ECTS INFORMATION PACKAGE
2006-7 Academic Year

Department of Electrical and Electronics Engineering
Hacettepe University, Ankara, Turkey

April 2007
Ankara

This document can be obtained from www.ee.hacettepe.edu.tr

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I. Introduction

This information package provides the necessary information about the structure of the EEE Department, the content of the courses offered, and the ECTS credits of these courses in order to assist the incoming visiting students through the SOCRATES-ERASMUS Programme for planning their study in our department.

For the information package introducing Hacettepe University, please visit:
http://www.abofisi.hacettepe.edu.tr/eng/belgeler/informationpackageforincomingstudents.doc

II. Our Department

The Department of Electrical and Electronics Engineering was established in 1975. The first group of engineers were graduated from the department in 1978. Today the department offers B.S, M.S, and Ph.D degrees in Electrical and Electronics Engineering.

With its present 424 undergraduate and 166 graduate students, the Electrical and Electronics Engineering Department aims at providing a balance of theoretical excellence and practical experience. Amongst all student the number of female student is approximately 10%.

The vision of the department is to be the best in the areas of education and training; science and technology; research, development and application in electrical and electronics engineering.

The mission of the department is to make contribution to the science and technology in the different fields of electrical and electronics engineering, to graduate high quality engineers equipped with the knowledge and skills required in the today's world and the abilities of problem solving and analytical thinking, and to provide support to technological development of our country by the engineering activities carried out in cooperation with the industry.

The main educational and research areas in the department are

- Communication Systems,
- Digital Signal Processing,
- Electromagnetics and Microwave Techniques,
- Control Systems,
- Computers and Computer Networks,
- Microelectronics,
- Biomedical Engineering,
- Electrical Machines and Power Systems.

Within the first three years, the undergraduate students take various courses to gain certain skills and background theory in all essential areas of electrical and electronics engineering. And in the last year, they have the opportunity to specialize in the subjects above by selecting necessary courses.

There are many well equipped educational and research-based laboratories together with two general-purpose computer rooms with high-speed Internet access in the department. These laboratories are

- Biomedical Laboratory
- Computer Laboratories
- Control Systems Laboratory
- Control Systems Research Laboratory
- Digital Design Laboratory
- Digital Signal Processing Laboratory
- Electrical Machines Laboratory
- Electronics Laboratories
- Machine Shop
- Maintenance Laboratory
- Microprocessor Laboratory
- Microwave and Antenna Laboratory
- Neuroscience Laboratory
- Numerical Electromagnetics Laboratory

- Printed Circuit Implementation Laboratory
- Student’s Project Laboratory
- Telecommunications Laboratory
- VLSI Laboratory

The students are selected for studying in our department from among the first 1-2% of most successful nominees in the nation-wide selection examination for university entrance.

The medium of instruction is English and those students who fail the English proficiency examination study in a one-year preparatory school before they begin with the department.

The engineers graduated from our department can easily find jobs both in private and government sectors. They are especially preferred in the hightech companies and in the areas where research and development activities dominate.

Along with the other engineering departments, The Department of Electrical and Electronics Engineering is located in the Beytepe Campus which is about 12 km from Ankara town center. There are frequent municipal / private bus services and underground railway to and from downtown.

II.1 Faculty Members

Currently, the number of the faculty members is 21. Among these, 8 are professors, 3 are associate professors, 8 are assistant professors and 2 are instructors. There are also 19 teaching and research assistants.

The members of the faculty and their professional interests are:
Prof.Dr. **Feza Arıkan**, Ph.D.: Northeastern University, USA, 1992
Electromagnetics, Antenna Systems, Propagation, HF Communication, Radar Systems, Radar Signal Processing

Prof.Dr. **Işık Çadırcı**, Ph.D. : Middle East Technical University, Turkey, 1994
Power Electronics, Electrical Motor Drives

Prof.Dr. **Hüseyin Demircioğlu**, Ph.D.: Glasgow University, UK, 1990
Predictive Control, Adaptive/Self-tuning Control, Auto-tuning, System Identification, Optimal Control, Parameter Estimation

Prof.Dr. **H. Selçuk Geçim** (Dean), Ph.D.: Surrey University, UK, 1978
Analog and Digital Circuit Design, Semiconductor Techniques, Speech Processing

Prof.Dr. **A. Salim Kayhan** (Chair), Ph.D.: University of Pittsburgh, USA, 1991
Time-Frequency Methods,Signal Processing,Spectral Estimation, Array Processing, Multiuser Detection

Prof.Dr. **Adnan Köksal**(Vice Chair), Ph.D.: North Carolina State University,USA, 1993
Numerical Electromagnetics, Moment Method, Microwave Systems

Prof.Dr. **Mehmet Şafak**, Ph.D.: Catholic University of Louvain, Belgium, 1975
Satellite Communication Systems, Mobile Radio Systems,Communication Systems,Reflector Antennas,Wave Propagation

Prof.Dr. **Erdem Yazgan**, Ph.D.: Hacettepe University ,Turkey, 1980
EMT,Satellite Communicaton,Reflector Anntenas,Propagation

Assoc.Prof.Dr. **Uğur Baysal**, Ph.D.: Hacettepe University ,Turkey, 1999
Neuroscience, in vivo tissue resistivity/conductivity estimation, biomagnetic inverse problem solution, biomedical instrumentation, medical imaging, technology/internet assisted education, medical informatics, MRI coils, PC interface and hardware design and development

Assoc.Prof.Dr. **Çiğdem Seçkin Gürel**, Ph.D.: Hacettepe University ,Turkey, 2000
Electromagnetics, Microstrip structures, Frequency Selective Surface Design

Assoc.Prof.Dr. **Birsen Saka**, Ph.D.: Hacettepe University, Turkey, 1995
Electromagnetic theory, antennas

Assist.Prof.Dr. **Emre Aktaş**, Ph.D.: The Ohio State University, USA, 2002
Wireless communications: Multiuser detection, equalization, channel estimation, soft iterative decoding, pilot signal aided transmission

Assist.Prof.Dr. **Ali Ziya Alkar**, Ph.D.: University of Colorado at Boulder, USA, 1995
VLSI, Computer Architecture and Programming, Microprocessors and Digital Design, VLSI Simulation and Testing, Hardware Description Languages, Application of Cryptology to hardware. Software Engineering, High Level Synthesis, Embedded Systems Design, Network Security

Assist.Prof.Dr. **Derya Altunay**, Ph.D.: Hacettepe University, Turkey, 1998
Fuzzy Logic Structures, Fuzzy Models and Systems, Control Theory, Approximate Reasoning, Artificial Intelligence, Intelligent Systems, Knowledge-Based Systems

Assist.Prof.Dr. **A.Semih Bingöl**, Ph.D.: Bogazici University, Turkey, 1990
Signal Processing, Image and Speech Processing, Pattern Recognition

Assist.Prof.Dr. **Mehmet Demirer**, Ph.D.: The University of Sussex, UK, 1995
Computer graphics, Computer architecture, Medical imaging, Mathematical Models in Music

Assist.Prof.Dr. **Yakup S. Özkazanç**, Ph.D.: University of Maryland, USA, 1994
Control & Estimation Theory and Applications, Navigation, Guidance and Flight Control Systems,Sensors and Electronic Warfare Systems, Control and Automation Engineering, Nonlinear Systems and Stability, Mechanical Systems and Mechatronics

Assist.Prof.Dr. **Mücahit K. Üner**, Ph.D.: Syracuse University, USA, 1993
Detection-Estimation Theory, Statistical Radar Signal Processing, Communication Theory, Image Processing

Assist.Prof.Dr. **Atila Yılmaz**, Ph.D.: University of Sussex, UK, 1996
Biomedical Signal Processing, Neural Networks, Adaptive Filters, ECG Signals, Dynamic Logic, Knowledge Based Systems

Instr.Dr. **Umut Sezen**, Ph.D.: University of Warwick, UK, 2003

Instr.Dr. **Cenk Toker** (ERASMUS Coordinator), Ph.D.: King's College London, UK, 2004
Communication theory, communication systems, space-time signal processing, MIMO channel equalization, optimization

Professors are, in general, responsible from the theoretical courses whereas assistants conduct the laboratory experiments under the supervision of the corresponding professor.

III. SOCRATES/ERASMUS Procedure

The steps of the procedure for the student and teaching staff exchange programme between our deparment and a possible partner can be summarised in chronological order as follows:

III.1 Bilateral Agreement

Prior to student and teaching staff exchange, a Bilateral Agreement must be signed between our university and the partner institution. Student and teaching staff mobility is possible only after this aggreement. This is generally initiated by the Erasmus coordinators of both parties.
However, under exceptional circumstances, a student who is willing to visit our department may contact a specific member of our faculty, and a specific Bilateral Agreement can be signed between his department and ours for the following academic year.

* Unless otherwise is agreed on between two institutions, the possible codes of the programme we offer are
    06.2 Electrical Engineering
    06.5 Electronics Engineering, Telecommunications
    12.8 Medical Technology (corresponds to Biomedical Engineering)
(The ISO Country Code of Turkey is TR and the ERASMUS ID of Hacettepe University is TR ANKARA03.)

III.2 Learning Agreement

An undergraduate student can visit our department for both taking undergraduate level courses we offer and conducting an undergraduate project. Similarly, a postgraduate student (MSc or PhD) can take postgraduate level courses and/or conduct part of his/her research in collaboration with one of the members of our faculty.

In any case, the work s/he will be doing here should be agreed upon between the coordinator of his/her home institution and the coordinator of our university through a learning agreement. In other words, a learning agreement which is prepared for a specific visiting student, is signed by both institutions and indicates the courses that will be taken during the visit to our department and/or the project or research that will be conducted here.

The learning agreement of our university can be obtained from:
http://www.abofisi.hacettepe.edu.tr/eng/belgeler/learningagreement.doc

III.3 Incoming ERASMUS Student Application

A prospective visiting student must fill out an incoming student application form which can be obtained from:
http://www.abofisi.hacettepe.edu.tr/eng/belgeler/studentapplicationform.doc
After having the form signed by the coordinators of the partner institution, the student should apply to our university for the planned study by sending it to us. After approving the application, we will send the form back to you. (Please do not forget to apply for an accommodation at the same time.)

III.4 Academic Recognition Sheet, Transcript of Records, Duration Sheet

These documents must be signed upon the completion of the study by both our university and the partner institution in order the study of the visiting student be recognised by the sending institution. Please contact your coordinator for details.

IV. Description of the offered course:

IV.1 Description of the tables

IV.1.1 Level:

The Electrical and Electronics Engineering Department offers two levels of course. The undergraduate level aims at providing the fundamentals of the electrical engineering profession upto a certain depth. General structure of the undergraduate programme is composed of theoretical courses, in which the theoretical background of a specific topic is given, accompanied by laboratory courses in which the practical aspects of these topics are implemented and observed directly by the student.

In general, theoretical courses are presented by lecturing on the white board. However, some of the courses also include homeworks. In laboratory courses, students generally form groups of 2-5 and perform experiments related to the corresponding theoretical course under the supervision of a teaching assistant.

The postgraduate programme includes the courses which can be taken during the MSc or PhD studies. These are more specialised courses investigating a particular topic in greater detail. Although mostly they involve lecturing on the white board, most of them are also supported by homeworks and/or term projects.

IV.1.2 Teaching Method:

There are several types of teaching methods. The most basic one is Theoretical Lectures. The lecturer explains the topic either on a white-board or by presentation slides.

In additions, homeworks and term project can also assist the learning of the student besides lectures. This may also include library and literature search.

Another basic teaching method is Laboratory Work. Students form groups of 3-5 and perform a specific experiment regularly in the supervision of a research assistant. Normally each student is expected to prepare a preliminary work before starting the experiment. Generally, laboratory courses synchronously follow similar content as the theoretical course. By this way, it is aimed that besides learning the theoretical fundamentals of electrical and electronics engineering, students also realise and observe the practical aspects of the profession.

IV.1.3 Status of the Course:

In the undergraduate programme, the department offers two types of courses. Until the sixth semester all the departmental courses are compulsory and students must take these courses. During the final year most of the courses are elective. Students are free to choose among these courses with the requirement of the fullfiling the credit limit criterion. Normally, during sixth semester a student decides a study area and contiunues to take the related elective courses during the following semesters.

In the postgraduate programme, two out of five defined courses should be taken as compulsory. These five courses are: ELE 701, ELE 703, ELE 704, ELE705, ELE 770. The student is free to choose the remaining courses among the postgraduate programme courses or (at most two) final year courses.

IV.1.4 Hours per week:

This indicates the duration of lecturing only during a week. It does not give the time required to do the homeworks or other supplementary work. As a rule of thumb a student may need to spend approximately 6-7 hours a week for a course.

IV.1.5 ECTS Credits:

Under normal circumstances a student has to collect 30 ECTS credits per semester.

IV.1.6 Duration of Courses:

All courses occupy a single semester.

IV.1.7 Assessment Methods:

The main assessment method is examination. Almost all courses require one or two midterm and a final examination. Apart from this, homeworks, quizzes, laboratory and term project performance may also affect the grading.

IV.1.8 Prerequisites:

In general none of the courses require a formal prerequisite. However, in order to be able to follow the course, the student is assumed to have successfully completed several other courses. In this case, these courses are indicated in the Notes section of the tables.

V. Grading System

v.i National Grading System

Upon completion of a course, the grades in the national system corresponding to the total points collected in the course is given in the following table:

Points	Grade	Coefficient
90-100	A1	4,00
85-89	A2	3,50
75-84	B1	3,00
70-74	B2	2,50
65-69	C1	2,00
60-64	C2	1,50
55-59	D1	1,00
50-54	D2	0,50
0-49	F3	0,00
	F2	0,00
	F1	0,00

A student must succesfully collect at least 135 national credits in order to complete the undergraduate program.

Similarly a postgraduate student must succesfully finish 7 courses which can be postgraduate and/or at most two final year undergraduate courses.

v.ii ERASMUS Grading System

The ERASMUS Grading System is given in the following table:

ECTS Grade	% of successful students normally achieving the grade	Definition
A	10	EXCELLENT – outstanding performance with only minor errors
B	25	VERY GOOD – above the average standard but with some minor errors
C	30	GOOD – generally sound work with a number of notable errors
D	25	SATISFACTORY – fair but with significant shortcomings
E	10	SUFFICIENT – performance meets the minimum criteria
FX	-	FAIL – some more work required before the credit can be awarded
F	-	FAIL – considerable further work is required

IV.2 Courses Offered in the 2006-7 Academic Year

IV.2.1 Undergraduate

Fall 2006-7	HU*/ ECTS Credits	Spring 2006-7	HU*/ ECTS Credits
1st Year			
ELE 107 – Computers and Programming I	3 0 3 / 6	ELE 100 – Introduction to Electrical Engineering	0 2 0 / 1
MAT 123 – Mathematics I	5 0 5/10	ELE 108 – Computers and Program. II	4 0 4 / 6
FIZ 134 – Physics I	4 0 4 / 6	MAT 124 – Mathematics II	5 0 5 / 10
FIZ 111 – Physics Laboratory I	0 3 1 / 2	FIZ 144 – Physics II	4 0 4 / 6
KIM 127 – Fundamentals of Chemistry	3 0 3 / 6	FIZ 121 – Physics Laboratory II	0 3 1 / 2
ING 153 – Speaking and Present. Skills I	3 0 3 / 4	ING 154 – Speaking and Present. Skills II	3 0 3 / 4
TKD 103 – Turkish I	2 0 2 / 3	TKD 104 – Turkish II	2 0 2 / 3
2nd Year			
ELE 203 – Circuit Theory I	4 0 4 / 6	ELE 204 – Circuit Theory II	4 0 4 / 6
ELE 217 – Solid State Electronics	3 0 3 / 5	ELE 210 – Electronics I	3 0 3 / 5
ELE 241 – Intro. Electromagnetics Thry.	3 0 3 / 5	ELE 214 – Electronics Laboratory I	0 3 1 / 2
ELE 271 – Measurement Laboratory	0 3 1 / 2	ELE 242 – Electromagnetic Fields	3 0 3 / 5
ECO 141 – Introduction to Economics	3 0 3 / 3	MAT 236 – Engineering Mathematics II	4 0 4 / 6
MAT 235 – Engineering Mathematics I	4 0 4 / 6	BUS 252 – Introduction to Management	3 0 3 / 3
AIT 203 – Princ. of Atatürk and History of Turkish Revolution I	2 0 2 / 3	AIT 204 – Princ. of Atatürk and History of Turkish Revolution II	2 0 2 / 3
3rd Year			
ELE 301 – Signals and Systems	3 0 3 / 5	ELE 302 – Probability Theory	3 0 3 / 6
ELE 311 – Electronics II	3 0 3 / 5	ELE 312 – Digital Electronics	3 0 3 / 6
ELE 313 – Electronics Laboratory II	0 3 1 / 2	ELE 314 – Digital Electronics Laboratory	0 3 1 / 2
ELE 331 – Digital Design and Switching Theory	3 0 3 / 5	ELE 324 – Telecommunication Theory I	3 0 3 / 6
ELE 333 – Digital Design and Switching Theory Lab.	0 3 1 / 2	ELE 326 – Telecommun. Theory Laboratory I	0 3 1 / 2
ELE 343 – Electromagnetic Waves	3 0 3 / 5	ELE 354 – Control Systems	3 0 3 / 6
ELE 361 – Electric Machines I	3 0 3 / 5	ELE 356 – Control Systems Lab.	0 3 1 / 2
ELE 365 – Electric Machines Lab. I	1 0 1 / 2		
4th Year			
ELE 401 – Project I	0 3 1 / 2	ELE 402 – Project II	0 3 1 / 2
ELE 403 – Control Systems Design	3 0 3 / 6	ELE 410 – Commun. Systems Design	3 0 3 / 6
ELE 405 – Control Systems Design Lab.	0 3 1 / 2	ELE 412 – Data Communications	3 0 3 / 6
ELE 407 – Digital Signal Processing	3 0 3 / 6	ELE 414 – Microprocessor Architecture and Programming II	3 0 3 / 6
ELE 409 – Digital Signal Processing Lab	0 3 1 / 2	ELE 430 – Computer Control	3 0 3 / 6
ELE 411 – Data Structures	3 0 3 / 6	ELE 434 – Computer Control Laboratory	0 3 1 / 2
ELE 413 – Microprocessor Architecture and Programming I	3 0 3 / 6	ELE 444 – Antennas and Propagation	3 0 3 / 6
ELE 415 – Microprocessor Architecture and Programming Lab. I	0 3 1 / 2	ELE 440 – Antennas and Propagation Laboratory	0 3 1 / 2
ELE 425 – Telecommun. Theory II	3 0 3 / 6	ELE 446 – Microwave Techniques II	3 0 3 / 6
ELE 427 – Telecommunication Theory Laboratory II	0 3 1 / 2	ELE 448 – Microwave Techniques Lab II	0 3 1 / 2
ELE 445 – Microwave Techniques I	3 0 3 / 6	ELE 452 – Fundamentals of Medical Imaging	3 0 3 / 6
ELE 447 – Microwave Techniques Lab I	0 3 1 / 2	ELE 454 – Power Electronics	3 0 3 / 6
ELE 451 – Fundamentals of Biomedical Engineering	3 0 3 / 6	ELE 456 – Power Electronics Laboratory	0 3 1 / 2

(*) HU Credits: (a b c) a: Number of theoretical lectures per week, b: Number of pratical lectures per week, c: Total Credits

All 1st and 2nd year courses are compulsory. All 3rd year courses, except ELE 324 and ELE 326 are compulsory. All 4th year courses, except ELE 401 and ELE 402 are elective.

The courses with codes ELE XXX are offered by the Electrical and Electronics Engineering Department.

