# Department of Electrical and Computer Engineering
# University of Cyprus
# Undergraduate Prospectus 2007

# Introduction

Electrical and Computer Engineering (ECE) is a key discipline, at the heart of the technology frontier. It deals with the design and analysis of electrical, magnetic and optical devices, and the processing, control, and transmission of information and energy. The tools used in electrical and computer engineering include electrical, electromagnetic and optical phenomena, systems theory, and computational hardware and software.

Electrical Engineering is a broad field that covers many diverse areas of study such as microelectronics, digital communications, wireless systems, photonic systems, power systems, signal processing, computer technology, microprocessors, automation and feedback control, neural networks, and electronic device fabrication. Computer engineering is the science and technology of design, implementation and maintenance of the hardware and software components of modern computing systems and computer-controlled equipment. Computer engineers are solidly grounded in the theories and principles of computing, mathematics and engineering, and apply these theoretical principles to design hardware, software, networks, and computerized equipment and instruments to solve technical problems in diverse application domains. Students and faculty in Electrical and Computer Engineering also develop synergies with disciplines outside of engineering; for example with medicine and the life sciences that can lead to education and research in biomedical engineering.

The job opportunities for electrical and computer engineers are many, and is anticipated to be even more in the future as technology pushes into new frontiers. Electrical and computer engineers work in industry, private practice, government agencies and education and research organizations performing functions that include research and development, planning, designing, construction, operating and maintaining a variety of electrical and computing apparatus and systems. They also test equipment, solve operating problems, and estimate the time and cost of projects. Beside manufacturing, research, development and design, many are employed in administration and management or technical sales.

## *Degrees Offered*

The Department is offering two undergraduate and four postgraduate degrees as follows

- BSc in Electrical Engineering
- BSc in Computer Engineering
- Master in Electrical Engineering
- Master in Computer Engineering
- PhD in Electrical Engineering
- PhD in Computer Engineering

This guide focuses on the undergraduate programs of study. Refer to the Graduate Prospectus for information on the graduate programs of study.

## *Areas of Research*

Research in the Department of Electrical and Computer Engineering focuses on the following areas:

1. Telecommunications Systems and Networks
2. Signal and Image Processing
3. Biomedical Engineering
4. Power and Renewable Energy Systems

5. Electronic Devices and Nanotechnology
6. Decision, Control and Automation Systems
7. Computational Intelligence and Robotics
8. Electromagnetics, Microwaves, Antennas and Optics
9. Digital Hardware Design and Test
10. Computer Networks
11. Software Systems and Real Time Computing
12. High Performance Computing and Architectures

For more information on the Faculty of the Department and their individual research interests please consult the "Academic Staff" section of this prospectus.

## Department's Mission

The mission of the Department of Electrical and Computer Engineering at the University of Cyprus is to provide a comprehensive, state-of-the-art education that prepares students to be successful in engineering practice and advanced studies. The Department's graduates command the fundamentals of Electrical and Computer Engineering and gain in depth knowledge in one or more specialization areas. The Department's objectives are met through programs of study that consist of basic mathematics and science courses, core courses that promote ECE fundamentals and technical electives that provide in depth specialization in various technology areas. The programs encourage a balanced mixture between theoretical and experimental work.

## General Objectives

The following objectives apply to both of the programs offered by the ECE Department, Electrical Engineering (EE) and Computer Engineering (CE). All Department's graduates should gain the following.

1. Sound knowledge of mathematics and general science. Knowledge of probability and statistics applicable to ECE. Ability to apply knowledge of mathematics, science, and engineering to solve engineering problems.
2. Ability to identify, formulate, and solve engineering problems using techniques, skills and modern engineering tools necessary for engineering practice.
3. Basic component and systems level understanding and their integration. Ability to design a system, component, or process to meet desired needs.
4. Ability to design and conduct experiments as well as analyze and interpret data.
5. Ability to troubleshoot engineering problems.
6. Ability to function on multidisciplinary teams and to communicate effectively. Ability to perform in leadership roles.
7. Knowledge of contemporary issues and ability to apply ECE principles to address the technological challenges of the future.
8. Understanding of professional and ethical responsibility.
9. Broad education necessary to understand impact of engineering solutions in global/societal context. Recognition of need for and ability to engage in lifelong learning.

## Specific Program Objectives

Each of the offered programs of study has its own specialized learning objectives as indicated below.

### *Electrical Engineering (EE) Objectives*

These are learning objectives that apply to the EE program. Students should have the following abilities and skills

1. Ability to use software packages and write computer programs to solve engineering problems.
2. Knowledge of basic electrical and electronic components and their use in analogue and digital circuits.
3. Ability to develop and use models for the analysis and design of components and systems.
4. Breadth of knowledge in the areas of electronics, electromagnetics, communication systems, power systems, optical engineering, digital logic, computer organization and microprocessors.
5. Demonstrate in depth knowledge in at least one of the areas of communication systems, signal processing, feedback control systems, computational intelligence, power systems, microwave and optical engineering, antennas, electronics, bioengineering.

### *Computer Engineering (CE) Objectives*

These are learning objectives that apply to the CE program. Students should have the following abilities and skills

1. Ability to use software packages and write computer programs to solve engineering problems.
2. Knowledge of basic electrical and electronic components and their use in analogue and digital circuits.
3. Ability to develop and use models for the analysis and design of computer systems.
4. Breadth of knowledge in the areas of computer organization, microprocessors, computer architecture, operating systems, computer networks and engineering computing..
5. Demonstrate in depth knowledge in at least one of the areas of computer architecture, very large system integration (VLSI), intelligent systems, computer networks, simulation and software engineering.

## Undergraduate Degree Programs

The program of studies at the University of Cyprus is based on the European Credit Transfer Systems (ECTS) units. The ECTS is a tool for promoting pan-European recognition of programs of study and qualifications. It is a tool for establishing and securing transparency, as well as a means for building communication and cooperation among institutions, while simultaneously broadening the educational choices of students. Roughly, an ECTS unit corresponds to a student workload of 25-30 hours (including lectures, tutorials, labs, projects etc.). To obtain a B.Sc. degree in Electrical or Computer Engineering 240 ECTS units are required. These are distributed to basic science courses, ECE core and elective courses, design project, and to language and free elective courses as shown in **Table** 1.

Required science courses include courses from the faculties of mathematics, physics, biology, computer science and management. General free elective courses should be taken from at least two different Faculties of the University of Cyprus (not included in the student's specialization).

The first and second years of the Electrical Engineering (EE) and Computer Engineering (CE) programs are common. Students are initially admitted into the Department of Electrical and Computer Engineering. By the end of their 2nd year, students select, in consultation with their academic advisor, to enter either in the EE program or CE program.

| | Course Category | ECTS Units | | | Course Category | ECTS Units |
|---|---|---|---|---|---|---|
| 1 | Required science courses | 66 | | 4 | Capstone design project | 14 |
| 2 | ECE core courses | 99 | | 5 | Foreign languages | 10 |
| 3 | ECE elective courses | 36 | | 6 | General free electives | 15 |
| | | | | | **Total** | **240** |

**Table 1:** Degree requirements

During the first two years, the program of study is structured to provide students with a rigorous body of knowledge in mathematics, physics and electrical engineering fundamentals, which is essential in achieving a deep understanding of more advanced electrical engineering topics. In the third year the students, depending on their degree program, receive training in more advanced but fundamental topics in electrical or computer engineering. In the fourth year, students have the flexibility to select elective courses from a variety of specialization areas according to their individual interests, from more than one area of specialization. In addition, the fourth year also includes a team design project, which can be chosen from a variety of categories. The project is intended to prepare students in addressing challenging engineering problems, which require collaboration with other students and integration of electrical and computer engineering knowledge.

## EE and CE Common Program of Study

As already mentioned, during the first two years, the Electrical Engineering and Computer Engineering programs are common. All students are required to take the courses listed below (First and Second Year). It is emphasized that the material covered in various courses may heavily depend on the material covered in earlier courses. As a result, students will not be allowed to register for courses for which they do not fulfill the prerequisite requirement. The prerequisites for each course are shown in the Course Description Section. In addition, these course dependencies are summarized in the flowcharts shown at the end of that section.

The course lists below explicitly show the students' expected workload in hours per week classified as class Instruction (I), Tutorial (T), Lab (L) and Homework (H). Courses marked with an 'X" in the P-column indicate that they include some design projects. As already mentioned, there is a direct relationship between the ECTS Units assigned to each course and the expected student workload. This relationship is explained through the following example: ECE 100 is assigned 5 ECTS Units because the student workload over the entire semester is expected to be something between 125-130 hours[1]. This workload is broken down into 3 hours of class instruction, 1 hour of laboratory work and 5 hours of homework per week. Over the first 13 weeks of the semester the total student workload is about 110 hours. Students are also expected to work for about 15-30 hours to prepare for the final examination. Thus the total course workload is about 125-140 hours which corresponds to the 5 ECTS Units. The ECTS Units of all other courses are similarly evaluated.

[1] An ECTS Unit represents a workload of 25-30 hours, therefore 5 ECTS units represent 125-150 hours.

## First Year

| Code | Course Name | I[2] | T | L | H | P | ECTS Units |
|---|---|---|---|---|---|---|---|
| PHY 131 | General Physics I | 3 | 1 | | 5 | | **6** |
| MAS 021 | Calculus I | 3 | 1 | | 5 | | **6** |
| BIO 101 | Intro to Modern Biology | 3 | | | 5 | | **5** |
| ECE 100 | Intro to Design and Engineering | 3 | | 1 | 5 | X | **5** |
| ECE 101 | Intro to Design and Eng. Lab | | | 3 | 1 | X | **2** |
| LAN 100 | General Advanced English | 3 | | | 5 | X | **5** |
| | **Semester Total** | 14 | 2 | 3 | 25 | | **29** |
| PHY 132 | General Physics II | 3 | 1 | | 5 | | **6** |
| MAS 022 | Calculus II | 3 | 1 | | 5 | | **6** |
| CS 034 | Programming Principles I | 3 | 1 | 3 | 3 | X | **7** |
| ECE 102 | Electrical Circuits and Networks | 3 | 2 | | 6 | | **7** |
| LAN 104 | English for Technical Purposes | 3 | | | 5 | X | **5** |
| | **Semester Total** | 15 | 4 | 3 | 24 | | **31** |

## Second Year

| Code | Course Name | I | T | L | H | P | ECTS Units |
|---|---|---|---|---|---|---|---|
| MAS 023 | Mathematics III | 3 | 1 | | 5 | | **6** |
| ECE 210 | Digital Logic Design | 3 | 1 | | 5 | | **6** |
| ECE 211 | Digital Systems Lab | | | 3 | 4 | X | **4** |
| CS 035 | Data Structures and Algorithms | 3 | 1 | 2 | 4 | X | **7** |
| ECE 203 | Circuits and Measurements Lab | 2 | | 3 | 3 | X | **5** |
| | **Semester Total** | 11 | 3 | 8 | 21 | | **28** |
| MAS 024 | Mathematics IV | 3 | 1 | | 5 | | **6** |
| PHY 133 | General Physics III | 3 | 1 | | 5 | | **6** |
| ECE 220 | Signals and Systems I | 3 | 1 | | 5 | | **6** |
| ECE 205 | Electronic Devices and Circuits I | 3 | 1 | | 5 | | **6** |
| ECE 212 | Computer Organization & Microprocessors | 3 | | | 5 | | **5** |

[2] These numbers indicate the student's expected workload in hours per week: I – class Instruction, T – Tutorial, L – Lab, H – Homework. P indicates that the course includes a design project.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ECE 213 | Computer Org. & Microprocessors Lab. | | | 3 | 3 | X | **3** |
| | **Semester Total** | 15 | 4 | 3 | 28 | | **32** |

## *Electrical Engineering (EE) Program of Study*

During the third year, students elect to follow the EE program of study. These students are required to take the following courses.

### Third Year

| Code | Course Name | I | T | L | H | P | ECTS Units |
|---|---|---|---|---|---|---|---|
| ECE 305 | Electronic Devices and Circuits II | 3 | | | 5 | | **5** |
| ECE 320 | Signals and Systems II | 3 | 1 | | 5 | | **6** |
| ECE 331 | Electromagnetic Fields | 3 | 1 | | 5 | | **6** |
| ECE 325 | Iterative Methods | 3 | | 2 | 3 | X | **6** |
| | General Free Elective | 3 | | | 5 | | **5** |
| | **Semester Total** | 15 | 2 | 2 | 23 | | **28** |
| ECE 306 | Electronic Devices and Circuits Lab | 1 | | 3 | 3 | X | **5** |
| ECE 324 | Intro to Random Signals and Systems | 3 | 1 | | 5 | | **6** |
| ECE 333 | Electromagnetic and Optical Engineering | 3 | 1 | | 5 | | **6** |
| ECE 359 | Intro to Communication Systems | 3 | | | 5 | | **5** |
| ECE 340 | Power Engineering | 3 | | | 5 | | **5** |
| | General Free Elective | 3 | | | 5 | | **5** |
| | **Semester Total** | 16 | 2 | 3 | 28 | | **32** |

### Fourth Year

| Code | Course Name | I | T | L | H | P | ECTS Units |
|---|---|---|---|---|---|---|---|
| ECE 401 | Capstone Design Project | | | | 10 | X | **7** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 5 | | **5** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| | General Free Elective | 3 | | | 3 | | **6** |
| | **Semester Total** | 12 | 3 | 6 | 24 | | **30** |
| ECE 402 | Capstone Design Project | | | | 10 | X | **7** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| PBA434 | Entrepreneurship Management | 3 | | | 5 | | **5** |
| **Semester Total** | | 12 | 3 | 6 | 24 | | **30** |

## EE Areas of Concentration

Students following the Electrical Engineering program should take 6 elective courses (36 ECTS units) from the following list of technical elective courses, including 3 courses from one of the following areas of concentration (subject to approval, a student may select one or two Computer Engineering electives).

**Communication Systems and Networks**

ECE 360 Computer Networks
ECE 420 Stochastic Processes
ECE 429 Digital Signal Processing
ECE 450 Information Theory
ECE 451 Advanced Communication Systems
ECE 453 Wireless Telecommunication Networks
ECE 455 Fiber-optics Communication
ECE 456 Communication Systems Laboratory
ECE 457 Computer Systems and Network Security
ECE 464 Mobile Computing Systems
ECE 466 Performance Evaluation of Computer Systems and Simulation
ECE 468 Optimization for Engineers
ECE 484 Modeling and Simulation of Computer Systems

**Biomedical Engineering**

ECE 429 Digital Signal Processing
ECE 471 Neurophysiology and Senses
ECE 473 Instrumentation and Sensors
ECE 474 Bio-instrumentation and Physiology Laboratory
ECE 476 Biomedical Imaging
ECE 477 Biomedical Optics
ECE 478 Digital Image Processing

**Power Engineering**

ECE 422 Dynamic System Control
ECE 441 Electromechanical Energy Conversion
ECE 442 Power System Analysis
ECE 444 Power Electronics
ECE 445 Power Systems: Generation and Control
ECE 447 Renewable Energy: Photovoltaics
ECE 448 Advanced Electric Machines
ECE 468 Optimization for Engineers

**Control Systems and Computational Intelligence**

ECE 420 Stochastic Processes
ECE 421 Introduction to Computational Intelligence
ECE 422 Dynamic System Control
ECE 423 Advanced Computer Control
ECE 424 Fault-Tolerant Systems
ECE 425 Introduction to Robotics
ECE 427 Embedded and Real-Time Systems
ECE 428 Control Systems Laboratory
ECE 429 Digital Signal Processing
ECE 468 Optimization for Engineers

**Waves and Antennas and Optics**

ECE 430 Electromagnetic Theory
ECE 431 Radio Frequency and Microwave Circuits
ECE 433 Optical Engineering
ECE 434 Introduction to Photonics
ECE 435 Optical Engineering and Photonics Laboratory
ECE 436 Solid State Electronic Devices
ECE 437 Electromagnetic Waves and Antenna Theory
ECE 438 Microwave Circuits
ECE 447 Renewable Sources of Energy: Photovoltaics

## *Computer Engineering (CE) Program of Study*

During the third year, students elect to follow the CE program of study. These students are required to take the following courses.

### Third Year

| Code | Course Name | I | T | L | H | P | ECTS Units |
|---|---|---|---|---|---|---|---|
| ECE 320 | Signals and Systems II | 3 | 1 | | 5 | | **6** |
| ECE 312 | Computer Architecture | 3 | | 2 | 5 | X | **7** |
| ECE 311 | Discrete Analysis and Structure | 3 | 1 | | 5 | | **6** |
| ECE 325 | Iterative Methods | 3 | | 2 | 3 | X | **6** |
| | General Free Elective | 3 | | | 5 | | **5** |
| | **Semester Total** | 15 | 2 | 4 | 23 | | **30** |
| ECE 324 | Intro to Random Signals and Systems | 3 | 1 | | 5 | | **6** |
| ECE 317 | Engineering of Computing | 3 | | 2 | 5 | | **6** |
| ECE 313 | Engineering of Operating Systems | 3 | | 3 | 5 | X | **7** |
| ECE 360 | Computer Networks | 3 | | 2 | 5 | | **6** |
| | General Free Elective | 3 | | | 5 | | **5** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Semester Total** | 15 | 2 | 5 | 25 | | **30** |

## Fourth Year

| Code | Course Name | I | T | L | H | P | ECTS Units |
|---|---|---|---|---|---|---|---|
| ECE 401 | Capstone Design Project | | | | 10 | X | **7** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 5 | | **6** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| | General Free Elective | 3 | | | 5 | | **5** |
| | **Semester Total** | 12 | 3 | 6 | 24 | | **30** |
| ECE 402 | Capstone Design Project | | | | 10 | X | **7** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| ECE xxx | ECE Technical Elective | 3 | 1 | 2 | 3 | | **6** |
| PBA 335 | Entrepreneurship Management | 3 | | | 5 | | **5** |
| | **Semester Total** | 12 | 3 | 6 | 24 | | **30** |

## CE Areas of Concentration

Students following the Computer Engineering program should take 6 elective courses (36 ECTS units) from the following list of technical elective courses, including 3 courses from one of the following areas of concentration (subject to approval, a student may select one or two Electrical Engineering electives).

