Fixed–length and varying–length codes, definition and classification of codes, Kraft inequality, Shannon, Huffman, Fano, Shan-

non–Fano–Elias, arithmetic, and Lempel–Ziv codes. Application of source codes in data compression, zip, bzip, pkzip, gzip, 7zip. Channel coding, mutual information between discrete random variables, data processing inequality, differential entropy, maximum differential entropy distributions, mutual information between continuous random variables, communication channel capacity, capacity of simple channels, capacity of the discrete or continuous input Gaussian–noise channel, channel coding theorem. Channel codes, linear block codes, Hamming, Hadamard, Golay, and LDPC codes, optimal (soft–decision) and algebraic (hard–decision) decoding of linear block codes and their performance, error detection and correction, cyclic codes, implementation of cyclic codes, BCH and Reed–Solomon codes, convolutional codes and their optimal decoding, the Viterbi algorithm and its performance, concatenated codes, Turbo code. Application of channel codes in data recording and transmission, CD/DVD, modem, DSL, 3G, DVB, WiFi, WiMAX. Rate–distortion theory, lossy source coding, application in JPEG, MPEG, H.26X.

Natural Language Processing TEL 413

Introduction to computational linguistics and natural language engineering with emphasis on interactive natural language systems. Areas covered: morphology, phonology, syntax (part of speech tagging, parsing), semantics & language understanding, pragmatics and dialogue. Basic modeling tools used: regular expression, finite state machines, weighted (probabilistic) finite state machines, n–gram models (Markov models), context–free & context–sensitive grammars, decision trees, probabilistic grammars, first–order logic, phrase–based translation models. Application covered: spell–checkers, morphological analyzers & stemmers, part–of–speech tagging, robust parsing, natural language understanding, intention recognition, dialogue modeling, dialogue systems, multimodal dialogue systems, statistical machine translation, web applications.

Introduction to Modeling and Performance Evaluation of Communication Networks TEL 414

Introduction to queueing theory based modeling of communication networks (Little's theorem, the M/M/1 and M/M/m/m Markovian queues, the general service time distribution queue, the M/G/1 queue with service vacations, priority queues. Design, modeling and performance evaluation of Medium Access Control (MAC) protocols for: 1) wireless integrated voice/data/compressed video services networks, 2) packet radio networks, 3) wireline high–speed metropolitan/local area networks and wireless local area networks. Transmission scheduling techniques for communication networks.

Statistical Signal Processing for Communications TEL 415

Review of linear algebra tools: rank, span, nullspace, Sylvester's inequality, eigenvalue decomposition of general square and Hermitian matrices, singular value decomposition, properties and applications. Rayleigh quotient, quadratic minimization, matrix inversion Lemma. Spectral analysis: power spectral density, the periodogram estimator and its statistical properties. Line spectra estimation: parametric methods and applications in wireless communications and array processing. Adaptive filtering: Gradient descent, LMS, RLS and convergence analysis. Applications of adaptive filtering in channel equalization.

Modern Topics in Automatic Control SYS 412

Introduction to neural nets, linear separability and its properties, learning laws, Backpropagation, Hopfield, supervised and non–supervised learning laws, simulated annealing, applications in pattern recognition, dynamic neural networks, applications in systems identification and control. Introduction to fuzzy logic, fuzzy dynamical systems, industrial applications, Introduction to adaptive control. DSP dynamical systems control.

Industrial Control Systems SYS 413

Introduction to control of industrial production systems. Scheduling and control. Cost reduction and optimization with quality improvement. Real time quality control. Total quality management. Software simulators used in optimization. The system SIMPLE++. Heuristic and non heuristic optimization methods. Adaptive optimization. Industrial applications. Discrete logic control. Programmable Logic Controllers, production systems, production control.

Neural Networks and Applications SYS 414

Introduction to neural networks, multilayered feedforward neural networks, the Backpropagation algorithm. Recurrent neural networks Hopfield, self–organizing neural networks, Kohonen maps, associative memories. Examples in integrated intelligent system design with neural networks.