IV.2.2 Postgraduate

Fall 2006-7	**HU*/ ECTS Credits**	**Spring 2006-7**	**HU*/ ECTS Credits**
ELE 701 – Linear Systems Theory (+)	3 0 3 / 9	ELE 704 – Optimization (+)	3 0 3 / 9
ELE 703 – Probability and Stochastic Processes (+)	3 0 3 / 9	ELE 707 – Electromagnetic Compatibility	3 0 3 / 9
ELE 706 – Green's Function in Electromagnetics	3 0 3 / 9	ELE 721 – Microwave Circuit Design Techniques	3 0 3 / 9
ELE 710 – Analog Integrated Circuits	3 0 3 / 9	ELE 722 – Fiber Optic Systems	3 0 3 / 9
ELE 720 – Electromagnetic Wave Propagation	3 0 3 / 9	ELE 724 - Electromagnetic Wave Theory II	3 0 3 / 9
ELE 723 – Electromagnetic Wave Theory I	3 0 3 / 9	ELE 726 – Computation Methods in Electromagnetics	3 0 3 / 9
ELE 728 – Antenna Theory and Analysis	3 0 3 / 9	ELE 731 – Digital Communications II	3 0 3 / 9
ELE 730 – Digital Communications I	3 0 3 / 9	ELE 736 – Detection and Estimation Theory	3 0 3 / 9
ELE 737 – Information Theory	3 0 3 / 9	ELE 754 – Nonlinear Systems	3 0 3 / 9
ELE 739 – Special Topics in Telecommun.	3 0 3 / 9	ELE 763 – Photovoltaic Energy Conversion	3 0 3 / 9
ELE 764 – Switch Mode Power Supplies	3 0 3 / 9	ELE 769 – Special Topics in Electrical Power Systems	3 0 3 / 9
ELE 771 – Spectral Estimation	3 0 3 / 9	ELE 770 – Statistical Signal Processing (+)	3 0 3 / 9
ELE 781 – Navigation, Guidance and Control	3 0 3 / 9	ELE 773 – Pattern Recognition	3 0 3 / 9
ELE 790 – Contemporary Cryptology	3 0 3 / 9	ELE 784 – Optimal Estimation and Control	3 0 3 / 9
ELE 794 – Biomedical Signal Processing	3 0 3 / 9	ELE 791 – Knowledge Based Systems	3 0 3 / 9
		ELE 792 – Bioelectricity	3 0 3 / 9

(*) HU Credits: (a b c) a: Number of theoretical lectures per week, b: Number of pratical lectures per week, c: Total Credits

(+): Two out of these five courses should be taken as compulsory.

V. Course Descriptions

V.1 Undergraduate Programme Courses

Course Code and Title:	**ELE 100** **Intoduction to Electrical Engineering**		**Level:** Undergraduate	**Year/Semester:** 1st/Fall
Teaching Method:	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 2	**ECTS Credits:** 1
Lecturer(s):	Department Faculty			
Course Contents:	Each week a faculty member gives a presentation related to his/her area.			
Objectives of the Course:	This course aim at introducing the basic fields in electrical engineering. Upon completion the student is expected to be aware of the various aspects of the electrical engineering profession.			
Bibliography:	• -			
Assessment Method(s): -		**Prerequisite(s):** None		
Notes:				

Course Code and Title:	**ELE 107** **Computers and Programming I**		**Level:** Undergraduate	**Year/Semester:** 1st/Fall
Teaching Method: Theoretical Lectures and Homeworks	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 3	**ECTS Credits:** 6
Lecturer(s):	Assist. Prof. Dr. Derya Altunay (Section 21) Assist. Prof. Dr. Emre Aktaş (Section 22)			
Course Contents:	Introduction, History of computing and computers Basic structure of computers, Number systems, Binary codes, Arithmetic operations, Boolean algebra and applications, The CPU and main memory, Computer architecture and organization Input and output units, Secondary storage units, Computer software, Data structures, File and database concepts, Programming and languages, Program development and structured programming, Computer networks, The Internet and applications, Computer security and privacy.			
Objectives of the Course:	The purpose of this course is to introduce the students to fundamental concepts of computers and computing. This course does not teach students “how to use computers” specifically, but it covers various aspects of computers at a moderate level, including all the topics given in the course contents. The choice of covering as many topics at reasonable level as possible is especially made. This broad range of coverage will provide a strong and adequate background for students to move on to other computer related areas. By the completion of this course the students will: - Become familiar with computer terminology. - Identify and categorize the hardware/software components of computer systems and know their functions. - Understand the fundamental principles by which the computers operate. - Have an understanding of the basics of working in a networked environment, security and privacy issues. - Be aware of the ethical and social issues when using computers. In other words, learn and understand the following topics: I. Introduction, History of computing and computers II. Basic structure of computers, Number systems III. Binary codes, Arithmetic operations IV. Boolean algebra and applications V. The CPU and main memory VI. Computer architecture and organization VII. Input and output, Secondary storage VIII. Computer software IX. Data structures, File and database concepts X. Programming and languages, Program development and structured programming			

	XI. Computer networks XII. The Internet and applications, Computer security and privacy
Bibliography:	• Computers, Capron and Johnson, 8th Ed., Prentice Hall. • Computers, Long and Long, 12th Ed., Prentice Hall. • Computer Confluence, Beekman and Rathswohl, 6th Ed., Prentice Hall. • Digital Fundamentals, Thomas L. Floyd, 8th Ed., Prentice Hall.
Assessment Method(s): 2 Midterm Exams (20% each), Homeworks (%10), Final Exam(50%)	**Prerequisite(s):** None
Notes:	

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 108
Computers and Programming II</td><td>Level:
Undergraduate</td><td>Year/Semester:
1st/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures, Homeworks and Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Ali Ziya Alkar (Section 21)
Assist. Prof. Dr. Mehmet Demirer (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Comments on program forms and programming structure in pascal. Subroutines. Data types, storage concepts and dynamic data structures. Reading and storing data. Programming decision trees. Input and output features. Program analysis. Description of the problem solution. Implementation of algorithms as programs. Debugging a program. Introduction to control structures. Decision structures. Expressions, strings, built-in functions and user defined fuction. Loop and nested loop structures. Arrays and subscripts. Formatted output and files. Recursion. Arrays and pointers. Pointers to fuctions. Functions as arguments. Introduction to Programming using Pascal.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Programming structures and Introduction to High Level Languages
II. Program analysis. Description of the problem solution. Implementation of algorithms as programs. Debugging a program.
III. Reading and storing data. Input and output features.
IV. Data types,
V. Introduction to control structures. Decision structures. Expressions, strings,
VI. Built-in functions and user defined function.
VII. Loop and nested loop structures.
VIII. Subroutines.
IX. Arrays and subscripts. Formatted output and files.
X. Pointers
XI. Recursion.
Upon successful completion of the course, the student learns the above topics and gains the ability to write high level languatge computer programs.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• PASCAL, Koffman. 4th or 5th Ed., Addison Wesley.</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (20% each), Homework (10%), Laboratory (15%), Final Exam (35%)</td><td colspan="3">Prerequisite(s):
ELE 107 is recommended.</td></tr>
<tr><td colspan="5">Notes:</td></tr>
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<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 203
Circuit Theory I</td><td>Level:
Undergraduate</td><td>Year/Semester:
2nd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
4</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Atila Yılmaz (Section 21)
Dr. Cenk Toker (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">- Circuit Variables
    - Voltage and Current
- Circuit Elements
    - Voltage and Current Sources
    - Resistance
    - Kirchoff’s Voltage and Current Laws
- Simple Resistive Circuits
    - Resistors in Series and in Parallel
    - Voltage and Current Division
- Techniques of Circuit Analysis
    - Node-Voltage and Mesh-Current Methods
    - Source Transformations and Thevenin and Norton Equivalents
    - Maximum Power Transfer
    - Superposition
- The Operational Amplifier
    - Fundamentals of OpAmps
    - Amplifier Circuits
- Inductance and Capacitance
    - Characteristics of the Inductor and Capacitor
    - Series and Parallel Combinations of Inductance and Capacitance
- Response of First Order RL and RC Circuits
    - Natural Responses of RL and RC Circuits
    - Step Responses of RL and RC Circuits
    - General Solution for the Natural and Step Responses
- Natural and Step Responses of RLC Circuits
    - Introduction to and Forms of Natural Response of RLC Circuits
    - Step Response of RLC Circuits</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">ELE 203 is one of the basic courses of the department providing the fundamentals of circuit analysis. Students completing the course successfully are assumed to gain the following skills,
- know the basic circuits elements (resistor, inductor, capacitor, and voltage and current supplies) and their electrical characteristics,
- learn the fundamental methods of electrical circuits analysis, such as the Ohm’s Law, Kirchoff’s Laws, Node-Voltage and Mesh-Current Methods, Equivalent Circuits, etc.,
- be able to conduct basic power calculation of electrical circuits,
- learn the basics of op-amp circuits, be able to analyse circuits with op-amps,
- be able to analyse first and second order electrical circuits, mostly utilising differential equations,
- be able to recognise the type of a circuit and gain insight in predicting its electrical response.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Electric Circuits, Nilsson and Riedel, 7th Ed., Prentice Hall.</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25%), Final Exam (50%)
(Closed book, classical written examinations)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 271 Measurement Laboratory.</td></tr>
</table>

<table>
<tr><td colspan="1">Course Code and Title:</td><td colspan="2">ELE 204
Circuit Theory II</td><td>Level:
Undergraduate</td><td>Year/Semester:
2nd/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
4</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Atila Yılmaz (Section 21)
Dr. Cenk Toker (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">- Sinusoidal Steady-State Analysis
- the Sinusoidal Source and the Sinusoidal Response
- the Passive Circuit Elements and the Kirchoff’s Laws in the Frequency Domain
- Source Transformations and Thevenin-Norton Equivalent Circuits
- Node-Voltage and Mesh-Current Methods
- Sinusoidal Steady-State Power Calculations
- Instanteneous Power
- Average, Reactive and Complex Power
- the rms Value and Power Calculations
- Maximum Power Transfer
- Mutual Inductance
- State Equations
- Introduction to the Laplace Transform
- Definition of the Laplace Transform
- Functional and Operational Transforms
- Inverse Transforms
- The Laplace Transform in Circuit Analysis
- Circuits Elements and Circuit Analysis in the s-domain
- the Transfer Function and its Partial Fraction Expansion
- Convolution Integral
- the Steady-State Sinusoidal Response
- Introduction to Frequency Selective Circuits
- Low-pass, High-pass, Bandpass and Bandreject Filters
- Active Filter Circuits
- First-Order Low-pass and High-pass Active Filters
- Op-Amp Bandpass and Bandreject Filters
- Higher-Order Op-Amp Filters
- Narrowband Active Filters</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Together with ELE 203, ELE 204 forms the fundamentals of electrical circuit analysis which will be utilised in many future courses. Students completing the course successfully are assumed to gain the following skills,
- be exposed to sinusoidal steady-state analysis,
- be able to recognise the similarities between the topics covered in ELE 203 with the frequency domain approach introduced here, and be able to directly use the methods in the frequency domain,
- be able to perform power calculations for circuits with sinusoidal source such as the mains supply,
- learn the Laplace Transform and its use in circuit analysis,
- be able to analyse a complicated circuit by the Laplace Transform,
- learn how to design advanced frequency selective circuits and their electrical charateristics,
- learn how to design active filters with better response.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Electric Circuits, Nilsson and Riedel, 7th Ed., Prentice Hall.</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each), Final Exam (50%)
(Closed book, classical written examinations)</td><td colspan="3">Prerequisite(s):
None.</td></tr>
<tr><td colspan="5">Notes: ELE 203 is recommended.</td></tr>
</table>

Course Code and Title:	**ELE 210** **Electronics I**		**Level:** Undergraduate	**Year/Semester:** 2nd/Spring
Teaching Method: Theoretical Lectures	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 3	**ECTS Credits:** 5
Lecturer(s):	Prof. Dr. Selçuk Geçim (Section 21) Dr. Umut Sezen (Section 22)			
Course Contents:	Diodes and related applications, clippers and clampers. Reflectors, half-wave rectifiers, full-wave rectifiers, RC and LC filters, power supply design. Ripple and voltage regulation concepts. DC biasing to BJT and providing bias stability. DC biasing to FET and bias stability. Small signal analysis in one-stage amplifiers, amplifier modelling by using h parameters, analysing gain and other parameters for all amplifier types. Frequency response of amplifers with BJT and FET.			
Objectives of the Course:	A student should acquire the following skills (a) Understand the operation and application of the basic electronic elements: diodes and transistors. (b) Perform AC/DC analysis on an electronic circuit (c) Understand the frequency response concept (d) Design voltage rectifier and voltage regulator circuits (e) Design a transistor amplifier (BJT or FET) for the given gain, input-output impedance and frequency response specifications			
Bibliography:	• Electronic Devices & Circuit Theory, Boylestad and Nashelsky, 8th Ed., Prentice Hall • Integrated Electronics, Millman and Halkias, McGraw-Hill • Electronic Circuit Analysis and Design, Neamen, McGraw-Hill			
Assessment Method(s): 2 Midterm Exams (25% each), Final Exam (50%)		**Prerequisite(s):** ELE 203 and ELE 217 are recommended.		
Notes: Accompanied by ELE 214 Electronics Laboratory I.				

Course Code and Title:	**ELE 214** **Electronics Laboratory I**		**Level:** Undergraduate	**Year/Semester:** 2nd/Spring
Teaching Method: Laboratory Work	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 3	**ECTS Credits:** 2
Lecturer(s):	Teach. Assist. Ş. Serdar Özen Teach. Assist. Işıltan Sayın Teach. Assist. Vekil Sarı			
Course Contents:	Introduction to PSpice. Semiconductor diodes and rectifer circuits. Zener diodes and their regulator applications. Characteristics of bipolar junction transistors. Characteristics of junction field effect transistors. AC/DC analysis of BJT amplifiers. AC/DC analysis of JFET amplifers. Frequency response of amplifers with BJT and FET.			
Objectives of the Course:	I. Introduction of Simulation Programs II. Diode Characteristics and their Rectifier Applications III. Zener Diode Characteristics and their Rectifier Applications IV. BJT Characteristics V. Review of Previous Studies VI. BJT Amplifier Applications VII. JFET Characteristics VIII. JFET Amplifier Applications IX. Project Work Upon successful completion of the course, the student learns the above topics and gains the ability to analyse an electric circuit.			
Bibliography:	• Electronic Devices & Circuit Theory, Boylestad and Nashelsky, 8th Ed., Prentice Hall • Integrated Electronics, Millman and Halkias, McGraw-Hill			

	• Electronic Circuit Analysis and Design, Neamen, McGraw-Hill
Assessment Method(s): Laboratory performance (including lab reports, 30%), Quizzes (30%), Preparation (simulation) Reports (10%), Final Exam (30%)	**Prerequisite(s):** ELE 203 and ELE 217 are recommended.
Notes: Accompanies ELE 210 Electronics I.	

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 217
Solid State Electronics</td><td>Level:
Undergraduate</td><td>Year/Semester:
2nd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assoc. Prof. Dr. Uğur Baysal (Section 21)
Assoc. Prof. Dr. Çiğdem Seçkin Gürel (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Crystal, policrystall, amorph materials, definitions, energy band structure of solid materials, conductor, insulator and semiconductor, charge carrier generation, recombination, conduction in semiconductors, diffusion and drift currents, electronic parameter measurements, PN junction, potential, capacitanceand other parameters, BJT and FET basics and operation</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Describes crystal, materials, conductor and insulator concepts
II. Understands energy bands in semiconductors, Energy band diagrams
III. Explains carriers in semiconductors, Understands and describes carrier formation on semiconductors, generation and recombination concepts, solves problems
IV. Defines Diffusion and drift current, explains Measurement of electronics parameters for semiconductors.
V. Analyses and explains PN junctions, PN junction potential, junction capacitance and defines special diyotes
VI. Describes internal structure of bipolar junction capacitor (BJT) analyses current gain, solves problems on these topics,
VII. Describes internal structure of field effect transistor (FET) analyses current gain, solves problems on these topics,

Upon successful completion of the course, the student learns the above topics and gains the ability to analyse and describe basic solid state electronic devices</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Solid State Electronics Lecture Notes, Baysal,
• Solid State Electronic Devices, B.G.Streetman</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each), Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students are expected to have complete freshman calculus and physics</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 241
Introduction to Electromagnetic Theory</td><td>Level:
Undergraduate</td><td>Year/Semester:
2nd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Erdem Yazgan (Section 21)
Assoc. Prof. Dr. Birsen Saka (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Brief review of vector calculus emphasizing concepts pertaining to EM theory. Coulomb’s law. Gauss’ law. Electric potential. Conductors and dielectrics in static electric field. Electric flux density, permittivity. Boundary conditions for electrostatics. Capacitance and capacitors. Electrostatic force and work. Poisson’s Laplace’s equations and uniqueness theorem. Image method for electrostatics.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course is expected to acquire the following skills:
I. Vector Calculus
II. Coulomb’s Law and Gauss Law
III. Electric Potential
IV. Electric Dipol and Polarization
V. Boundary Conditions for Conductors and Dipoles
VI. Capacitance
VII. Electrostatic Force
VIII. Electrostatic Energy and Pressure</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Field and Wave Electromagnetics, Cheng, 2nd Ed., Addison-Wesley</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each), Homeworks (10%), Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 242
Electromagnetic Fields</td><td>Level:
Undergraduate</td><td>Year/Semester:
2nd/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Erdem Yazgan (Section 21)
Assoc. Prof. Dr. Birsen Saka (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Steady electric currents, Ohm’s law, EMF concept. Kirchhoff’s voltage and current laws. Boundary conditions for steady currents, resistance calculations. Postulates of static magnetic fields, vector magnetic potential, Biot-Savart Law, magnets and magnetization. Magnetic filed intensity, relative permeability and magnetic materials. Reluctance and application to magnetic circuits. Boundary conditions for static magnetic fields. Faraday’s law, inductance and inductors. Magnetic energy, force and torque.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course is expected to acquire the following skills:
I. Laplace’s and Poisson’s Equation and Uniqueness Theorem
II. Method of Images
III. Static Electric Current
IV. Resistance
V. Boundary Conditions for Lossy Media
VI. Magnetostatic Fields, Ampere’s Law, Biot-Savart Law
VII. Magnetic Materials
VIII. Boundary Conditions for Magnetic Materials
IX. Inductance
X. Magnetostatic Force and Energy</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Field and Wave Electromagnetics, Cheng, 2nd Ed., Addison-Wesley</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each), Homeworks (10%), Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 271
Measurement Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
2nd/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Şölen Kumbay
Teach. Assist. Can Turgu
Teach. Assist. Serkan Zobar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Measurement of voltage, current and resistance using AVO meter: AVO meter as ammeter, AVO meter as voltmeter, AVO meter as ohmmeter, resistance color coding, Kirchoff’s Current Law, Kirchoff’s Voltage Law. Basic meter as DC ammeter, basic meter as DC voltmeter, basic meter as DC ohmmeter, internal reistance of a basic meter, loading effect of a voltmeter and ammeter. Thevenin and Norton Theorems. Linearity and Superposition Theorems. Power in DC circuits. Cathode Ray Oscilloscope: use of CRO in amplitude, frequency and phase measurement, Lissajous figures. First order circuits: RC circuits, RL circuits</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">A student should acquire the following skills
I. Measurement of voltage, current and resistanc using AVO meter
II. Resistance color coding
III. Kirchoff’s Current Law, Kirchoff’s Voltage Law.
IV. Basic meter as DC ammeter, basic meter as DC voltmeter, basic meter as DC ohmmeter
V. Loading effect of a voltmeter and ammeter
VI. Thevenin and Norton Theorems
VII. Linearity and Superposition Theorems
VIII. Power in DC circuits
IX. Cathode Ray Oscilloscope
X. Lissajous figures
XI. First order circuits: RC circuits, RL circuits</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Electric Circuits, Nilsson and Riedel, 7th Ed., Prentice Hall.</td></tr>
<tr><td colspan="2">Assessment Method(s):
7 Preliminary Works 14%, 6 Quizes 30%, Final Exam 35%, Laboratory Performance 21%</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 203 Circuit Theory I.</td></tr>
</table>

Course Code and Title:	**ELE 301** **Signals and Systems**		**Level:** Undergraduate	**Year/Semester:** 3rd/Fall
Teaching Method: Theoretical Lectures	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 3	**ECTS Credits:** 5
Lecturer(s):	Assist. Prof. Dr. Mücahit Üner (Section 21) Assist. Prof. Dr. A. Semih Bingöl (Section 22)			
Course Contents:	Course contents have been listed below: - Signal and system definitions, Continuous and Discrete-time signals and systems, basic signal and system properties. - Convolution representation of linear and time-invariant systems. - Periodic signals and continuous and discrete-time Fourier Series. - Continuous-time Fourier Transform and its properties. Frequency response. - Discrete-time Fourier Transform and its properties. - Relationship between time and frequency domains. Analysis of first and second-order systems. Filters. - Sampling and the Nyquist theorem, processing of continuous-time signals by discrete-time systems. - The Laplace Transform and its properties. Poles and Zeroes. - The z-transform and its properties.			
Objectives of the Course:	I. Basic signal and system properties II. LTI systems, convolution sum and integral III. Continuous-time Fourier series IV. Discrete-time Fourier series V. Continuous-time Fourier transform VI. Discrete-time Fourier transform VII. Time and frequency domain analyses, filters VIII. Sampling IX. Laplace transform X. Z-transform Astudent who successfully completes this course is expected to: a. Learn the above topics and, b. Possess the skılls to analyze linear-time invariant systems in both time and frequency domains and compute their output.			
Bibliography:	• Signals and Systems, Oppenheim, Willsky, 2nd Ed., Prentice-Hall • Fundamentals of Signals and Systems Using The Web and MATLAB, Kamen, Heck, 2nd Ed., Prentice-Hall			
Assessment Method(s): First Midterm (20%) + Second Midterm (30%) + Final Exam (50%)		**Prerequisite(s):** None		
Notes:				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 302
Probability Theory</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Mücahit Üner (Section 21)
Assist. Prof. Dr. A. Semih Bingöl (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">- Probability introduced through Set Theory
- Random Variable
- Operations on one Random Variable
- Multiple Random Variables
- Operations on Multiple Random Variables
- Random Processes - Temporal Characteristics
- Random Processes - Spectral Characteristics</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Introduction and definitions
II. Joint and conditional probability. Bayes theorem. Independent events and Bernoulli trials.
III. The random variable concept. Probability distribution and density functions. Conditional distributions and densities.
IV. Expected values, moments and characteristic functions.
V. Transformations of a single random variable.
VI. Multiple random variables, joint distribution and density functions.
VII. Limit theorems. Operations on multiple random variables.
VIII. Definition of a random process. Independence and stationarity.
IX. Time averages, statistical averages and ergodicity. Autocorrelation and cross-correlation functions.
X. Gauss and Poisson processes.
XI. Power spectrum and cross power spectrum. White and colored noise.
XII. Response of linear, time-invariant systems to random processes.