**Computer Hardware Systems**

ECE 403 Microprocessor Systems
ECE 404 Computer Hardware Systems
ECE 405 Programmable ASICs Design
ECE 406 Digital VLSI Circuit Design
ECE 407 Computer Aided Design for VLSI
ECE 408 Digital Design with FPGA
ECE 409 Advanced Computer Architecture
ECE 424 Fault-Tolerant Systems
ECE 427 Embedded and Real-Time Systems

**Intelligent Systems**

ECE 420 Stochastic Processes
ECE 421 Introduction to Computational Intelligence
ECE 424 Fault-Tolerant Systems

| | | |
|---|---|---|
| ECE | 425 | Introduction to Robotics |
| ECE | 426 | Artificial Intelligence |
| ECE | 427 | Embedded and Real-Time Systems |
| ECE | 429 | Digital Signal Processing |
| ECE | 468 | Optimization for Engineers |
| ECE | 480 | Brain Computer Interface |

**Computer Networks**

| | | |
|---|---|---|
| ECE | 395 | Introduction to Communication Systems |
| ECE | 417 | Distributed Systems |
| ECE | 420 | Stochastic Processes |
| ECE | 424 | Fault-Tolerant Systems |
| ECE | 450 | Information Theory |
| ECE | 453 | Wireless Telecommunication Networks |
| ECE | 457 | Computer Systems and Network Security |
| ECE | 462 | Network Computing |
| ECE | 464 | Mobile Computing Systems |
| ECE | 466 | Performance Evaluation of Computer Systems and Simulation |
| ECE | 468 | Optimization for Engineers |
| ECE | 484 | Modeling and Simulation of Computer Systems |

### *Capstone Design Projects*

All EE and CE students are required to complete a team capstone design project. This is a full year design project course. During the spring term of their third year, students are required to form teams and each team is required to propose a project. The students can chose a project from any of the following categories:

- Supervisor suggested project
- Student suggested project
- Industry suggested project
- School of Engineering competition project
- Interdisciplinary project in connection with students from other departments

# Course Description

## *ECE Required Core Courses*

| **ECE 100** | **Introduction to Design and Engineering** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☒ | **5** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:** George Ellinas

**Objectives:** Provide and overview of the electrical and computer engineering discipline. Teach engineering design principles. Provide basic electronics and computing skills. Teach engineering ethics. Cultivate teamwork. Teach the students how to research a topic, write a technical report and make a technical presentation. Introduce some basic engineering tools and laboratory equipment.

**Outcomes:**

- The students become familiar with the professions of electrical and computer engineering. They are also acquainted with the various technical areas and specializations within the fields of electrical and computer engineering.

- Learn to apply knowledge of mathematics, science and engineering.
- Develop the ability to work in teams and to communicate effectively with others.
- Demonstrate basic knowledge of the design process by applying it to solve engineering problems.
- Ability to troubleshoot engineering problems.
- Ability to conduct experiments and analyze and interpret data
- Ability to understand professional and ethical responsibilities
- Ability to learn computational tools.

**Description:** This course consists of a series of lectures and labs. In this course the students learn Engineering basics and design principles, the various ECE programs of study, the problems that Electrical and Computer engineers are asked to solve, and the methods used in dealing with engineering problems. This course also provides information on engineering ethics, social implications, intellectual property, project management, and teamwork. Basic electronics and computing skills are taught, as well as library skills and web site design. Several guest lectures are offered on future trends of technology. Lab Topics: Basics of computer use, Basic electronics lab, Fiber optics and lasers lab, Power lab.

**Bibliography:**

- C. B. Fleddermann and M. D. Bradshaw, *Introduction to Electrical and Computer Engineering*, Upper Saddle River: Prentice Hall, 2003.
- D. White and R. Doering, *Electrical Engineering Uncovered*, Upper Saddle River: Prentice Hall, 2001.
- P. Schiavone, *Engineering Success*, Upper Saddle River: Prentice Hall, 2002.
- C. B. Fleddermann, *Engineering Ethics*, Upper Saddle River: Prentice Hall, 2004.
- S. K. Howell, *Engineering Design and Problem Solving*, Upper Saddle River: Prentice Hall, 2002.

**Assessment:** One test and a final examination.
Homework assignments and research project.
Laboratory reports.

| **ECE 101** | **Introduction to Design and Engineering Lab** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 3 | 1 | ☒ | **2** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:** George Ellinas

**Objectives:** Teach engineering design principles. Provide basic electronics, engineering and computing skills. Cultivate teamwork. Introduce some basic engineering tools and laboratory equipment. Teach the students how to work in a laboratory environment. Teach the students how to design and implement a system both in hardware and software to meet certain specifications and perform a specified task.

**Outcomes:**

- Learn to apply knowledge of mathematics, science and engineering.
- Learn to design and implement a system to meet desired needs
- Develop the ability to work in teams and to communicate effectively with others.
- Demonstrate basic knowledge of the design process by applying it to solve engineering problems.

- Ability to troubleshoot engineering problems.
- Ability to learn computational tools.

**Description:** This course consists of a design laboratory. In this course the students learn Engineering basics and design principles, project and time management, and teamwork. Basic electronics, technology and computing skills are taught. The students are asked to solve an engineering problem, usually by designing and implementing a system both in hardware and software. This system must meet given specifications and must perform a specified task. The engineering problem usually involves a robot design and programming and a robotics competition.

**Bibliography:**
-

**Assessment:** Laboratory reports and robotics competition.

| **ECE 102** | **Electrical Circuits and Networks** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 2 | | 5 | ☐ | **7** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:** George Georgiou

**Objectives:** Provide in depth knowledge and understanding in the basic circuit components. Introduce the concepts of current, voltage, power and energy. Provide the tools for analyzing electric circuits.

**Outcomes:**
- Demonstrate knowledge and understanding of the fundamental theorems and methods of circuit analysis.
- Ability to create and use models for analyzing system behavior.
- Ability to perform transient and sinusoidal steady-state analysis.

**Description:** Circuit models: KCL and KVL, mesh current and voltage analysis. Thevinin and Norton equivalent circuits. Network theorems: one-port and two-port networks, sinusoidal steady-state analysis and transient analysis of first- and second-order networks, response to exponential driving functions, power considerations.

**Bibliography:**
- J.W. Nilsson, and S.A. Riedel, *Electric Circuits,* Prentice-Hall, 2000.
- R.C. Dorf, *Introduction to Electric Circuits,* Wiley, 1993.

**Assessment:** Two tests and a final examination
Homework assignments.

| **ECE 203** | **Circuits and Measurements Lab** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | | 3 | 3 | ☒ | **5** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | ECE 102 | | | | | |

**Coordinator:**

**Objectives:** Analyze, design and experiment with electric circuits

**Outcomes:**
- Demonstrate familiarity with laboratory equipment and instruments.
- Ability to validate models through laboratory experimentation.
- Ability to design and test simple circuits.
- Ability to work in teams and communicate effectively with others.

**Description:** Laboratory experiments involving basic instrumentation. Safety and electricity. Signal sources and sinks. Signal acquisition (transducers; signal generators). Signal measurement: Real and virtual instruments. Signal Processing: basic circuits, active circuits, Op-amp amplifier and filter, measurement of frequency response, RC filter with square wave input. Signal analysis & characterization. Speech spectrum.

**Bibliography:**
- Paul Horowitz, Winfried Hill, *The Art of Electronics*
- Stanley Wolf, Richard F.M. Smith, *Student Reference Manual for Electronic Instrumentation Laboratories*

**Assessment:** Laboratory exercises and reports. Design project.

| **ECE 205** | **Electronic Devices and Circuits I** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | ECE 102 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of electronic components and circuits. Introduce Semiconductor devices and their basic applications. Provide the tools for analyzing electronic circuits.

**Outcomes:**
- Demonstrate knowledge of basic semiconductor components.
- Ability to develop and analyze models of electronic components.
- Ability to analyze and design electronic circuits.

**Description:** Semiconductor materials: pn junction, diode circuits, DC and AC diode circuit analysis. Diode circuits: rectifier circuits, clipper and clamper circuits, zener diode circuits, multiple diode circuits, photodiode and LED circuits. Bipolar Junction Transistor: DC analysis, basic applications and transistor biasing. Basic BJT amplifiers: bipolar and common emitter amplifiers, AC load line analysis, emitter-follower amplifier, common base amplifier, multistage amplifier. Field Effect Transistors (FET): MOSFET DC analysis, MOSFET applications. Basic FET amplifier: MOSFET amplifier, common source amplifier, source follower amplifier, amplifiers with MOSFET load devices, multistage amplifiers. Op-amp circuits: Bipolar, BiCMOS, CMOS, voltage regulators, differentiators, integrators, active filters.

**Bibliography:**
- A. Sedra and K. C. Smith, *Microelectronic Circuits*, Oxford University Press, 4th Ed., 1998.
- G. W. Roberts and A. Sedra, *SPICE for Microelectronic Circuits*, Oxford University Press, 2nd Ed., 1997
- D. A. Neamen, "Electronic Circuit Analysis and Design", Irwin, 1996.

**Assessment:** Two tests and a final examination.
Homework assignments.

| **ECE 210** | **Digital Logic Design** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☐ | **6** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:** Maria K. Michael

**Objectives:** Provide knowledge and understanding of Boolean algebra and digital concepts, with concentration on the analysis and design of combinational and sequential logic networks. Provides a foundation for subsequent study in computer architecture and VLSI design.

**Outcomes:**

- Demonstrate knowledge of fundamental Boolean principles and manipulation and their application to digital design.
- In depth understanding of combinational and sequential digital/logic circuits, and modular design techniques.
- Ability to analyze and synthesize logic circuits.
- Basic understanding of datapath and control unit design, and memory basics.

**Description:** Digital number systems and information representation; arithmetic operations, decimal and alphanumeric codes. Binary logic, Boolean algebra (identities, functions and manipulation), standard forms, simplification. Logic gates, switch-level and CMOS implementation, integrated circuits. Combinational logic design: circuits (gate level), design hierarchy and procedures, computer-aided design. Two-level and multi-level implementations. Arithmetic (add, subtract, multiply) and other popular (multiplexers, encoders, decoders) modules. Sequential logic design: latches, flip-flops, state machines design and minimization (Mealy and Moore models), design problems. Registers and Counters. Memory and programmable logic design (ROMs, PLAs, PALs, FPGAs). Language-directed combinational and sequential design (VHDL). Introduction to register-level design: datapath and control, basic computer architecture.

**Bibliography:**


- M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals,* 3rd Ed. (Prentice-Hall, 2004. Companion Website http://www.prenhall.com/mano
- J. A. B. Marcovitz, *Introduction to Logic Design,* McGraw-Hill, 2002.
- F. Wakerly, *Digital Design Principles and Practice,* 3rd Ed., Prentice-Hall, 2000
- M. M. Mano, *Digital Design,* 2nd Ed. (Greek translation), Papasotiriou, Athens 1992
- S. Brown and Z. Vranesic, *Fundamentals of Digital Logic with VHDL Design,* McGraw-Hill, 2000.
- J. P. Hayes, *Introduction to Digital Logic Design,* Addison-Wesley, 1993.
- J. P. Uyemura, A First Course in Digital Systems Design, Brooks/Cole, 2000.


**Assessment:** Two tests and a final examination, Homework and class quizzes

| **ECE 211** | **Digital Systems Lab** | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|
| | | 1 | | 2 | 4 | ☒ | **4** |
| Year: 2 | Core ☒ | Elective ☐ | Co-requisites: | ECE 210 | | | |

**Coordinator:** Maria K. Michael

**Objectives:** To provide hand-on experience in designing and implementing digital/logic circuits. The laboratory experiments involve the design and testing of digital systems using small and medium scale integrated circuits as well as programmable devices. Students are exposed to designing with both discrete components and CPLD/FPGA based system boards. Computer-Aided Design tools and hardware description programming language (VHDL) are used extensively for design, simulation, and verification.

**Outcomes:**

- Ability to design, simulate and implement basic combinational and sequential logic circuits.
- Ability to use digital logic design tools to design circuits according to specifications.
- Ability to test and troubleshoot digital logic circuits.
- Ability to work in teams and communicate effectively with others.

**Description:** The laboratory experiments involve the design and testing of digital systems using small and medium scale integrated circuits. Students are exposed to designing with both discrete components and CPLD/FPGA based system boards. Computer-Aided Design tools and hardware description programming language (VHDL) are used extensively for design, simulation, and verification.

**Bibliography:**


- M. M. Mano and C. R. Kime, Logic and Computer Design Fundamentals, 3nd Ed. Prentice-Hall, 2004. Companion Website http://www.prenhall.com/mano
- S Yalamanchili, VHDL Starters Guide, Prentice-Hall, 1998.
- M. M. Mano, Digital Design, 2nd Ed. (Greek translation), Papasotiriou, Athens 1992
- Robert Dueck, Digital Design with CPLD Applications and VHDL, Delmar/Thomson Learning
- Z. Salcic and A. Samailagic, Digital Systems Design and Prototyping Using Field Programmable Logic and Hardware Description Languages, Kluwer, 2000.


**Assessment:** Laboratory exercises and reports. Design project. Midterm and final exam.

| **ECE 212** | **Computer Organization and Microprocessors** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☐ | **5** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | ECE 210,211, CS034 | | | | | |

**Coordinator:** Maria Michael

**Objectives:** Introduction of students in Electrical and Computer Engineering to the design and organization of modern digital computers by showing the relationship between hardware and software, and focusing on the concepts that are the basis of the current computers such as microprocessors. Provides a foundation to Computer Engineering students for subsequent study in computer architecture.

**Outcomes:**

- Understanding of the fundamentals of modern computer systems, the functionality of their components, instruction sets and their underlying execution.
- In-depth understanding of microprocessor datapath and control unit design, and memory hierarchy.
- Ability to understand and analyse the performance of computer systems and know how to improve their efficiency (pipelining, caches, etc).

**Description:** Introductory course to modern computer organization and architecture, focusing on the programmer visible aspects of the machine, and their corresponding implementation. Topics include: machine language, instruction set architecture (MIPS), computer arithmetic, performance analysis and improvement, microprocessor design, datapath and control unit design, pipelining, memory hierarchy, input/output, and communication.

**Bibliography:**

- D. A. Patterson and J. L. Hennessy, *Computer Organization and Design: the Hardware/Software Interface,* Morgan Kaufmann Publishers,
- M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals,* Prentice-Hall, $3^{rd}$ Ed., 2004.
- D. Steetman, *See MIPS Run*, Morgan Kaufman, 2002.
- J. Hayes, *Computer Architecture and Organization*, McGraw Hill, $2^{nd}$ Ed., 1988.
- J. L. Hennessy and D. A. Patterson, *Computer Architecture: A Quantitative Approach,* Morgan Kauufman, $3^{rd}$ Ed., 2003
- M. Mano, *Computer System Architecture*, Prentice-Hall, $3^{rd}$ Ed., 1993
- E. Farquhar and P. Bunce, *The MIPS Programmer's Handbook,* Morgan Kaufman.

**Assessment:** Two tests and a final examination. Homework assignments.

| **ECE 213** | **Computer Organization and Microprocessors Lab** | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|
| | | 1 | | 2 | 3 | ☒ | **3** |
| Year: 2 | Core ☒ | Elective ☐ | Co-requisites: | ECE 212 | | | |

**Coordinator:** Maria Michael

**Objectives:** To provide an in-depth understanding of the underlying organization of modern computer systems and microprocessors via hands-on experience in design and implementation of such systems. The laboratory experiments include symbolic programming and simple microprocessor design using CAD tools and implementation using programmable devices.

**Outcomes:**

- Practical understanding of computer organization and design.
- Practical experience in symbolic programming using MIPS Assembly and the SPIM simulator.
- Practical experience in microprocessor design and implementation using Computer-Aided Design tools, hardware description languages (such as VHDL) and programmable devices.
- Experience of design team work by participating in a large design project.

**Description:** This laboratory consists of two major parts:

- The first part involves symbolic programming in MIPS Assembly and use of the SPIM simulator extensively (on a Linux platform). Weekly assignments focus on practicing in different individual organizational issues, such as arithmetic function implementation, instruction addressing modes, program stack, decision and branching, program recursion, etc. System-level issues such as interrupts and I/O functions are considered in the project.
- The second part concentrates on design problems using the Altera Max Plus II tools for schematic and/or VHDL design and simulation (Windows platform). A simple microprocessor is designed on a step-by-step basis and implemented using CPLD/FPGA based system boards. The different components of the microprocessor are designed on an individual basis (via weekly assignments) whereas the integration, verification and implementation are a group effort.

**Bibliography:**

- D. A. Patterson and J. L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Morgan Kaufman, 3rd Ed., 2005.
- P. J. Ashenden, *The Student's Guide to VHDL, 2ed*, Morgan Kaufmann Publishers, 1998.
- D. Steetman, *See MIPS Run*, Morgan Kaufman, 2002.
- S Yalamanchili, VHDL Starters Guide, Prentice-Hall, 1998.
- E. Farquhar and P. Bunce, *The MIPS Programmer's Handbook,* Morgan Kaufman.
- M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals,* Prentice-Hall, 3rd Ed., 2004.
- J. L. Hennessy and D. A. Patterson, *Computer Architecture: A Quantitative Approach,* Morgan Kauufman, 3rd Ed., 2003

**Assessment:** Laboratory assignments and design project.

| **ECE 220** | **Signals and Systems I** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | ECE 102 | | | | | |

**Coordinator:** Marios Polycarpou

**Objectives:** Provide the tools for analyzing linear time invariant (LTI) systems in the time and frequency domains.

**Outcomes:**

- Demonstrate knowledge and understanding of the mathematical tools, methods and techniques used for analyzing continuous-time signals and systems.

**Description:** Basic continuous and discrete-time signals in Linear Vector Spaces, impulse functions, basic properties of discrete and continuous linear time-invariant (LTI) systems, difference and differential LTI systems, Fourier series representation of continuous-time periodic and aperiodic signals, Fourier Transform, Laplace transform, time and frequency analysis of continuous-time LTI systems, applications of transform techniques to electric circuit analysis.