Computer Architecture ACE 411

Historical perspective, Performance Trends, Technology Trends, VLSI layout and cost models, Measuring performance, Instruction set paradigms, Superscalar and ILP, Instruction issue, Nonlinear pipes, Branch prediction, Speculation, Limits of ILP, Multithreading, VLIW, Virtual memory, Virtual machine and OS support, Buses, I/O, and disk, Shared memory multiprocessors, Cache coherence schemes, Distributed shared memory Vector/array processors.

Microelectronic System Implementation ACE 412

Design and implementation methodology, rapid system prototyping (RSP), the waterfall model. Project management with PERT and GANTT charts, system cost and time–to–market issues. System decomposition and partitioning, top–down and bottom–up design methodologies. Subsystem reusability, intellectual property (IP) cores, technology mapping, special–purpose architectures. Power analysis, thermal analysis, design for reliability. Intellectual property protection, patents, trade secrets. How to proceed from an initial idea to a final product, startup company issues.

Parallel and Distributed Computer System Architecture ACE 413

Introduction to parallel computer architectures: execution models and the Flynn taxonomy, SIMD and MIMD architectures, shared memory and message passing systems, computer networks. Shared memory architectures and cache coherence, memory consistency models. Networks, clusters of workstations and grid computers as parallel computers. Parallel computer architecture performance evaluation and benchmarks, parallel and distributed software development issues, programming models for parallel computers. Input/Output (I/O) systems for parallel computers.

Optoelectronics ACE 414

Elements of optics and solid–state physics, modulation of light, display devices, Lasers and applications, photodetectors, fiber optics, optical communication systems.

Power Electronics ACE 415

Introduction, thyristors, triacs, power transistors, power MOSFETs, GTO thyristors, IGBT transistors. Rectifiers (single–phase, three–phase, controlled, etc). DC–DC converters, DC–AC inverters, cycloconverters, battery chargers. Maximum power point tracking (MPPT), high–frequency link, snubbers, special inductors and transformers. Power supply units (linear, switching, uninterruptible, power regulation). Heat radiation, harmonics, electromagnetic compatibility, protection. Applications to electric drive systems.

Renewable Energy Sources ACE 416

Introduction to the energy problem. Renewable energy sources categories. Wind energy (wind velocity measurement, estimation of the Weibull distribution parameters, types and operation principles of wind turbines, types and operation principles of electrical generators, interconnection with the power grid, autonomous operation, power absorption maximization). Solar energy, incident solar energy calculations, solar thermal systems, passive solar systems, applications. Photovoltaic solar plants (basic principles, crystalline PV cells, thin film PVs, electrical characteristics of silicon PV cells, autonomous PV systems, grid connected PV systems, maximum power tracking systems, inverters, fundamentals of industrial electronics). Small hydro plants. Electric energy storage systems (batteries, pump storage hydro systems, fuel cells, etc.). Geothermal energy. Biomass. Tidal energy. RES applications. RES legislation elements. Environmental impact of RES.

Computer–Aided Manufacturing PMA 421

Introduction to Computer–Aided Manufacturing, birth – death models, the system M/M/1, Markov systems, the Erlang distribution, collective service, advanced models M/G1, M/G/G/1, G/G/m, advanced models for analyzing production lines. Introduction to the problems and models of flexible manufacturing systems (FMS).

Industrial Sociology SSC 302

The basic concepts of Sociology of Labour and Development, focusing on changes in production systems generally and particularly in the manufacturing sector (middle and large size industry), in conjunction with relevant sectors of production and scientific activity. Analytic and synthetic approach at various scales (international, national, local–regional) to issues relating to industrial relations, production processes, research and development (R&D), the know–how, industrial policy, interdisciplinary and interindustrial relations.

9th Semester

Software Engineering COMP 501

Software processes. Management of procedures for building large software systems. Risk analysis and risk management. Issues of organization and staffing.

Analysis and requirements setting. Techniques for software development with emphasis on object–oriented methods and UML. Design patterns and frameworks. Version control. Software testing. Certification and quality assurance. Software maintenance and product delivery strategies.