A student who successfully completes this course is expected to:
a. Learn the above topics, and
b. Acquire the skills to analyze nondeterministic signals by modelling them as random processes.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Probability, Random Variables, and Random Signal Principles, Peebles, Jr., 4th Ed., McGraw-Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
First Midterm (20%) + Second Midterm (30%) + Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 311
Electronics II</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Selçuk Geçim (Section 21)
Dr. Umut Sezen (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Feedback and negative feedback applications on amplifiers. Multi-stage amplifiers, DC amplifiers, AC coupled amplifiers. Analysing differential amplifiers, operational amplifiers and their internal structure. Operational amplifiers applifiers. A, B, AB, C and D class power amplifiers. Analysing positive feedback, oscillators, and oscillators types.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">A student should acquire the following skills
(a) Fully understand and identify the negative and positive feedback circuits
(b) Analyse the differential and operational amplifier circuits and understand their applications
(c) Design operational amplifier circuits according to the given specifications
(d) Understand the A, B, AB, C ve D class power amplifier circuits and their applications
(e) Select the suitable power amplifier and design its circuit according to the given specifications
(f) Understand the oscillator circuits and oscillator types</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Integrated Electronics, Millman and Halkias, McGraw-Hill
• Electronic Devices & Circuit Theory, Boylestad and Nashelsky, 8th Ed., Prentice Hall
• Microelectronics, Millman and Grabel, McGraw-Hill
• Electronic Circuits: Discrete and Integrated, Schilling and Belove, McGraw-Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 313 Electronics Laboratory II.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 312
Digital Electronics</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Mehmet Demirer (Section 21)
Dr. Umut Sezen (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Ebers-Moll models. Switching modes of BJT and JFET transistor. States of a transistor. Logic gates: RTL, DTL, TTL, ECL, Schottky TTL and Advanced Schottky TTL. MOS digital circuits: NMOS, PMOS, CMOS. Multivibrators: monostable, astable, bistable; Schmitt triger circuits.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Ebers-Moll models.
II. Switching modes of BJT and JFET transistor.
III. States of a transistor.
IV. Logic gates: RTL, DTL, TTL, ECL.
V. Schottky TTL and Advanced Schottky TTL.
VI. MOS digital circuits.
VII. NMOS, PMOS, CMOS.
VIII. Multivibrators: monostable, astable, bistable.
IX. Schmitt triger circuits.

Upon successful completion of the course, the student learns the above topics and gains the ability to analise circuits containing logical gates.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Digital Integrated Circuits, DeMassa&Ciccone, Wiley
• Integrated Electronics, Millman and Halkias, McGraw-Hill
• Microelectronics, Millman and Grabel, McGraw-Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 314 Digital Electronics Laboratory.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 313
Electronics Laboratory II</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. K. Erinç Akdoğan
Teach. Assist. Işıltan Sayın</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Direct coupled amplifiers, feedback amplifiers, differential amplifier, operational amplifier (OPAMP), bandwidth, slew rate and offsets of opamps (esp. LM 741), active filters, power amplıfıers, oscillators.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">A student should acquire the following skills
(a) Use the simulation tool, PSpice to design the electronic circuits (esp. transistor and opamp circuits)
(b) Fully understand and identify the negative and positive feedback circuits
(c) Analyse the differential and operational amplifier circuits
(d) Design operational amplifier circuits according to the given specifications
(e) Select the suitable power amplifier and design its circuit according to the given specifications
(f) Understand the oscillator circuits and oscillator types</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Integrated Electronics, Millman and Halkias, McGraw-Hill
• Electronic Devices & Circuit Theory, Boylestad and Nashelsky, 8th Ed., Prentice Hall
• Microelectronics, Millman and Grabel, McGraw-Hill
• Electronic Circuits: Discrete and Integrated, Schilling and Belove, McGraw-Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
Laboratory performance (including lab reports, 30%), Quizzes (%30), Preparation (simulation) Reports (10%), Final Exam (30%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 311 Electronics II.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 314
Digital Electronics Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Spring</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Gökhan Şengül
Teach. Assist. K. Erinç Akdoğan
Teach. Assist. Metehan Dikmen</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Switching circuits of BJT and JFET., sweep generator, RTL "NOR" , DTL "NAND", TTL "NAND" logic gates, collector coupled monostable and astable multivibrators, Schmitt trigger (ST) circuit, integrated circuit monostable, astable multivibrators and 555 timer circuits</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">A student should acquire the following skills
(a) Use the simulation tool, PSpice and Proteus to design the electronic circuits (esp. transistor and opamp circuits)
(b) Fully understand switching modes of BJT and JFET transistors
(c) investigating gates circuits
(d) learning the various types of circuits based on BJT
(e) using the integrated circuits of previously designed circuits
(f) Understand the working principles of 555timer, monostable/astable multivibrators.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Digital Integrated Circuits, DeMassa and Ciccone, John Wiley & Sons.
• Digital Integrated Electronics, Taub and Schilling, McGraw-Hill.</td></tr>
<tr><td colspan="2">Assessment Method(s):
Laboratory performance (including lab reports, simulations, 30%), Quizzes (30%), Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 314 Digital Electronics.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 324
Telecommunications Theory I</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. A. Salim Kayhan (Section 21)
Assist. Prof. Dr. Emre Aktaş (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Review of the Fourier transform and its properties, Transmission of signals through linear sytems,
filters, Hilbert Transform, pre-envelope, canonical representation of band-pass signals, band-pass systems, phase and group delay, amplitude modulation (AM), double-sideband subressed carrier modulation (DSB-SC), filtering of sidebands, vestigal sideband modulation, single sideband modulation (SSB), frequency-division multiplexing (FDM), angle modulation, frequency modulation (FM), phase-locked loop, noise analysis of AM and FM, superheterodyne receiver, television.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Review of the Fourier transform and its properties, Transmission of signals through linear sytems,
Filters
II. Amplitude modulation (AM), double-sideband subressed carrier modulation (DSB-SC),
III. Hilbert Transform, pre-envelope, canonical representation of band-pass signals,
band-pass systems
IV. Filtering of sidebands, vestigal sideband modulation, single sideband modulation (SSB)
V. Angle modulation, frequency modulation (FM)
VI. Random processes, correlation function, power spectral density
VII. Noise in AM modulation
VIII. Noise in FM modulation
IX. Television signal

Upon succesful completion of the course the student learns fundamental analytical representation tools of telecommunication systems, the fundamental analog modulation methods and their noise analyses.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Communication Systems, Haykin, 4th Ed., John Wiley & Sons</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each) + Final Exam (50%)
Classical Written</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Familiarity with systems and probability theory is assumed.
Accompanied by ELE 326 Telecommunications Theory Laboratory I.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 326
Telecommunications Theory Laboratory I</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Spring</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Gürhan Bulu
Teach. Assist. Serap H. Ertaş</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Introduction to analog modulation systems, filters, DSB, DSB-SC, SSB modulation and demodulation, frquency modulation and demodulation, superheterodyne receivers.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">A student should acquire the following skills
(a) Obtaining the frequency characteristics of the filters.
(b) Understanding the basi principles of AM and DSB-SC modulation techniques
(c) Learning the differences of AM, DSB-SC, SSB signals and structure of superheterodyne receiver
(d) Learning the basics of FM modulatio and demodulation techniques</td></tr>
</table>

	(e) Investigating the practical concepts in FM such as stereo encoding/decoding, preemphasis/deemphasis filtering
Bibliography:	• Communication Systems, Haykin, 4th Ed., John Wiley & Sons
Assessment Method(s): Laboratory performance, Quizes and Preliminary Works (50%), Final Exam (50%)	**Prerequisite(s):** None
Notes: Familiarity with systems and probability theory is assumed. Accompanies ELE 324 Telecommunications Theory I.	

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 331
Digital Design and Switching Theory</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Derya Altunay (Section 21)
Assist. Prof. Dr. Semih Bingöl (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Course contents are listed below:
- Elements and functions of digital logic.
- Delay time power dissipation, noise immunity and loading considerations.
- Analysis and design of combinational logic circuits. Universal gates. Minimization of combinational circuits. Karnaugh maps.
- Adders, decoders, encoders, code converters, multiplexers and demultiplexers.
- Error detection and correction, parity generators/checkers.
- Hazards in combinational circuits.
- Flip-Flops and multivibrators. Counters, shift registers, and memories.
- Analysis and synthesis of synchronous sequential circuits.
- RAM, ROM, PLA and PAL devices.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Upon successful completion of the course, the student is expected to possess the following skills:
- The ability to simplify logic expressions.
- The ability to analyze and design any combinational logic circuit.
- The ability to analyze and design any synchronous sequential circuit.
The student is also expected to have a thorough understanding of the basic logic building blocks and be able to use them in more complicated digital circuits.
In other words,
I. Combinational logic circuits
II. Combinational logic circuits analysis and design
III. Sequential circuits analysis and design
IV. Registers and counters
V. Memory and PLDs
VI. Hazards, Fault detection</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Logic and Computer Design Fundamentals, M.M.Mano and C.R.Kime, Prentice-Hall
• Digital Design, 3rd ed., M.M.Mano, Prentice-Hall
• Digital Design: Principles and Practices, 4th ed., J.F.Wakerly, Prentice-Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Two Midterm Exams (25% each) and Final exam (50%)</td><td colspan="3">Prerequisite(s):</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 333 Digital Design and Switching Theory Laboratory.</td></tr>
</table>

Course Code and Title:	**ELE 333** **Digital Design and Switching Theory Lab.**		**Level:** Undergraduate	**Year/Semester:** 3rd/Fall
Teaching Method: Laboratory Work	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 3	**ECTS Credits:** 2
Lecturer(s):	Teach. Assist. Gökhan Şengül Teach. Assist. Çağatay Yavuzyılmaz Teach. Assist. Cüneyt Barlak			
Course Contents:	Basic combinational circuit elements and their typical applications. Binary codes, decoders and encoders. Multiplexers and demultiplexers. Adders and subtractors Error detection and correction, hazards in combinational circuits. Flip-Flops, counters and shift registers. Sequence generators, pseudorandom sequence generators. Analysis and design of synchronous sequential circuits.			
Objectives of the Course:	The purposes of the course are: (a) To get acquainted with practical usage of commercial ICs. (b) To provide hands on experience on the use of common logic families and SSI/MSI building blocks. (c) To apply the principles of combinational and sequential logic design learned in class to practical circuit design.			
Bibliography:	Digital Design, 3rd ed., M.M.Mano, Prentice Hall Digital Design: Principles and Practices, 4th ed., J.F.Wakerly, Prentice Hall Digital Fundamentals, 9th ed.,T.L. Floyd, Prentice Hall			
Assessment Method(s): Laboratory performance (including preliminary works and lab reports) (30%), Quizzes (30%), Final Exam (40%)		**Prerequisite(s):** None.		
Notes: Accompanies ELE 331 Digital Design and Switching Theory.				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 343
Electromagnetic Waves</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Adnan Köksal (Section 21)
Prof. Dr. Feza Arıkan (Section 22)</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Contents of the course may be outlined as follows:
· Introduction
· Solution of static boundary value problems in different coordinate systems.
· Time-varying fields.
· Maxwell’s equations, boundary conditions.
· Potential functions.
· Wave equations and their solutions.
· Plane waves and their propagation in different media.
· Flow of electromagnetic power, poynting vector.
· Reflections and refraction of plan waves at plane interfaces.
· TEM waves and introductory transmission line concepts.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course aims at understanding of basic electromagnetic wave propagation. Students successfully completing this course is expected to acquire the following skills:
- To recognize boundary value problems and to be able to form their solutions..
- To understand Maxwell's equations and to be able to use them together with boundary conditions.
- To be able to find fields using potential functions.
- To be able to form simple solutions of wave equation.
- To investigate the propagation, reflection and refraction of plane waves.
- To be able to calculate flow of electromagnetic power.
- To understand introductory transmission line concepts.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Field and Wave Electromagnetics, Cheng, 2nd Ed., Addison Wesley
• Electromagnetic Fields and Waves, Lorrain, Corson, 2nd Ed., Freeman
• Applied Electromagnetics, Plonus, McGraw Hill
• Electromagnetic Waves and Radiating Systems, Jordan, Balmain, 2nd Ed., Prentice Hall
• Inroductory Engineering Electromagnetics, Popovic, Addison Wesley
• Schaum's Outline Series in Electromagnetics</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Quizzes (30% each) + Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

Course Code and Title:	**ELE 354** **Control Systems**		**Level:** Undergraduate	**Year/Semester:** 3rd/Spring
Teaching Method: Theoretical Lectures and Homeworks	**Teaching Language:** English	**Status:** Compulsory	**Hours per week:** 3	**ECTS Credits:** 6
Lecturer(s):	Assist. Prof. Dr. Yakup Özkazanç (Section 21) Assist. Prof. Dr. Derya Altunay (Section 22)			
Course Contents:	Historical perspective of control systems, basic concepts of open loop and closed loop, feedback. Models of physical systems: electrical components, mechanical systems, fluid systems, thermal systems, servomotors. Block diagrams, signal-flow graphs. State-space description, state transitions matrix, companion form, diagonalization of A matrix, transfer function decomposition. Time response analysis, s-plane, steady-state error analysis. Sensitivity, disturbance rejection and stability analysis, Routh-Hurwitz criterion, root-locus plotting. Frequency response analysis: Bode, polar and magnitude-phase plots, Nyquist analysis, gain/phase margins, Nichols chart.			
Objectives of the Course:	The main purpose of this course is to teach fundamental analysis methods for control systems. The analysis methods discussed in the course are also usefull for control system design, however analysis aspects of the methods will be emphasized. Various methods for transient analysis, steady-state anlysis and stability analysis will be studied. To that end, after a comprehensive introduction to systems modelling; both frequency domain and time domain approaches are studied in detail. Design point of view is given implicitly via analysis examples. The topics covered in the course is reinforced via experiments conducted in ELE 356 (Control Systems Laboratory).			
Bibliography:	• Linear Control Systems: Analysis and Design, D'Azzo, Houpis, 4. Ed., McGraw-Hill • Modern Control Systems, Dorf, Bishop, 9. Ed, Addison Wesley • Feedback Control of Dynamical Systems, Franklin, Powell, Emami-Naeini, 4. Ed., Addison Wesley • Automatic Control Systems, Kuo, 7. Ed., Prentice Hall • Control Systems Engineering, Nise, 3. Ed., John Wiley • Modern Control Engineering, Ogata, 4. Ed, Prentice Hall • Feedback Control Systems, Phillips, Harbor, 3. Ed., Prentice Hall • Schaum's Outline of Feedback Control Systems, Stubberud, Willams, DiStefano, 2. Ed., McGraw-Hill			
Assessment Method(s): Midterm Exam (40%) + Homeworks (10%) + Final Exam (40%)		**Prerequisite(s):** None		
Notes: The student is expected to have taken second year circuits and engineering mathematics courses before. Accompanied by ELE 356 Control Systems Laboratory.				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 356
Control Systems Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Spring</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Serkan Zobar
Teach. Assist. Şölen Kumbay</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Input and output transducers (position, temperature, pressure, flow rate, humidity, speed, acceleration, light level, soud level). Signal conditioning circuits (comparator, amplifier and coverter circuits). Display devices. Basic on/off control systems. Speed control systems. Temperature control systems. Obtaining frequecy responses experimentally. Using computer softwares in obtaining the time responses of control systems.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Intensify the material tought in ELE354 by applications. Investigating open- and closed loop control systems with the help of example systems. Learning about various transducers and their usage in applications. The student is expected to comprehend
I. Position control systems
II. Input and output transducers
III. Temperature control systems
IV. Basic on/off control systems
V. Speed control systems.
VI. Signal conditioning circuits
VII. Display devices</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Ogata, Modern Control Engineering, Prentice Hall, 2001</td></tr>
<tr><td colspan="2">Assessment Method(s):
Laboratory performance (5%), Reports (10%), Homework (35%), Final (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 356 Control Systems Laboratory.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 361
Electric Machines I</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
5</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Işık Çadırcı
Dr. Umut Sezen</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Basic concepts of magnetic circuits: magnetization, energy storage, hysteresis and eddy-current losses. Transformers: equivalent circuit, open-and short circuit tests, regulation, efficiency, polarity. Electromechanical energy conversion: filed energy, co-energy, force, torque, doubly-excited systems. Principles of rotating machines: armature mmf, induced emf, torque production. D. C. machines: emf and torque production, magnetization characteristic, methods of excitation, generator and motor analysis, rating and efficiency. Single-phase induction motors: equivalent-circuit, s/s operation, starting. Linear induction motor, split-phase, capacitor type, shaded pole. Special machines</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is designed to equip seniors with knowledge about basic concepts on electromechanical energy conversion, the operating characteristics of electrical machines and transformers, and their steady-state analysis based on equivalent circuit models.
The student is expected to learn the following:
I. Basic Concepts of Magnetic Circuits
II. Single-Phase Transformers
III. Electromechanical Energy Conversion
IV. Principles of Rotating Machines
V. DC Machines
VI. Single-Phase Induction Motors
VII. Special Machines</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Electric Machinery Fundamentals, Chapman, 3rd Ed., McGraw-Hill
• Electric Machinery, Fitzgerald, Kingsley, Umans, 5th Ed., McGraw-Hill
• Electric Machines, Slemon, Straughen, Addison Wesley
• Principles of Electrical Machinery and Power Electronics, Sen, John Wiley
• Electromechanics and Electric Machines, Nasar, Unnewehr, 2nd Ed., John Wiley</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each), Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: The students are expected to successfully complete the undergraduate level electromagnetics courses: ELE 241 and ELE 242
Accompanied by ELE 365 Electric Machines Laboratory I.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 365
Electric Machines Laboratory I</td><td>Level:
Undergraduate</td><td>Year/Semester:
3rd/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Ahmet Selçuk
Teach. Assist. Sevda Balk</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Power measurement in a.c. circuits. Single-phase transformer: voltage and current waveforms, hysteresis loop, polarity test, efficiency and regulation, open-and short-circuit tests. D.C. machines: magnetization characteristic, excitation types and performance charracteristics of generators and motors. Single phase induction motors: types, starting and operation</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is designed to equip seniors with practical knowledge about magnetic circuits, transformers, and electrical machines (DC and Single-Phase AC machines) by experiments carried out in the Electrical Machines Laboratory.
The student is expected to learn the following:
I. Power Measurement in A.C. circuits.
II. Single-phase Transformer: Voltage and current waveforms, hysteresis loop, polarity test
III. Single-phase Transformer: efficiency and regulation, open-and short-circuit tests</td></tr>
</table>