**Bibliography:**

- A.V. Oppenheim, A.S. Willsky, and S.H. Nawab, *Signals and Systems*, 2nd edition., Prentice Hall, 1996.
- R.E. Ziemer, W.H. Tranter, and D.R. Fannin, *Signals and Systems: Continuous and Discrete*, Prentice Hall, 1994.

**Assessment:** Two tests and a final examination.

Homework assignments.

| **ECE 320** | **Signals and Systems II** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | ECE 220 | | | | | |

**Coordinator:** Charalambos Charalambous

**Objectives:** Provide the tools for analyzing discrete-time linear time invariant (LTI) systems in the time and frequency domains. Introduce feedback control systems.

**Outcomes:**
- Demonstrate knowledge and understanding of the mathematical tools, methods and techniques used for analyzing discrete-time signals and systems.
- Ability of applying the tools in the analysis and design of communication and feedback control systems.

**Description:** Analysis of LTI single-loop feedback systems via transform techniques. Discrete-time Fourier series, discrete-time Fourier transform, and Z transform. Time and frequency analysis of discrete-time LTI systems, sampling systems, application of continuous and discrete-time signal theory to communication systems, digital control systems, and signal processing.

**Bibliography:**
- A.V. Oppenheim, A.S. Willsky, and S.H. Nawab, *Signals and Systems*, 2nd edition., Prentice Hall, 1996.
- R.E. Ziemer, W.H. Tranter, and D.R. Fannin, *Signals and Systems: Continuous and Discrete*, Prentice Hall, 1994.

**Assessment:** Two tests and a final examination
Homework assignments.

| **ECE 324** | **Introduction to Random Signals and Systems** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Introduce random variables and random processes as they apply in the electrical and computer engineering discipline.

**Outcomes:**
- Demonstrate knowledge and understanding of probability theory and statistics as they apply in the electrical and computer engineering discipline.

**Description:** Basic probabilistic models. Conditional probability and Bayes' rule. Random variables and vectors, distribution and density functions, expectation and characteristic functions. Statistical independence, laws of large numbers, Central-limit theorem. Introduction to random processes; second-order processes. Linear systems subject to random processes inputs; power spectral density.

**Bibliography:**
- A. Leon-Garcia, Probability and Random Processes for Electrical Engineering, $2^{nd}$ Ed. Addison-Wesley, 1994.
- Sheldon Ross, first course in probability

**Assessment:** Two tests and a final examination
Homework assignments.

| **ECE 325** | **Iterative Methods** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 2 | 3 | ☒ | **6** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | CS035 | | | | | |

**Coordinator:**

**Objectives:** Application of iterative methods such as numerical, optimization and computational techniques for solving engineering problems.

**Outcomes:**

- Ability to formulate and solve computationally-based problems.
- Demonstrate knowledge and understanding of numerical and optimization methods such as linear programming, dynamic programming and gradient-based techniques for solving engineering problems.
- Ability to design, implement, test and troubleshoot tools that are based on iterative methods for solving engineering problems.

**Description:** This course covers a broad spectrum of techniques for solving problems using iterative methods. During the course we will study various problems (search, decision, optimization) and we will investigate various algorithmic approaches for solving them. Emphasis will be given to the problem formulation, the precise description of the algorithm that solves the problem, as well as to the analysis of the correctness and efficiency of the algorithms. Topics include: Analysis of Algorithms, Brute Force and Exhaustive Search, Divide-and-Conquer, Decrease-and-Conquer. Problem Transformation, Dynamic Programming, Greedy Algorithms, linear Programming, Decision Trees, *P*, *NP*, and *NP-Complete* Problems.

**Bibliography:**

- Anany Levitin, “Introduction to The Design and Analysis of Algorithms ”, 2nd Edition, Prentice Hall, 2007.
- T. Cormen, C. Leiserson, R. Rivest, and C. Stein, "Introduction to Algorithms", 2003.
- R. Johnsonbaugh, M. Schaefer, "Algorithms", 2004
- J. Kleinberg and E. Tardos, "Algorithm Design", 2005
- W. Gautschi, *Numerical Analysis: An Introduction*, Birkhauser, 1997.
- D.P. Bertsekas, *Network Optimization*, Athena Scientific

**Assessment:** A midterm and a final examination.
Homework assignments and lab reports

| **ECE 401/2** | **Capstone Design Project** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 10 | ☒ | **14** |
| Year: 4 | Core ☒ | Elective ☐ | Prerequisites: | $4^{th}$ year students | | | | | |

**Coordinator:**

**Objectives:** Allow students to work together in teams to solve an engineering problem utilizing the knowledge and skills they have acquired from all courses.

**Outcomes:**

- Demonstrate the ability to apply the knowledge and tools from all courses to solve engineering problems.
- Ability to work in teams and effectively communicate with others.
- Ability to deliver technical reports and oral presentations.

**Description:** This is a full year design projects course requirement for all fourth year electrical and computer engineering students. During the spring term of their third year, students are required to form teams and each team is required to propose a project

**Bibliography:**

- M. Michaelson, *How to Write and Publish Engineering Papers and Reports,* Oryx Press, 1990.

**Assessment:** Project defense and final report.

## *Electrical Engineering (EE) Required Courses*

| **ECE 305** | **Electronic Devices and Circuits II** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☐ | **5** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | ECE 205 | | | | | |

**Coordinator:**

**Objectives:** Provide in depth knowledge and understanding of electronic components and circuits with emphasis on analogue components. Provide the tools for analyzing and designing electronic circuits.

**Outcomes:**

- Demonstrate in-depth knowledge of electronic components.
- Ability to develop and analyze models of electronic components.
- Ability to analyze and design electronic circuits.

**Description:** Brief introduction to integrated circuit fabrication process. Essential MOS device physics for in depth analysis of circuits. Low frequency small and large signal analysis of single stage amplifiers with various loads. Cascode and folded cascode, differential and multistage amplifiers, passive and active current mirrors and sources. High frequency response of single and differential amplifiers and application of the Miller approximation. Noise in electronic circuit components, noise in simple amplifiers. Feedback amplifiers and feedback topologies, loop gain, stability of feedback circuits and frequency compensation. Op-amp design – single and two stage op-amps, gain boosting, common mode feedback, power supply rejection and noise in op-amps. Introduction to reference circuits.

**Bibliography:**

- Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, Int. Edn., McGraw-Hill, 2001.
- A. Sedra and K. C. Smith, *Microelectronic Circuits*, Oxford University Press, 4th Ed., 1998.
- G.W. Roberts and A. Sedra, *SPICE for Microelectronic Circuits*, Oxford University Press, 2nd Ed., 1997

**Assessment:** Two tests and a final examination

Homework assignments.

| **ECE 306** | **Electronic Devices and Circuits Lab** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | | 3 | 3 | ☒ | **5** |
| Year: 3 | Core ☒ | Elective ☐ | Pre/Co-requisites: | ECE 205, ECE 305 | | | | | |

**Coordinator:**

**Objectives:** Analyze, design, simulate and layout electronic devices and circuits

**Outcomes:**

- Design, simulate and layout electronic circuits (Cadence design flow)
- Ability to verify analytical models through simulation and extraction.
- Ability to work in teams and communicate effectively with others.

**Description:** This lab will introduce the students to an industrial-strength "Integrated Circuit Design Tools" through which they will design basic analog and digital building blocks.

The digital circuits will consist of: CMOS inverters and logic circuits, transmission gates, shift registers, flip-flops, monostables and astables, oscillator circuits, static and dynamic memory cells.

The analog circuits will be chosen from any of the circuits taught in ECE 305 and will compare analytical models with simulations.

Finally students will form groups and work as a team to put together a chip of their choice. The best design or two will be sent for fabrication.

**Bibliography:**
- Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, Int. Edn., McGraw-Hill, 2001.
- Cadence online help manuals
- Jan M. Rabaey, "Digital Integrated Circuits"

**Assessment:** Laboratory exercises and reports. Design project.

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 331** | **Electromagnetic Fields** | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | 3rd year students | | | | | |

**Coordinator:**

**Objectives:** To introduce the basic concepts of electromagnetic field theory.

**Outcomes:**
- Demonstrate knowledge and understanding of the basic concepts of electromagnetic field theory.
- Ability to develop and analyze electromagnetic models.
- Ability to analyze transmission lines and transformers.
- Demonstrate knowledge and understanding of wave propagation.

**Description:** Maxwell's and wave equations, electrostatics, magnetostatics. Transmission lines; time and space dependence of signals, line parameters, input impedance, reflection coefficient, standing-wave ratio, transient behavior. Impedance matching; Transformers, stubs, analysis using the Smith Chart.

**Bibliography:**
- Cheng, *Field and Wave Electromagnetics*
- Skitek, *Marshal, Electromagnetic Concepts and Applications*
- Ulaby, *Applied Electromagnetics*
- D. M. Pozar, *Microwave Engineering*, 3rd Ed. Wiley, 2004.

**Assessment:** Two tests and a final examination

Homework assignments.

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 333** | **Electromagnetic and Optical Engineering** | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | ECE 331 | | | | | |

**Coordinator:**

**Objectives:** The aim of the course is to introduce students to the analysis of signals and systems in the microwave and optical parts of the electromagnetic spectrum.

**Outcomes:** Demonstrate in depth knowledge and understanding of electromagnetic wave properties, their propagation and their interaction with matter.

**Description:** This course involves study of wave phenomena with specific applications to waves in media and electromagnetic phenomena. Topics include Maxwell's equations and the plane wave equations, dispersion, radiation of EM waves, interaction of EM waves with matter, reflection of EM waves at boundaries, interference and diffraction, microwave and optical waveguides

**Bibliography:** •

**Assessment:** Two tests and a final examination. Homework.

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 340** | **Power Engineering** | | | 3 | | | 5 | ☐ | **5** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | 3rd year status | | | | | |

**Coordinator:** Elias Kyriakides

**Objectives:** This course aims to provide the students with the essential basic knowledge that is required for Power Engineering. The students learn to analyze three-phase circuits in star and delta configurations as well as to calculate the active, reactive and apparent powers in circuits. Basic notions such as the per unit system and power factor correction are analyzed and applied. The students then study magnetism and magnetic circuits. In depth knowledge and analysis of electric machines (single-phase and three-phase transformers, dc motors, synchronous and asynchronous machines). Familiarization with power electronics equipment (rectifiers, dc/dc converters, uninterruptible power supplies).

**Outcomes:**

- The students are expected to understand and apply the basic principles in Power Engineering and that they will be able to analyze three-phase circuits. They are also expected to know the basic parts and to describe the operating principles of single-phase and three-phase transformers, and dc and ac machines.

**Description:** This is an introductory course in electric power engineering. Single and three phase electric circuits, phasor diagrams, star and delta connections, active, reactive and apparent power. Per unit system and power factor correction. Magnetism and magnetic circuits. Single phase and three phase transformers. Types of dc machines and torque-speed characteristics. Synchronous machines, their types, equivalent circuits, open and short circuit characteristics. Principles of operation of induction motors, equivalent circuits and phasor diagrams. Introduction to power semiconductor devices. Half and full bridge rectifiers. Buck, boost and buck-boost converters.

**Bibliography:**


- S. J. Chapman, *Electric machinery and power system fundamentals*, New York: McGraw Hill, 2002.
- T. Wildi, *Electrical machines, drives, and power systems*, 5th ed., Upper Saddle River: Prentice Hall, 2002.
- G. G. Karady and K. Holbert, *Electrical energy conversion and transport: an interactive computer-based approach*, Piscataway: IEEE Press, 2005.
- Z. A. Yamayee and J. L. Bala Jr., *Electromechanical energy devices and power systems*, John Wiley and Sons, Inc., 1994.
- Γ. Ξυπτέρα, *Ηλεκτρικές μηχανές, Τόμος Ι: Μηχανές συνεχούς ρεύματος και ασύγχρονες μηχανές*, Θεσσαλονίκη: Εκδόσεις Ζήτη, 1995.
- Β. Στεργίου και Σ. Τουλόγλου, *Ηλεκτρικές μηχανές εναλλασσόμενου ρεύματος*, Περιστέρι: Εκδόσεις Ίων, 1999.
- Σ. Αντωνόπουλος, *Μετασχηματιστές*, Περιστέρι: Εκδόσεις Ίων, 1995.


**Assessment:** Two tests and a final examination

Homework assignments.

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 359** | **Introduction to Communication Systems** | | | 3 | | | 5 | ☒ | **5** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | ECE 320 | | | | | |

**Coordinator:**

**Objectives:** Provide basic knowledge and understanding of analog communication systems. Learn basic analog modulation and demodulation techniques. Learn to calculate noise in AM and FM systems. Provide basic knowledge of digital analog systems. Understand PCM and PAM systems. Learn basic digital modulation and demodulation/detection techniques. Learn to calculate probability of error in digital communications systems. Learn basic applications of communications systems. Work in teams to solve a design problem.

**Outcomes:**

- Understand basic analog and digital communications systems
- Demonstrate knowledge and understanding of transmitter and receiver components.
- Ability to apply these components in applications.
- Learn to apply knowledge of mathematics, science and engineering.
- Demonstrate basic knowledge of the design process by applying it to solve engineering problems.
- Ability to learn computational tools.
- Ability to work in teams

**Description:** Analysis and design of analog communication systems: AM and FM modulation and demodulation. Noise in AM and FM systems. Power Spectral Density. Digital communication systems: Sampling, quantization and encoding. Companding, Delta-modulation and other compression techniques. Pulse shaping, intersymbol interference, equalization. PCM and PAM systems. Digital modulation and demodulation/detection techniques. Time and Frequency Division Multiplexing. Probability of error in digital communication systems. Information sources and channels. Applications. Examples; telephone systems, cable TV systems, satellite communication systems and broadcasting systems.

**Bibliography:**

- S. Haykin, *Communication Systems,* 4th Edition, Wiley, 2001.
- J.G. Proakis and M. Salehi, *Communication Systems Engineering*, 2nd Edition, Prentice Hall, 2002
- A. Carlson, P. Crilly, J. Rutledge, *Communication Systems*, 4th Edition, McGraw Hill, 2002.
- M. Schwartz, *Information, Modulation and Noise*, McGraw Hill, 1987
- B.P. Lathi, *Modern Digital and Analog Communications Systems*, Oxford University Press: 1989
- L.W. Couch, *Modern Communication Systems Principles and Applications*, Prentice-Hall: 1995
- R.E. Ziemer and W.H. Tanser, *Principles of Communications: Systems, Modulation, and Noise*, Wiley, 1995
- J.D. Gibson, *Principles of Analog and Digital Communications*, Prentice Hall, 1993.

**Assessment:** Midterm and final examinations
Homework assignments and project.

## *Computer Engineering (CE) Required Courses*

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 311** | **Discrete Analysis and Structures** | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of mathematical techniques and tools fundamental for representing and analyzing problems in computer engineering.

**Outcomes:**

- Demonstrate knowledge and understanding of the fundamental tools and techniques used to analyze problems in computer engineering.
- Ability to apply logic and proof techniques.
- Ability to apply mathematical induction.
- Ability to analyze graph, trees and combinatorial structures.

**Description:** Function and set operations, sequences and summations, proportional logic, predicate logic, rules of inference, methods of proof, principle of induction, relations, graphs, graph algorithms, trees, combinations, recursion, recurrence relations.

**Bibliography:**

- K. Rosen, *Discrete Mathematics and Its Applications*, McGraw Hill, 1999.

**Assessment:** Two tests and a final examination

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 312** | **Computer Architecture** | | | 3 | | 2 | 5 | ☒ | **7** |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | ECE 212 | | | | | |

**Coordinator:**

**Objectives:** Provide a thorough introduction to the architectural features of present-day processors and computing systems. To impart the experience of completing a large design project.

**Outcomes:**
- In-depth knowledge in aspects of instruction execution in high performance processors, processor pipelining, optimizations in cache designs and memory hierarchy.
- Ability to design basic instruction sets and to program using machine and/or hardware description programming languages.
- Ability to design, simulate, and implement a complete microprocessor.

**Description:** This course overviews the architecture of traditional computing systems and extensively practices various hardware/architectural and software/algorithmic means that enhance performance of computer systems. Both uni-processor and multi-processor systems are investigated. Students are expected to apply basic knowledge learned in the course to design more advanced systems. Different computational models (in-order issue, in-order execute, in-order issue out-of-order execute, and out-of-order issue out-of-order execute) are studied and linked to the existing systems. Finally, by simulating and analyzing processor components students are expected to get more insight into the conceptual issues learned in the course.

**Bibliography:**
- J. L. Hennessy and D.A. Patterson, *Computer Architecture: A Quantitive Approach*, Morgan Kaufman, 3rd Ed., 2005

**Assessment:** Two tests and a final examination. Homework.
Design project.

| ECE 313 | Engineering of Operating Systems | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 3 | 5 | ☒ | 7 |
| Year: 3 | Core ☒ | Elective ☐ | Prerequisites: | ECE 310 | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to all fundamental concepts of modern computer operating systems.

**Outcomes:**
- Demonstrate knowledge and understanding of the principles of operating systems
- Understand the abstraction and services provided by operating systems
- Understand fundamental algorithms and data structures used in operating systems
- Gain practical experience in developing operating systems

**Description:** An introduction/overview to modern operating systems. Examine the services and abstractions commonly provided by operating systems, and study the underlying mechanisms used to implement them. Topics include: process management, scheduling, and synchronization; interprocess communication; memory management (basic, virtual, page replacement algorithms); input/output and file systems, deadlocks, Unix operating system, distributed operating systems and distributed file systems. Programming assignments and case studies are used to illustrate the fundamental concepts.

**Bibliography:**
- A. Tanenbaum, *Modern Operating Systems*, Prentice Hall, 2001
- A. Silberschats, J. Peterson, and P. Galvin, *Operating System Concepts,* 6$^{th}$ Edition, Wiley, 2002.
- W.Stallings, *Operating Systems, Internals and Design Principles*, 4$^{th}$ Edition, Prentice-Hall, 2001.

