MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670100 Introduction to Electrical and Electronics Engineering

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:1
   Applied/Laboratory Credits: 0
   Total Credits: NC

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Fatih Kamışlı

4. **Text book, title, author, and year:**
   Five Equations that Changed the World, M. Guillen, Abacus, Time Warner Books UK, 1995.
   i. **other supplemental materials:**
   1- *Poetry of the Universe – A Mathematical Exploration of the Cosmos*, R. Osserman, (Evrenin Şiiri, TÜBİTAK Popüler Bilim Kitapları, 2000), 1995.
   2- *Great Scientific Experiments*, R. Harré, (Büyük Bilimsel Deneyler, TÜBİTAK Popüler Bilim Kitapları, 1994), 1980.
   3- *Natural Philosophy and Evolution of Scientific Thinking*, G. Gündüz (ODTÜ Kimya Müh. Bölümü); Lecture Notes.
   4- *Uygarlığın Seyir Defteri*, Ç. Tuncay, Arkadaş Yayınları, 1996.
   5- *Doğa Bilimleri Tarihi*, O. Gürel, İmge Yayınları, 2001.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   An orientation course introducing the students to the engineering in general and electrical and electronics engineering in particular with a discussion of the past, present and future of major areas. Course emphasizes the ethical issues in electrical engineering.
   ii. **prerequisites or co-requisites:** None
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be introduced to the profession of engineering in general, and electrical engineering in particular; with a discussion of the past, present and future of the major areas.

Specific outcomes of instruction
- Gain historical perspective of engineering - Have an overview of research topics in METU EE Department - Have discussions on ethics and professional ability - Develop written and oral communication skills

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	X
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	X
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, description of the problem-oriented course structure; some anecdotes from departmental life and brief history of METU.
Week 2	Isaac Newton (1642-1727) - Veni
Week 3	Isaac Newton (1642-1727) - Vidi
Week 4	Isaac Newton (1642-1727) - Vici
Week 5	Daniel Bernoulli (1700-1782) - Veni
Week 6	Daniel Bernoulli (1700-1782) - Vidi,Vici
Week 7	Michael Faraday (1791-1867) - Veni
Week 8	Michael Faraday (1791-1867) -Vidi
Week 9	Michael Faraday (1791-1867) -Vici
Week 10	Class-Experiment: 'Two Transistor LED Flasher'
Week 11	Primitive electromagnetic telegraph device of Gauss and Weber in 1833, and that of Morse in 1835; Maxwell and his formulation of relationships between electricity and magnetism in 1873; Hertz and experimental proof of the existence of electromagnetic waves in 1888.
Week 12	First telephone by Bell in 1878, long distance connections between Boston, Massachusetts and New York by 1884; first practical filament lamp by Swan and Edison, illumination of New York streets in 1882; Tesla and his numerous inventions including the telephone repeater, poly-phase alternating-current system in 1885, induction motor, alternating-current power transmission, Tesla coil transformer in 1891, wireless communication and fluorescent lights, conflicts with Marconi, and ethical problems to be discussed in the class.
Week 13	Fleming and vacuum diode in 1904, De Forest and vacuum triode in 1906, Armstrong and his super-heterodyne receiver in 1918 and

	wideband frequency modulation in 1925-33, patent conflicts between Armstrong and Lee de Forest, so ethical problems for class discussion, Zworykin and television tube in 1923, color tube in 1925, Brattain-Bardeen-Shockley and the transistor in December 1947; finally, Boole, Turing, Shannon and computers, connecting the electrical age to the information age.
Week 14	Education, people and research subjects of the METU-EEE department.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670201 Circuit Theory I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 4
   Applied/Laboratory Credits: 0
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Barış Nakiboğlu
   Prof. Dr. T. Engin Tuncer

4. **Text book, title, author, and year:**
   Fundamentals of Electric Circuits, C. K. Alexander and M. N. O. Sadiku, McGraw-Hill Book Company.
   i. **other supplemental materials:**
      1- *Electric Circuits*, J. W. Nilsson and S. A. Riedel, Pearson Prentice Hall.
      2- *Linear and Nonlinear Circuits*, L. O. Chua, C. A. Desoer, E. S. Kuh, McGraw-Hill Book Company.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Lumped circuits: Kirchoff's laws, basic lumped elements, circuit graphs, circuit equations, linear and nonlinear resistive circuits, first and second order dynamic circuits. Introduction to operational amplifier circuits.
   ii. **prerequisites or co-requisites:** MATH119
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Comprehension of basic lumped circuit concepts.