<table>
<tr><td></td><td>IV. D.C. machines : The magnetızatıon curve of separately excıted DC generators
V. DC Generators : Load characteristics of separately and shunt excited generators
VI. DC Motors: Output characteristics of series and shunt motors
VII. Single Phase Induction Motors: Types, starting and operation</td></tr>
<tr><td>Bibliography:</td><td>• ELE 365 Electrical Machines Laboratory Manual</td></tr>
<tr><td>Assessment Method(s):
Quizes, Laboratory Reports, and Final Exam</td><td>Prerequisite(s):
None</td></tr>
<tr><td colspan="2">Notes: The students are expected to successfully complete the undergraduate level electromagnetics courses: ELE 241 and ELE 242
Accompanies ELE 361 Electric Machines.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 401
Project I</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Project</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">A project supervisor is assigned to each student.</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Independent study guided by a faculty member: design and implementation of an electrical or electronic circuit, system or a software performing a specified task and/or a theoretical and/or computer analysis of an engineering problem, submitting a project report that is approved by the supervisor.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The final year project aims at the assessment of the project planning, designing and implementation abilities of the student.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• -</td></tr>
<tr><td colspan="2">Assessment Method(s):
Project work and report (100%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 402
Project II</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Project</td><td>Teaching Language:
English</td><td>Status:
Compulsory</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">A project supervisor is assigned to each student.</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Independent study guided by a faculty member: design and implementation of an electrical or electronic circuit, system or a software performing a specified task and/or a theoretical and/or computer analysis of an engineering problem, submitting a project report that is approved by the supervisor.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The final year project aims at the assessment of the project planning, designing and implementation abilities of the student.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• -</td></tr>
<tr><td colspan="2">Assessment Method(s):
Project work and report (100%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 403
Control System Design</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Yakup Özkazanç</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Design considerations: PID control, phase-lead and phase-lag compensator design on root-locus and Bode plots. Closed-loop transfer function selection, implementability, asymptotic tracking. Linear algebraic design: unity-feedback, input/output and two-degree of freedom configurations. State-space design, state feedback. Robust control system design. Nonlinear control systems: common nonlinearities, describing function analysis, linearization, phase-plane analysis, singular points, limit cycles.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is a continuation of ELE 354 (Control Systems) which basically emphasizes “analysis” of control systems. In ELE 403, our purpose will be to treat systems and control issues from a design point of view. We will cover both classical (frequency domain, root locus, PID) and modern (state space, algebric design) methods for control system design. We will also discuss modifications and/or extensions of these approaches for realistic models involving nonlinearities, multiple loops, time delays and digital implementations. Grading will be based on homeworks, a midterm and a final examination. Some homeworks will require the use of Matlab and/or SIMULINK for simulations of control system design examples.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Linear Control Systems: Analysis and Design, D’Azzo, Houpis, 4. Ed., McGraw-Hill
• Modern Control Systems, Dorf, Bishop, 9. Ed, Addison Wesley, 2001.
• Feedback Control of Dynamical Systems, Franklin, Powell, Emami-Naeini, 4. Ed., Addison Wesley
• Control Theory: Multivariable and Nonlinear Methods, Glad, Ljung, Taylor & Francis
• Control Systems Design, Goodwin, Graebe, Salgado, Prentice Hall
• Automatic Control Systems, Kuo, 7. Ed., Prentice Hall
• Classical Feedback Control with MATLAB, Lurie, Enright, Marcel Dekker
• Modern Control Engineering, Ogata, 4. Ed, Prentice Hall
• Control Systems Engineering, Nise, 3. Ed., John Wiley
• Feedback Control Systems, Phillips, Harbor, 3. Ed., Prentice Hall
• Schaum’s Outline of Feedback Control Systems, Stubberud, Willams, DiStefano, 2. Ed., McGraw-Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
Midterm Exam (40%), Homeworks (10%) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: The students are assumed to have taken an introductory control course (such as ELE 354) before. Accompanied by ELE 405 Control System Design Laboratory.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 405
Control System Design Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Serkan Zobar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Position and velocity control systems. Using PID controllers in control system. Nonlinear properties of relay control systems. Using computer softwares in obtaining root locus and frequency responses of control systems. Root locus and frequency response designs of phase lead, phase lag and PID controllers using computer softwares.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course aims to provide practical knowledge about the use of PID controllers and relays in the design of a control system, and to make the students familiar with the computer softwares used in control system design.
The student is expected to learn and analyse the following
I. Position Control Systems
II. Using PID Controllers in Control Systems
III. Nonlinear Properties of Relay Control Systems
IV. Using Computer Softwares in Obtaining Root Locus and Frequency Responses of Control Systems
V. Root Locus and Frequency Response Designs of Phase Lead, Phase Lag and PID Controllers Using Computer Softwares
VI. Speed Control Systems
VII. Display Devices</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Control System Design Laboratory Manual
• Modern Control Systems, R.C. Dorf, R.H. Bishop, 9th Ed., Addison Wesley
• Automatic Control Systems, B.C. Kuo, 7th Ed., Prentice Hall
• Modern Control Engineering, K.Ogata, 2nd Ed., Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Preliminary Works, Experiment Reports, Homework and Final Exam</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 403 Control System Design.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 407
Digital Signal Processing</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. A. Salim Kayhan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Discrete-time signals and systems. Difference equation representation. Sampling, decimation, interpolation. Review of the Z-transform. Transform analysis of linear, time-invariant systems. Structures for discrete-time systems. Effects of quantization. Infinite impulse response (IIR) and finite impulse response (FIR) filter design techniques. The discrete Fourier series, the discrete Fourier transform and Fast Fourier transform. Intoduction to two dimensional signals and systems.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students are supposed to gain the following abilities:
I. Review of Discrete-time signals, systems, Fourier, Z-tr.
II. Sampling, Decimation, Interpolation
III. Frequency Response
IV. Flow Graph Structures
V. Filter Design
VI. Discrete Fourier Tr.
VII. Fast Fourier Tr.
VIII. 2-D Signal Processing
Upon successful completion of the course, the student learns the above topics and gains the ability to implement fundamental signal processing methods.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Oppenheim and Schafer, Discrete-time Signal Processing, Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each, classical) + Final Exam (50%, classical)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students are supposed to have basic knowledge of signals and systems.
Accompanied by ELE 409 Digital Signal Processing Laboratory.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 409
Digital Signal Processing Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Gürhan Bulu
Teach. Assist. Ş. Serdar Özen</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Sampling, decimation and interpolation. Reconstruction and effects of aliasing. Design and implementation of digital filters. Quantization and effects of quantization on Digital systems. Windowing functions and their properties. Implementation and investigation of discrete Fourier transform and Fast Fourier transform algorithms. Experiments using speech signals.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">A student should acquire the following skills
(a) Obtaining digital signals using sampling and changing the sampling rate and also understanding the Fourier transform and its properties
(b) Understanding the interrelationship between the transfer function, difference equation and impulse response,
(c) Designing an appropriate quantizer for a given signal.
(d) Designing a digital IIR fiter by using Butterworth and Chebyshev approximations
(e) Understanding the concept of windowing and its effects on spectrum and also designing a FIR filter using windowing.
(f) Realizing filtering (linear convolution) using DFT and circular convolution and also filtering speech signal using these methods.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Discrete-Time Signal Processing, Oppenheim, Schafer and Buck, 3th Ed., Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Laboratory performance, Quizes and Preliminary Works (50%), Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
</table>

Notes: Students are expected to have completed "Signals And Systems" course.
Accompanies ELE 407 Digital Signal Processing.

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 410
Communication Systems Design</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Mehmet Şafak</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Introduction to Telecommunication systems,
Antenna fundementals and the link calculations,
System noise,
Channel modeling.
GSM system</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The aim of this course is to introduce the basics of RF engineering and the fundamental concepts of telecommunication systems. The students are asked to combine the knowledge they accumulated from the courses on statistical communication theory, antennas and propagation to study the gross design of telecommunication systems. As a case study, GSM system is studied.
Upon successful completion of the course, the student gains an insight about the gross design of telecommunication systems and in particular of GSM systems, including
I. Introduction to telecommunication systems
II. Antenna fundamentals
III. The LOS link calculations
IV. System noise calculations
V. Channel modeling
VI. GSM system</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Digital Communications, Glover and Grant, Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Two midterm Exams and Final Exam</td><td colspan="3">Prerequisite(s):
ELE425, ELE 302 and ELE324</td></tr>
<tr><td colspan="5">Notes: Students are expected to have completed "Signals And Systems" course.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 411
Data Structures</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Mehmet Demirer</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Problem analysis and specifications. Data structures; selection, algorithm development and implementation. Simple data types. Arrays, records, sets and their implementations. Strings as data structures. Stacks with arrays and records. Recursion. Queues. Lists; linked lists, array and pointer based applications. Searching; linear and binary search, binary search trees, hash tables. Sorting; basic sorting schemes, heapsort, quicksort, radix sort. Trees and graphs; trees, binary trees and graphs.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The purpose of the course is to give students good programming skills through use of a high level language. Students learn how to cope with software problems using a high level programming language with data structures. In order to accomplish this, students are equipped with tools like techniques for analysis and diagnosis of a problem, learning algorithmic methods, finding a solution to a problem using various techniques and programming tools, together with efficient programming techniques, documenting a software solution for future diagnosis and writing programs using data structures efficiently.
Upon successful completion of the course, the student learns the above topics and gains the ability to write programs using data structures, including
I. Problem analysis and specifications
II. Data structures; selection, algorithm development and Implementation
III. Simple data types.</td></tr>
</table>

	IV. Arrays, records, sets and their implementations. V. Strings as data structures. VI. Stacks with arrays and records. VII. Recursion. Queues. Lists; linked lists, array and pointer based applications. VIII. Searching; linear and binary search, binary search trees, hash tables. IX Sorting; basic sorting schemes, heapsort, quicksort, radix sort. X Trees and graphs; trees, binary trees and graphs.
Bibliography:	Advanced Programming in Pascal with Data Structures, Nyhoff, Leestma, Maxwell Macmillan Int. Ed. Algorithms in C, Sedgewick, Addison-Wesley.

Assessment Method(s): 2 Midterm Exams (25% each), Final Exam (50%)	**Prerequisite(s):** None
Notes:	

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 412
Data Communications</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures, Homeworks and Project</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Emre Aktaş</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Contents of the course may be outlined as follows:
- Introduction, layered structure of computer networks
- Physical layer: Guided transmission media, unguided transmission media, data and modulation, multiplexing, duplexing, multiple access methods
- Data link layer: Stop-and-wait flow control, sliding-window flow control, stop-and-wait ARQ, selective-reject ARQ, go-back-N ARQ, performance issues of flow control and error control
- Review of queueing theory: Discrete-time Markov chain, Little's theorem, M/M/1 queue, M/M/m queue
- Medium access control sublayer: Static and dynamic channel allocation, ALOHA, carrier sense multiple access protocols, limited contention, protocols, wireless LAN protocols
- Network layer: Virtual-circuit and datagram subnets, sink tree, Dijktra's algorithm, flooding, distance vector routing, link state routing, internetworking, fragmentation, subnets, CIDR (Classless InterDomain Routing)
- Transport layer: Transport layer services, socket primitives for TCP, transport protocols</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Upon succesful completion of the course the student
- Understands the concept of layered structure in computer networks
- Identifies the issues and parameters related to each layer
- Gains a background in methods and algorithms used in each layer
In other words the student is expected to learn and analyse the following
I. Introduction, layered structure of computer networks
II. Physical layer: Guided transmission media, unguided transmission media, data and modulation, multiplexing, duplexing, multiple access methods
III. Data link layer: Stop-and-wait flow control, sliding-window flow control, stop-and-wait ARQ, selective-reject ARQ, go-back-N ARQ, performance issues of flow control and error control
IV. Review of queueing theory: Discrete-time Markov chain, Little's theorem, M/M/1 queue, M/M/m queue
V. Medium access control sublayer: Static and dynamic channel allocation, ALOHA, carrier sense multiple access protocols, limited contention, protocols, wireless LAN protocols
VI. Network layer: Virtual-circuit and datagram subnets, sink tree, Dijktra's algorithm, flooding, distance vector routing, link state routing, internetworking, fragmentation, subnets, CIDR (Classless InterDomain Routing)
VII. Transport layer: Transport layer services, socket primitives for TCP, transport protocols</td></tr>
<tr><td>Bibliography:</td><td colspan="4">Textbook:
• Computer Networks, Andrew S. Tanenbaum, Fourth Edition, Pearson Education
References:
• Data and Computer Communication, W. Stallings, 6th Ed, Prentice Hall
• Data Networks, D. Bertsekas and R. Gallager, 2nd Ed, Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Quizzes and homeworks (20%), Midterm Exam (20%), Project+Final Exam (60%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 413
Microprocessor Architecture and Programming I</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Ali Ziya Alkar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Microprocessors and microcomputers. The 8085 MPU and its operation. Memroy interfacing. I/O devices. Memory mapped and periphal I/O. 8085 assembly language structure. Insruction set overview, formats and classification. Instructions and their usage. Programming with various instructions. Stack and subroutines. Aritmetic operations and multiprecision aritmetic. Interrupts and their usage. Interfacing data converters. Serial I/O and data communication. Inerfacing keyboards and displays.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">First of all microprocessor history how the microprocessors have evolved until today is given. Throughout the course the Intel 8085 microprocessor is thought .The initial objective is to teach the basic working principles of this CPU and related with this to introduce the bus structure that is found in any microcomputer. Then the memory structures are introduced where the bus is interfaced and address selection mechanism is given. With this the student will have a complete knowledge on how to integrate a memory to a CPU. Following this the Input Output devices are interfaced with the CPU to complete a full system. The different possible versions of how to interface I/O devices is also introduced here. In this way the student can be flexible to chose either one of different approaches while designing microcomputer systems. In order to program these systems the student learns to program in the Assembly language. In addition the interrupts are introduced to connect the 8085 microprocessor to the external word in addition to using polling techniques. Overall as a result the student will be equipped with anough knowledge to design a micocomputer system.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Microprocessor, architecture, programming and applications with the 8085/8080A, Gaonkar, Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams (25% each), Homeworks (5%), Final Exam (45%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 415 Microprocessor Architecture and Programming Laboratory I.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 414
Microprocessor Architecture and Programming II</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures, Homeworks and Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Ali Ziya Alkar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Programmable interface devices. Interfacing with handshake signals and interrupt. Multipurpose programmable devices. Programmable keyboard/display interface. Genaral purpose programmable peripheral devices. Bidirectional data transfer between two microcomputers. Programmable interval timer. Programmable interrupt controller. Direct memory access and DMA controller. Standarts in serial I/O. Software and hardware controlled serial I/O. Basic technological and operational principles of some data storage and peripheral devices.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The goal of the course is to expand the knowledge and practice the student has had during the first term ELE413 course and to introduce the embedded systems, With the content of the course we are here introducing a more advanced microprocessor system from Intel. As a result the student will be able to program Intel architectures until Pentium processors in the Assembly and Machine Languages. The benefit of trying out the code on a PC platform is exteremly nice thus the student can see the results of the program with a great convenience of working on a PC. The course introduces different modern ways of addressing possibilities. In addition serial/parallel communication protocols with programmable peripheral devices is introduces. The external programmable devices ranging from programmabale interrupt controllers to counters are also introduced in this course. While doing all these the student,away from memorizing document sheets, will instead concentrate on the efficiency on the hardware and software design. The lab contributes to the class lectures in additional scheduled hours with at least 5 experiments. Apart from the Intel Architecture microprocessors the embedded controllers such as PIC and 8051 are introduced to present the possible other architectures while designing different systems.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• The Intel Microprocessors, Brey, 5th Ed., Prentice Hall,
• The 80x86 IBM PC and Compatible Computers, Mazidi & Mazidi, Prentice Hall
• An Introduction to the Intel Family of Microprocessors, Antonakos, Prentice Hall
The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware and Applications, Triebel and Singh, Prentice Hall
• Assembly Language for Intel Based Computers, Irvine, Prentice Hall
• Computer Architecture Pipelined and Parallel Processor Design, Flynn, Jones and Bartlett Publishers
• Computer Architecture and Logic Design, Thomas Bartee, McGraw Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
Midterm Exam (30%), Final Exam (35%), Homeworks (5%), Lab-Works (30%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 415
Microprocessor Architecture and Programming Laboratory I</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Kenan Bozdaş
Teach. Assist. Alper Uçar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Microprocessors and microcomputers. 8085 Architecture and Programming. Usage of an 8085 based microprocessor training set. Data transfer functions and instructions. Input/Output by using LED and dipswitches. Arithmetic and Logical operations. Program control and branching instructions. Delay. Memory allocation. 8085 assembler and assembly language. Instruction set, structure of instructions, classification and usage of instructions. Programming with different instructions. Stack and Subroutines. Timers and Interrupts.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Data Transfer Operations
II. I/O and Arithmetical/Logical Operations
III. Logic Operations and Delay
IV. Subroutines
V. BCD Arithmetic and Memory Allocation
VI. Timers, Interrupts and Built-in Services
Upon successful completion of the course, the student learns the above topics and gains the ability to implement a function using an 8085 microprocessor.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Microprocessor, architecture, programming and applications with the 8085/8080A, Gaonkar, Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
5 Quizzes (20%), 1 Midterm Exam (30%), Laboratory Performance (10%) and Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 413 Microprocessor Architecture and Programming I.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 425
Telecommunications Theory II</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Mehmet Şafak</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Pulse Modulation: Sampling, quantizing and encoding of analog signals. Multiplexing Baseband Pulse modulation: Matched filter, intersymbol interference, equalization Signal-space analysis: Matched-filter and correlation-type detection and MAP and ML decoding
Passband Digital transmission: PSK, FSK, ASK, QAM modulations and bit-error rate analysis in AWGN channels. Spectral efficiency of various modulation schemes.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Pulse Modulation: Sampling, quantizing and encoding of analog signals. PPCM. Multiplexing
II. Baseband Pulse modulation: Matched filter, intersymbol interference, equalization
III. Signal-space analysis: Matched-filter and correlation-type detection and MAP and ML decoding
IV. Passband digital transmission: PSK, FSK, ASK, QAM modulations and bit-error rate analysis in AWGN channels. Spectral efficiency of various modulation schemes.
Upon successful completion of the course, the student will learn the above-cited fundamental topics, which are essential in digital communications. These topics cover the conversion of analog signals into digital, and transmission of digital signals in baseband and passband channels.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Communication Systems, Haykin, John Wiley</td></tr>
<tr><td colspan="2">Assessment Method(s):
2 Midterm Exams and Final Exam</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 427 Telecommunications Theory Laboratory II.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 427
Telecommunications Theory Laboratory II</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Metehan Dikmen
Teach. Assist. Serap Haşimoğlu Ertaş</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Sampling and reconstruction, time division multiplexing (TDM), pulse time modulation (PTM), pulse code modulation (PCM), differential PCM (DPCM), delta modulation (DM), baseband data transmission methods, amplitude shift keying (ASK), frequency shift keying (FSK), phase shift keying (PSK)</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">1 - To recognize that a signal can be reconstructed from its samples if the sampling is made at Nyquist rate
2 - To learn pulse transmission techniques
3 - To learn how to construct TDM signals
4 - To investigate PCM, DPCM, DM methods and quantization techniques
5 - To compare ASK, FSK and PSK signals in time and frequency domains</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Communication Systems, Haykin, John Wiley
• Modern Digital and Analog Communication Systems, Lathi, HRW</td></tr>
<tr><td colspan="2">Assessment Method(s):
Laboratory Performance (including reports and preliminary work, 20%), Quizzes (40%), Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 425 Telecommunications Theory II.</td></tr>
</table>

Course Code and Title:	**ELE 430** **Computer Control**		**Level:** Undergraduate	**Year/Semester:** 4th/Spring
Teaching Method: Theoretical Lectures	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 6
Lecturer(s):	Prof. Dr. Hüseyin Demircioğlu			
Course Contents:	Description of computer control. Sampling of continuous-time signals. Signal reconstruction: zero-order hold, aliasing. Linear difference equations and discrete-time transfer functions. Poles, zeros and stability. The jury's stability test. Modelling and block diagram analysis. Mapping between the s-plane and z-plane. Discrete-time equivalents to continuous-time transfer functions: hold equivalence, forward and backward difference method, Tustin's method, pole-zero mapping. Time response analysis. Robot locus and Bode design. State space representation. Canonical forms. Solution of state space equations. Discretization of continuous-time state space equations. Controllability, reachability and observability. State feedback and Ackermann's formula. Deadbeat control. Observers. Duality.			
Objectives of the Course:	Today, control systems are largely realized in digital form either on a computer or on cards that have computing power such as microcontroller or DSP cards. In this course, the necessary background is given in order to be able to understand such control systems and it is aimed at equipping students with the knowledge and skills needed to analyse and realise such systems.			
Bibliography:	• Discrete-Time Control Systems, Ogata, Prentice Hall • Digital Control of Dynamic Systems, Franklin, Powell, Workman, Addison Wesley			
Assessment Method(s): Two Midterm Exams (%25 each) and Final Exam (%50)		**Prerequisite(s):** None		
Notes: Accompanied by ELE 434 Computer Control Laboratory.				