**Assessment:** Two tests and a final examination
Programming assignments and design project.

| ECE 317 | Engineering of Computing | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3 | | 2 | 5 | ☒ | **6** |
| Year: 3 | Core ☐ | Elective ☒ | Prerequisites: | 3rd year students | | | |

**Coordinator:**

**Objectives:** To teach students different techniques and paradigms of the software development, life cycle models, ways of team organization, the steps that have been followed in the workflows of requirements, OO analysis, OO design, OO implementation, OO maintenance. Also to give students the chance to work in teams to develop a software product following the steps of the workflows of the object oriented paradigm.

**Outcomes:**

- know different techniques and paradigms of the software development, life cycle models, ways of team organization. They will also have the ability of choose the proper approach for each project according to the characteristic of the project and the team of developers that will work on it
- have the abilities to follow the steps of the workflows of Requirements, OO analysis, OO design, OO implementation, OO maintenance in order to develop a software product providing all the needed deliverables
- understand the advantages of the OO paradigm in contrast of the classical one.
- understand the importance to follow known methodologies for the successful development of big software products.
- have the experience of developing of a software product working in teams

**Description:** This course introduces students to the basic ideas and modern tools and techniques used in the development of big software products. We pay attention in techniques and life cycle models that lead to an efficient and reliable development of an easily maintained software product.

The object oriented paradigm is presented in details during the course. The students learn step by step through theory and cases studies how to develop a software following the unified process and the workflows of the OO paradigm. Also issues regarding human elements and ethics are discussed.

During the course the students are called to apply techniques and methodologies taught in the course to develop in teams a software product.

**Bibliography:**


- Stephen R. Schach «Object-Oriented and Classical Software Engineering» Mcgraw-Hill College; 6th edition, 2005
- Ian Sommerville “Software Engineering” (7th Edition), Addison Wesley; 2005


**Assessment:** Two tests and a final examination

Programming assignments and design project.

| **ECE 360** | **Computer Networks** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 2 | 5 | ☐ | **6** |
| Year: 3 | Core ☐ | Elective ☒ | Prerequisites: | 3rd year students | | | | | |

**Coordinator:**

**Objectives:** Provide basic knowledge and understanding of the networking issues, the layering approach and basic protocols.

**Outcomes:**
- Demonstrate knowledge and understanding of circuit switch and packet switch networks.
- Demonstrate knowledge and understanding of the OSI layers and basic protocols.
- Ability to create a simple networking application.

**Description:** Computer network design goals. Circuit switched, packet switched and virtual circuit switched networks. The course will introduce the layering approach and the OSI layer model. It will cover issues of the physical, data link and network layers and introduce the Internet Protocol (IP). Reliable end-to-end communication and the transport layer. Introduce the UDP and TCP protocols.

**Bibliography:**
- L. Peterson and B. Davie, Computer Networks, A Systems Approach, 3rd. Ed., Morgan Kaufman Publishers, 2004.
- J.F. Kurose and K.W. Ross, *Computer Networks, A Top-Down Approach Featuring the Internet*, 2nd Ed. Addison Wesley, 2003
- A. Tanenbaum, *Computer Networks*, 3rd Ed. Prentice Hall, 1996

**Assessment:** Two tests and a final examination
Homework assignments.

## *Technical Elective Courses*

<table>
<tr><td rowspan="2">ECE 403</td><td colspan="3" rowspan="2">Microprocessor Systems</td><td>I</td><td>T</td><td>L</td><td>H</td><td>P</td><td>ECTS</td></tr>
<tr><td>3</td><td>1</td><td>2</td><td>3</td><td>☒</td><td>6</td></tr>
<tr><td>Year: 4</td><td>Core ☐</td><td>Elective ☒</td><td>Prerequisites:</td><td colspan="6">ECE 212</td></tr>
</table>

**Coordinator:**

**Objectives:** Provide an introduction to microprocessor technology, design, development, and programming of microprocessor-based systems.

**Outcomes:**
- Demonstrate knowledge and understanding of a microprocessor system.
- Ability to design a complete simple microprocessor system. Ability to design memory and I/O systems and the interaction between software and hardware.
- Ability to program a microprocessor system with assembly language programming.

**Description:** Architecture of the 8088/86 microprocessor, address bus, control bus; instruction set of the 8088, physical addresses, addressing modes; assembly language programming of 8088. Memory addressable space (ROM and RAM), memory interfaces for the 8088; I/O, parallel I/O operations, I/O interfaces of the 8088, serial communication protocol, universal synchronous/asynchronous transmitter receiver (USART). Hardware and software interrupts, vector table, interrupt service routines; commands for system monitor functions; disks, sectors, files, directories, file operations, DOS and BIOS routines.

Lab component: implementation of a complete microprocessor-based system (8088 processor, oscillator, frequency divider, address/data/control busses, system and program memory, input/output system with parallel ports and USART, monitor in assembly language to manage the single board computer).

**Bibliography:**
- W.A. Triebel and A.Singh, *The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications*, Prentice Hall, 4th Edition, 2002.
- R.J. Tocci and F.J. Ambrosio, *Microprocessors and Microcomputers: Hardware and Software*, Prentice Hall, 6th edition, 2002.
- W. Kleitz, *Digital and Microprocessor Fundamentals*, Prentice Hall, 4th Edition, 2003.

**Assessment:** Two tests and a final examination.
Design project.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **ECE 404** | **Computer System Design** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | 2 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 212 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of integrated hardware and software development, construction and testing of embedded systems.

**Outcomes:**

- Demonstrate knowledge and understanding of integrated hardware and software development
- Ability to construct and test embedded systems that meet the design specifications.
- Ability to design hardware systems subject to the technical, economic, and environmental constraints.
- Ability to work in teams and communicate effectively with others.

**Description:** Typical composition of an embedded system and the functionalities of widely used components. Basic steps involved in developing an embedded system, various IC technologies and factors that impact different design metrics. Development of simple embedded systems with both software tools and hardware development board. Analysis and comparison of design alternatives such as different hardware/software partitions regarding to economics, timing performance, size, power, etc.

Lab component: Design projects involves assembly language programming and the use of hardware description languages (VHDL/Verilog), design entry, simulation, and synthesis using CAD tools; design, implementation, and testing using complex programmable logic devices (CPLDs) and field-programmable gate arrays (FPGAs).

**Bibliography:**


- F. Vahid and T. Givargis, *Embedded Systems Design: A Unified Hardware/Software Approach*, John Wiley and Sons, 2001.
- P. Ashenden , G. Peterson , and D. Teegarden , *The System Designers Guide to VHDL-AMS*, 2002
- C. Roth, *Digital Systems Design Using VHDL*, PWS Publishing Company, 1998.
- M. Michaelson, *How to Write and Publish Engineering Papers and Reports,* Oryx Press, 1990.


**Assessment:** Two tests and a final examination.
Design project.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **ECE 405** | **Programmable ASICs Design** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | 2 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 212 | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to the theoretical concepts and experimental design and construction of Application Specific Integrated Circuits (ASICs) using programmable logic hardware.

**Outcomes:**
- Demonstrate knowledge and understanding of hardware design and realization.
- Gain extensive synthesis and design experience.
- Knowledge of rapid prototyping techniques using modern programmable technologies such as Field Programmable Gate Arrays (FPGAs) and Programmable Logic Devices (PLDs).
- Ability to design hardware systems using modern computer-aided design tools.

**Description:** ASIC logic cells and I/O architecture. Analysis and synthesis of parallel processing systems, analysis and synthesis of arithmetic and logic systems. Pipeline systems and cache memories. State machines, counters, and shift registers, feedback sequential circuits. General PLD and FPGA architecture and technology. Design, placement, and routing of PLD and FPGA designs.

Lab component: Experience in ASIC rapid prototyping using academic/commercial CAD tools and FPGA-based system boards. Analysis and synthesis of a complete system.

**Bibliography:**
- Z. Salcic and A. Samailagic **,** *Digital Systems Design and Prototyping Using Field Programmable Logic and Hardware Description Languages*, Kluwer, 2000
- M.J.S. Smith, *Application-Specific Integrated Circuits*, Addison-Wesley Pub Co, 1997.
- J.O. Hamblen and Michael D. Furman, *Rapid Prototyping of Digital Systems,* Kluwer Academic Publishers, 1999.

**Assessment:** Two tests and a final examination.

Laboratory exercises and design project.

| **ECE 406** | **Digital VLSI Circuit Design** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | 2 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 212 | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to the design, analysis and layout of digital Very Large Scale Integration (VLSI) circuits.

**Outcomes:**
- Demonstrate in-depth knowledge of MOS transistor theory and the CMOS technology
- Knowledge in characterization and performance evaluation of VLSI circuits
- Ability to use commercial and/or academic Computer-Aided Design tools to design, layout, simulate and verify VLSI circuits.

**Description:** MOS transistor theory, standard CMOS design (primitive and complex gates, transmission gates and tri-states), CMOS processing technology and layout design (silicon semiconductor technology, process steps, N-well/P-well/SOI processes, design layers, design rules, layout optimization), circuit characterization and performance estimation, CMOS logic structures, basic memory elements (design and optimization), design of VLSI combinational systems, VLSI testing, subsystem design (data-path and arithmetic units), memory (RAM, multi-port RAM, ROM, content-addressable).

Lab component: Usage of CAD tools for the design, layout, simulation, characterization, and performance estimation of digital VLSI circuits and systems.

**Bibliography:**
- J. Rabaey*, A. Chandrakasan and B. Nicolic, "Digital Integrated Circuits", Prentice Hall, 2003*
- N. Weste, K. Eshraghian, M.J.S. Smith, *Principles of CMOS VLSI Design: A Systems Perspective with Verilog/VHDL Manual***,** Pearson Addison Wesley; 2nd Ed., 2000.
- W. Wolf, *Modern VLSI Design: A systems approach*, Prentice-Hall, 1994
- W. Wolf**,** *Modern VLSI Design: System-on-Chip Design,* Prentice Hall, 3rd Ed., 2002.

**Assessment:** Two tests and a final examination.
Lab assignments and design project.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **ECE 407** | **Computer Aided Design for VLSI** | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | 3 | 1 | 2 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 212, ECE 325 | | | | |

**Coordinator:**

**Objectives:** To provide an introduction to the fundamentals of Computer-Aided Design tools for the modelling, design, analysis, test, and verification of digital Very Large Scale Integration (VLSI) systems.

**Outcomes:**

- Establish comprehensive understanding of the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- Demonstrate knowledge and understanding of fundamental concepts in CAD.
- Demonstrate knowledge of computational and optimization algorithms and tools applicable to solving CAD related problems.
- Establish capability for CAD tool development and enhancement.

**Description:** The rapid and on-going increase of the complexity of digital integrated circuits (ICs) requires the use of computer-aided design tools in order to effectively and efficiently design such large electronic systems. This course introduces the techniques of modelling digital systems at various abstraction levels, and the computer-aided design (CAD) algorithms that are applied to these models to support the various design and analysis tasks. This is not a "how-to" course on using CAD tools. Rather, it concentrates on the study of the algorithms used by CAD tools and the design methodologies they promote. The course will cover: modelling of digital systems for simulation and automated synthesis using modern hardware description languages (VHDL), logic synthesis and optimization, physical design automation (placement, floor-planning and routing) considering the CMOS technology, testing (fault models, simulation, basic test generation), timing analysis and verification.

Lab component: Usage of existing academic and commercial CAD tools for several of the above problems. Development (in C/C++) of selected CAD algorithms.

**Bibliography:**


- M.J.S. Smith, *Application-Specific Integrated Circuits*, Addison-Wesley Pub Co, 1997.
- P. J. Ashenden, *The Designer's Guide to VHDL,* Morgan Kaufmann, 2nd ed.,2002.
- W. Wolf, *Modern VLSI Design: Systems on Silicon,* Prentice, 2nd ed., 1998.
- G.De Micheli, *Synthesis and Optimization of Digital Circuits,* McGraw-Hill, 1994.
- G. Hachtel and F. Somenzi, *Logic Synthesis and Verification Algorithms,* Kluwer, 1998.
- N.A. Sherwani, *Algorithms for VLSI Physical Design Automation*, Kluwer Academic Publishers; 3rd ed., 1999.
- M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI circuits, Kluwer, 2001.


**Assessment:** A midterm and a final examination.
Lab assignments and final project

| ECE 408 | Digital Design with FPGA | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | $4^{th}$ year students | | | | | |

**Coordinator:** Charis Theocharides

**Objectives:** This course provides the students with fundamental FPGA chip knowledge and its application to rapid digital system implementation using top down design in VHDL. Through lectures and laboratory assignments, students are provided with learning experiences that enable them to accomplish the course outcomes as listed below.

**Outcomes:** Primary Outcomes:

- Design the electronic/logic circuits that form the basic building blocks of a computer system
- Demonstrate basic laboratory skills, including the use of standard laboratory equipment
- Design the architecture and organization of the basic components of a computer system
- Design, implement, verify and evaluate the operation of a digital systems
- Demonstrate independent learning by using unfamiliar computer systems and software tools to solve technical problems
- Interpret the specifications of general and special purpose programming language, and use these languages to design computer programs that are correct and efficient

**Description:** The course aims in teaching modern rapid prototyping techniques using state-of-the-art software and hardware design principles. Students taking the course will learn how digital systems are designed from specifications to a fully functional and working prototype. Through the use of FPGA prototyping boards, students will be given design specifications and will proceed to design, develop, synthesize, implement, test, debug and deliver a complete FPGA design project.

**Bibliography:**

- M.J.S. Smith, *Application-Specific Integrated Circuits*, Addison-Wesley Pub Co, 1997

**Assessment:** One midterm and a final examination. Lab assignments and a semester project.

| ECE 409 | Advanced Computer Architecture | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 212, 213 | | | | | |

**Coordinator:**

**Objectives:**

**Outcomes:**

-

**Description:** The format of the class is lecture and discussion. Students will work on a project related but not limited to a topic discussed in the course. Students can work on design and implementation of several real world problems such as network processors and embedded systems, microprocessor architectures and energy efficient and reliable systems. The projects can lead to operational prototype systems and/or publishable papers. Most importantly, experiences from the projects will benefit the student in future job search and career development.

**Bibliography:**

- John L. Hennessy and David A. Patterson, *Computer Architecture: A Quantitative Approach, 3rd Edition,* Morgan Kaufman.

**Assessment:** Two midterm and final examinations, semester project, regular homework, and lab assignments.

| **ECE 417** | **Distributed Systems** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th year students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to distributed systems.

**Outcomes:**
- Demonstrate knowledge and understanding of the principles of distributed systems.
- Ability to analyze and design distributed systems.

**Description:** In this course we study the basic techniques developed to support applications that run on different computers that are joined via a network. Also, different issues regarding the design of distributed systems are also studied during this course.
We will pay attention on:
- Synchronization of processes that run on different computers that are joined via a network when they assert common resources of the systems.
- Issues regarding global state, synchronised and asynchronised algorithms, computation of the time and message complexity of distributed algorithms, the chef election problem and different solutions for it, interprocess communication, distributed mutual exclusion, fault tolerance, and distributed transactions and cryptography.
- Case study of different distributed systems like mobile DS, peer-to-peer, sensor nets etc.

**Bibliography:**
- G. Coulouris, J. Dellimore and T. Kindberg, *Distributed Systems: Concepts and Design,* Addison –Wesley, 2000.
- A. Tanenbaum, *Distributed Systems: Principles and Paradigms*, Prentice Hall, 2002.

**Assessment:** Two tests and a final examination
Programming assignments and design project.

| **ECE 420** | **Stochastic Processes** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 6 | ☐ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 324 | | | | | |

**Coordinator:** Stavros Toumpis

**Objectives:** To familiarize students with the most common stochastic processes encountered in Electrical Engineering

**Outcomes:**
6. Demonstrate knowledge and understanding of the mathematical tools, methods and techniques used in the analysis of stochastic processes

**Description:** Fundamentals of Random Processes: definition of random processes, continuous and discrete random processes, stationarity and ergodicity. Analysis and Processing of Random Signals: power spectral density, linear system response, optimum linear systems and the Kalman filter. Markov Chains: discrete and continuous Markov chains, classes of states, recurrence properties, and limiting probabilities. Introduction to Queuing theory: Little's theorem, the M/M/1 and M/M/k/k queues.

**Bibliography:**

- Alberto Leon-Garcia, Probability and Random Processes for Electrical Engineering
- Sheldon Ross, Probability Models

**Assessment:** Midterm examination, Final examination, weekly homeworks

| ECE 421 | Introduction to Computational Intelligence | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th year students | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of optimization techniques and learning algorithms.

**Outcomes:**

- Demonstrate knowledge and understanding of optimization methods and solution tools.
- Demonstrate understanding of learning algorithms.
- Ability to formulate and solve optimization problems.

**Description:** Introduction to the tools and methods in the design, analysis, optimization, and control of industrial systems. Topics include neural networks and their application in complex system modeling, fuzzy logic, information fusion methods, and optimization schemes. MATLAB used as the software platform. Topics in more details: Optimization Methods; Gradient methods, Linear Programming, Constrained Problems and Lagrange Multiplier Method, Search Method, Ordinal Optimization, Genetic Algorithms, Application. Neural Networks: Basic concepts, Backpropagation algorithm, Competitive learning, Data clustering networks, Application in hierarchical modeling for complex systems, application examples. Knowledge representation methods.

**Bibliography:**

- C. Bishop, *Neural Networks for Pattern Recognition*, Oxford University Press, 1996
- L.X. Wang, *A Course in Fuzzy Systems and Control*,
- M. Mitchell, *An Introduction to Genetic Algorithms*,

**Assessment:** Two tests and a final examination.
Design project.

| ECE 422 | Dynamical Systems and Control | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 320 | | | | | |

**Coordinator:**

**Objectives:** Provide in-depth knowledge and understanding of dynamical systems and feedback control of linear and non-linear systems. Provide tools for the analysis and design of such systems.

**Outcomes:**

- Demonstrate understanding of dynamic systems and their response to various inputs.
- Demonstrate knowledge and understanding of stability issues.
- Ability to analyze and design feedback control systems.
- Demonstrate knowledge and understanding of frequency-response design methods, root locus design techniques and state-space design approach.