Human–Computer Interaction AIS 502

The goal of this course is to present the principles and methods of evaluating human computer interaction. Cognitive models, perception, vision, attention and memory workload, knowledge acquisition evaluation. Technologies and interactive methods. Advantages and disadvantages of such methods. Interaction interfaces (menu–based, natural language, forms, etc.). Principles of interaction design. Usability evaluation metrics. Techniques for assessing usability and interactive tools.

Autonomous Agents COMP 503

Agents and environments, uncertainty and probability, probabilistic reasoning. Bayesian networks, exact and approximate inference in Bayesian networks, enumeration and sampling algorithms. Temporal probabilistic reasoning (filtering, prediction, smoothing, most likely sequence), dynamic Bayesian networks. Mobile robot navigation: motion control, path planning, localization, mapping, simultaneous localization and mapping (SLAM). Decision making under uncertainty, Markov decision processes, optimal policies, value iteration, policy iteration. Reinforcement learning, prediction and control, basic and advanced reinforcement learning algorithms. Multi–agents systems, game theory, multi–agent coordination, coordinated learning. Applications to autonomous robotic agents and laboratory instruction of robot programming tools.

Economics of the Information Society AIS 504

The industry of the Information Society and the basic principles for starting and running successful businesses in this domain. The environment of high–tech industries and the environment of the information industry. Basic principles and procedures for the creation of a start–up company in the information domain, emphasizing creativity and technological innovation, focus on goals, opportunity and timing, technology development, marketing, financing, creation of partnerships. The economics of information, information cost, information pricing, business plans, financing, targets of opportunity, market planning, product planning, management of research and development, marketing, sales management, legal coverage for intellectual property rights on information, management and organization of human resources for delivering products and services. The influence of the Internet to the information industry. Market models for producing and distributing products in the market.

Society and Information Technology AIS 505

The importance of spreading information and communication technologies and their applications in society, the restructuring of societies, organizations and businesses, the risks of their misuse, and the legal framework (Greek and European) which governs the operation of enterprises and organizations. Applications of information technology in society: e–government, e–commerce, e–tourism, e–health, e–learning, e–services, environmental monitoring. Integrated television and Internet services and applications. Basic principles of protection of personal information and individual rights, productivity, quality of work, monitoring, user communities, preservation of social groups. Mechanisms of encryption and security of personal data. Automation of business operations. Patents, intellectual property rights, ways of protecting and exploiting multimedia and software products. Legislation (Greek and European) for the operation and collaboration of businesses in research, creation, and marketing of multimedia products and information technology.

Data Management and Processing in Sensor Networks COMP 506

Sensor nodes: Characteristics, constraints. Sensor network applications. Distributed data processing in sensor networks. Continuous Queries. Types of continuous queries and their characteristics. Query Languages. Data collection techniques (pull–based and push–based). Data storage, indexing and search techniques. Aggregation tree. Synchronization and data transmission. Different techniques of forming the aggregation tree. Distributed sensor (self)-organization. Approximate queries in sensor networks. Observing moving objects. Information loss and duplicate calculation of information: means of handling such issues. Quality of sensor measurements. Ways of isolating and removing spurious measurements.

Modern Topics in Computer Science COMP 52x

1. Information System Security COMP 521

Introduction (history, classical cryptography). Steganography: methods of concealing information (information hiding, digital copyright marking, covert channels), steganalysis. Secure architecture: threats/attacks, security