Course Code and Title:	**ELE 434** **Computer Control Laboratory**		**Level:** Undergraduate	**Year/Semester:** 4th/Spring
Teaching Method: Laboratory Work	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 2
Lecturer(s):	Teach. Assist. Çağatay Yavuzyılmaz			
Course Contents:	Experimenting with A/D-D/A converters, sampling and zero order hold. Digital control of a servo system and observing the effects of sampling rate on the performance. Response of discrete-time systems and examining the effects of pole zero location. Comparing different discrete-time approximations of continuous-time systems. Experimenting with root locus and Bode design techniques. Pratical aspects and computer implementation of a PID controller. Experimenting with state feedback and observers.			
Objectives of the Course:	The aim is to provide a better understanding of the theoretical subjects taught in ELE 430 Computer Control course via computer simulations and experiments carried out on laboratory setups, and to allow students to improve their abilities in this respect.			
Bibliography:	• Discrete-Time Control Systems, Ogata, Prentice Hall • Digital Control of Dynamic Systems, Franklin, Powell, Workman, Addison Wesley			
Assessment Method(s): Laboratory performance including preliminary works and reports (30%) + Quizzes (30%) + Final Exam (40%)		**Prerequisite(s):** None		
Notes: Accompanies ELE 430 Computer Control.				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 440
Antennas and Propagation Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Çağatay Yavuzyılmaz</td></tr>
<tr><td>Course Contents:</td><td colspan="4">1. Radiation Pattern Measurements from a fundamental aperture antenna such as a Horn and a parasitic array such as Yagi-Uda array
2. Measurement of Antenna Gain
3. Doppler shift and CW Doppler radar principles
4. Microstrip antennas and identification of basic parameters
5. LOS computation which forms the basic mode of propagation in higher frequency bands and measurement of antenna losses.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">In this course, the students are expected to apply their theoretical knowledge from ELE 444 Antennas and Propagation course. The major objectives of this course are
(a) The comprehension of certain antenna parameters and basic concepts (such as gain, directivity, radiation pattern, polarization) through practice
(b) Understanding of practical application of antennas and environmental factors used in the experiments
(c) Understanding of the Doppler radar principle with a basic radar model</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Antennas and Radiowave Propagation, Collin, McGraw Hill: New York
• Antenna Theory, Balanis, John Wiley and Sons, New York</td></tr>
<tr><td colspan="2">Assessment Method(s):
Lab Preliminary work and participation in the experiments (20%), Midterm Exam (30%), Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanies ELE 444 Antennas and Propagation.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 444
Antennas and Propagation</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Feza Arıkan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The course has two major contents: Antennas and propagation.The antenna part has these topics: Introduction to Antennas, Fundamentals of EM Radiation, Fundamental Antenna Parameters, Radiation from small elements (dipoles and loops) and arbitrary current distributions, Dipoles and Loops, Introduction to Antenna Arrays, Basic Array Design (Array Pattern Synthesis), Aperture Type Antennas, Field Equivalence Principles, Aperture Antenna Examples (Horns, Slots, Microstrips, Reflectors, Lenses), Receiver Antennas. The Radio Wave Propagation part includes propagation mechanisms and propagation modes for ELF, VLF, LF, MF, HF, VHF, UHF and SHF (Microwave and millimeter) bands, Multipath, Fading, Ground Reflection, Diffraction, Refraction, Attenuation, Propagation Loss.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The students are expected to understand the basics of radiation and reception thru antennas. The two basic antenna types are introduced: wire and aperture antennas. At the end of the course, the students should be able to compute the radiation from any type of wire antenna with any type of current distribution and the radiation from basic types of aperture antennas with any type of aperture field distribution. The students should be able differentiate various types of antennas by their fundamental parameters such as bandwidth, first null and half power beamwidths, radiation patterns, efficiency and radiation resistance. Arrays are an important part of the course and the students should be able to compute radiation from linear, and planar arrays. They are exposed to basics of array pattern synthesis and introduced to optimum array design with Chebyshev polynomials. The second major group of antennas, aperture antennas are introduced through Fourier Transform technique and field equivalence principles. The student is expected to distinguish various forms of aperture type antenas with respect to their main electrical parameters such as bandwidth, first null and half power beamwidths, radiation patterns, aperture efficiency and application areas. The receiving antennas are discussed through reciprocity theorem and effective length and effective aperture. The students should be able to figure out the open circuit voltage for any type of antenna and combine the antenna output with receiver noise. At the end of the course, the students should have a basic understanding of the EM spectrum and and enough background in propagation mechanisms of each band. They should also understand the important factors that affect wave propagation in atmosphere and have a basic background in communication theory.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Antennas and Radiowave Propagation, Collin, McGraw Hill
• Antenna Theory, Balanis, John Wiley and Sons
• Antennas, Kraus, McGraw Hill
• Electromagnetic Waves and Radiating Systems, Jordan and Balmain, Prentice Hall
• Various Internet Web Sites</td></tr>
<tr><td colspan="2">Assessment Method(s):
Two Midterm Exams (20% each), Homeworks (10%) and Final Exam (50%) (Exams are closed book and notes)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: The students are expected to successfully complete the undergraduate level electromagnetic wave courses ELE 241, ELE 242, ELE 343
Accompanied by ELE 440 Antennas and Propagation Laboratory.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 445
Microwave Techniques I</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Erdem Yazgan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Plane Wave, The Wave Equations, Transmission Lines, Phase and Attenuation Constants, Rectangular and Circular Waveguides, Concept of Modes. Impedance Transformation and Matching Techniques. Equivalent Circuit Analysis in Waveguides and Scattering Matrix. Microwave Measurement Techniques.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Review of Electromagnetic Wave Propagation
II. TEM, TE, TM Modes
III. Transmission Lines
IV. Waveguides
V. Impedance Concept, Powerflow
VI. Impedance Matching
VII. Impedance and Admittance Matrices
VIII. Scattering Matrix

Upon successful completion of the course, the student learns the above topics and gains the ability to analyse an electric circuit.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Foundations For Microwave Engineering, Collin, McGraw-Hill
• Microwave Engineering, Pozar, Wiley</td></tr>
<tr><td colspan="2">Assessment Method(s):
Two Midterm Exams (25% each), Homeworks (10%), Final Exam (40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Accompanied by ELE 447 Microwave Techniques Laboratory I.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 446
Microwave Techniques II</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Adnan Köksal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Contents of the course may be outlined as follows:
- Introduction
- Planar transmission lines
- Series and parallel resonant circuits
- Cavities, Fabry-Perot resonators, excitation of cavities
- Power dividers, directional couplers and hybrids
- Periodic structures, k-b diagrams
- Filter design by insertion loss method and implementation
- Microwave realization of filters
- Microwave transistor amplifier design</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course aims to develop basic understanding of design at microwave frequencies.
Students successfully completing this course is expected to acquire the following skills:
- To recognize passive microwave circuit elements and blocks.
- To design basic filter designs. These can be Butterworth or Chebychev filters with
- low pass
- high pass
- band pass
- band stop or band reject
frequency behavior.
- To realize filter designs in the form of transmission line circuits.
- To design microwave amplifiers.
- To find microstrip or stripline dimensions of transmission line circuit designs.
- To be ready in microwave circuit theory and techniques for a more detailed analysis and design studies.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Microwave Engineering, Pozar, Addison Wesley
• Foundations For Microwave Engineering, Collin, 2nd Ed., McGraw-Hill</td></tr>
<tr><td colspan="3">Assessment Method(s):
Two quizzes (30% each) + Final Exam (40%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students are required to know or should be willing to study themselves some of the subjects in ELE 445 course.
Accompanied by ELE 448 Microwave Techniques Laboratory II.</td></tr>
</table>

Course Code and Title:	**ELE 447** **Microwave Techniques Laboratory I**		**Level:** Undergraduate	**Year/Semester:** 4th/Fall
Teaching Method: Laboratory Work	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 2
Lecturer(s):	Teach. Assist. Gökşen Turgut Şansal Teach. Assist. Volkan Akan			
Course Contents:	Contents of the course may be outlined as follows: - Transmission Line Theory - Measurement of Voltage Standing Wave Ratio & Basics of Frequency and Wavelength - Measurement of Microwave Power - Determination of The I-V Characteristic of the Diode Detector - Measurement of Impedance - Microwave Tuner			
Objectives of the Course:	To understand how transmission lines behave basically: standing wave patterns for different loads, resonance at some specific frequencies, affect of attenuation on resonance and impedance transforming property of half-wavelength lines. To measure the wavelength of a signal in a rectangular waveguide, using an absorption type frequency meter. To understand the meaning of Voltage Standing Wave Ratio and to learn two methods of measuring VSWR and when to use them. Learning the methods of measuring microwave power and obtaining the attenuator characterictics by a series of power measurements using a power meter with a diode type power sensor. To verify that a microwave diode detector has a square-law characteristic for small signals. To become familiar with the concept of impedance in a waveguide, to understand the meaning of characteristic impedance, to learn an impedance measurement method. To understand the necessity of tuning of a mismatched load and to learn how to use a slotted-line tuner to achieve a match between a load and a source.			
Bibliography:	• Foundations For Microwave Engineering, Collin, McGraw-Hill • Microwave Engineering, Pozar, Addison Wesley			
Assessment Method(s): Two Midterm Exams (25% each) and Final Exam (50%)			**Prerequisite(s):** None	
Notes: 5 Experiments, 1 weekly hours Accompanies ELE 445 Microwave Techniques I.				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 448
Microwave Techniques Laboratory II</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Gökşen Turgut Şansal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Contents of the course may be outlined as follows:
· Introduction to the Microwave VCO Source and Crystal Detector and Action of a 3-Port Circulator
· Directional Coupler
· Series and Shunt Tees
· Measurement of Insertion Loss: Insertion Loss Characteristic of a Low Pass Filter
· Properties of a Power Divider and Rat-Race Hybrid Coupler
· Measurement of Return Loss, Reflection Coefficient and VSWR</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course aims to develop basic understanding of measurement at microwave frequencies and for analysis of the passive microwave devices. Students successfully completing this course is expected to acquire the following skills:
- to know the basic properties of a circulator and its applications in microwave systems
- to understand how a directional coupler can be used to separate the incident and reflected waves
- how to measure the voltage reflection coefficient in a microwave circuit,
- to know the definitions of and to have measured the coupling, directivity, isolation and insertion loss of a directional coupler,
- to know applications of the directional coupler in microwave measurements and systems.
- to know the two basic forms of waveguide tee-junction
- to be able to measure the insertion loss of a microwave component
- to measure the insertion loss of a microstrip low pass filter
- to know how power may be split in microstrip systems using a Wilkinson power divider and also by means of rat-race hybrid ring coupler
- to know the meaning of return loss and its relationship with reflection coefficient and VSWR
- to be able to measure return loss utilizing a directional coupler</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Microwave Engineering, Pozar, Addison Wesley
• Foundations for Microwave Engineering, Collin, 2nd Ed., Mc-Graw Hill
• Experimental Handouts, HÜ. EE. Dept.</td></tr>
<tr><td colspan="3">Assessment Method(s):
Two Midterm Exams (25% each) and Final Exam (50%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students are required to know or should be willing to study themselves some of the subjects in ELE445 - ELE447 courses.
6 Experiments, 1 weekly hours
Accompanies ELE 446 Microwave Techniques II.</td></tr>
</table>

Course Code and Title:	**ELE 451** **Introduction to Biomedical Engineering**		**Level:** Undergraduate	**Year/Semester:** 4th/Fall
Teaching Method: Theoretical Lectures, Homeworks and Laboratory Work	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 6
Lecturer(s):	Assoc. Prof. Dr. Uğur Baysal Assist. Prof. Dr. Atila Yılmaz			
Course Contents:	General principles of biomedical measurement systems. Transducers for displacement, force, pressure, temperature, and radiation measurements. Measurement of pressure, volume, and flow. Origin of bioelectrical potentials, ionic basis of action potentials. Propagation of action potentials. Biopotential electrodes. Theory of EKG, EMG, EEG. Amplification and processing of bioelectric signals, instrumentation amplifier, intereference-reduction. Grounding, shielding, isolation, and electrical safety in medical instrumentation.			
Objectives of the Course:	Biomedical engineering, in general, is an interdisciplinary field in which knowledge in engineering, biology, chemistry and medicine is used to obtain new information of biological systems and development of new devices, processes, and algorithms in the field. Students will learn well known systems and their principles in medicine and biology along with the engineering formation gained for analysing the methods and approaches in this different field. The origin of the measurable biologic signals, their mathematical models and measuremet methods are among the knowledge that students will gain. After learning the analysis of the bioelectric signals, studying design aspects of the mesurement equipments by using the engineering skills and experiencing special practical problems in medical field after understanding the analysis of the bioelectric signals will be important echievement for the students who may work in this area.			
Bibliography:	• Medical Instrumentation, Application and Design, Webster, 3rd Ed., Wiley • Bioinstrumentation, Webster, Wiley			
Assessment Method(s): **2** Midterm Exams (20% each), Research Reports and Experiments (10%) and Final Exam (50%)		**Prerequisite(s):** None		
Notes:				

Course Code and Title:	**ELE 452** **Fundamentals of Medical Imaging**		**Level:** Undergraduate	**Year/Semester:** 4th/Spring
Teaching Method: Theoretical Lectures and Homeworks	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 6
Lecturer(s):	Assoc. Prof. Dr. Uğur Baysal Assist. Prof. Dr. Atila Yılmaz			
Course Contents:	Modern medical imaging systems, fundamentals, principles and applications, X-ray radiography, ultrasound imaging, radionuclide imaging, magnetic resonance imaging, imaging systems hardware, data acquisition, performance criteria, spatial resolution, contrast and noise			
Objectives of the Course:	Understanding biomedical and medical imaging systems physics, decision making about image quality, comparing different medical imaging systems, learning engineering aspects of medical imaging systems			
Bibliography:	• Fundametals of Medical Imaging Lecture Notes, U Baysal • Biomedical Instrumentation, Webster			
Assessment Method(s): Homeworks (10%), 2 Midterm Exams (20% each) and Final Exam (50%)		**Prerequisite(s):** None		
Notes:				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 454
Power Electronics</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
6</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Işık Çadırcı</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Introduction, Power Semiconductor Devices, Loss Calculations and Cooling of Power Semiconductors, Rectifier Circuits, Converter Operation in 4-Quadrants, AC Voltage Controllers, Choppers, Inverters, Switch Mode Power Supplies, Protection of Power Converters, Applications</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is designed to equip seniors with knowledge about operation characteristics and major application areas of modern power semiconductor devices, and associated power converters to give them an ability to design and choose such systems for various industrial applications, i.e.
I. Basic Definitons, goals of electronic power conversion, application areas, classification of power converters
II. Power Semiconductors
III. Loss Calculations and Cooling of Power Semiconductors
IV. Rectifier Circuits
V. Converter Operation in Four Quadrants
VI. AC Voltage Controllers
VII. Choppers
VIII. Inverters
IX. Protection of Power Converters</td></tr>
<tr><td>Bibliography:</td><td colspan="4">Textbooks:
• Power Electronics, Lander, 3rd. Ed., Mc Graw Hill
• Power Electronics: Converters, Applications and Design, Mohan, Undeland and Robbins, 2nd Ed., John Wiley and Sons
Reference Books:
• Power Electronics – Principles and Applications, Vithayathil, Mc Graw-Hill
• Power Electronics: Circuits, Devices and Applications, Rashid, Prentice Hall
• Power Electronics and AC Drives, Bose, Prentice Hall</td></tr>
<tr><td colspan="3">Assessment Method(s):
2 Midterm Exams (20% and 25%), Homeworks (5%) and Final Exam (50%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: ELE 210 Electronics Course
Accompanied by ELE 456 Power Electronics Laboratory.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 456
Power Electronics Laboratory</td><td>Level:
Undergraduate</td><td>Year/Semester:
4th/Spring</td></tr>
<tr><td>Teaching Method:
Laboratory Work</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
2</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Teach. Assist. Cüneyt Barlak
Teach. Assist. Sevda Balk</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Application of power semiconductors, single-phase uncontrolled and controlled rectifier circuits, three-phase rectifiers, choppers, inverters</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is designed to equip seniors with practical knowledge about power semiconductors, and their converter applications. The student is expected to learn and analyse the following
I. Static Characteristics of Power Semiconductor Devices
II. Single Phase Rectifier Circuits- Half Wave and Center Tapped</td></tr>
</table>

	Circuits III. Single Phase Rectifier Circuits- Bridge Rectifiers IV. Three Phase Rectifier Circuits- Half Wave Rectifier Circuits V. Three Phase Rectifier Circuits- Bridge Rectifier Circuits VI. DC Chopper Power Control	
Bibliography:	• ELE 454 Power Electronics Laboratory Manual	
Assessment Method(s): Two midterms: (20% and 25%), Homeworks (5%) and Final Exam (50%)		**Prerequisite(s):** None
Notes: 6 experiments to be carried out in laboratory Accompanies ELE 454 Power Electronics.		