**Description:** Introduction to the concept of feedback; open loop and closed loop. Mathematical modeling of engineering systems. Nonlinear dynamical control systems; general differential equations and state variables, linearization. State descriptions and transfer function descriptions. Linear state space systems; zero-input and zero state solutions, stability, observability, controllability. Analog realizations of general linear differential equations. . Performance limitations. Open-loop, feedforward, closed-loop configurations. Performance specifications. The Nyquist criterion; stability margins, unstructured uncertainty and robust stability. Classical design. Systems with delay. Pole placement.

**Bibliography:**
- K. Ogata, *Modern Control Engineering*, Prentice Hall.
- G.F. Franklin, *Feedback Control Dynamic Systems*,

**Assessment:** Two tests and a final examination.
Design project.

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 423** | **Advanced Computer Control** | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 422, ECE 324 | | | | | |

**Coordinator:**

**Objectives:** Provide in-depth knowledge and understanding of dynamical systems and feedback control of linear and non-linear systems. Provide tools for the analysis and design of such systems.

**Outcomes:**
- Demonstrate understanding of dynamic systems and their response to various inputs.
- Demonstrate knowledge and understanding of stability issues.
- Ability to analyze and design feedback control systems.
- Demonstrate knowledge and understanding of frequency-response design methods, root locus design techniques and state-space design approach.

**Description:** This is a continuation of the first course in control systems. Frequency response and state space methods for designing feedback control systems will be covered. Other practical control design issues that will be covered include digital control systems robust control and adaptive control systems. Case studies for control systems design will be investigated.

**Bibliography:**
- K. Ogata, *Discrete Time Control Systems*, Prentice Hall.

**Assessment:** Two tests and a final examination.
Design project.

| | | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 424** | **Fault Tolerant Systems** | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th year students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to fault tolerant systems.

**Outcomes:**
-

**Description:** The course offers an exposure to advanced concepts in the design of fault-tolerant digital systems, including combinational and dynamic systems. The course blends together techniques from coding and complexity theory, digital design, and control, automata and system theory. The topics addressed include fault models and error manifestations, module and system level fault detection and identification mechanisms, techniques for reliability/availability assessment, coding in computer systems, reconfiguration techniques in multiprocessor systems and VLSI processor arrays, and software fault tolerance techniques.

**Bibliography:**
- 

**Assessment:** Two tests and a final examination.
Design project.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 425** | **Introduction to Robotics** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | 2 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th year students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to robotic systems and system automation.

**Outcomes:**
- Demonstrate knowledge and understanding of the basic concepts in robotics and system automation.
- Ability to design simple robots to solve engineering problems.

**Description:** The course objective is to introduce the students to the principles of robotics. In particular, the course starts from simple problems in transformations, kinematics and inverse kinematics, dynamics, and control. Later in the semester, more complex problems in sensing, force control, mobile robots, and robot programming will be discussed.

**Bibliography:**
- 

**Assessment:** Two tests and a final examination.
Design project.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 426** | **Artificial Intelligence** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | $4^{th}$ year students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to the main concepts and principles of artificial intelligence.

**Outcomes:**
- Demonstrate knowledge and understanding for the principles of artificial intelligence.
- Demonstrate understanding of search and inference techniques as well as logic and theorem proving.
- Ability to use specialized programming languages to solve problems.

**Description:** Introduction to Artificial Intelligence. Problem solving, search, inference techniques. Logic and theorem proving. Knowledge representation, rules, frames, semantic networks. Planning and scheduling. Lisp programming language.

**Bibliography:**
- Winston. *Artificial Intelligence*, Addison-Wesley, 1992
- P.C. Jackson, *Introduction to Artificial Intelligence*, Doven Pubns, 1985.

**Assessment:** Two tests and a final examination.
Design project.

| ECE 427 | Embedded and Real-Time Systems | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | 2 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | $4^{th}$ year students | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the fundamental and advanced concepts of real-time and embedded systems.

**Outcomes:**

- Demonstrate knowledge and understanding of the principles of real-time systems.
- Ability to design and implement real-time systems.

**Description:** Characteristics of real-time and embedded systems, Methodologies for design, implementation and testing, Exception handling, Concurrent Programming, Inter-task communication and synchronization. Aspects of operating systems: Task scheduling algorithms, Memory management, device driver development, Real-time kernels, Kernel support for network communication.

**Bibliography:**

- A. Berger, *Embedded System Design: An Introduction to Processes, Tools and Techniques*,
- C. Siva Ram Murthy and G. Manimaran, *Resource Management in Real-time Systems and Networks*, MIT Press, March 2001

**Assessment:** Two tests and a final examination.
Design project.

| ECE 428 | Control Systems Laboratory | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 3 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Pre/Co-requisites: | ECE 422, ECE 423 | | | | | |

**Coordinator:**

**Objectives:** Design and implement controllers

**Outcomes:**

- Ability to analyze and design feedback controlled systems.
- Ability to implement and analyze the performance of controllers.
- Ability to design and implement controllers when the plant parameters are uncertain.
- Ability to test and troubleshoot systems and controllers.
- Ability to work in teams and communicate effectively with others.

**Description:** Experimental studies for the design of control systems, with particular emphasis on motion control of the inverted pendulum. Fundamentals of sensors and actuators. Linear compensator specification and design in the time and the frequency domain. Pole placement. Effect of model uncertainty on performance.

**Bibliography:**

-

**Assessment:** Experiment reports and design project.

| ECE 429 | Digital Signal Processing | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 320 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of analysis tools for digital signal processing.

**Outcomes:**
- Demonstrate knowledge and understanding of discrete-time signal representation and analysis tools.
- Ability to analyze discrete-time signals using the z-transforms, discrete Fourier transform (DFT), Fast Fourier transform (FFT).
- Ability to design digital filters using Infinite Impulse Response (IIR) and Finite Impulse Response (FIR).
- Ability to utilize DSP software tools.

**Description:** Discrete-time signals and systems; Fourier and Z-transform analysis techniques, the discrete Fourier transform; elements of FIR and IIR filter design, filter structures; FFT techniques for high speed convolution; quantization effects.

**Bibliography:**
- A.V. Oppenheim and R.W. Schafer, *Discrete-Time Signal Processing*, Prentice Hall.

**Assessment:** Two tests and a final examination.
Design project.

| ECE 430 | **Electromagnetic Theory** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 331 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of basic principles and tools of electromagnetic theory

**Outcomes:**
- 

**Description:** FUNDAMENTAL CONCEPTS: Maxwell' equations: integral form, differential form; Constitutive relations; Time-dependent wave equation; Boundary conditions; Time-harmonic fields; Power flow: Poynting theorem; Wave equation. FIELD REPRESENTATIONS: Inhomogeneous wave equation; Vector and scalar potentials; Hertz vectors; Linear system concepts; Solution to the 3-D wave equation; Green's functions; Integral equations; Field representation via potential and Hertz vectors. PLANE WAVES: Nature of a plane wave; Polarization states; Plane-wave expansion; Reflection and transmission at an interface. PLANAR WAVEGUIDES: Mode concepts; Grounded dielectric slab (thin-film optical waveguides); Rectangular metallic guide; Rectangular cavity. CYLINDRICAL WAVES: Scalar wave functions; Circular metallic guide; Coaxial cable; Fiber optical cable; Cylindrical wave representations. THEOREMS AND CONCEPTS: Duality; Uniqueness; Image theory; Equivalence principle; Babinet's principle; Reciprocity.

**Bibliography:**
- 

**Assessment:** Midterm examination, Final examination, weekly homeworks

| ECE 431 | **Radio Frequency and Microwave Circuits** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 333 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the fundamental principles of radio frequency and microwave circuit.

**Outcomes:**

- Demonstrate knowledge and understanding of waves and wave propagation in different media.
- Demonstrate knowledge and understanding of the RF and microwave circuit components.
- Ability to develop and analyze models of components and circuits.
- Design and analyze RF and microwave circuits

**Description:** Fundamentals: The wave equation; Plane waves; Losses in conductors and dielectrics. RF/Microwave transmission lines: The distributed circuit representation of transmission lines, Transient response of transmission lines, Phase and group velocity, dispersion, High-speed digital interconnects, TEM, TE and TM waves, Parallel-plate transmission line, dielectric slab waveguide, co-axial cable, Stripline; Microstrip; Coplanar waveguide. RF/Microwave Resonators: Series and parallel resonators; The Q-factor; Coupling to resonators). Matching Networks: L and PI matching networks, Single and double stub tuners, RF transformers, scattering matrix, The scalar and vector network analyzer/theory of calibration, 2-ports). 3-port RF Devices: Power combiners/dividers, The Wilkinson divider, Circulators and isolators. 4-port RF Devices: Directional couplers; The 90-degree hybrid; The 180-degree ring-hybrid). Coupled Lines and Devices: Coupled lines as a four port; Coupled-line directional couplers; The Lange coupler). RF/Microwave Filters: Periodic structures, The insertion loss method, The Kuroda identities, Stepped impedance filters; Coupled-line filters, SAW filters.

**Bibliography:**


- D. M. Pozar, *Microwave and RF Design of Wireless System*, Wiley, 2000.
- D. M. Pozar, *Microwave Engineering*, 3rd Ed. Wiley, 2004.
- K. Chang, *RF Microwave Wirelss Systems*,
- B. Razavi, *RF Microelectronics*,


**Assessment:** Two tests and a final examination.
Homework assignments.

| **ECE 433** | **Optical Engineering** | | | I: 3 | T: 1 | L: | H: 5 | P: ☒ | ECTS: **6** |
|---|---|---|---|---|---|---|---|---|---|
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 333 | | | | | |

**Coordinator:**

**Objectives:** Provide a solid background in the theory and application of optical systems

**Outcomes:**

- Demonstrate knowledge and understanding of the fundamentals of optical waves, their propagation and interaction with basic optical components.
- Ability to apply the fundamentals in the design of optical systems.

**Description:** Introduction to optical science with engineering applications. Geometrical optics: ray-tracing, aberrations, lens design, apertures and stops, radiometry and photometry. Wave optics: basic electrodynamics, polarization, interference, wave-guiding, Fresnel and Faunhofer diffraction, image formation, resolution.

**Bibliography:**


- W.J. Smith, *Modern Optical Engineering*, McGraw Hill, 2000.


**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| ECE 434 | Introduction to Photonics | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 331 | | | |

**Coordinator:** Stavros Iezekiel

**Objectives:** The aim of the course is to give students a solid background in the physical understanding of photonic phenomena, and to apply this to the analysis of photonic components such as optical waveguides, resonators and lasers..

**Outcomes:** The students will have a fundamental understanding of:

- key optical phenomena (including geometrical optics, wave optics and photon-like behaviour)
- the guiding of light in both optical fibres and planar waveguides
- the basic interaction of light with matter
- the operation of lasers

**Description:** This course will cover the primary components of a fiber optic system, namely, optical fibers, emitters (semiconductor lasers and light emitting diodes), and photodetectors. It will also provide an overview of the characteristics and underlying physics of guided wave devices and optoelectronic integrated circuits. Topics include: Nature of light: Waves and Photons , Geometrical and ray optics, Wave Optics, Electromagnetic Optics, Polarisation: Jones vectors and Jones matrices, Interference and diffraction, Interaction of light with matter, Optical resonators and beam optics, Photons and Atoms, Basic theory of semiconductor lasers.

**Bibliography:**

- B.E.A. Saleh and M.C. Teich, *Fundamentals of Photonics*, Wiley-Interscience.
- K Lizuga, *Elements of Photonics*,
- B. Saleh, *Fundamentals of Photonics*,

**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| ECE 435 | Optical Engineering and Photonics Laboratory | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|
| | | 2 | | 3 | 3 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Pre/Co-requisites: | ECE 434 | | | |

**Coordinator:** Stavros Iezekiel

**Objectives:** The aim of the course is to provide students the opportunity to investigate optical phenomena and basic optical fibre systems in a laboratory environment.

**Outcomes:**

- The student will have an experimentally-based understanding of:
  - key optical phenomena (including reflection and refraction, polarisation, diffraction, interference and coherence)
  - optical waveguiding in single-mode and multimode
  - optical fibre attenuation and dispersion, and the impact of these (and of transmitter characteristics) on optical fibre-link performance
  - the basic operation of erbium-doped fibre amplifiers
  - the construction and operation of fibre-ring lasers
  - The student will also have the opportunity to construct a mini-project in one of the above areas.

**Description:** Laboratory projects to parallel and illustrate the concepts of the Optical Engineering and Photonics courses. Topics: Wave-properties of light: polarisation, diffraction, interference, coherence, Optical waveguide measurements and analysis, Characterisation of optical fibre components and links, Characterisation of optical fibre amplifiers and lasers.

**Bibliography:**
- B.E.A. Saleh and M.C. Teich, *Fundamentals of Photonics*, Wiley-Interscience.

**Assessment:** Pre-lab quizzes, Experiment reports and design project.

| **ECE 436** | **Solid State Electronic Devices** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 305 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the principles of solid state electronic devices.

**Outcomes:**
- Demonstrate knowledge and understanding of the principles of solid state electronic devices.
- Ability to model and analyze solid state devices.
- Ability to design simple integrated circuits.

**Description:** Semiconductor materials and carrier transport; p-n junctions and Schottky barriers; bipolar and field effect transistors; integrated circuits.

**Bibliography:**
- B. Streetman and S. Benerjee, *Solid State Electronic Devices*, Prentice Hall, 1999
- R.T. Paynter, *Introductory Electronic Devices and Circuits: Electron Flow Version*, Prentice Hall, 1999.

**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| **ECE 437** | **Electromagnetic Waves and Antenna Theory** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 333 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the principles of antenna design.

**Outcomes:**
- Demonstrate the analytical and experimental understanding of the parameters which give a phenomenological description of an antenna link.
- Demonstrate understanding of the electromagnetic antenna principles.
- Ability to use analytical tools and methods to analyze and design various antennas.

**Description:** Fundamental Antenna Parameters: System aspects. Fundamental Electromagnetic Theorems: Reciprocity, duality, radiation integral. Wire and Mobile Communications Antennas: Dipoles, loops, ground-effects. Phased Arrays I: Linear & circular, base station antennas. Phased Arrays II: 2D-arrays, infinite-array model, multimedia satellite front-ends. Self-Impedance: Integral equations and moment methods. Mutual-Impedance: Induced EMF method. Aperture Antennas I: Equivalent currents, rectangular apertures, horn-antennas. Aperture Antennas II: Plane-wave expansion, slots, Babinet's principle. Broadband Antennas: Self-complementarity, spirals, log-periodic.

**Bibliography:**
- C. Balanis, *Antenna Theory: Analysis and Design* $2^{nd}$ Edition, , John Wiley & Sons, 1997
- D. M. Pozar, *Microwave Engineering*, $3^{rd}$ Ed. Wiley, 2004.

**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| **ECE 438** | **Microwave and Radio-Frequency Circuits** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 331 | | | | | |

**Coordinator:**

**Objectives:**

**Outcomes:**
-

**Description:** The wave equation; Losses in conductors and dielectrics; RF/microwave transmission lines; Transients on transmission lines; Planar lines (microstrip, stripline, coplanar waveguide); Scattering parameters; 3- and 4-port devices (power dividers/combiners, couplers, isolators & circulators); Coupled lines and devices; RF/microwave filters; Microwave active circuits(RF amplifiers, mixers, receiver front ends).

**Bibliography:**
-

**Assessment:** Midterm examination, Final examination, weekly homeworks

| **ECE 441** | **Electromechanical Energy Conversion** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 340 | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to the fundamental concepts related to electromagnetic fields and energy conversion.

**Outcomes:**
- Demonstrate knowledge and understanding of the fundamental concepts related to electromagnetic fields and energy conversion
- Demonstrate understanding of the physical laws which govern the behavior of electromechanical systems.
- Ability to develop and use modeling techniques for the analysis and design of electromechanical systems.
- Demonstrate knowledge and understanding of the principles of operation and design of the major types of electric machinery.
- Demonstrate understanding of the impact of electric energy and energy processes on the economy and society in general.

**Description:** Lumped parameter concepts of electromechanics. Energy, co-energy in the derivation of torques and forces. Examples of electric machines: - dc, synchronous and induction types. Steady-state, transient and stability analysis. Power electronic controllers.

**Bibliography:**
- Krause, *Analysis of Electric Machinery*, IEEE Press, 1995
- C.M. Ong, *Simulation of Electrical Machines in MATLAB/Simulink*

**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 442** | **Power System Analysis** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 340 | | | | | |

**Coordinator:**

**Objectives:** To understand various power system components and their role in the power system. To analyze balanced three phase power systems. To model transmission lines and power system components in transmission networks. To understand the practical problems in the operation of power systems and to have the ability to suggest remedies and alternative solutions.

**Outcomes:**

- The students are expected to be able to model the most important power system components such as transmission lines, loads, generators, transformers, capacitors and reactors. They should be able to analyze power systems under steady state conditions. They are expected to know how to analyze a faulted system into three equivalent balanced circuits through symmetrical components. They should be able to design and simulate a power transmission system according to given operational criteria and constraints. They should understand the technical, economic, and environmental implications of the design of power systems.

**Description:** This course provides fundamental knowledge on the understanding of power system analysis. The students acquire basic analytical skills to perform analysis of systems. Topics include: review of phasors, complex power and balanced three phase circuits; symmetrical components; per unit system; transformers and per unit sequence models; transmission line modeling; power flow solution techniques; symmetrical faults; bus impedance and admittance matrices; power system stability; practical projects to understand the theoretical aspects of the course.

**Bibliography:**


- J. D. Glover and M. S. Sarma, *Power System Analysis and Design*, 3rd ed., Pacific Grove: Thomson Learning, 2002.
- H. Saadat, *Power System Analysis*, McGraw Hill, 2002.
- A. R. Bergen and V. Vittal, *Power Systems Analysis*, Prentice Hall, 1999.
- J. J. Grainger and W. D. Stevenson Jr., *Power System Analysis*, McGraw Hill, 1994.