Specific outcomes of instruction
- Modeling, circuit analysis and design; lumped elements and lumped circuits. - Charge flow, current, KCL, current equations, voltage, KVL, voltage equations; terminal equations; basic lumped elements. - Branch, power and energy. Circuit topology, interconnection equations. Branch relations. - Classifications of lumped elements and lumped circuits. Formulation and solution of lumped circuits.

   ii. Comprehension of basic properties and analysis methods of resistive circuits.

Specific outcomes of instruction
- Independent voltage and current sources; linear time-invariant resistors, dependent sources, ideal transformers. - Linear time-varying and nonlinear resistors and dependent sources. - Node, modified node and mesh analysis methods. Superposition. - One-port and two-port circuits, reciprocity, symmetry. - Analysis of linear time-varying and simple nonlinear resistive circuits. Small signal analysis.

- Dual resistive circuits. - Diodes. Analysis and design of piecewise-linear resistive circuits.

iii. Comprehension of basic properties and analysis methods of resistive operational amplifier circuits.

Specific outcomes of instruction
- Operational amplifiers. Ideal models. - Analysis and properties of basic operational amplifier circuits. - More realistic models. - Analysis of operational amplifier circuits with nonlinear resistors.

iv. Comprehension of basic properties of dynamic elements.

Specific outcomes of instruction
- Waveforms. Ramp, step, impulse and exponential functions. - Linear/nonlinear and time-invariant/time-varying capacitors, inductors and coupled inductors. Energy storage.

v. Comprehension of basic properties and analysis methods of first order dynamic circuits.

Specific outcomes of instruction
- Solutions to first order linear constant coefficient differential equations. Zero-input, zero-state and complete solutions; homogeneous and particular solutions; transient and steady-state solutions. Convolution. - Analysis of linear time-invariant RC and RL circuits. Ramp, step, pulse, impulse, exponential and sinusoidal responses. - First order dynamic circuits with diodes and operational amplifiers. - Simple first order dynamic circuits with time-varying and nonlinear resistors.

vi. Comprehension of basic properties and analysis methods of simple second order circuits.

Specific outcomes of instruction
- Solutions to second order linear constant coefficient differential equations. - Analysis of parallel and series linear time-invariant RLC circuits. Step and impulse responses. - Miscellaneous simple second order dynamic circuits.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	

6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1,2	I. Basic Concepts
Week 3, 4, 5	II. Linear Time-Invariant Resistive Circuits
Week 6	III. Time-Varying and Nonlinear Resistive Circuits
Week 7,8	IV. Operational Amplifier Circuits
Week 9	V. Dynamic Elements
Week 10, 11, 12	VI. First Order Circuits
Week 13, 14	VII. Simple Second Order Circuits

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670202 Circuit Theory II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 4
   Applied/Laboratory Credits: 0
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof Dr. T. Engin Tuncer
   Prof. Dr. Çağatay Candan

4. **Text book, title, author, and year:**
   Fundamentals of Electric Circuits, C. K. Alexander and M. N. O. Sadiku, McGraw-Hill Book Company.
   i. **other supplemental materials:**
   1- *Electric Circuits*, J. W. Nilsson and S. A. Riedel, Pearson Prentice Hall.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Sinusoidal steady-state analysis. Three-phase circuits. Coupled inductors. Frequency response. Linear time-invariant dynamic circuits: state equations, natural frequencies, complex frequency domain analysis. Time-varying and nonlinear circuits.
   ii. **prerequisites or co-requisites:** EE201, MATH219
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Comprehension of analysis methods for linear time-invariant dynamic circuit.