V.2. Postgraduate (M.Sc. and Ph.D.) Programme Courses

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 701
Linear Systems Theory</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Compulsory (*)</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Hüseyin Demircioğlu</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Review of transform techniques. Linear spaces. Linear operators. Range space and null spaces. Eigenvectors. Singular value decomposition (SVD). Norms, linear system description: input-output and state variable descriptions, time invariant and time varying system descriptions. Discrete time systems. Modal decomposition. Linear system analysis: controllability, observability and stability.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Many engineering problems can be analyzed and solved within the framework of system concept, which is a very fundamental notion in engineering. It is possible to classify systems into two main groups as liner and nonlinear although they may have many different properties and characteristics. Systems can be assumed as linear under certain conditions despite the fact that most of the systems are nonlinear. In this way, linear systems point of view can also be used in the analysis of nonlinear systems. In this course, the aim is to provide the necessary background for the students to be able to understand and solve the engineering problems by using the theory and methods developed for linear systems.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Linear System Theory and Design, Chen, HRW
• Linear Systems, Kailath, Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Homeworks (20%), Midterm Exam (30%) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 703
Probability Theory and Stochastic Processes</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Compulsory (*)</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Mücahit Üner</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The axioms of probability, probability space, conditional probability, combined experiments, Bernoulli trials, the concept of a random variable, distribution and density functions, conditional distributions, asymptotic approximations for binomial random variables,functions of one random variable, the transformation of a random variable, mean and variance concepts, moments, characteristic functions, two random variables, bivariate distributions, one function of two random variables, two functions of two random variables (Jacobian matrix), joint moments, joint characteristic functions, conditional bivariate distributions, conditional expected variables.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">In probability theory, random variables, transformations, expected values, conditional densities, characteristic functions can not be mastered with mere exposure. These concepts must be clearly defined and must be developed, one at a time, with sufficient elaborations. In this course, the materials are presented in this manner with many practical application examples and it is aimed to have the students have the ability to solve the problems they work on by using these concepts as a tool.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Probability, Random Variables, and Stochastic Processes, Papoulis, Pillai, 4th Ed., Mc-Graw Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
Homeworks, 1 Midterm Exam and Final Exam</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 704
Optimization</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures, Homeworks and Term Project</td><td>Teaching Language:
Turkish</td><td>Status:
Compulsory (*)</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Dr. Cenk Toker</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Content of the course is composed of three parts:
1. Theory (Mathematical Background that will be used throughout the course)
Convex Sets, Convex Functions, Convex Optimization Problems and Duality
2. Applications (Several application examples)
Approximation and Fitting, Statistical Estimation and Geometric Problems
3. Algorithms (Optimization algorithms)
Unconstrained minimization, Equality constrained minimization, Interior-point methods</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The main objective of engineering is to find the best (optimum) solution for a practical application or a theoretical problem. In many situations finding the best solution is not straightforward and advanced techniques are required to solve these problems. This course aims at providing the methods for solving such problems.
A student who completed the course successfully is expected to gain the following abilities:
- to recognise the optimisation problems that raise in engineering applications,
- to obtain the necessary mathematical background to solve these problems,
- to learn and gain experience in the methods for solving these problems. In further detail
I. Model an engineering problem as a mathematical problem and learn basic terminology of optimization
II. Learn optimality conditions for unconstrained optimization and convexity, and implement basic optimization problems using these conditions
III. Learn Quadratic Functions and their use in optimization and comprehend the graphical representation of optimization problems
IV. Learn Line Search algorithms and issues related to the convergence of an iterative algorithm
V. Learn, analyse and implement the Gradient Descent Algorithm
VI. Learn, analyse and implement the Steepest Descent Algorithm
VII. Learn, analyse and implement the Conjugate Direction Methods
VIII. Learn, analyse and implement the Newton’s Algorithm
IX. Learn the concept of duality in optimization
X. Learn, analyse and implement the Lagrange method for solving constrained optimization problems
XI. Investigate and implement problems with equality constraints
XII. Investigate and implement problems with inequality constraints
XIII Learn, analyse and implement the solutions to linear optimization problems</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Convex Optimization, Boyd, Vanderberghe, Cambridge Univ. Press
• Linear and Nonlinear Optimization, Luenberger, Kluwer Academic Publishers
• Bertsekas, Nonlinear Programming, Athena Scientific
• Applied Optimization, Baldick, Cambridge
• Lecture Notes, Bertsekas, MIT
• Lecture Notes, Freund, MIT.</td></tr>
<tr><td colspan="2">Assessment Method(s):
10 Homeworks (20%), Midterm Exam (closed book, written, 20%), Term Project (30%) and Final Exam (closed book, written, 30%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: It is assumed that the students are familiar with the concepts of Linear Algebra and Geometry.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 705
Complex Analysis in Electromagnetics</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Adnan Köksal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The contents of the course may be given as below:
- Introduction, Complex numbers
- Functions, limit and continuity
- Derivative, Cauchy-Riemann equations
- Complex integration and Cauchy Theorem
- Cauchy integral equation and its consequences
- Infinite series, Taylor and Laurent expansions
- Residue theorem and its applications
- Transformations and conformal transformations
- Applications of conformal transformations
- Infinite products, special functions
- Asymptotic methods</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course is expected to acquire the following skills:
- To understand the introductory concepts of the complex analysis methods.
- To be able to analyze the convergence of series.
- To understand residue theorem and apply it to different integration problems.
- To understand conformal transformation and its applications.
- To investigate transmission lines using conformal transformation.
- To be able to carry out asymptotic expansions and evaluate some integrals asymptotically.
- To be ready to study further special studies in these topics.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Theory and Problems of Complex Variables, Spiegel, Schaum’s Outline Series, McGraw Hill
• Basic Complex Analysis, Marsden, Freeman and Co.
• Mathematical Physics, a Modern Introduction to its Foundations, Hassani, Springer-Verlag
• Mathematical Methods in the Physical Sciences, Boas, 2nd Ed., John Wiley and Sons
• Advanced Calculus for Applications, Hildebrand, 2nd Ed., Prentice Hall
• Complex Variables and Applications, Churchill, Brown, and Verhey, 3rd Ed., McGraw Hill
• Advanced Calculus, Taylor and Mann, 3rd Ed., John Wiley and Sons
• Methods of Theoretical Physics, Part I, Morse, Feshbach, McGraw Hill</td></tr>
<tr><td colspan="3">Assessment Method(s):
Homeworks + Final Homework totaling (100%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 706
Green’s Functions in Electromagnetics</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Adnan Köksal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The contents of the course may be given as below:
· Introduction.
· Sturm-Liouville problems.
· One dimensional Green's functions in closed form and in eigenfunction series.
· Separation of variables.
· Higher dimensional Green's function in rectangular, cylindrical and spherical coordinates.
· Relation with the solution of electromagnetic related inhomogeneous partial differential equations.
· Diyads and basic theorems.
· Vector wave functions.
· Dyadic Green's functions in closed form and wave function expansions.
· Application of Green’s function methods to electromagnetics with emphasis on numerical modeling.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course is expected to acquire the following skills:
-To understand the introductory concepts of Green's function methods.
-To classify electromagnetic problems.
-To obtain Green's function for one dimesional problems under different boundary conditions.
-To obtain Green's functions in two and three dimensions using separation of variables.
-To expand dyadic Green's functions using vector wave functions.
-To be ready to study further special studies in these topics.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Dyadic Green Functions in Electromagnetic Theory, Chen-to Tai, IEEE Press
• Field Theory of Guided Waves, Collin, IEEE Press
• Waves and Fields in Inhomogeneous Media, Chew, IEEE Press
• Generalized vector and dyadic analysis, Chen-to Tai, IEEE Press
• Methods of Theoretical Physics, Part I, Morse and Feshbach, McGraw Hill
• Intermediate Mathematics of Electromagnetics, Stinson, Prentice Hall
• Mathematical Physics, Butkov, Addison-Wesley
• Mathematical Physics, a Modern Introduction to its Foundations, Hassani, Springer-Verlag
• Advanced Calculus for Applications, Hildebrand, 2nd Ed., Prentice Hall
• Mathematical Methods in the Physical Sciences, Boas, 2nd Ed., John Wiley and Sons
• Advanced Calculus, Taylor and Mann, 3rd Ed., John Wiley and Sons
• Basic Complex Analysis, Marsden, W.H. Freeman and Co.
• Complex Variables and Applications, Churchill, Brown, and Verhey, 3rd Ed., McGraw Hill</td></tr>
<tr><td colspan="3">Assessment Method(s):
Homeworks + Final Homework totaling (%100)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 707
Electromagnetic Compatibility</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures, Homeworks and Term Project</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assoc. Prof. Dr. Birsen Saka</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Basics of Electromagnetic Compatibility (EMC). EMC units. Sources and modeling of Electromagnetic interference (EMI). Electrostatic discharge. Shielding theory. High and low impedans fields. Inductive and capacitive coupling. Application of shielding, grounding and bonding. EMI filters. Frequency spectrum utilization and planning. EMC regulations and measurements.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I Basics of Electromagnetic Compatibility (EMC).
II EMC units.
III Sources and modeling of Electromagnetic interference (EMI).
IV Electrostatic discharge.
V Shielding theory.
VI High and low impedans fields.
VII Inductive and capacitive coupling.
VIII Application of shielding, grounding and bonding.
IX EMI filters.
X Frequency spectrum utilization and planning.
XI EMC regulations and measurements.

Upon successful completion of the course, the student understands the concept of the electromagnetic compatibility and have foundation to work on special aspects of electromagnetic compatibility.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Engineering Electromagnetic Compatibility, Kodali, IEEE Press
• Introduction to Electromagnetic Compatibility, Paul, John Wiley & Sons
• Noise reduction techniques in electronic systems, Ott, 2nd Ed., John Wiley & Sons
• www.egr.msu.edu/em/research/goali/notes</td></tr>
<tr><td colspan="2">Assessment Method(s):
Homeworks (10%), Midterm Exam (20%), Term Project (20%) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 710
Analog Integrated Circuits</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Method:
Theoretical Lectures and Projects</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Ali Ziya Alkar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">I. Introduction to Analog IC design
II. CMOS Processing Technology and Analog Layout Techniques\
III. IC technology
IV. Single Stage Amplifiers
V. Differential Amplifiers
VI. Frequency Response of Amplifiers
VII. Noise
VIII. Operational Amplifiers
IX. In Class Presentation of Groups for Final Projects
X. In Class Presentation of Groups for Final Projects</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The goal in this course is to teach the basics of the Analog Electronics in VLSI with the IC design in mind. The student will be able to get an Introduction to Analog IC design and the CMOS Processing Technology and Analog Layout Techniques and have an understanding of the IC technology in Analog World. The projects will enhance the learning on biweekly intervals. There will also be Final Prioject where the student will actually do the design and present the work in class. Upon successful completion of the course, the student will be able to work with Analog IC from design to layout.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">Text Book:
• Principles of CMOS VLSI Design- A systems perspective, Weste and Eshraghian, Addison Wesley
Recommended Reading
• CMOS Digital Integrated Circuits - Analysis and Design, Kang and Leblebici
• Basic VLSI Design, Pucknell and Eshragian, Prentice Hall
• A VHDL Primer, Bhasker, Prentice Hall
• Chip Level Modeling with VHDL, Armstrong, Prentice Hall
• VLSI Cookbook</td></tr>
<tr><td colspan="3">Assessment Method(s):
Homeworks 15%, Projects 35%, Final Project 15%, Final 35%</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 711
CMOS VLSI Circuit Design</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, Projects and Lab. Demonstrations</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. A. Ziya Alkar</td></tr>
<tr><td>Course Contents:</td><td colspan="4">NMOS and CMOS technologies and fundamentals of CMOS design. Process technologies. Layout design rules. Performance estimation. CMOS circuits and logic design. Symbolic layout systems. Introduction to hardware description languages, VHDL. Simulation.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The goal in this course is to teach the basics of the ASIC and the FPGA design. The design principles are thought as bottom up in this course. Initially the layout level calculations and current voltage relations are discussed. Then the layout drawing of designs and their simulations in the laboratory is experimented. This level is mostly for the benefit of ASIC designers working with RF etc. The resistor, capacitance calculations at this level is introduced. Then in the transistor level these designs are revisited at a higher level. this enables a comparison to be made between two abstraction levels in terms of parasitic effects. Following this the CMOS fabrication is presented. Scaling is discussed to expose the student with the facts of the developing VLSI technology. Limiting factors on Scaling is also discussed. CMOS design is thought in detail and various ways of CMOS design is presented and discussed. VHDL design is thought to enable the student to design and debug much faster. With the VHDL design in hand, the student experiments a whole top down design approach to see all the stages of a VLSI design. Following this an FPGA experiment is performed to complement the course. FPGA enables the result of the work to be seen instantaneously.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">Text Book:
• Principles of CMOS VLSI Design- A systems perspective, Weste and Eshraghian, Addison Wesley
Recommended Reading
• CMOS Digital Integrated Circuits - Analysis and Design, Kang and Leblebici
• Basic VLSI Design, Pucknell and Eshragian, Prentice Hall
• A VHDL Primer, Bhasker, Prentice Hall
• Chip Level Modeling with VHDL, Armstrong, Prentice Hall
• VLSI Cookbook</td></tr>
<tr><td colspan="2">Assessment Method(s):
Homeworks (15%), Projects (Approx. 3-4 small projects for individual work, 35%), Final Project (Group work, 15%) and Final Exam (35%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students need to learn enough Unix to run their programs in SUN workstations in the VLSI lab.
Students should have taken analog and digital electronics courses.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 720
Electromagnetic Wave Propagation</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Erdem Yazgan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Radio wave propagation in free space, the effects of the Earth's surface on propagation, propagation problems for the line of sight paths. Influence of the troposphere ans Ionosphere on propagation, concept of diffraction, frequency sharing, noise and interference problems.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Basic Parameters in Electromagnetic Wave Propagation
II. Free Space Attenuation and Boundary Conditions
III. Ionospheric Propagation
IV. Tropospheric Propagation
V. Diffraction
VI. HF, LOS and Satellite Communications
VII. Examples of the Application of Electromagnetic Wave Propagation
VIII. Radio Wave Propagation Standarts
Upon successful completion of the course, the student learns the above topics and gains the ability to analyse an electric circuit.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Radio Wave Propagation, L. Boithias, North Oxford Academics.
• Propagation of Radio Waves, M. Dolukhanov, Unıon of Soviet Socialist republics.
• Radio Wave Propagation over Ground, T.S.M Maclean, Z. Wu, Chapman and Hall</td></tr>
<tr><td colspan="3">Assessment Method(s):
Homeworks(30%), Midterm Exam (20%) and Final Exam (40%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 721
Microwave Circuit Design Techniques</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Term Project</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Erdem Yazgan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Course covers microstrip structures, single and multistage amplifier design, advanced filter design, parametric amplifier design, oscillator design and mixer design with different methods in the fild of high frequency circuit design.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Detectors
II. Mixers
III. Filters
IV. Multiplexers
V. Microstrip Structures
VI. Impedance and Admittance Inverters
VII. Advanced Microwave Amplifier Design
VIII. Usage of Package Programs About Filter and Amplifier Design

Upon successful completion of the course, the student learns the above topics and gains the ability to analyse an electric circuit.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Foundations For Microwave Eng., Collin, McGraw-Hill
• Microwave Circuit Design Using Linearanel Nonlinear Tech., Vendelin, Pavio and Rahde, John Wiley and Sons.</td></tr>
<tr><td colspan="3">Assessment Method(s):
Term project 20(%), 2 Midterm Exams (50%), Final Exam (30%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 722
Fiber Optic Systems</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, Homeworks and Term Project</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assoc. Prof. Dr. Çiğdem Seçkin Gürel</td></tr>
<tr><td>Course Contents:</td><td colspan="4">1- Review of the general EM Theory,
2-Diffraction Theory and Applications,
3-Interference Theory and applications,
4-Fourier Optics and applications
5- Analysis of dielectric waveguides and optical fibres; modal propagation and applications,
6- Some optical application examples.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. History of Optics
II. Opticcal Theories
III. Basic Electromagnetic Theory
IV. Diffraction Theory and Applications
V. Interference Theory and Applications
VI. Fourier Optics and Applications
VII. Optical Waveguide Principles
VIII. Fiber Optical Waveguides and Modal Propagation
IX Other Applications of Optics (in presentation form)
Upon successful completion of the course, the student learns the above topics and gains the ability to analyse and describe basic optical devices.</td></tr>
</table>

Bibliography:	• Fundamentals of Photonics, Saleh and Teich, Wiley • Optoelectronics and Photonics, S.Kasap, Prentice Hall • Other Graduate or Undergraduate Level Text Books	
Assessment Method(s): Homeworks (15%) in total, Midterm Exam (take-home exam, 20%), Term Project (25%) and Final Exam (closed/open book and notes, 40%)		**Prerequisite(s):** None
Notes:		

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 723
Electromagnetic Wave Theory I</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Feza Arıkan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">1. Fundamental Relations and Theories of Electromagnetics, Maxwell Equations, Boundary Conditions, Different Media Types
2. Wave equations and solutions for source free media
3. Time Varying Fields, Reflection, Refraction, Polarization,
4. Wave equations and their solution for complex waves and for inhomogeneous media
5. Complex Waves (Trapped - Untrapped Surface Waves, Zenneck Waves, Plasmons)
6. Reflection and Turning Points for Inhomogeneous Media
7. Guided Waves, Waveguides and dielectric optical guides, Resonators, GRIN and Step Index Optical Fibers, Dispersion in Waveguides,
8. Propagation Modes in Optical Fibers, Rectangular, Circular and Spherical Waveguides.
9. Dispersion and Anisotropic Media, Polarization in dielectric media, Wave propagation in magneto-ionic and ferromagnetic media and solution of wave equation in both in warm and cold ionoplasma and ferrites.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The students are expected to review the fundamental relations and theories of Electromagnetics. The undergraduate EM knowledge is revised and enlarged to new concepts which are not typically covered in undergraduate level such as dielectric waveguides, resonators, complex waves, inhomogeneous media and anisotropic media. The past and current applications of the theories are also introduced through real life examples. The students are expected to form a basic understanding of the EM theory and develop a strong foundation for their future studies in EM.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Electromagnetic Wave Propagation, Radiation and Scattering, Ishimaru, Prentice Hall
• Electromagnetic Wave Theory, Kong, John Wiley
• Waves and Fields in Inhomogeneous Media, Chew, Van Nostrand Reinhold
• Advanced Engineering Electromagnetics, Balanis, John Wiley
• Other Graduate or Undergraduate Level Text Books</td></tr>
<tr><td colspan="2">Assessment Method(s):
Homeworks (30%), 2 Midterm Exams (closed book and notes, in class, 15% each) and Final Exam (closed/open book and notes, in class, 40%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: No formal prerequisites, yet the students are expected to successfully complete the undergraduate level EM Theory courses. In order to follow the course and text book, a good command of English is also required. Text book, homeworks and tests are in English. Also some lectures are given in English.</td></tr>
</table>