**Assessment:** Two tests and a final examination.
Homework and design project.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 444** | **Power Electronics** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th Year Students | | | | | |

**Coordinator:**

**Objectives:**

**Outcomes:**

- 

**Description:** Introduction to power electronic components, electric circuits with switchesand diodes. Controlled single phase and three phase thyristor rectifiers. Analysis and operation of single phase and three phase power inverters. Output voltage control of inverters using the Sinusoidal Pulse Width Modulation (SPWM) technique. Application of power electronic configurations in electronic control systems, electrical machines, renewable energy systems, uninterruptible power supply systems (UPS), electric power transmission networks, DC-DC converters, AC-AC regulators, choppers, pulse width modulation, high voltage direct current (HVDC) transmission, Flexible AC Transmission Systems (FACTS), static voltage controllers (SVC), Thyristor Controlled Series Compensation (TCSC), phase angle regulators, and unified power flow controllers (UPFC).

**Bibliography:**

-

**Assessment:** Two tests and a final examination.

Homework assignment and design project.

| **ECE 445** | **Power Systems: Generation and Control** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th Year Students | | | | | |

**Coordinator:**

**Objectives:** To understand the principles of power system generation, operation and control. To learn and be able to apply various optimization methods for the distribution of the load to the available generating units. To understand and be able to perform power flow analysis using commercial software packages. To understand the behavior and response of synchronous generators to sudden changes in the load and generation.

**Outcomes:**

- The students are expected to be able to understand and apply the basic concepts of power system generation, operation and control. They are expected to know how to optimally select a subset of generators to serve a load (unit commitment) and how to optimally distribute the load demand to that subset of generators (economic dispatch). They should be able to perform a power flow analysis of a power system, understand the basic concepts of state estimation and the importance of telemetry and power system measurements in the smooth and safe operation of a power system. They should be able to model and analyze the behavior of a power system (including models of generators, governor, turbine, transmission lines, loads, control areas, and tie lines) and calculate the steady state frequency after a sudden disturbance.

**Description:** This course provides the basics of power system generation and control. Economic dispatch, unit commitment, automatic generation control. Dynamic and linear programming will be introduced and applied to solve power system problems. Overview of steam and hydroelectric units, fuel scheduling, production costing, generation control and state estimation, power flow.

**Bibliography:**


- A. J. Wood and B. F. Wollenberg, "Power Generation Operation and Control," 2nd ed., New York: J. Wiley and Sons, 1996.
- G. T. Heydt, "Computer Applications for Power Systems," Stars in a Circle Publications, Scottsdale, AZ, 1996.
- P. Kundur, "Power System Stability and Control," McGraw Hill, New York, 1994.
- J. D. Glover and M. S. Sarma, *Power System Analysis and Design*, 3rd ed., Pacific Grove: Thomson Learning, 2002.
- R. Bergen and V. Vittal, *Power Systems Analysis*, Prentice Hall, 1999.

**Assessment:** Two tests and a final examination.
Homework assignment and project.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ECE 447** | **Renewable Sources of Energy: Photovoltaics** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | | | | | | |

**Coordinator:** George E. Georghiou

**Objectives:**
Introduction of renewable sources of energy with emphasis on photovoltaics (PV)
Overview of the current state in Cyprus
Overview of the history of PV, PV development and market drivers
Device physics, physics of PV systems and solar radiation concepts
Analysis at the Cell and Module Levels
Analysis and description of PV systems
Limitations in efficiency
Overview of the current fabrication technologies and applications in PV technology

**Outcomes:**

- To introduce the current state of PV technologies in Cyprus and worldwide and to emphasize the need for further development
- To provide good understanding and application of device physics, PV systems and solar radiation concepts
- Ability to undertake analysis at the cell, module and system level
- Ability to review current fabrication technologies with application to PVs

**Description:** Introduction to renewable energy sources with main emphasis on photovoltaic (PV) energy conversion. Current state in Cyprus and potential. Types of photovoltaic systems. History of photovoltaic technology development. Current status: Technology, Policy, Markets.

Solar insolation. Short review of semiconductor properties. Generation, recombination and the basic equations of device physics. Efficiency limits, losses, and measurements. Physics of photovoltaic systems, including basic operating principles, design and technology, and performance of individual solar cells and solar cells systems.

Current fabrication technologies. Design of cells and modules. Other materials. Applications.

**Bibliography:**


- M.A, Green, “Solar Cells: Operating Principles, Technology and System Applications”, Prentice Hall 1982, reprinted by university of new south wales, 1992
- F.C. Treble, (ed), “Generating Electricity from the Sun”, Pergamon Press 1991, 1st Ed (august 1, 1991)
- G. Boyle, (ed) “Renewable Energy: Power for a Sustainable Future”, Oxford University press, 1996
- S.R. Wenham, M.A. Green, & M.E. Watt, “Applied Photovoltaics”, University of New South Wales, Centre for Photovoltaic Devices & Systems
- M.A. Green, “Silicon Solar Cells: Advanced Principles and Practice”, University of New South Wales, Centre for Photovoltaic Devices & Systems 1995


**Assessment:** Exam, Midterm, Assignments

| ECE 448 | Advanced Electric Machines | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | | 3 | 6 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 340 | | | | | |

**Coordinator:**

**Objectives:** To study the theory and practice related to electric machinery, their models, and their performance characteristics. To apply the concepts learnt in the lectures to practical applications in the laboratory. To design and set up control circuits for various types of electric machines.

**Outcomes:** The students are expected to gain a deep understanding of the parts, models, characteristics, and operational behavior of electric machines such as dc motors, synchronous machines, and induction generators. They are expected to design and construct circuits involving ac and dc machines, including their control circuitry. They should be able to make decisions as to the appropriate machine to be used for different types of applications and select the required ratings.

**Description:** In depth analysis of the operation and the characteristics of transformers, dc machines and single phase and three phase ac machines. Each lecture will be followed by an experimental session to enhance the understanding of students in the subject area. Dc machine lectures and experiments include shunt, series and compound wound machines both in the motor and generator modes. Ac machines include squirrel cage and slip ring induction motors, salient pole and round rotor synchronous generators/motors and universal motors. The transformer lectures and experiments will concentrate on no load and on load characteristics, and short circuit and open circuit tests. The interaction of the power supply with machines and other types of load will be studied through the connection with a transmission line.

**Bibliography:**

- S. J. Chapman, *Electric machinery and power system fundamentals*, New York: McGraw Hill, 2002.
- T. Wildi, *Electrical machines, drives, and power systems*, 5th ed., Upper Saddle River: Prentice Hall, 2002.
- G. G. Karady and K. Holbert, *Electrical energy conversion and transport: an interactive computer-based approach*, Piscataway: IEEE Press, 2005.
- Z. A. Yamayee and J. L. Bala Jr., *Electromechanical energy devices and power systems*¸ John Wiley and Sons, Inc., 1994.
- Γ. Ξυπτέρα, *Ηλεκτρικές μηχανές, Τόμος Ι: Μηχανές συνεχούς ρεύματος και ασύγχρονες μηχανές*, Θεσσαλονίκη: Εκδόσεις Ζήτη, 1995.
- Β. Στεργίου και Σ. Τουλόγλου, *Ηλεκτρικές μηχανές εναλλασσόμενου ρεύματος*, Περιστέρι: Εκδόσεις Ίων, 1999.
- Σ. Αντωνόπουλος, *Μετασχηματιστές*, Περιστέρι: Εκδόσεις Ίων, 1995.

**Assessment:** Midterm and final exams

Homework, laboratory reports and project.

| ECE 450 | Information Theory | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 359, ECE 324 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the principles of information transmission.

**Outcomes:**

- Demonstrate knowledge and understanding of source and channel models
- Demonstrate knowledge and understanding of Shannon's theory.
- Ability to apply the above tools in communications systems.

**Description:** Shannon's Reliable Data Transmission Block Diagram. Entropy and Relations to Reliable Communication: Source and Channel Models. Data Compression: lossless source coding (prefix codes, Ziv-Lempel algorithm), performance limits for channel codes, performance limits. Channel Capacity: additive Gaussian channels, finite-state channels. Rate Distortion: Quantization, compression subject to fidelity criterion. Network Information Theory: multiple access channel, broadcast channel, relay channel, interference channel. The effect of uncertainty on Shannon's Reliable Data Transmission Blocks.

**Bibliography:**

- Thomas Cover and Joy Thomas, Elements of Information Theory, John Wiley and Sons Inc., 1991

**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| **ECE 451** | **Advanced Communication Systems** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 359, ECE 324 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of advanced communication systems and some applications.

**Outcomes:**

- Ability to analyze and evaluate communication systems in the presence of noise.
- Demonstrate knowledge and understanding of access techniques FDMA, TDMA CDMA and random access.
- Demonstrate knowledge and understanding of information theory and coding.
- Ability to apply the above tools in communications systems.

**Description:** Noise in communication systems, signal-to-noise ratio. Performance of analog and digital communication systems under noise. Error probabilities and error control. Access techniques: FDMA, TDMA, CDMA, random access. Coding. Applications.

**Bibliography:**

- B.P. Lathi, *Modern Digital and Analog Communications Systems*, Oxford University Press: 1989
- L.W. Couch, *Modern Communication Systems Principles and Applications*, Prentice-Hall: 1995
- R.E. Ziemera and W.H. Tanser, *Principles of Communications: Systems, Modulation, and Noise*, Wiley, 1995
- J.G. Proakis and M. Salehi, *Communication Systems Engineering*, Prentice Hall, 1994
- J.D. Gibson, *Principles of Analog and Digital Communications*, Prentice Hall, 1993.
- S. Haykin, *An Introduction to Analog and Digital Communications*,
- A.V. Oppenheim and A.S. Willsky, *Signals and Systems*, Prentice-Hall: 1997

**Assessment:** Two tests and a final examination.
Homework assignment and design project.

| **ECE 453** | **Wireless Telecommunication Networks** | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|

| | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|
| | | 3 | | | 6 | ☐ | **6** |
| Year: 4 | Core ☐ / Elective ☒ | Prerequisites: | ECE 324 | | | | |

**Coordinator:** Stavros Toumpis

**Objectives:** To familiarize students with the theory, the basic principles, and the state of the art of current wireless telecommunication networks

**Outcomes:**

- Demonstrate knowledge and understanding of the basic engineering principles and overall operation on wireless telecommunication networks.

**Description:** Introduction and overview. Characteristics of the mobile radio environment-propagation phenomena. Cellular concept and channel allocation, Dynamic channel allocation and power control. Modulation Techniques. Multiple Access Techniques: FDMA, TDMA, CDMA. Second-generation, digital wireless systems. Performance analysis: admission control and handoffs. 2.5G/3G mobile wireless systems: packet-switched data. Wireless LANs and personal-area networks. Wireless ad hoc networks. Wireless Sensor Netw

**Bibliography:**

- Theodore Rappaport, Wireless Communications, Principles and Practise.
- Mobile wireless communications, Mischa Schwarz
- Wireless Communications, Andrea Goldsmith
- Wireless Communications and Networks, William Stallings

**Assessment:** One midterm and a final examination.
Homework assignments.

| ECE 455 | Fiber Optic Communication Systems and Networks | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|
| | | 3 | | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ / Elective ☒ | Prerequisites: | ECE 324 | | | | |

**Coordinator:** Georgios Ellinas

**Objectives:** To introduce the students to basic principles of fiber-optic communications and fiber-optic networks. In this course the students learn how light propagates in fibers and the physical layer effects during the transmission of light in the fiber medium. Understand the components of a fiber-optic link and how each component operates: Fibers, optical transmitters, optical receivers and optical amplifiers. Learn to design a fiber-optic link based on given specifications. Understand the basic optical node and networking architectures and learn how to route and how to restore optical connections. Learn about Wavelength Division Multiplexing.

**Outcomes:**

- Understand basic fiber-optic communications principles
- Solve basic fiber-optic transmission problems.
- Design a fiber-optic transmission link and assess its performance.
- Design optical switch fabric and node architectures
- Use routing and channel assignment techniques for optical connections
- Use restoration techniques for optical connections.
- Learn to apply knowledge of mathematics, science and engineering.
- Demonstrate basic knowledge of the design process by applying it to solve engineering problems.

**Description:** Optical Fibers, Wave and Ray Optics, Attenuation, Dispersion, Nonlinear Optical Effects, Optical Transmitters, LEDs, Lasers, Optical Receivers, PIN and APD Photodetectors, Receiver noise, Quantum efficiency, Receiver sensitivity, Optical amplifiers, EDFAs, Multichannel optical systems, Design and Performance of optical systems, optical networks, switch fabrics, node architectures, routing and wavelength assignment techniques, grooming, multicasting and fault detection and restoration.

**Bibliography:**
- G. Keiser, Optical Fiber Communications, 3rd Edition, 2000.
- G. Agrawal, Fiber Optic Communication Systems, 3rd Edition, Wiley, 2002.
- T. Stern and K. Bala, Multiwavelength Optical Networks: A Layered Approach, Prentice Hall, 1999.

**Assessment:** Midterm and final exams, homework.

| **ECE 456** | **Communications System Laboratory** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 451 | | | | | |

**Coordinator:**

**Objectives:** Analyze, design and evaluate communication systems.

**Outcomes:**
- Ability to design analogue and digital communication systems.
- Ability to implement and evaluate communication systems.
- Ability to test and troubleshoot communication systems.
- Ability to work in teams and communicate effectively with others.

**Description:** Experimental studies and simulation of analog and digital transmission techniques. Performance of AM and FM systems. FSK and PSK modulation techniques and spectra. Sampling of analog signals, PCM and TDM techniques.

**Bibliography:**
- S. Haykin, *An Introduction to Analog and Digital Communications*,
- B.P. Lathi, *Modern Digital and Analog Communications Systems*, Oxford University Press: 1989
- J.G. Proakis and M. Salehi, *Communication Systems Engineering*, Prentice Hall, 1994

**Assessment:** Laboratory report and design project.

| **ECE 457** | **Computer System and Network Security** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th year students | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the fundamental issues and solutions for achieving secure communications.

**Outcomes:**
- Demonstrate knowledge and understanding of security issues.
- Ability to identify computer and network security threats, classify the threats and develop a security model to prevent, detect and recover from the attacks.
- Encrypt and decrypt messages using block ciphers, sign and verify messages using well known signature generation and verification algorithms.
- Analyze existing authentication and key agreement protocols, identify the weaknesses of these protocols.

**Description:** Secure communications: encryption and decryption. Entropy, equivocation and unicity distance. Cryptanalysis and computational complexity. Substitution, transposition and product ciphers. Data Encryption Standard (DES): block and stream cipher modes. Modular arithmetic. Public key cryptosystems: RSA, knapsack. Factorization methods. Elliptic curve cryptography. Authentication methods and cryptographic protocols.

**Bibliography:**

- W. Stallings, *Cryptography and Network Security* Prentice Hall,1999.
- D. Gollmann, Computer Security, John Wiley & Sons, 1999.

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| ECE 462 | Network Computing | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th Year Students | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and tools for developing networked applications.

**Outcomes:**

- Demonstrate basic knowledge and understanding of computer networks.
- Demonstrate knowledge and understanding of tools for creating networked applications.
- Ability to design, develop and troubleshoot networked applications.

**Description:** Design and Java implementation of distributed applications that use telecommunication networks as their computing platform. Basics of networking: Java networking facilities. Introduction to open distributed processing: CORBA, Java1DL, JavaRMI, CGI/HTTP, DCOM, Componentware; Enterprise JavaBeans, ActiveX. Agents: Java code mobility facilities. Security issues; Java security model.

**Bibliography:**

- 

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| ECE 464 | Mobile Computing Systems | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th Year Students | | | | | |

**Coordinator:**

**Objectives:** Provides knowledge and understanding of the principles of mobile applications.

**Outcomes:**

- Demonstrate knowledge and understanding of wireless communications principles.
- Demonstrate knowledge and understanding of the principles of mobile applications.
- Ability to design and implement simple mobile applications.

**Description:** Systems to build mobile applications. Covers data link layer to application layer. Emphasis on existing wireless infrastructure and IETF protocols. Focuses on view of mobile application developer: communication systems, middleware and application frameworks, de-facto standards proposed/developed by industry consortia.

**Bibliography:**

- T.S. Rappaport, *Wireless Communications: Principles and Practice*, Prentice Hall, 2001
- W. Stallings, *Wireless Communications & Networks*, Prentice Hall, 2001.
- A. Tanenbaum, *Computer Networks*, 3rd Ed. Prentice Hall, 1996

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| ECE 466 | Performance Evaluation of Computer Systems and Simulation | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 324 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of the analytical tools used for assessing the performance of computer communication networks.

**Outcomes:**

- Demonstrate knowledge and understanding of the basing tools used for the analysis and performance evaluation of computer networks.
- Ability to apply these tools for performance

**Description:** Poisson process. Markov chains: birth and death processes. Basic queueing theory. Little's Law. Intermediate queueing theory: M/G/1, G/M/m queues. Advanced queueing theory: G/G/m queue, priority queue, network of queues, etc. Queueing applications in computer systems.

**Bibliography:**

- G.N. Higginbottom, *Performance Evaluation of Communication Networks*, Artech House, 1998.
- L. Kleinrock, *Queueing Systems*, Wiley-Interscience, 1975

**Assessment:** Two tests and a final examination.

Homework assignments and design project.

| ECE 468 | Optimization for Engineers | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:**

**Outcomes:**

- 

**Description:** Optimization for non-liner systems without constraints: Gradient based and Newton Techniques, convex optimization. Optimization with constraints and Lagrange methods. Dynamic programing. Applications in engineering systems.

**Bibliography:**

- D. Bertsekas, "Non-Linear Programming"
- D. Bertsekas, "Dynamic Programming"

**Assessment:** Midterm examination, Final examination, weekly homeworks

| ECE 471 | Neurophysiology and Senses | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | $4^{th}$ Year Students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to human physiology and the mathematics to model and analyze physiological systems at the molecular, cellular and systems levels.