mechanisms/services, security design/policies. Symmetric cryptography: component codecs, operating methods, DES/3DES/AES algorithms, applications/attacks. Asymmetric cryptography: the structure cryptographic systems based on public key, digital signatures, key management, RSA/DH algorithms, applications/attacks. Message authentication: secure summarization functions (MACs & hash functions), MD5/SHA–1/HMAC algorithms, applications/attacks. Cryptographic protocols: authentication/distribution of keys, examples (passwords, challenge–response, Lamport's Hash, Wide–Mouthed Frog, Needham–Schroeder, Otway–Rees, Kerberos), design principles and attacks. Public Key Infrastructure (PKI): digital certificates, certification service providers, certificate management, limitations. Security protocols on the Internet: network–level (IPsec) and transport level (SSL, TLS, WTLS, SSH) security protocols. Secure e–mail: protocols PGP, S/MIME. Security of electronic payments: electronic cash, on–line protocols for payments and credit cards. Security of electronic voting: requirements, protocols, examples, and attacks. Security of software and operating systems: programming errors, cryptographic libraries, trusted computing base. Electronic war: information as a competitive weapon, critical infrastructure, cyber–attacks, monitoring systems. Cryptographic policy and economic security legislation, privacy, anonymity, data protection, intellectual property, technological/financial incentives for the development of secure and safe products.

Wireless Telecommunication Systems and Networks TEL 501

Introduction to wireless networking technologies. Wireless network architectures. Wireless Medium Access Protocols. Wireless Wide Area Networks (WWANs): principles of cellular networks (cell structure, frequency reuse, mobility management), second generation systems (GSM, GPRS), third generation systems (UMTS). Mobility support in IP Networks (Mobile IP, WAP). Wireless Metropolitan, Local and Personal Area Networks (WMANs, WLANs, WPANs): WiMax and IEEE 802.16 (network architecture, protocol architecture, MAC layer, physical layer), WiFi and IEEE 802.11 (network architecture, protocol architecture, MAC layer, physical layer), Bluetooth and IEEE 802.15, wireless ad hoc and sensor networks (architecture, protocols, routing algorithms).

Modern Topics in Telecommunications TEL 52x

1. Optical Communication Systems TEL 521

Fiber optic and electro–optic devices technology, Laser as an optical communication signal source, transmission and detection of optical signals. Applications of optical systems in modern telecommunications.

2. Satellite Communications TEL 522

Analysis and design of satellite communication links. Applications of digital communication systems in satellite links. Satellite links in wide area networks. Analysis of intersystem interference in satellite communications.

3. Advanced Topics in Digital Communications TEL 523

Trellis coded modulation, trellis coded quantization. Hierarchical modulation for unequal error protection (priority bits – detail bits). Joint source – channel coding: Shannon's separation theorem for the unlimited decoding delay case (infinite codeword length). Practical communication systems and the advantages of joint source – channel coding.

4. Modern Coding Theory TEL 524

Modern coding and decoding techniques that approach Shannon's channel capacity. Data transmission with rate close to channel capacity and low error probability. Viterbi and BCJR algorithms for decoding of convolutionally coded signals. Decoding of linear block codes using convolutional decoding techniques. Turbo and Gallagher's low–density parity check codes and iterative decoding using two maximum–likelihood decoders and a priori information exchange.

5. Introduction to Asynchronous Transfer Mode (ATM) Networks TEL 525

Integrated Services Digital Networks, Circuit, Message and Packet Switching, Broadband ISDN, Asynchronous Transfer Mode (ATM). Source Characterization in ATM Networks: Quality of Service metrics, source traffic models. Traffic management in ATM networks: Call Admission Control, traffic policing and the Leaky Bucket Algorithm, reactive congestion control mechanisms. Routing in ATM networks. Switching in ATM networks: shared medium, shared memory and space division architectures, Banyan switches and their performance analysis. Introduction to queueing theory based modeling of communication networks: Little's theorem, Markovian queues (M/M/1, M/M/m, M/M/m/m), the M/G/1 and G/M/1 queues with server vacations, priority queues. Packet transmission protocols for third generation integrated services wireless networks. Scheduling techniques for packet data broadcasting over wireless channels.

Principles of Biomedical Systems SYS 501

X–ray and Non–X–ray systems, ultrasounds, MRI, Computerized tomography, 3–D volume space projection, biomedical image rendering, differences between liquids, solids and flesh. Surgical robot, applications and programming, laparoscopic surgeries, surgical automations.

Robotics SYS/PMA 502

Introduction to robotic systems, robotic manipulators, robot kinematics and dynamics. Robot programming languages, analysis and design. Vision, tactile and force sensors, analysis and their operation. Automatic control problems in robots and their applications.