Course Code and Title:	**ELE 724** **Electromagnetic Wave Theory II**		**Level:** Postgraduate	**Semester:** Spring
Teaching Methods: Theoretical Lectures and Homeworks	**Teaching Language:** Turkish	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Prof. Dr. Feza Arıkan			
Course Contents:	1. Green's Functions for Homogeneous Media, Radiation from an elementary electric dipole and from a magnetic dipole, Scalar solution to Green's Function, Eigenvalue expansion and Fourier Transform Method, Practical Applications 2. Radiation from Apertures and Beam Waves, Huygen's Principle, Kirchhoff Approximation, Fresnel and Fraunhofer Diffraction, Vector Green's Theorem and Stratton-Chu Formula, Equivalence Theorem 3. Antennas, Apertures and Arrays, Radiation from any given electric and magnetic current distributions, dipoles, slots, loops, microstrip antennas, arrays with equal and non-equal spacings 4. Scattering of Waves by conducting and dielectric objects, cross sections and scattering amplitude, Radar equations, Rayleigh scattering, Born Approximation, Physical Optics Approximation 5. Waves in Cylindrical Structures, Spheres and Wedges; Modeling of Scattering, Plane waves incident on a conducting and dielectric cylinder, Large Cylinders and Watson Transform, Mie Scattering from a sphere and plane wave excitation of a wedge			
Objectives of the Course:	In this course, the students are exposed to fundamental electromagnetic approximations and theorems for the solution of complex radiation and scattering problems. Formulation and application of scalar and vectoral Green's Functions are discussed for various radiation and scattering problems. Definitions and computation methods for scattering are introduced through scattering amplitude and cross sections and concepts are applied with radar examples. Undergraduate level antenna theory is revised and similarities of various types of radiation media are introduced using the examples of wire and aperture antennas. The students are expected to comprehend fundamentals of radiation and scattering problems with examples. The students are expected to understand how the same equation sets are used to solve both the forward (radiation) and inverse (scattering) problems with the application of necessary theorems and approximations to the canonical objects such as cylinders, spheres and wedges. The students who complete this course successfully should form a strong foundation for future EM scattering and radiation thesis studies.			
Bibliography:	• Electromagnetic Wave Propagation, Radiation and Scattering, Ishimaru, Prentice Hall • Electromagnetic Wave Theory, Kong, John Wiley • Green's Functions, Roach, Cambridge Univ. Press • Advanced Engineering Electromagnetics, Balanis, John Wiley • Other Graduate or Undergraduate Level Text Books			
Assessment Method(s): Homeworks (30%), 2 Midterm Exams (closed book and notes, in class, 15% each) and Final Exam (closed/open book and notes, in class, 40%)		**Prerequisite(s):** None		
Notes No formal prerequisites, yet the students are expected to successfully complete the undergraduate level EM Theory, Antennas and graduate level ELE 723 courses. In order to follow the course and text book, a good command of English is also required. Text book, homeworks and tests are in English. Also some lectures are given in English.				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 725
Analytical Methods in Electromagnetics</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Adnan Köksal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The contents of the course may be given as below:
- Fundamental theorems and concepts.
- Plane wave functions, modal expansion.
- Cylindrical wave functions, spherical wave functions.
- Wave transformations.
- Analysis of waveguide discontinuities and electromagnetic scattering using modal expansions.
- Green’s functions in rectangular, cylindrical and spherical coordinates in closed form and eigenfunction expansion.
- Closed form dyadic Green’s function.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course is expected to acquire the following skills:
- To understand the fundamental theorems of electromagnetics.
- To be able to carry out modal analysis using plane wave functions.
- To be able to carry out modal analysis using cylindrical wave functions.
- To be able to carry out modal analysis using spherical wave functions.
- To be able to carry out wave transformations.
- To be able to expand Green's functions in three orthogonal coordinate systems.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Time Harmonic Electromagnetic Fields, Harrington, McGraw Hill
• Advanced Engineerin Electromagnetics, Balanis, John Wiley & Sons</td></tr>
<tr><td colspan="3">Assessment Method(s):
Homeworks, Two Quizzes and Final Exam (totaling 100%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 726
Computational Methods in Electromagnetics</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Adnan Köksal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The contents of the course may be given as below:
- Introduction
-Classification of EM problems
- Quick review of linear algebra concepts
- Method of Moments
    - Theory
    - Applications to electrostatics
    - Two dimensional scattering problems
    - Radiation and scattering form wire structures
    - Current research topics
- Time Domain Integral Equation Methods
    - Wire Structures
    - Two and three dimensional problems
- Finite Difference Method
    - Theory
    - Treatment of Boundaries
    - Analysis of TEM structures
    - Finite Difference Time Domain Method
    - Current research topics
- Finite Elements Method
    - Theory
    - Elements and shape functions
    - Applications
- Other methods and related current research topics will be discussed if time permits.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course is expected to acquire the following skills:
- To understand the introductory concepts of the current computational electromagnetics methods.
- To be able to reduce encountered engineering problems to electromagnetic equations and to suggest a solution method.
- To develop skills and understanding to be able to use current EM softwares efficiently.
- To have foundation to work on special aspects of the computational electromagnetics.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Numerical Techniques in Electromagnetics, Sadiku, CRC Press
• Computational Methods for Electromagnetics, Peterson, Scott and Mittra, IEEE Press
• Field Computation by Moment Methods, Harrington, MacMillan
• Time Domain Electromagnetics, Rao, Academic Press
• Numerical Analysis of Electromagnetic Fields, Zhou, Springer-Verlag</td></tr>
<tr><td colspan="2">Assessment Method(s):
Computer Homeworks + Final Computer homework totaling (100%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

Course Code and Title:	ELE 728 **Antenna Theory and Analysis**		Level: Postgraduate	Semester: Fall
Teaching Methods: Theoretical Lectures and Homeworks	**Teaching Language:** Turkish	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Assoc. Prof. Dr. Birsen Saka			
Course Contents:	Aperture antennas: field equivalence principle, radiation integrals, Fourier transforms in aperture antenna theory, horn antennas. Wire antennas: method of mement, electric and magnetic field integrals. Reflector antennas and geometric theory of diffraction. Microstrip antennas: transmission line model, cavity model. Application of finite difference time domain method in the antenna analysis.			
Objectives of the Course:	Students successfully completing this course is expected to acquire the following skills: - To be able to design the aperture, wire, reflector and microstrip antennas. - To develop skills and understanding of the computational methods in antenna engineering. - To have foundation to work on special aspects of antenna design. i.e. I Aperture antennas: field equivalence principle, radiation integrals II Fourier transforms in aperture antenna theory, horn antennas. III Wire antennas: method of moment, electric and magnetic field integrals. IV Reflector antennas and geometric theory of diffraction. V Microstrip antennas: transmission line model, cavity model. VI Application of finite difference time domain method in the antenna analysis.			
Bibliography:	• Antenna Theory-Analysis and Design, Balanis, 2nd Ed., John Wiley & Sons • Antenna theory and design, Stuzman and Thiele, Wiley			
Assessment Method(s): Homeworks (30%), Midterm Exam (20%) and Final Exam (40%)		**Prerequisite(s):** None		
Notes:				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 730
Digital Communications I</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Mehmet Şafak</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Optimum Receiver:
Matched-filter vs correlation receiver.
Maximum likelihood (ML) vs maximum a-priority (MAP) decoding.
Optimum BER performance of various M-ary modulation schemes in AWGN channels.
Error-correction coding:
Block and convolutional codes.
Introduction to turbo and low-density parity-check codes (LDPC).
Spread-spectrum (SS) techniques:
Direct-sequence spread spectrum, Frequency-hopping spread-spectrum.
AJ, LPI, ranging, multiple-access capabilities.
Synchronization of SS systems.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is a continuation of ELE 425 and is intended to provide some of the fundamental concepts which could not be dealt in the undergraduate level, i.e.
I. Optimum Receiver: Matched-filter vs correlation receiver. Maximum likelihood (ML) vs maximum a-priority (MAP) decoding. Optimum BER performance of various M-ary modulation schemes in AWGN channels.
II. Error-correction coding: Block and convolutional codes. Introduction to turbo and low-density parity-check codes (LDPC).
III. Spread-spectrum (SS) techniques: Direct-sequence spread spectrum, Frequency-hopping spread-spectrum. AJ, LPI, ranging, multiple-access capabilities. Synchronization of SS systems.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Digital Communications, Proakis, McGraw Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
Two midterm exams and a final exam</td><td colspan="3">Prerequisite(s):
ELE 425</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 731
Digital Communications II</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Mehmet Şafak</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Brief review of probability and stochastic processes. Sums of random variables. Central limit theorem. Characterization of fading channels. Frequency selective and frequency non-selective fading. Fast and slow fading channels. Shadowing. Characterization of mobile communication channels. Effect of fading and shadowing in bit error rate performance. Diversity and combining techniques: selection diversity, switched diversity, equal gain combining and maximal ratio combining. Pre-detection and post-detection combining. MIMO systems. Multiple access techniques: FDMA, TDMA, CDMA, ALOHA, CSMA, token ring. Queueing theory.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course provides a detailed study of three important topics in wireless communications, namely, fading, diversity and combining and multiple access. The student is expected to learn how to analyse the following topics
I. Brief review of probability and stochastic processes. Sums of random variables. Central limit theorem.</td></tr>
</table>

	II. Characterization of fading channels. Frequency selective and frequency nonselective fading. Fast and slow fading. Shadowing. Characterization of mobile communication channels. Effect of fading and shadowing in bit error rate performance. III. Diversity and combining techniques: selection diversity, switched diversity, equal gain combining and maximal ratio combining. Pre-detection and post-detection combining. MIMO systems. IV. Multiple access techniques: FDMA, TDMA, CDMA, ALOHA, CSMA, token ring. Introduction to WiFi and WiMax. Queueing theory.
Bibliography:	• Digital Communications, Proakis, McGraw Hill
Assessment Method(s): Two midterm exams and a final exam	**Prerequisite(s):** ELE 425 and ELE 730
Notes:	

<table>
<tr><td colspan="2">Course Code and Title:</td><td colspan="2">ELE 736
Detection and Estimation Theory</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td colspan="2">Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td colspan="2">Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Mücahit Üner</td></tr>
<tr><td colspan="2">Course Contents:</td><td colspan="4">Classical Detection and Estimation Theory :
- Simple Binary Hypothesis Tests
- Decision Criteria, Performance : Receiver Operating Characteristic
- M Hypotheses
- Estimation Theory : Random and Nonrandom parameter estimation
- Composite Hypotheses
- The general Gaussian problem
Representation of Random Processes:
- Orthogonal representation
- Random process characterization
- White noise processes
Detection of continuous signals
- Detection of known signals in white Gaussian noise</td></tr>
<tr><td colspan="2">Objectives of the Course:</td><td colspan="4">The objective of the course is to provide a good understanding of detection and estimation theory which represents a combination of the classical techniques of statistical inference and the random process characterization of communication, radar, sonar, and other modern data processing systems. In detail these topics also include
I. Simple Binary Hypothesis Tests
II. M Hypothesis Testing
III. Random and Nonrandom Parameter Estimatioms
IV. Composite Hypotheses Testing
V. Deterministic Functions : Orthogonal Representations
VI. Random Process Characterization : Series Representation of Sample Functions
VII. White Noise Processes
VIII. Detection of Known Signals in White Gaussian Noise</td></tr>
<tr><td colspan="2">Bibliography:</td><td colspan="4">• Detection, Estimation, and Modulation Theory, Part I, Van Trees, Wiley</td></tr>
<tr><td colspan="3">Assessment Method(s):
Homeworks + 1 midterm + Final exam</td><td colspan="3">Prerequisite(s):
ELE 425</td></tr>
<tr><td colspan="6">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 737
Fundamentals of Information Theory</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Emre Aktaş</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Course outline
• Introduction, review of probability
• Entropy, relative entropy, mutual information, inequalities
• The asymptotic equipartition property
• Data compression
• Channel capacity
• Di erential entropy, the Gaussian channel
• Network information theory</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course are expected to acquire the following skills:
- Learn and use the main mathematical tools of information theory that quantify and relate information
- Learn fundamental limits for systems that communicate or store data.
- Utilize information theory in order to gain insight of and design any system that stores, processes, or communicates information</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Elements of Information Theory, Cover and Thomas, Wiley Interscience
• "Claude E. Shannon: A Retrospective on His Life, Work, and Impact", Gallager, IEEE Trans. Inform. Theory, vol.47, no.7, Nov. 2001
• "Fundamental Limits in Information Theory", Wyner, Proc. of the IEEE, vol.69, no.2, Feb. 1981
• "Fifty Years of Shannon Theory", Verdu , IEEE Trans. Inform. Theory, vol.44, no.6, Oct. 1998</td></tr>
<tr><td colspan="2">Assessment Method(s):
Quizzes, Homeworks and Midterm Exams (50%), Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Familiarity with telecommunications and probability theory is assumed.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 739
Special Topics in Communications</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, Homeworks and Term Project</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Dr. Cenk Toker</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Space-Time Propagation,
Space-Time Channel and Signal Models,
Capacity of Space-Time Channels,
Spatial Diversity,
Space-Time Coding without Channel Knowledge at Transmitter,
Space-Time Receivers,
Exploiting Channel Knowledge at the Transmitter,
Space-Time OFDM and Spread-Spectrum Modulation,
MIMO Multiuser,
Space-Time Co-channel Interference Mitigation,
Performance Limits and Trade-offs in MIMO Channels</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The main objective of this course is to introduce the latest progress and cutting/edge technologies in telecommunications technology to the student. Space-time communication techniques are currently being used in the 3G/UMTS systems and they are strong candidates for the next generation systems also.
A student taking this course is expected to gain the following abilities:
I. Learn the foundations of space-time wireless communications,
II. Learn and analyse spatial diversity and related definitions,
III Learn and analyse space-time coding,
IV. Learn and analyse spatial multiplexing,
V Learn and analyse MIMO multiuser systems,
VI Learn and analyse methods for mitigating co-channel interference in MIMO channels.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">Textbook:
• Introduction to Space-Time Wireless Communications, Paulraj, Nabar and Gore, Cambridge Univ. Press
Reference books:
• Fundamentals of Wireless Communications, Tse and Viswanath, Cambridge Univ. Press
• Wireless Communications, Goldsmith, Cambridge Univ. Press</td></tr>
<tr><td colspan="2">Assessment Method(s):
Midterm Exam (25%), Quizzes (10%), Term Project (30%), and Final Exam (35%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Matrix decompositions and probability theory will intensely be used during the course.
The student is assumed to have taken ELE 324, 425 and 410, or preferably ELE 730 and 731, or equivalent. Also a very good understanding of MAT 236 and ELE 302, or preferably ELE 701 and 703, respectively, is required.</td></tr>
</table>

Course Code and Title:	**ELE 753** **Adaptive Control**		**Level:** Postgraduate	**Semester:** Spring
Teaching Methods: Theoretical Lectures and Homeworks	**Teaching Language:** Turkish	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Prof. Dr. Hüseyin Demircioğlu			
Course Contents:	System models. Parameter estimation: Least Squares method, Recursive Least Squares (RLS), Extended Recursive Least Squares (ERLS), parameter tracking, covariance blow-up, gradient methods. Model reference adaptive control: MIT and SPR rules. Self-tuning control:Model reference control, Minimum Variance (MV) method, Generalized Minimum Variance (GMV), Generalized Predictive Control (GPC). Auto-tuning and gain scheduling. Stability, convergence and robustness.			
Objectives of the Course:	Control systems are usually designed by assuming that the system parameters are not changing. However, in many practical applications system parameters are not constant but changes with time and this affects the control performance adversely. Control systems that have the ability to sense the changes in the system parameters and to change itself accordingly in order to maintain a certain desired performance are called adaptive. In this course, the aim is to equip students with the necessary knowledge and skills in order to be able to understand, analyze and design such systems.			
Bibliography:	• Adaptive Control, Astrom and Wittenmark, Addison Wesley • Self-Tuning Systems, Wellstead and Zarrop, Wiley			
Assessment Method(s): Homeworks (25%), Midterm Exam (25%) and Final Exam (50%)		**Prerequisite(s):** None		
Notes:				

Course Code and Title:	**ELE 754** **Nonlinear Systems**		**Level:** Postgraduate	**Semester:** Spring
Teaching Methods:	**Teaching Language:** Turkish	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Prof. Dr. Hüseyin Demircioğlu			
Course Contents:	State space analysis of nonlinear systems. Stability concepts and Lyapunov theory. Frequency domain methods for stability. Controllability and observability for nonlinear systems. Nonlinear control systems design: feedback linearization, optimal control, sliding -mode control. Systems with special structure: mechanical, conservative, passive and gradient systems.			
Objectives of the Course:	In practice many systems are nonlinear. The objective of the course is to provide necessary background to understand, analyze and control such systems. These include nonlinear models and nonlinear phenomena; second-order systems, phase portraits; some fundamental properties of nonlinear state equations such as existence, uniqueness; stability analysis (Lyapunov, input-output, passivity); frequency domain analysis; controller design methods for nonlinear systems such as feedback linearization and sliding-mode control.			
Bibliography:	• Nonlinear Systems, H. K. Khalil, Prentice Hall, 3rd Ed. • Nonlinear Systems, S. Sastry, Springer			
Assessment Method(s): Homeworks (25%), Midterm Exam (25%) and Final Exam (50%)		**Prerequisite(s):** None		
Notes:				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 763
Photovoltaic Enerygy Conversion Systems</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assoc. Prof. Dr. Uğur Baysal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Power and energy review, energy resources in the world and turkey, electricity production from wind, solid state electronics of photovoltaic (PV) cells, DC-DC converters in PV systems, inverters, isolated PV systems, grid connected PV systems, advanced topics in PV systems</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">I. Explains various terms related to the subject, world energy resources, and reserves
II. Describes various sustainable energy resources, explains wind energy , solves problems under the topics,
III. Describes solid state electronic principles of photovoltaic cells , analyses the theoretical details of paralel and series connection of solar cells, performs simulation studies, solves problems,
IV. Explains general principles of DC-DC converters of photovoltaic cells, performs simulation studies, solves problems,
V. Describes inverters used in photovoltaic systems, performs simulation studies, solves problems,
VI. Explains major parts of isolated photovoltaic systems, performs simulation studies, solves problems,
VII. Describes grid connected photovoltaic systems, performs simulation studies, solves problems ,
VIII. Explains and describes advanced photovoltaic principles, performs simulation studies, solves problems,</td></tr>
<tr><td>Bibliography:</td><td colspan="4">•</td></tr>
<tr><td colspan="2">Assessment Method(s):
Homeworks(25%), Midterm Exam (25%) and Final Exam (%50)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 764
Switch Mode Power Supplies</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, Homeworks and Term Project</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Işık Çadırcı</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Introduction. Linear versus switch mode power supplies. Functional circuit blocks of an off-line switcher. Basic switch mode DC-DC converters. Switch mode power supply topologies. Control methods. Soft switching methods. Switch mode power supply transformer and magnetics desing. Multiple output power supplies. Electromagnetic compatibility considerations. Switch mode power supply applications.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is designed to equip seniors with knowledge about operation principles and design of modern switch mode power supplies and to give them an ability to choose such systems for various industrial applications. The student is expected to learn and analyse
I. Introduction
II. Switch Mode Power Supply (SMPS) Topologies
III. SMPS Transformer and Magnetics Design
IV. Control Methods in SMPS
V. Soft Switching Methods
VI. Multiple Output Power Supplies
VII. EMC Considerations
VIII. Term Project</td></tr>
<tr><td>Bibliography:</td><td colspan="4">Texbooks:
• Switching Power Supply Design, Pressman, 2nd Ed., Mc Graw Hill
• Power Electronics: Converters, Applications, and Design, Mohan, Undeland and Robbins, 3rd Ed., John Wiley and Sons (Ch.7, Ch.10 and Ch.30)
Reference Books and Notes:
• Power Electronics – Principles and Applications, Vithayathil, Mc Graw-Hill
• Practical Switching Power Supply Design, Brown, Academic Press Inc.
• Switch Mode Power Supply Handbook, Billings, Mc Graw Hill
• Unitrode (TI) Power Supply Design Seminar Notes
• ON Semiconductors Switchmode Power Supply Reference Manual, 1999
• Phillips Semiconductors, ‘Power Semiconductor Applications’, Application Notes
• Fundamentals of Power Electronics – Lecture Notes, Erickson,
• ST Microelectronics, Application Notes on ‘Topologies for Switched Mode Power Supplies</td></tr>
<tr><td colspan="3">Assessment Method(s):
4-5 Homeworks (25%), One Midterm Exam (closed book and notes, in class, 25%) and Term Project (50%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: No formal prerequisites, yet the students are expected to successfully complete the undergraduate course: ELE 454. Homeworks using Power 4-5-6 / PSIM software, Design and implementation of an SMPS</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 769
Special Topics in Electric Power Systems - Electrical Motor Drive Systems</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, Homeworks and Laboratory Work</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. Işık Çadırcı</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Introduction - Basic definitions for static dc and ac drives, classifications, four-quadrant operation and operating characteristics. Load characteristics. Definition of the speed control problem, Solid State DC Motor Speed Control, Solid State AC Motor Speed Control, Practical Aspects of Electric Motor Drives, Dynamic Analysis of Electric Motors, Electric Braking, Electric Motor Starting, Selection of Drives, Intermittent Loads.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">This course is designed to equip seniors with knowledge about operation principles and design of modern, static AC and DC motor drives, and to give them an ability to choose such systems for various industrial applications. The student is expected to learn and analyse
I. Introduction
II. Mechanical System
III. Mechanical Load Characteristics
IV. Four Quadrant Drive Characteristics
V. Solid State DC Motor Speed Control
VI. Solid State AC Motor Speed Control
VII. Electric Braking
VIII. Electric Motor Starting
IX. Selection of Drives
X. Intermittent Loads</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Power Semiconductor Drives, Dewman, Slemon and Straughen, John Wiley and Sons
• Solid State DC Motor Drives, Kusko, The MIT Press
• Thyristor Control of AC Motors, Murphy, Pergamon Press
• Electric Motor Drives: Modeling, Analysis, and Control, Krishnan, Prentice Hall
• Power Electronics and AC Drives, Bose, Prentice Hall
• Thyristor Control of Electric Drives, Subrahmanyam, Mc Graw-Hill
• Power Electronics: Circuits, Devices and Applications, Rashid, Prentice Hall
• Power Electronics. Converters, Applications and Design, Mohan, Undeland and Robbins, 2nd Ed., John Wiley and Sons
• Power Electronics and Variable Frequency Drives, Bose, IEEE Press
• Power Electronics, Lander, 3rd. Ed., Mc Graw Hill</td></tr>
<tr><td colspan="2">Assessment Method(s):
One Midterm Exam (closed book and notes, 25%), 4 Homeworks and Laboratory Work (25%) and Final Exam (closed book and notes, 50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: No formal prerequisites, yet the students are expected to successfully complete the undergraduate level ELE 454 and ELE 361 courses. Text Book, Homeworks and Exams are in English</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 770
Statistical Signal Processing</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Compulsory (*)</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. A. Salim Kayhan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Metric space, inner product, norm etc. definitions.
Review of Probability and stochastic processes.
Estimation methods: Bayes, MAP, MLE, LMSE.
Filtering, estimation and prediction methods: Wiener, Levinson ve Kalman filters</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Successful students are supposed to gain the following abilities:
Knowledge of basic estimation filtering prediction methods such as Bayes, MAP, MLE, LMSE,Wiener, Levinson ve Kalman filters.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Mathematical Methods and Algorithms for Signal Processing, Moon and Stirling.
• Optimum Signal Processing, Orfanidis
• Fundamentals of Statistical Signal Processing, Kay, Prentice Hall</td></tr>
<tr><td colspan="3">Assessment Method(s):
Midterm Exams(30%, classical), Homeworks (20%) and Final Exam (50%, classical)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students are supposed to have basic knowledge of signals and systems, linear algebra and statistics.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 771
Spectral Estimation</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Prof. Dr. A. Salim Kayhan</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Review of probability and stochastic processes. Periodogram and Blackman-Tukey spectral estimation. Autoregressive (AR), moving average (MA) and autoregressive-moving average (ARMA) spectral estimation. Minimum-variance spectral estimation. PHD, MUSIC. Bispectrum and polyspectrum.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Successful students are supposed to gain the following abilities:
Knowledge of basic estimation spectral estimation methods used for analysis of stochastic processes, i.e the following topics
I. Probability and Random Processes
II. Power Spectrum, Periodogram, Avg. Per., Blackman Tukey.
III. Parametrik Modeling
IV. AR, MA, ARMA models
V. Sinusoidal parameter Est.
VI. Higher Order Spectrum
VII. Nonstationary Processes
VIII. Array Processing</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Spectral Analysis of Signals, Stoica
• Modern Spectral Estimation, Kay, Prentice Hall
• Digital Spectral Analysis, Marple</td></tr>
<tr><td colspan="3">Assessment Method(s):
Midterm Exams(30%, classical), Homeworks (20%) and Final Exam (50%, classical)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: Students are supposed to have basic knowledge of signals and systems, linear algebra and statistics.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 773
Pattern Recognition</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures, Homeworks and Term Project</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Semih Bingöl</td></tr>
<tr><td>Course Contents:</td><td colspan="4">The contents of the course have been given below:
- Fundamental concepts of pattern recognition: pattern classes, pattern features, extraction of features, classification.
- Statistical decision theory, the Bayes classifier, Minimax and Neyman-Pearson rules, error bounds.
- Supervised learning: estimation of probability density functions, maximum likelihood and Bayes estimation.
- Nonparametric pattern recognition techniques, Parzen windows, nearest neighbour and k-nearest neighbourhood algorithms.
- Discriminant analysis, series approximations, least squares and relaxation algorithms.
- Unsupervised learning and clustering.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">Students successfully completing this course are expected to acquire the following skills:
- To understand the fundamental concepts behind state of the art statistical pattern recognition systems.
- To be able to suggest a solution to a novel pattern recognition problem.
- To have a foundation to work on special aspects of pattern recognition and related areas.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Pattern Classification, R. O. Duda, P. E. Hart and D. G. Stork, 2nd Ed., John Wiley and Sons
• Statistical Pattern Recognition, A. Webb, Oxford University Press Inc.
• Pattern Recognition, S. Theodoridis, K. Koutroumbas, Academic Press
• Pattern Recognition and Image Analysis, E. Gose, R. Johnsonbaugh, S. Jost, Pretice Hall Inc.
• Discriminant Analysis and Statistical Pattern Recognition, G.J. McLachlan, John Wiley and Sons</td></tr>
<tr><td colspan="3">Assessment Method(s):
Analytical and Computer Homeworks (50%), Term Project / Presentation (20%) and Final Exam (30%)</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: The student is required to have a knowledge of elementary pobability theory</td></tr>
</table>