**Outcomes:**

- Demonstrate understanding of cellular metabolism, ability to quantitatively describe enzyme kinetics, glycolysis and membrane potentials.
- Understanding of transport across cell membranes, ability to quantitatively describe diffusion and carrier mediated transport.
- Understanding of electrical signals and cell to cell communication in neurons, ability to quantitatively describe membrane ion channels, excitability, calcium dynamics, bursting and synaptic transmissions.
- Understanding of visual and auditory physiology, ability to quantitatively describe retinal light adaptation, frequency tuning in the inner ear and cochlear function.
- Understanding of the somatic and autonomic nervous systems.
- Understanding of skeletal and smooth muscle, ability to quantitatively model cross bridges.
- Understanding of integrated control of body movement.

**Description:** Principles of mass transport and electrical signal generation for biological membranes, cells, and tissues. Mass transport through membranes: diffusion, osmosis, chemically mediated, and active transport. Electric properties of cells: ion transport; equilibrium, resting, and action potentials. Kinetic and molecular properties of single voltage-gated ion channels. Application of the principles of energy and mass flow to major human organ systems. Mechanisms of regulation and homeostasis. Anatomical, physiological, and pathophysiological features of the cardiovascular, respiratory, and renal systems. Emphasis on those systems, features, and devices that are most illuminated by the methods of physical sciences.

**Bibliography:**

- D. Silverthorn, *Human Physiology*
- J.P. Keener, J. Sneyd, *Mathematical Biology*

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| **ECE 473** | **Instrumentation and Sensors** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 1 | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 205 | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to specific examples of how instrumentation is used in medicine and the unique design requirements for bioinstrumentation

**Outcomes:**

- Demonstrate knowledge and understanding on current methods in bioinstrumentation and the challenges to improve current techniques

**Description:** Measurement and analysis of biopotentials and biomedical transducer characteristics; electrical safety; applications of FETs, integrated circuits, operational amplifiers for signal processing and computer interfacing; signal analysis and display on the laboratory minicomputer. Lectures and laboratory.

**Bibliography:**

- J.G. Webster, *Medical Instrumentation Applications and Design*, 2nd Ed. Houghton Mifflin and Company
- Geddes and Baker, *Principles of Applied Biomedical Instrumentation*
- J. Bronzino, *The Biomedical Engineering Handbook*, CRC Press

**Assessment:** Two tests and a final examination.
Homework assignments and design project..

| ECE 474 | Bio-instrumentation and Physiology Laboratory | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | | 3 | 3 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 206 | | | | |

**Coordinator:**

**Objectives:** Design equipment for measuring natural biopotentials. Data analysis to solve real problems. Through oral presentations and written reports students learn effective communication skills.

**Outcomes:**

- Ability to design medical equipment to meet technical and safety specifications using a team approach.
- Ability to test and troubleshoot medical equipment.
- Ability to work in teams and communicate effectively with others.

**Description:** Laboratory and computer exercises that illustrate the concepts in bio-instrumentation and physiology. Laboratory work includes some animal studies.

**Bibliography:**

- J.G. Webster, *Medical Instrumentation Applications and Design*, 2nd Ed. Houghton Mifflin and Company
- Geddes and Baker, *Principles of Applied Biomedical Instrumentation*
- J. Bronzino, *The Biomedical Engineering Handbook*, CRC Press
- *Essential Standards for Biomedical Equipment Safety and Performance*, AAMI

**Assessment:** Laboratory reports and design project.

| ECE 476 | Biomedical Imaging | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | 1 | | 5 | ☒ | 6 |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 321 | | | | |

**Coordinator:**

**Objectives:** Provide an introduction (in qualitative terms) of the relevance of principal biomedical imaging modalities for diagnostic imaging problems.

**Outcomes:**

- Demonstrate knowledge and understanding in qualitative terms the principal contemporary biomedical imaging modalities including projection X-ray, computed tomography, ultrasound, magnetic resonance imaging, positron emission tomography, single photon emission computed tomography, fluorescent imaging, optical coherence tomography.
- Ability to describe the signal pathways from the stimulus/transducer to image-display for each biomedical imaging modality.
- Ability to apply signal and image processing techniques to data collected using one of the principal biomedical imaging modalities.
- Ability to describe the economic costs in purchasing, operating, and maintaining biomedical imaging instrumentation

**Description:** The purpose of this course is to present an overview of biomedical imaging systems and image analysis. The course will examine various imaging modalities including xray, ultrasound, nuclear, and MRI. Microscopy will also be presented. How these images are formed and what types of information they provide will be presented. Image analysis techniques will also be emphasized. Specific analysis techniques will include the analysis of cardiac ultrasound, mammography, and MRI functional imagery.

**Bibliography:**

- R.A. Robb, *Biomedical Imaging, Visualization and Analysis*, Wiley-Liss, 1999.

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| **ECE 477** | **Biomedical Optics** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 333 | | | | | |

**Coordinator:**

**Objectives:** Lay out the physical foundation of using light and tissue optical properties for students to understand optical phenomena in tissue and biomedical applications of optics.

**Outcomes:**

- Demonstrate knowledge and understanding the principles of lasers, current laser technology, detectors, fiber optics and sensors
- Demonstrate knowledge and understanding of the interaction of light with cells and tissues
- Ability to analyze optical imaging techniques, linear and nonlinear optical spectroscopy, fluorescence and Raman spectroscopy, microscopy and light interaction with biological tissues.

**Description:** The optical behavior of random media such as tissue in interaction with laser irradiation. Basic principles of optical tomographic imaging of biological materials for diagnostic or therapeutic applications. Optical-based tomographic imaging techniques including photothermal, photoacoustic, and coherent methodologies. Measurement and interpretation of spectra: steady-state and time-resolved absorption, fluorescence, phosphorescence, and Raman spectroscopy in the ultraviolet, visible, and infrared portions of the spectrum.

**Bibliography:**

- Paras N. Prasad, *Introduction to Biophotonics*
- Tuan Vo-Dinh (Editor), *Biomedical Photonics Handbook*

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| **ECE 478** | **Digital Image Processing** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 320 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of analysis tools for digital image processing.

**Outcomes:**

- Demonstrate knowledge and understanding of discrete-time signal representation and analysis tools.
- Ability to analyze discrete-time signals using the z-transforms, discrete Fourier transform (DFT), Fast Fourier transform (FFT).
- Ability to design digital filters using Infinite Impulse Response (IIR) and Finite Impulse Response (FIR).
- Ability to utilize DSP software tools.

**Description:** Two-Dimensional (2-D) Signals and Fourier Transform; 2-D DFT, DCT, FFT; 2-D FIR Filter Design and Implementation; image processing basics; edge detection; rank order (median) filtering, motion estimation; image enhancement; image restoration; image coding; advanced topics.

**Bibliography:**

-

**Assessment:** Two tests and a final examination.
Design project.

| **ECE 480** | **Brain Computer Interface** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | $4^{th}$ Year Students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to brain signals and methods of processing them.

**Outcomes:**

-

**Description:** Brain-Computer Interfaces (BCI) are systems which utilise the differences in the electrical activity (EEG) obtained during various mental processes as an input to a device, e.g. computer, prosthetic arm. The aim of this course is the introduction to BCI technology. The electrical brain activity will be traced from the moment it is generated through to the moment it is utilised as a direct command to a device. This will allow a simultaneous look at the various state-of-the-art data processing methods utilised in BCI systems and which could also be utilised for analysis of other signals with characteristics similar to the EEG.

**Bibliography:**

-

**Assessment:** Two tests and a final examination.
Homework assignments and design project.

| **ECE 482** | **Database Systems** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | $4^{th}$ Year Students | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of database systems and their applications.

**Outcomes:**

- Demonstrate knowledge and understanding of the principles of database models.
- Demonstrate knowledge and understanding of database management.
- Ability to design and develop simple database applications.

**Description:** Database definitions, applications, and architectures. Conceptual design based on the entity-relationship and object-oriented models. Relational data model: relational algebra and calculus, normal forms, data definition and manipulation languages. Database management systems: transaction management, recovery and concurrency control. Current trends: object-oriented, knowledge-based, multimedia and distributed databases.

**Bibliography:**

- Peter Rob, *Database Systems: Design, Implementation, and Management*, 5th Ed. Course Technology, 2001.

**Assessment:** Two tests and a final examination.

Homework assignments and design project.

| **ECE 484** | **Modeling and Simulation of Computer Systems** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | ECE 324, ECE 325 | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge and understanding of basic tools for modeling and simulating computer systems and discrete event systems in general.

**Outcomes:**

- Demonstrate knowledge and understanding of state automata and Perti-nets
- Develop simple simulation tools for analyzing computer systems.
- Ability to use simulation tools for analyzing and designing computer systems.
- Ability to analyze

**Description:** Modeling of discrete event systems: Automata and Petri-nets. Simulation techniques. Random number generators. Basic statistics for analysis of simulation results. Techniques for speeding up simulation. Simulation of processors, cache memory, and computer networks. Elementary queueing theory and Markov chains.

**Bibliography:**

- S.M. Ross, *Simulation*, Academic Press, 2001.
- C. Cassandras and S. Lafortune, *Introduction to Discrete Event Systems*, Kluwer, 1999.
- Jerry Banks et. al. *Discrete-Event System Simulation*, Prentice Hall, 2000.
- B. Zeigler, T. Kim and H. Praehofer, *Theory of Modeling and Simulation*, Academic Press

**Assessment:** One test and a final examination.

Assignments and design project.

| **ECE 485** | **Multimedia Systems** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th Year Students | | | | | |

**Coordinator:**

**Objectives:** Provide an introduction to multimedia systems and applications.

**Outcomes:**

- Demonstrate knowledge and understanding of the fundamental principles of multimedia systems.
- Demonstrate knowledge and understanding of the forms of data and coding schemes involved in multimedia applications.
- Demonstrate knowledge and understanding of network management issues.

**Description:** This course covers engineering aspects of multimedia systems with particular emphasis on the theory, design, features, performance, complexity analysis, optimization and application of multimedia engineering technologies. Topics include sound/audio, image and video characterization, compression requirements, source entropy and hybrid coding, transformer coding, wavelet based coding, motion estimation, JPEG coding standard, digital video coding, MPEG-1/2 coding, content-based processing, traffic characterization, networking resource management.

**Bibliography:**

- K. R. Rao et. al., *Multimedia Communication Systems: Techniques, Standards, and Networks*, Prentice Hall 2002

**Assessment:** Two tests and a final examination.

Design project.

| **ECE 499** | **Special Topics** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 6 | ☒ | **6** |
| Year: 4 | Core ☐ | Elective ☒ | Prerequisites: | 4th Year Students | | | | | |

**Coordinator:**

**Objectives:**

**Outcomes:**

**Description:** A seminar-type presentation and discussion of special topics in electrical and computer engineering. Opportunity for undergraduate students and instructors to investigate a topic of common interest. Topic and responsible faculty announced each term, as subjects of interest are identified. These subjects are given independently or sequentially, as circumstances require.

**Bibliography:**

**Assessment:**

## *Required Courses from Other Departments*

| **MAS 021** | **Calculus I** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Provide the necessary mathematical background

**Outcomes:**

- Demonstrate knowledge and understanding of differentiation and integration

**Description:** Basic review: Numbers, absolute values and inequalities, functions, composite functions, one-to-one functions, function inverse. Coordinate geometry. Limits and rates of change: Definition of the limit, calculating limits of functions, continuity, tangent of a function and rate of change. Derivatives: Differentiation formulas and function derivatives. Higher derivatives. Derivatives as rates of change (velocity and acceleration). Chain rule. Differential and Newton's approximation. Applications of Derivatives and Curve Sketching. Mean value theorem. Maximum, minimum and points of inflection. Horizontal and vertical asymptotes. Applied maximum and minimum problems. L'Hospital's rule.

Integration: Area and definite integral. Anti-derivatives and the fundamental theorem of integral calculus. Indefinite integrals. Evaluation of integrals. Estimates of definite integrals and numerical integration. Applications of Integrals. Using tables of integrals. Area between curves. Volume by parallel cross section and the shell method. Improper integrals. Moments and centers of mass. Average value of a function

**Bibliography:**

- H. Anton, *Calculus*
- S.K. Stein, *Calculus and Analytic Geometry*
- J. Stewart, *Calculus.*
- S.L. Salas, E. Hille, J.T. Anderson, *Calculus, one and several variable*

**Assessment:** Two tests and a final examination

| **MAS 022** | **Calculus II** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | MAS 021 | | | | | |

**Coordinator:**

**Objectives:** Provide the necessary mathematical background

**Outcomes:**

-

**Description:** Techniques of Integration: Integration by parts. Partial fractions. Powers and products of sines and cosines. Trigonometric powers. Integrals involving $\sqrt{a^2 \pm x^2}$ and $\sqrt{x^2 \pm a^2}$. Rational expressions in $\sin x$ and $\cos x$. Sequences and Series: Sequences and series. Convergence of a series, the integral and comparison tests. Absolute and conditional convergence. Alternating series. Power series. Taylor and Maclaurin series. Polar Coordinates: Polar coordinates. Area in polar coordinates. Parametric equations. Arc length and speed on a curve. Area of a surface of revolution.

Vectors: Algebra of vectors. Vectors in space. Dot product and cross product of vectors. Lines and planes. Partial Derivatives Functions of several variables. Graphs of equations and level curves. Partial derivatives. Tangent planes and differentials. The Chain rule. Directional derivatives, gradients, divergence and curl. Critical points and extrema.

**Bibliography:**

- H. Anton, *Calculus*
- S.K. Stein, *Calculus and Analytic Geometry*
- J. Stewart, *Calculus.*
- S.L. Salas, E. Hille, J.T. Anderson, *Calculus, one and several variable*

**Assessment:** Two tests and a final examination

| **MAS 023** | **Mathematics III :** Multivariable Calculus and Linear Algebra | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | MAS 022 | | | | | |

**Coordinator:**

**Objectives:** Provide the necessary mathematical background

**Outcomes:**

**Description:** Multiple Integrals: Double and triple integrals double integrals over rectangles and more general regions. Integrals in cylindrical, spherical and in polar coordinates. Applications: surface areas, averages and centroids. Line and Surface integrals: Line integrals, fundamental theorem of line integrals, surface integrals, Green's and Stoke's Theorems, Divergence theorem.
Linear Algebra: Solution of systems of linear equations, Gaussian elimination, Linear independence, basis and dimension. Matrix inversion and pseudo-inverse.
Orthogonality: Inner products and projections, Orthogonal bases and orthogonal matrices and the Gram-Schmidt Orthogonalization. Determinants: Properties of determinants, formulas for determinants, applications of determinants. Eigenvalues and eigenvectors, characteristic equation and evaluation of eigenvalues and eigenvectors. Matrix diagonalization. Applications. Similarity transformations and triangular forms.

**Bibliography:**
- H. Anton, *Calculus*
- S.K. Stein, *Calculus and Analytic Geometry*
- J. Stewart, *Calculus.*
- S.L. Salas, E. Hille, J.T. Anderson, *Calculus, one and several variable*

**Assessment:** Two tests and a final examination

<table>
<tr><td rowspan="2">MAS 024</td><td colspan="3" rowspan="2">Mathematics IV: Linear Algebra and Ordinary Differential Equations</td><td>I</td><td>T</td><td>L</td><td>H</td><td>P</td><td>ECTS</td></tr>
<tr><td>3</td><td>1</td><td></td><td>5</td><td>☐</td><td>6</td></tr>
<tr><td>Year: 2</td><td>Core ☒</td><td>Elective ☐</td><td>Prerequisites:</td><td colspan="6">MAS 022</td></tr>
</table>

**Coordinator:**

**Objectives:** Provide the necessary mathematical background

**Outcomes:**

**Description:** First Order Differential Equations: Solutions to first order linear and non-linear differential equations. Separable equations, exact equations, homogeneous equation. Applications.
Second Order Differential Equations: Fundamental solutions of homogeneous equations. The non-homogeneous problem. Methods of undetermined coefficients and variations of parameters. Series solutions. Applications in electrical networks.
Systems of First Order Linear Equations: Homogeneous linear systems with constant coefficients. Complex eigenvalues. Repeated eigenvalues. Non-homogenous linear systems. Partial Differential Equation: Separation of variables and Fourier Series.
Non-Linear Differential Equation and Stability Analysis. Phase planes and stability. Liapunov's Method.

**Bibliography:**
- W.E. Boyce and R.C. Diprima, *Elementary Differential Equations and Boundary Value Problems*

**Assessment:** Two tests and a final examination

<table>
<tr><td rowspan="2">PHY 131</td><td colspan="3" rowspan="2">General Physics I: Mechanics, Waves and Thermodynamics</td><td>I</td><td>T</td><td>L</td><td>H</td><td>P</td><td>ECTS</td></tr>
<tr><td>3</td><td>1</td><td></td><td>5</td><td>☐</td><td>6</td></tr>
<tr><td>Year: 1</td><td>Core ☒</td><td>Elective ☐</td><td>Prerequisites:</td><td colspan="6"></td></tr>
</table>

**Coordinator:**

**Objectives:** Provide the necessary background in physics

**Outcomes:**

**Description:** Measurement units, coordinate systems. Motion in one and more dimensions, velocity, acceleration, reference frames. Forces, Newton’s laws. Work, mechanical energy. Momentum, center of mass. Torque, angular momentum, moment of inertia. Oscillations. Universal gravitation, Kepler’s laws. Wave equation, transverse and longitudinal waves, Phase and group velocity. Thermodynamics;. Heat and the First and Second Law, Engines, Refrigerators and Entropy.

**Bibliography:**

**Assessment:** Two tests and a final examination

| **PHY 132** | **General Physics II:** Electricity and Electromagnetism and Optics | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | |

**Coordinator:**

**Objectives:** Provide the necessary background in physics

**Outcomes:**

**Description:** Electricity and Electromagnetism: Electric Fields. Gauss’s Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. DC Electrical Circuits Magnetic Fields. Sources of Magnetic Field. Faraday’s Law. Induction and Motors. AC Electrical Circuits. Electromagnetic Waves, Doppler effect for sound and light. Optics: Geometrical optics, Haygen’s and Fermat’s principle, optical instruments. Interference, Young’s experiment, Michelson’s interferometer, multiple beam interference, Rayleigh’s resolution criterion, Fraunhofer diffraction, diffraction gating, Bragg’s law, Polarization, Malu’s law, double refraction, production of circular polarized light, blackbody radiation, Planck’s quantum hypothesis, photoelectric effect.