Control Systems Design SYS 503

Process models. Performance criteria. Safe operation constraints. Quality description. Error functions. Theoretical performance limits. Linear controllers, PID. Model based control. Controller tuning. Manual tuning methods, automatic tuning and adaptation. Elements of non–linear controllers, Examples in design of automatic control systems.

Applications of Neuro–Fuzzy Logic in Control Systems SYS 504

Scheduling and routing problems, industrial optimization, QoS control in multimedia applications. ATM traffic control, channel equalization and channel assignment. Neuro–fuzzy applications in character recognition and document analysis.

Optimal Control SYS 505

Introduction to the calculus of variations, Pontryagin's maximum principle, and application of the method to finding a solution in the problem of optimal control for a deterministic dynamical system and to determining the boundary conditions for the boundary value problem. Applications of optimal control in practical problems, such as a minimum fuel consumption, application in biological problems, application in economic models.

VLSI and ASIC System Design ACE 501

Very Large Scale Integration (VLSI) circuit technology, Field Effect Transistor (FET) principles, processing technologies, design under scale, design flows and design rules. Basics of ratioed logic. Circuit and digital logic design of Complementary Metal Oxide Semiconductor (CMOS) circuits. The pass transistor and the CMOS switch, logic gates in fully complementary logic. Design methodology for Application Specific Integrated Circuits (ASIC) and system design issues. Dynamic logic with precharge/evaluate circuits. Sequential logic with 2–phase and multi–phase clocks. Static and dynamic RAM design. Power distribution and clock distribution methodologies.

Electronic System Testing ACE 502

Fault modeling, stuck–at, and open circuit faults, and fault categories, permanent/transient. Testing equipment, bed–of–nails and boundary testing methods. Testing algorithms, FAN, PODEM, etc. Automatic test pattern generation (ATPG), fault isolation. Simulation of faults in combinational and sequential circuits. Fault isolation and fault location determination. Self–test design techniques, built–in self–test (BIST). Scan–based design and testing of circuits: Boundary scan, LSSD, system level testing with JTAG.

Analog CMOS Design ACE 503

Introduction to Design of Analog VLSI circuit technology with CMOS. Basic structures: MOSFET, diodes, resistors, capacitors poly and MIM, MOS varactors. Physics of MOS transistors, charges checking model. Operation modes of MOSFET, patient, moderate and strong inversion, saturation and non–saturation. Ideal symmetrical design model. Model of interconductance and capacities. Equivalent circuit with weak signal at low, medium and high frequencies. Effect of temperature, thermal and flicker noise. Short channel phenomena. Parasitic phenomena in resistance, capacitance, current drain, and compatible bipolar operation. Layout, statistical behaviour and matching. Inversion index, design principles based on inversion index and channel length: DC profit, transitional frequency, noise, saturation voltage, DC matching. Circuit design libraries in SPICE tools. EKV model of MOS transistors. Basic structures of analog CMOS circuits. Current mirrors, voltage and current sources. Key structural components of amplifiers. Differential pair, differential amplifier. Design of operational amplifiers OpAmps and OTA. Special CAD tools for designing analog CMOS circuits.

Modern Topics in Electronics and Computer Architecture ACE 52x

1. Reconfigurable Computing Systems ACE 521

Design with reconfigurable logic (FPGA). Application mapping to fine–grain and coarse grain reconfigurable logic. Usage of embedded block RAM (BRAM) and clock distribution mechanisms (PLL/DLL). Methods to download designs to FPGA's. Design flows, manual placement, critical path analysis, optimization for speed or logic density or power consumption. Design for very high speeds (› 200MHz).

2. Design for Reliability and Fault Tolerance ACE 522

Fault modeling, redundancy techniques, reliability evaluation, error detection and correction codes, self–checking circuits, triple– and n–mulular redundancy (TMR, nMR), fault detection. Failsafe software. Case studies and architectures for fault tolerance (e.g. ESS6, Tandem). Hardware vs. software faults, n–version programming, checkpointing. Case studies.