Specific outcomes of instruction
- Complex frequency, complex exponential function. - Node, polynomial node, mesh and state space formulations. - Natural response, natural frequencies, stability. State transition matrix. - Solutions under complex exponential inputs. Phasor concept. Transient and steady state responses.

   ii. Comprehension of sinusoidal steady-state analysis.

Specific outcomes of instruction
- Sinusoidal steady-state analysis of linear time-invariant dynamic circuits. Phasor domain circuits. - Power calculations in the sinusoidal steady-state. Power factor correction.

   iii. Comprehension of basic properties and analysis methods of balanced three-phase circuits.

Specific outcomes of instruction
- Balanced three-phase circuits. Analysis methods. Delta and Y circuits. - Power calculation in balanced three-phase circuits.

   iv. Comprehension of complex frequency domain analysis.

Specific outcomes of instruction

- Laplace Domain formulation and solution of linear time-invariant dynamic circuits. - Complex frequency domain circuits and their analysis. - Impulse response and transfer function. Pole/zero diagrams.

v. Comprehension of frequency response.

Specific outcomes of instruction
- Frequency response function. Magnitude, phase and group delay characteristics. - Bode Plots. - First and second order LC filters; active filters. - Resonance. - Design of Butterworth and Chebychev filters.

vi. Comprehension of formulation of time-varying and nonlinear dynamic circuits.

Specific outcomes of instruction
- State space formulations of time-varying dynamic circuits. - State space formulations of nonlinear dynamic circuits.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Node, modified (polynomial) node, mesh and state-space formulations. Complex frequency; complex exponential function.
Week 2	Natural response. Natural frequencies. State transition matrix. Particular solutions for complex exponential inputs. Phasors.
Week 3	Particular solutions for complex exponential inputs (cntd). Phasors.
Week 4	Periodic functions. Responses of LTI dynamic circuits to sinusoidal excitations. Analysis of phasor domain circuits; phasor diagrams.

Week 5	Passive one-ports: resistive, inductive and capacitive one-ports. Superposition in the SSS. Instantaneous, average, complex, real, reactive and apparent powers. Power calculations in the SSS.
Week 6	Power factor correction. Maximum power transfer. Three-phase voltage sources and loads; Y and Delta connections.
Week 7	Analysis of balanced three-phase circuits. Power calculations.
Week 8	Laplace transformation. Real rational functions. Solution of formulation equation by Laplace transformation.
Week 9	Complex frequency domain voltages and currents. Analysis of complex frequency domain circuits.
Week 10	System functions: input and transfer functions. Two-port circuits: impedance, admittance, hybrid, chain and scattering representations.
Week 11	Frequency response functions. First order lowpass, highpass and allpass passive LC filters. Second order lowpass, highpass, bandpass, bandstop and allpass passive LC and active RC filters.
Week 12	Parallel and series resonance: resonant frequency, quality factor, resonance circuits with finite-Q capacitors and inductors. Magnitude and frequency scalings.
Week 13	Bode plots. Design of Butterworth and Chebyshev filters.
Week 14	State-space formulation of time-varying and nonlinear dynamic circuits.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670212 Semiconductor Devices and Modeling

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Serdar Kocaman

4. **Text book, title, author, and year:**
   Solid State Electronic Devices, 6th Edition, B. G. Streetman, S. K. Banerjee, Prentice Hall, 2006.
   i. **other supplemental materials:**
      Lecture Notes

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
      Basic semiconductor concepts. Physical electronics. Physics of p-n junction diodes, bipolar junction transistors, and field effect transistors. Transistor biasing and small-signal models. Secondary effects in transistors. Dynamic models for diodes and transistors p-n-p-n switching devices. Modeling concepts for computer-aided design and introduction to circuit analysis with Spice.
   ii. **prerequisites or co-requisites:** MATH119
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be able to comprehend the fundamentals of solid-state electronics and semiconductor devices and utilize the semiconductor electron devices efficiently in discrete and integrated circuit applications.