Course Code and Title:	**ELE 780** **Radar Systems**		**Level:** Postgraduate	**Semester:** Spring
Teaching Methods: Theoretical Lectures and Homeworks	**Teaching Language:** Turkish	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Prof. Dr. Feza Arıkan			
Course Contents:	1. Radar Fundamentals 2. Radar Transmitters 3. Radar Antennas 4. Propagation Path 5. Radar Target Models; RCS 6. Radar Clutter 7. Radar Receiver and Detection 8. Indicators and Displays 9. Matched Filter; Ambiguity Function 10. Pulse Compression 11. CW and Pulsed Radars 12. Radar Waveforms Analysis 13. Target Tracking 14. SAR Radars			
Objectives of the Course:	Radar is an interdiciplinary system. Students successfully completing this course is expected to have a thorough understanding radar as a system with all of its aspects, starting from the transmitter and ending in indicator and display. The course introduces the radar both in hardware (transmitter, antenna, target, receiver, indicator and display) and in software (radar pulses, detection in noise, range, location and velocity measurements, radar related signal processing including matched filter and ambiguity function). The students should have a general knowledge of various application areas, factors effecting the radars operation such as noise, interference, jamming, clutter and propagation. The students are expected to assess a radar system by its power requirements, antenna systems, propagation environment, types of target, receiver noise figures and possible losses. Various real life examples in all topics are discussed and students are expected to have an insight to the complexity of real life problems, and also follow the recent advances and current research areas in radar systems.			
Bibliography:	• Radar System Analysis and Design Using MATLAB, Mahafza, Chapman & Hall/CRC • Principles of Modern Radar, Eaves and Reedy, Van Nostrand Reindhold Company • Radar Principles, Levanon, John Wiley • Introduction to Radar Systems, Skolnik, 2nd Ed, McGraw Hill • Radar System Analysis, Barton, Prentice Hall • Radar Handbook, Skolnik, 2nd Ed, McGraw Hill • Radar Design Principles, Nathanson, McGraw Hill • Radar Reflectivity of Land and Sea, Long, Artech House • Various Internet Web Sites			
Assessment Method(s): 10 Homeworks (35% in total) 2 Midterm Exams (closed book and notes, in class, 15% each) and Final Exam (closed/open book and notes, 35%)		**Prerequisite(s):** None		
Notes: No formal prerequisites, yet the students are expected to successfully complete the undergraduate level EM theory, Antennas, Telecommunication, DSP, Probability and Statistics Courses. In order to follow the course and text book, a good command of English is also required.				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 781
Navigation, Guidance and Control</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Yakup Özkazanç</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Review of control, filtering and estimation methods. Fundamentals of navigation. Inertial navigation systems. Radio navigation systems. Fundamentals of guidance systems. Tactical and strategic guidance methods. Modeling and control of aircraft and spacecraft.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The main objective of this course is to familiarize the student with the basic pillars of guided vehicle technology. To that end; fundamental navigation, guidance and control topics related to guided systems will be discussed. In particular, tactical and ballistic missile guidance, inertial and radio navigation systems, integrated navigation systems and flight control systems will be studied in some detail.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Tactical and Strategic Missile Guidance, Zarchan, AIAA Press
• Missile Guidance and Control Systems, Siouris, Springer-Verlag
• Modern Navigation, Guidance and Control Processing, Lin, Prentice Hall
• Guided Weapons, Lee, Brasseys
• Fundamentals of Astrodynamics, Bate, Mueller and White, Dover Publications
• Automatic Flight Control Systems, McLean, Prentice Hall
• Aircraft Control and Simulation, Stevens and Lewis, Wiley Interscience
• Automatic Control of Aircraft and Missiles, Blacklock, John Wiley
• Aerospace Avionics Systems: A Modern Synthesis, Siouris, Academic Press, 1993.
• Global Positioning System: Theory and Applications, Parkinson and Spilker, AIAA
• http://www.fas.org
• http://www.globalsecurity.org</td></tr>
<tr><td colspan="3">Assessment Method(s):
Weekly homeworks and a final examination.</td><td colspan="2">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: No formal prerequisite. However student is expected to have a working knowledge of basic control and signal theories.</td></tr>
</table>

Course Code and Title:	**ELE 784** **Optimal Estimation and Control**		**Level:** Postgraduate	**Semester:** Spring
Teaching Methods:	**Teaching Language:**	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Assist. Prof. Dr. Yakup Özkazanç			
Course Contents:				
Objectives of the Course:				
Bibliography:	•			
Assessment Method(s):		**Prerequisite(s):** None		
Notes:				

Course Code and Title:	**ELE 785** **Neural Networks**		**Level:** Postgraduate	**Semester:** Spring
Teaching Methods: Theoretical Lectures and Homeworks	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Assist. Prof. Dr. Atila Yılmaz			
Course Contents:	Knowledge representation and learning paradigms. Adaptation and generalization in neural networks. The structure of common neural network unit in comparison with the biological neuron. Perceptron and multilayer perceptrons. Types of backpropagation learning algorithms and their fundamental principles. Fuzzy control of backpropagation learning. Radial Basis Function (RBF) networks and their learning strategies. Temporal processing: temporal backpropagation and recurrent networks. Unsupervised networks and their learning rules. Application of neural networks in medicine especially in ECG signal processing. Recent developments.			
Objectives of the Course:	This course presents background theory to understand the applicability and limitations of neural networks. The course will teach a variety of contemporary approaches to neural networks in the concept of experience and learning and how to implement them as computer programs in Matlab. The structures like Perceptrons, RBFN and competitive learning will be included to describe different types of neural network with their architecture, accompanied learning algorithms and implementation considerations. At the end of the course, students are expected to understand and use of Neural network approach towards engineering problems as an powerful alternative to standart methods.			
Bibliography:	• Neural Networks: A Comprehensive Foundation, Haykin, 2nd Ed., Prentice Hall			
Assessment Method(s): Midterm Exam (10 %), Homework Reports (40%) and Final Examination (50%)		**Prerequisite(s):** None		
Notes:				

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 787
Electronic Warfare</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Yakup Özkazanç</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Introduction to electronic warfare. Fundamentals of radar systems. Radar as EW threats. Electronic support measures (ESM). Electronic countermeasures (ECM). Electronic counter-countermeasures (ECCM). EW systems simulation and performance analysis. New trends in EW systems.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The main objective of this course is to familiarize the student with the fundamentals of electronic warfare systems technology. To that end; elektronic support measures, electronic conter measures and electronic counter-counter measures will be studied. Before the study of electronic warfare systems, a through review of radar and electro-optic sensors is given.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Applied ECM, Vol. 1,2,3, Van Brunt
• Introduction to Radar Systems, Skolnik, 2.Ed., McGraw Hill
• Radar Anti-Jamming Techniques, Maksimov, Artech House
• Introduction to Electronic Warfare, Schleher, Artech House
• Radar Electronic Warfare, Golden, AIAA
• Modern Radar System Analysis, Barton, Artech House
• Radar Vulnerability to Jamming, Lothes, Artech House
• Active Radar Electronic Counter Measures, Chrzanowski, Artech House
• Introduction to Electronic Defense Systems, 2nd Edition, Neri, Artech House
• Electronic Warfare Receiver Systems, Vaccaro, Artech House
• Electronic Warfare in the Information Age, Schleher, Artech House
• EW101: A First Course in Electronic Warfare, Adamy, Artech House
• Fundamentals of Electronic Warfare, Vakin, Artech House</td></tr>
<tr><td colspan="2">Assessment Method(s):
Bi-weekly homeworks and a final examination.</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: No formal prerequisite. However student is expected to have a working knowledge of basic signals, communications and controls theories.</td></tr>
</table>

<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 790
Contemporary Cryptology</td><td>Level:
Postgraduate</td><td>Semester:
Fall</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homework</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Mehmet Demirer</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Overview. Services, mechanisms and attacks. Classical encryption techniques. Symmetric cipher methods. Block ciphers and data encryption standards. Introduction to number theory and finite fields. Advanced encryption standards. Symmetric ciphers: DES, Blowfish, RC5, RC4. Confidentiality using symmetric encryption. Public key encryption and hash functions. Discrete logarithms. Public key cryptography: RSA, key management, Diffie-Hellman key exchange, Elliptic curve cryptography. Hash algorithms; MD5, Secure hash algorithm, RIPEMD-160, HMAC. Digital signatures, authentication protocols, digital signature standards.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The main objective of this course is to provide students with the basics of cryptology techniques. Students who completes this course are expected to have acquired thorough understanding of encryption and crypyology techniques. This course also covers mathematical concepts used in the public-key cryptology, such as Prime numbers, Fermat's and Euler's theorems. Various practical problems and solutions are investigated, as well as the prospective techniques are discussed during this course.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Cryptography and Network Security, Stallings, Prentice Hall.</td></tr>
<tr><td colspan="2">Assessment Method(s):
1 Homework (25%), 1 Midterm Exam (25%) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes: No formal prerequisite. However students are expected to have basics of maths.</td></tr>
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<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 791
Knowledge-Based Systems</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
English</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assist. Prof. Dr. Derya Altunay</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Foundations of KBSs, Propositional and predicate logic, Knowledge representation, Methods of inference and reasoning, Rule-based systems, Semantic networks and frames, Object-based systems, Search structures, Representing uncertainty, Reasoning under uncertainty, Approximate reasoning and fuzzy logic, Hybrid systems, Knowledge acquisition, Alternative approaches in reasoning: case-based reasoning, model-based reasoning, KBS development tools, KBS applications.</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The purpose of this course is to give students an understanding of various aspects of knowledge-based systems. This course will also facilitate students to engage in KBS related research topics.
By the completion of this course the students should:
- Understand the principles by which the KBSs work.
- Have an understanding of different methodologies of KBSs.
- Be able to apply these concepts to implement KBSs.
- Identify and categorize the problems for which a KBS approach would be appropriate.
- Be familiar with a range of KBS applications.
- Be familiar with some KBS development tools.</td></tr>
<tr><td>Bibliography:</td><td colspan="4">• Introduction to Expert Systems, Jackson, 3rd Ed., Addison-Wesley
• Expert Systems -- Principles and Programming, Giarratano and Riley, 4th Ed. Thomson/PWS
• The Engineering of Knowledge-Based Systems, Gonzalez and Dankel, Prentice Hall
• Artificial Intelligence: A Modern Approach, Russell and Norvig, 2nd Ed., Prentice Hall</td></tr>
<tr><td colspan="2">Assessment Method(s):
Midterm Exam (30%), Homeworks (20%) and Final Exam (50%)</td><td colspan="3">Prerequisite(s):
None</td></tr>
<tr><td colspan="5">Notes:</td></tr>
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<table>
<tr><td>Course Code and Title:</td><td colspan="2">ELE 792
Bioelectricity</td><td>Level:
Postgraduate</td><td>Semester:
Spring</td></tr>
<tr><td>Teaching Methods:
Theoretical Lectures and Homeworks</td><td>Teaching Language:
Turkish</td><td>Status:
Elective</td><td>Hours per week:
3</td><td>ECTS Credits:
9</td></tr>
<tr><td>Lecturer(s):</td><td colspan="4">Assoc. Prof. Dr. Uğur Baysal</td></tr>
<tr><td>Course Contents:</td><td colspan="4">Vector calculus in electrical fields in biological media, related mathematical background. Membrae potential calculation by using Nernst, Planck and Goldman equations. Action potential derivation, modelling ion movements, Hodgkin and huxley equations, action propagation in single muscle fiber, application of fundamental principles in heart and nerve electrophysiology</td></tr>
<tr><td>Objectives of the Course:</td><td colspan="4">The student is expected to gain the following abilities
I. Explains general mathematical background related to electric fields in a volume conductor
II. Can analyse and solve Nerst-Planc ve Goldman equations
III. Explains and comments about membrane potential sources
IV. Explains the nreasons for action potentail and solves examples
V. Describes paralel conduction in fibers
VI. Analyses cable equations in single muscle fiber
VII. Describes the relationship between cellular action potential and action current equaitons
VIII. Applies general information gained in the lectures on cardiac and</td></tr>
</table>

	nevre physiology
Bibliography:	• Prof. Ferit Pehlivan, Biyofizik, 2004 • Prof. G. Çelebi, Biyomedikal Fizik, 1993 • Benedekt, Bioelectricity
Assessment Method(s): Midterm Exam (25%), Homeworks (25%) and Final Exam (50%)	**Prerequisite(s):** None
Notes:	

Course Code and Title:	ELE 793 **Computerized Tomographic Imaging**		**Level:** Postgraduate	**Semester:** Fall
Teaching Methods: Theoretical Lectures and Homeworks	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Assoc. Prof. Dr. Uğur Baysal			
Course Contents:	Fundamentals of imaging algorithms, nonrefractive tomographic imaging methods, aliasing and noise, computerized tomographic imaging with diffracting sources, agebraic reconstruction technique, simultaneous iterative reconstruction technique, reflection tomography, computerized ultrasonic tomographing methods, magnetic resonance, impedance tomography.			
Objectives of the Course:	The student is expected to gain the following abilities I. Describes image reconstruction algorithms II. Describes and analyses nondiffractive source reconstruction and performs simulations III. Describes and analyses aliasing and noise issues in nondiffractive source reconstruction and performs simulations IV. Describes and analyses diffractive source reconstruction and performs simulations V. Explains and simulates algebraic reconstruction methods (ART, SIRT, SART) VI. Describes and analyses reflection tomography and performs simulations VII. Describes and analyses X-ray tomography and computed tomography and performs simulations VIII. Explains advanced issues such as, ultrasound tomography, magnetic resonance tomography and electrical impedance tomography			
Bibliography:	• Computerized Tomographic Imaging, Kak and Slaney			
Assessment Method(s): Homeworks (25%), 1 Midterm Exam (25%) and Final Exam presentation (50%)		**Prerequisite(s):** None		
Notes: Basic information about medical imaging fundametals is suggested				

Course Code and Title:	ELE 794 **Biomedical Signal Processing**		**Level:** Postgraduate	**Semester:** Fall
Teaching Methods: Theoretical Lectures, Homeworks and Experimental Studies	**Teaching Language:** English	**Status:** Elective	**Hours per week:** 3	**ECTS Credits:** 9
Lecturer(s):	Assist. Prof. Dr. Atila Yılmaz			
Course Contents:	Classification of Biomedical Signals. Origin of Biosignals and their systemic properties (Nerve action potential and ENG, myoelectric activity and EMG, myocardiac activity and ECG, brain activities and EEG). Memory and Correlation Analysis in Biomedical Signals. Application of essential techniques on biomedical case studies. Noise sources in biomedical systems. Examples of noise removal and signal compensation. Modeling biomedical system based stochastic signals. Preprocessing and feature extraction.			
Objectives of the Course:	This course aims at reviewing the basics of signal processing theory and methods used in studies of Biomedical field and extending the knowledge in signal processing with the examples that might be encountered in the fields of Biology and Medicine. The student is expected to gain the following abilities: I. Classification of biomedical signals II. Signals and measurements of biological systems: ECG,EEG,EMG III. Memory and correlation analysis IV. Continuous and discrete models V. Noise sources in biomedical systems VI. Noise cancellation and signal conditioning VII. Spectral analysis and modeling VIII. Feature extraction, classification and artificial intelligence			

	applications
Bibliography:	• Biomedical Signal Analysis: A case-study approach, Rangaraj M. Rangayyan, IEEE Press/Wiley Inter-Science • Biomedical Signal Processing and Signal Modeling, Eugen N. Bruce, John Wiley & Sons
Assessment Method(s): Midterm Exams(20% each), Research Reports and Experiments (20%), Final Examination (40%)	**Prerequisite(s):** None
Notes:	