**Bibliography:**

**Assessment:** Two tests and a final examination

| **PHY 133** | **General Physics III:** Classical and Quantum Mechanics | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | | 5 | ☐ | **6** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | PHY 131, PHY132 | | | |

**Coordinator:**

**Objectives:** Provide the necessary background in physics

**Outcomes:**

**Description:** Classical Mechanics. Inertial frames of reference and generalized coordinates, Newtonian Mechanics, Lagrangian formalist, conservation laws, motion in a central potential, gravitational fields, small amplitude oscillations, rigid bodies, Hamilton equations. Quantum Mechanics. The Schrodinger equation and the wave function. Introduction to the statistical interpretation of quantum mechanics. Wave function normalization. Mean values and operators of position, momentum, and energy. One dimensional potentials. Infinite square well. Harmonic oscillator. Delta function potential. Finite square well. Free particle.

**Bibliography:**

**Assessment:** Two tests and a final examination

| **BIO 101** | **Introduction to Modern Biology** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☐ | **5** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Provide a general science background in modern biology.

**Outcomes:**

**Description:** Structure and function of the cell nucleus, nucleic acids, genetic code, genes, gene copying and transcription, proteins, translation, cellular organelles, cytoskeleton, cell cycle, mitosis, meiosis, fertilization, Biotechnology, Genome mapping, human genetic disorders (hemoglobin-related, muscular and neuronal disorders), molecular diagnostics. Bioethical issues of modern applications of biology, sponge encephalopathy (prions), retroviruses, genetic therapy, cancer.

**Bibliography:**

**Assessment:** Two tests and a final examination

| **CS 034** | **Programming Principles I** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | 3 | 3 | ☒ | **7** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Provide knowledge on the main concepts of programming. Develop capacities to analyze, design and develop computer programs.

**Outcomes:**

- Demonstrate knowledge and understanding of the software development process
- Demonstrate knowledge and understanding of the basic programming principles and program design
- Demonstrate knowledge and understanding of data types, control structures, functions and modular programming.
- Ability to design and develop simple programs.

**Description:** Presentation of the software development process and introduction to the basic principles of programming and program design using the C language. Global overview of the C language with emphasis on data types, control structures, functions and modular programming.

**Bibliography:**

**Assessment:** Two tests and a final examination

Programming exercises and a project

| **CS 035** | **Data Structures and Algorithms** | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | 1 | 2 | 4 | ☒ | **7** |
| Year: 2 | Core ☒ | Elective ☐ | Prerequisites: | CS 131 | | | | | |

**Coordinator:**

**Objectives:** Provide an increased level of exposure to programming techniques and algorithms.

**Outcomes:**

- Demonstrate knowledge and understanding of static and dynamic memory allocation.
- Ability to program with abstract data types.
- Ability to work with stacks, queues, linked lists, trees
- Demonstrate knowledge and understanding of sorting and searching algorithms. Ability to analyze these algorithms.
- Ability to design and develop software programs.

**Description:** Advanced programming techniques and methodologies based on the C language. Topics include static and dynamic memory manipulation, file management, pointers, recursion, and dynamic data structures. Abstract data types. Stacks, queues, linked lists, trees. Techniques for algorithm design. Sorting and searching algorithms. Analysis of algorithms and complexity notation. Case studies.

**Bibliography:**

**Assessment:** Two tests and a final examination

Programming exercises and a project

| **PBA 434** | **Entrepreneurship Management** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | | **5** |
| Year: 4 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Provide basic microeconomic principles and basic knowledge of business management and the business cycles with emphasis on new ventures.

**Outcomes:**

**Description:** Basic microeconomic principles. Overview of entrepreneurship through case studies and readings. Analysis of risks and rewards of a business opportunity, the obstacles to be overcome in starting and managing a new venture, and the skills and resources required for success.

**Bibliography:**

**Assessment:** Two tests and a final examination

| **LAN 100** | **General Advanced English** | | | **I** | **T** | **L** | **H** | **P** | **ECTS** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☒ | **5** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** .

**Outcomes:**

**Description:** This is an advanced, general, integrated skills course in English and study skills, designed to prepare students for using English for academic purposes.

**Bibliography:**

**Assessment:** One test and a final examination.

Reading and writing assignments.

| LAN 104 | English for Technical Purposes | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☒ | **5** |
| Year: 1 | Core ☒ | Elective ☐ | Prerequisites: | LAN 100 | | | | | |

**Coordinator:**

**Objectives:**

**Outcomes:**

**Description:** This course aims at developing advanced engineering listening, reading and writing skills, with emphasis on technical documents, oral reports, and graphics. Students undertake the task of preparing reports, papers and making presentations.

**Bibliography:**

**Assessment:** One test and a final examination.

Homework assignments and technical reports.

## *Service Course offered to Other Departments*

| ECE 001 | Health and Technology | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☐ | **5** |
| Year: 1 | Core ☐ | Elective ☒ | Prerequisites: | | | | | | |

**Coordinator:** Constantinos Pitris

**Objectives:** Provide basic knowledge on some of the technological innovations that are used in modern medicine.

**Outcomes:**

- Demonstrate knowledge of the basic principles of the technologies that are used in modern medicine.
- Demonstrate knowledge and understanding of the economic and ethical issues relating to technological innovations in medicine.

**Description:** Medicine has made tremendous progress since the beginning of the century. It has evolved from an art, when chances of survival were heavily stacked against the patient, to a science which saves lives every day. Medical technology, i.e. the inventions that put science to practical use, includes, among others, the discovery or invention and development of anesthesia, antiseptics, X rays, blood transfusions, artificial and human organ transplants, and medical imaging techniques such as CT, MRI and ultrasound. This course examines the technological bases of some of the most important innovations in medical technology and analyzes the economic and ethical issues surrounding them. The course aims to enhance the understanding not only of the science, the machinery and the organization of modern medicine but also of its origins, its social context, and its alternative futures. The course is intended for students of all majors without any specific science background.

**Bibliography:**

- Instructor’s notes

**Assessment:** One test and a final examination.

Homework assignments and a research project.

| ECE 007 | Information Technology without Equations | | | I | T | L | H | P | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 5 | ☐ | **5** |
| Year: 1 | Core ☐ | Elective ☒ | Prerequisites: | | | | | | |

**Coordinator:**

**Objectives:** Provide the basics of Information Technology and Data Communications to students from various disciplines without engineering or computer science background.

**Outcomes:**

- Demonstrate basic knowledge of information representation, information storage and transmission.
- Demonstrate knowledge of the Internet and the World Wide Web.
- Demonstrate knowledge of the underlying principles of telephone and data networks.

**Description:** During the course students will learn the basic principles of the operation of high-tech devices such as mobile phones, palm pilots, etc. The course will cover the Information Revolution and the unique product of Information Age, the World Wide Web. Furthermore, it will present the basics of information representation as well as various forms of information such as audio, image and video. The course will introduce aspects of Data Communication such as information transmission (wired, fiber-optic, radio and satellite), and data storage. The last part of the course will describe how telephone and data networks work and present basic concepts from information security.

**Bibliography:**

- D. Cyganski, A.O., Orr, and R.F. Vaz*, Information Technology Inside and Outside*, Prentice Hall, 2001

**Assessment:** One test and a final examination.

Homework assignments and a research project.

# Academic Staff

## *Marios Polycarpou, Professor*

Undergraduate studies at Rice University, USA (B.A. in Computer Science, 1987; B.Sc. in Electrical Engineering, 1987). Graduate studies at the University of Southern California, USA (M.Sc. 1989, Ph.D. 1992, in Electrical Engineering). He has taught as Assistant Professor and as Associate Professor (tenured) at the University of Cincinnati, USA (1992-2001). His research interests include intelligent decision and control systems, automation, neural networks and computational intelligence, automated fault diagnosis and distributed cooperative control systems. He is an Associate Editor of the journals: *IEEE Transactions on Neural Networks, IEEE Transactions on Automatic Control,* and the *International Journal of Applied Mathematics and Computer Science.* He is a Fellow of IEEE and currently serves as Vice President for Conferences of the *IEEE Neural Network Society*.

## *Charalambos Charalambous, Associate Professor*

Undergraduate and graduate studies at Old Dominion University, USA (B.Sc. 1987, M.Sc. 1988, Ph.D. 1992, all in Electrical Engineering). He worked as Post-doctoral Fellow at Idaho State University, USA (1993-1995), and he taught at McGill University, Canada as Assistant Professor (1995-1999) and as Associate Professor (tenured) at the University of Ottawa, USA (1999-2003). His research interests focus on optimization of stochastic systems, control, communications, bandwidth pricing, queuing systems, large deviations, information theory and statistical mechanics. He is an Associate Editor of the journal *IEEE Transactions on Automatic Control* and his is member of the *Control System Society Conference Editorial Board.*

## *Stavros Iezekiel, Associate Professor*

Undergraduate and graduate studies n electronic and electrical engineering at The University of Leeds, Leeds, U.K (B.Eng. 1987, and Ph.D1991). From 1991 to 1993, he worked in conjunction with the M/A-COM Corporate Research and Development Center, during which time he was involved with the development of microwave photonic multichip modules. At Leeds he was the Deputy Director of the Institute of Microwaves and Photonics and Director of Learning and Teaching with the School of Electronic and Electrical Engineering. Dr. Iezekiel was the recipient of the 1999 Institution of Electrical Engineers (IEE), U.K., Measurement Prize for his research on lightwave network analysis.

## *George E. Georghiou, Assistant Professor*

He is currently an Assistant Professor at the Department of Electrical and Computer Engineering, University of Cyprus. Prior to this, he was the undergraduate course leader in Electrical Engineering at the University of Southampton, Department of Electronics and Computer Science and a Research Advisor for the Electricity Utilization, University of Cambridge. Having graduated from the University of Cambridge with a BA (1995), MEng (1996), MA (1997) all with distinction and PhD (1999), Dr Georghiou continued his work at the University of Cambridge in the capacity of a Fellow at Emmanuel College for a further three years (1999-2002). Dr Georghiou has published over 80 papers in international journals and conference proceedings. Amongst his many scholarly achievements, he was awarded the outstanding paper award by the Journal of Microwave Power and Electromagnetic Energy in 1999 for the most significant technical scientific contribution. More recently, two of his papers were rated in the top 5% across all the Institute of Physics Journals (IOP). Dr Georghiou is also actively promoting the entrepreneurship role academics can play in society, and the commercialisation of cutting edge technology that stems from academic inventions. One of his ideas was a winner of the 2001 50k innovation award organised by the Cambridge University Entrepreneurs and as a result a company has since been launched to commercialise this technology.

## *Georgios Ellinas, Assistant Professor*

He holds a B.S., M.S., M.Phil, and a Ph.D. in electrical engineering from Columbia University. George is currently an Assistant Professor of Electrical and Computer Engineering at the University of Cyprus. Prior to joining the University of Cyprus George was an Associate Professor of Electrical Engineering at City College of the City University of New York. Before joining the academia, George was a senior network architect at Tellium Inc. In this role, he worked on lightpath provisioning and fault restoration algorithms in optical mesh networks, and the architecture design of the MEMS-based all-optical switch. George also served as a senior research scientist in Telcordia Technologies' (formerly Bellcore) Optical Networking Research Group. George performed research for the DARPA-funded Optical Networks Technology Consortium (ONTC), Multiwavelength Optical Networking (MONET) and Next Generation Internet (NGI) projects from 1993 to 2000.

## *Maria K. Michael, Assistant Professor*

Undergraduate studies at Southern Illinois University, USA (B.Sc. in Computer Science, 1996). Graduate studies also at Southern Illinois University, USA (M.Sc. in Computer Science, 1998; Ph.D. in Electrical and Computer Engineering, 2002). She has taught as a Lecturer at the Electrical and Computer Engineering department at Southern Illinois University, USA (2002), and as an Assistant Professor at the Computer Science and Engineering department at the University of Notre Dame, USA (2002-2003). She is a Member of IEEE and ACM. Her research interests fall in the broad area of Computer-Aided Design (CAD) for the design and test of VLSI circuits, with focus on the design and analysis of algorithmic methodologies for testing of timing faults, and timing analysis and verification. They expand to synthesis/re-synthesis aspects for improved testability and verification.

## *Christos Panayiotou, Assistant Professor*

Undergraduate and graduate studies at the University of Massachusetts at Amherst, USA (B.Sc. 1994, Ph.D. 1999 in Electrical Engineering, M.B.A 1999). He worked as a Research Associate at the Center for Information and System Engineering (CISE) and the Manufacturing Engineering Department at Boston University (1999-2002) and taught as a Visiting Lecturer at the University of Cyprus (2002-2003). His research interests include optimization and control of discrete-event systems with emphasis to computer communication networks, manufacturing systems and transportation networks. He is an Associate Editor for the Conference Editorial Board of the IEEE Control Systems Society.

## *Constantinos Pitris, Assistant Professor*

Undergraduate studies at the University of Texas at Austin, USA (B.Sc. Electrical Engineering, 1993). Graduate studies at the University of Texas at Austin, USA (M.Sc. Electrical Engineering, 1995), at the Massachusetts Institute of Technology (MIT), USA (Ph.D. 2000, Medical and Electrical Engineering) and at the Harvard Medical School (M.D., 2002). He worked as Postdoctoral Associate at the Wellman Laboratories of Photomedicine of the Massachusetts General Hospital and Harvard Medical School. His main research interests cover the areas of optics and biomedical imaging. The overlying goal of this research is the introduction of new technologies in clinical applications for the improvement of the diagnostic and therapeutic options of modern health care systems to directly impact patient prognosis and outcome.

## *Julius Georgiou, Lecturer*

Julius Georgiou received his M.Eng degree in Electrical and Electronic Engineering and Ph.D. degree in Biomedical Electronics from Imperial College London in 1998 and 2003 respectively. During the last two years of his Ph.D. he was heavily involved in a technology startup company, Toumaz Technology, as Head of Micropower Design. In 2004 he joined the Johns Hopkins University as a Postdoctoral Fellow, before joining the University of Cyprus in 2005. His main area of expertise is in ultra low power circuit techniques and has applied them to a range of applications spanning from biomedical implants to defense systems. He is a member of the IEEE Circuits and Systems Society, the BioCAS Technical Committee, as well as a member of the IEEE Circuits and Systems Society Analog Signal Processing Technical Committee.

## *Elias Kyriakides, Lecturer*

Elias Kyriakides received the Diploma of Technician Engineer in Electrical Engineering from the Higher Technical Institute, Nicosia, Cyprus in 1996 and the B.Sc. degree in Electrical Engineering from the Illinois Institute of Technology, Chicago, IL, USA in 2000. He received the M.S. and Ph.D. degrees in Electrical Engineering from Arizona State University, Tempe, AZ, USA in 2001 and 2003 respectively. He has worked as a Research Associate at Arizona State University from Aug. 2000-Dec. 2003 and as a Faculty Research Associate from Jan.-May 2004. In July 2004 he joined the Department of Electrical and Computer Engineering at the University of Cyprus. Dr. Kyriakides is working in the area of electric power engineering. He has published papers in refereed journals and international conferences. He is a Member of the IEEE, the IEE, and the Technical Chamber of Cyprus. He is a reviewer for a number of journals including the IEEE Transactions on Power Delivery, the IEEE Transactions on Power Systems, and the IEEE Transactions on Education. He was the recipient of the Palais Outstanding Doctoral Student Award at Arizona State University (2004), the third prize in the IEEE poster-paper session and contest for the paper entitled "On-line identification of generator and exciter parameters" (2002), the Alumni association award at the Illinois Institute of Technology (2000), and the Presidential award at the Higher Technical Institute (1996).

## *Theocharis Theocharides, Lecturer*

Theocharis Theocharides is a Lecturer in the Department of Electrical and Computer Engineering, at the University of Cyprus. Theocharis received his Ph.D. in Computer Engineering from Penn State University, working under the supervision of Professors Mary Jane Irwin and Vijaykrishnan Narayanan, in the areas of low-power computer architectures and reliable system design. As a member of the Embedded and Mobile Computing Research Center at Penn State, Theocharis' research revolved around the development of low-power and reliable Systems-on-Chip, with emphasis in the underlying interconnection architectures. He was a member of the Gigascale Systems Research Center (www.gigascale.org), where he collaborated with leading researchers in the fields of low-power and reliable on-chip interconnection networks. Theocharis published numerous papers on Application-Specific Systems-on-Chip, Networks-on-Chip, and hardware implementations of complex Multimedia and Machine Vision applications. Theocharis was honored with the Robert M. Owens Memorial Scholarship in May 2005. Upon receiving his Ph.D. in December 2005, he joined the Electrical and Computer Engineering department at the University of Cyprus as a visiting Lecturer. His research focuses on the development of low-power and reliable on-chip interconnection architectures, low-power VLSI design, embedded systems design and exploration of energy-reliability tradeoffs for chip multiprocessor systems.

## *Stavros Toumpis, Lecturer*

Stavros Toumpis received the Diploma in electrical and computer engineering from the National Technical University of Athens, Greece, in 1997, the M.S. degrees in electrical engineering and mathematics from Stanford University, CA, in 1999 and 2002, respectively, and the Ph.D.
degree in electrical engineering, also from Stanford, in 2003. From 1998 to 1999, he worked as a Research Assistant for the Mars Global Surveyor Radio Science Team, providing operational support. From 2000 to 2003, he was a Member of the Wireless Systems Laboratory, at Stanford University.

From 2003 to 2005, he was a Senior Researcher with the Telecommunications Research Center Vienna (ftw.), in Vienna, Austria. Since 2005, he is a Lecturer at the Department of Electrical and Computer Engineering at the University of Cyprus. His research is on wireless ad hoc networks, with emphasis on their capacity, the effects of mobility on their performance, medium access control, and information theoretic issues.

**Contact Information**

For additional information please contact the department secretary at:

Ms. Skevi Chrysanthou
Department of Electrical and Computer Engineering
University of Cyprus
75 Kallipoleos St
Nicosia 1678
CYPRUS

Tel: +357 22892251
Fax: +357 22892260
Email: skevichr@ucy.ac.cy