Specific outcomes of instruction
- Understand the basic properties of semiconductors - Understand the conduction mechanisms in semiconductors - Obtain essential knowledge of the principles, characteristics and limitations of semiconductor electron devices, as well as the underlying physics - Understand and use the newly developed devices in the future

   ii. Students will be able to understand, develop and use equivalent circuit models for semiconductor devices and perform analysis of transistor amplifier circuits.

Specific outcomes of instruction
- Utilize widely used equivalent circuit models for semiconductor electron devices to predict device behavior in electronic circuits - Perform small signal analysis of amplifier circuits containing transistors and diodes - Perform computer analysis of circuits containing semiconductor devices

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1, 2	Course introduction, solid-state electronic materials, bonding forces and energy bands in solids
Week 3	Impurities in semiconductors, drift and diffusion in semiconductors
Week 4	Generation-recombination of electrons and holes, continuity and diffusion equations
Week 5	p-n junction under equilibrium and forward/reverse bias, derivation of diode current expression
Week 6	Diode I-V characteristics, p-n junction capacitance, breakdown mechanisms, dynamic switching behavior of diode, photodetectors, solar cells, LEDs
Week 7	Introduction to the Bipolar Junction Transistor (BJT)
Week 8	BJT I-V characteristics and Ebers-Moll model
Week 9	BJT capacitances, Early effect in BJT and BJT biasing
Week 10	MOS capacitor and introduction to MOSFET
Week 11	MOSFET types and I-V characteristics, Body effect and channel length modulation
Week 12	MOSFET biasing and MOSFET as a switching device
Week 13	Small signal models for diodes and BJTs, transistor as an amplifier
Week 14	The common emitter amplifier, small signal models for FETs, the common source amplifier

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670213 Electrical Circuits Laboratory

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 0
   Applied/Laboratory Credits: 4
   Total Credits: 2

3. **Instructor's or course coordinator's name:** Prof. Dr. Çağatay Candan

4. **Text book, title, author, and year:**
   i. **other supplemental materials:**
   Laboratory Manuals

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Safety Issues. Voltage, current, resistance and power measuring instruments; signal generators; oscilloscopes. Terminal characteristics of linear and nonlinear resistors, capacitors and inductors. Experiments on resistive operational amplifier, RC RL and RLC circuits, transformers, impedance measurement.
   ii. **prerequisites or co-requisites:** - Co-requisite: EE201
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will learn and practice on basic electrical measuring instruments, basic circuit components and simple circuits.

Specific outcomes of instruction
- Learn about terminal characteristics of basic circuit components, modeling concepts, principles of basic measuring instruments, measurement techniques, behaviors of simple circuits, effective presentation of experimental results. - Understand ethical responsibility.

   ii. Students will learn how to implement and present a simple project.

Specific outcomes of instruction
- Implement a simple project. - Present project report.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X

3	an ability to communicate effectively with a range of audiences	X
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	
Week 2	
Week 3	Experiment 1 - Introduction to Laboratory Instruments and Circuit Elements
Week 4	Experiment 2 - Introduction to Cathode Ray Oscilloscopes and Signal Generators
Week 5	Experiment 3 - Introduction to Digital Storage Oscilloscopes
Week 6	Experiment 4 - Linear Resistive Circuits
Week 7	Experiment 5 - Nonlinear Resistive Circuits
Week 8	Experiment 6 - Capacitors and Inductors
Week 9	Experiment 7 - Basic Applications of Operational Amplifiers
Week 10	Experiment 8 - First Order Circuits
Week 11	Experiment 9 - Second Order Circuits
Week 12	
Week 13	
Week 14	

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670214 Electronic Circuits Laboratory

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 0
   Applied/Laboratory Credits: 4
   Total Credits: 2

3. **Instructor's or course coordinator's name:** Prof. Dr. Çağatay Candan

4. **Text book, title, author, and year:**
   i. **other supplemental materials:**
   Laboratory Manuals

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Practical usage of basic instruments for measurements and analysis of electronic circuits. Experiments on rectifier diodes, Zener diodes, transistors (BJT and FET) and on circuits composed of these devices: AC and DC analyses, biasing, thermal effects.
   ii. **prerequisites or co-requisites:** - Co-requisite: EE202,
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will practice on basic electrical measuring instruments; learn and practice on basic electronic components and simple electrical and electronic circuits.