3. Real–Time Systems ACE 523

Definition of real–time systems, alternative constraints (e.g. hard/soft real–time), task scheduling algorithms, examples of real–time operating systems for microprocessors (e.g. VX WORKS, TRON). Constraints in actual systems with asynchronous events (e.g. interrupts, DRAM refresh) and unpredictable performance (e.g. cache memories). Examples of actual real–time systems (e.g. avionics).

4. Low Power Systems ACE 524

Study of power reduction methods in high performance computing systems. Methods for static as well as dynamic power reduction. Approaches at the architectural level, logic design level, and circuit level. Description and implementation of CAD tools to model aspects of power estimation and assessment of power reduction. Methodology for power characterization and modeling, as well as power measurement from actual systems.

5. High–Performance Architecture ACE 525

Advanced (micro) architecture. The program as an intermediate representation. VLIW, super–scalar, decoupled access–execute, simultaneous multi–threading, multiscalar architectures. Branch and data prediction. Trace cache, clustered micro–architectures. Software pipelining. High performance memory system organization. Low power/energy architectures. Case study and comparison of the latest microprocessors.

6. Computer Aided Circuit Analysis ACE 526

Graph theory, circuit topology, the node analysis method, the mesh analysis method, simulation algorithms, DC response, AC response, transient response, Monte–Carlo analysis, sensitivity analysis, spectrum analysis, Fourier and FFT analysis. Simulation of actual electronic components. Circuits study using the SPICE program.

7. Power Electric Systems ACE 527

Introduction. Three–phase currents. Electric energy production (types of generation plants, steam turbines, gas turbines, Diesel units, hydroelectric units). Transmission and distribution of the electric energy (transmission lines, transformers, sub–stations). Electric generators (synchronous, inductive and DC). Electric drives (synchronous, inductive, DC, stepper, linear, RPM control). Electric installations. Environmental aspects.

8. Electronic Systems for Energy Management ACE 528

Categories of energy systems. The management problems and the role of electronics to their solution. Introduction to the Renewable Energy Sources (RES). Operation and characteristics of electronic systems in RES installations (wind farms, photovoltaic arrays, small hydroelectric units, etc). Software and hardware for RES energy management. Applications. The energy saving problem in buildings and houses. Introduction of the “smart building” concept. Sensors and actuators for energy management in buildings. Energy support systems for buildings (heating, cooling, ventilation, illumination). Software and hardware for energy management and interior conditions control in buildings. Conventional electronic systems for energy management and interior conditions control in buildings. Simulation tools and energy calculations of buildings. Distributed electronic systems and artificial intelligence methods for energy management and interior conditions control of buildings. Electronic units for interconnection of small RES plants to buildings. Applications.

9. RF Telecommunication Circuits Design ACE 529

High frequency amplifier circuits (RF, VHF, UHF, video), oscillators, frequency synthesizers, PLLs, tuned power amplifiers, receivers (RF, VHF, UHF), modems, noise.

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ΥΠΟΥΡΓΕΙΟ
ΕΘΝΙΚΗΣ ΠΑΙΔΕΙΑΣ
& ΘΡΗΣΚΕΥΜΑΤΩΝ

Το Προπτυχιακό Πρόγραμμα Σπουδών του Τμήματος Ηλεκτρονικών Μηχανικών & Μηχανικών Υπολογιστών του Πολυτεχνείου Κρήτης έχει ενταχθεί στο 2ο Επιχειρησιακό Πρόγραμμα Εκπαίδευσης και Αρχικής Επαγγελματικής Κατάρτισης (ΕΠΕΑΕΚ ΙΙ) του Υπουργείου Εθνικής Παιδείας και Θρησκευμάτων, με τη συγχρηματοδότηση της Ευρωπαϊκής Ένωσης και του Ευρωπαϊκού Κοινωνικού Ταμείου (ΕΚΤ).

ΕΥΡΩΠΑΪΚΗ ΕΝΩΣΗ
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