Specific outcomes of instruction
- Learn about terminal characteristics of basic electronic components, modeling concepts, measurement techniques, behaviors of simple electronic circuits, effective presentation of experimental results. - Understand ethical responsibility

   ii. Students will learn how to implement and present a project.

Specific outcomes of instruction
- Implement a project. - Present project report.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	X

4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	
Week 2	
Week 3	Experiment 1 - Semiconductor Junction Diodes and Rectifiers
Week 4	Experiment 2 - Zener Diodes
Week 5	Experiment 3 - Miscellaneous Op-Amp Circuits
Week 6	Experiment 4 - Impedance Measurement
Week 7	Experiment 5 - Frequency Response
Week 8	Experiment 6 - Active RC Filters
Week 9	Experiment 7 - JFET Characteristics and Biasing
Week 10	Experiment 8 - Bipolar Junction Transistor Characteristics
Week 11	Experiment 9 - Biasing of Bipolar Junction Transistors
Week 12	
Week 13	
Week 14	

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670224 Electromagnetic Theory

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:4
   Applied/Laboratory Credits: 0
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Lale Alatan

4. **Text book, title, author, and year:**
   1- *Fundamentals of Engineering Electromagnetics*, David K.Cheng, Pearson New International Ed., 2014.
   2- *Field and Wave Electromagnetics*, 2nd Edition, D. K. Cheng, Addison-Wesley, 1992.
   i. **other supplemental materials:**
   1- *Introductory Engineering Electromagnetics*, Z.D.Popovic, B.D.Popovic, Prentice-Hall, 2000.
   2- *Engineering Electromagnetics*, U.S.Inan, A.S.Inan, Addison-Wesley, 1999.
   3- *Elements of Electromagnetic*, M.N.O. Sadiku, Oxford University Press, 2001.
   4- *Electromagnetics, 5th Edition*, J.D.Krauss, McGraw-Hill, 1999.
   5- *Elements of Engineering Electromagnetics*, N.N.Rao, Prentice-Hall, 2000.
   6- *The Feynman Lectures on Physics, vol.2*, R.Feynman, Addison Wesley, 1998.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Review of vector analysis. Electrostatic fields in vacuum and material bodies. Dielectric properties of materials. Electrostatic energy and forces. Steady electric current and conductors. Static magnetic fields in vacuum and in materials. Magnetic energy and forces. Quasistatic fields and electromagnetic induction.
   ii. **prerequisites or co-requisites:** MATH120, PHYS106
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:**Required

6. **Specific goals for the course**
   i. Students will be able to use vector calculus efficiently to solve electromagnetic problems.

Specific outcomes of instruction
- Use Cartesian, cylindrical and spherical coordinate systems effectively - Comprehend scalar and vector field concepts - Use gradient, divergence and curl operations - Evaluate line, surface and volume integrals

   ii. Students will comprehend the electrostatic phenomena and be able to solve static electric field problems.

Specific outcomes of instruction

- Understand and apply Coulomb's law - Learn the differential and integral forms of the governing equations of electrostatics - Learn the behavior of conductors and dielectrics in static electric field - Compute the electric field due to arbitrary charge distributions using vector calculus - Comprehend and apply capacitance calculations - Comprehend and compute the electrostatic energy and forces

iii. Students will understand the concept of steady currents and be able to solve related problems

Specific outcomes of instruction
- Comprehend and use point forms of Ohm's law and continuity equation (conservation of charge) - Comprehend and apply resistance calculations - Calculate dissipated power

iv. Students will comprehend the magnetostatic phenomena and be able to solve static magnetic field problems

Specific outcomes of instruction
- Understand and apply Biot-Savart's law - Learn the differential and integral forms of the governing equations of magnetostatics - Learn the behavior of linear and ferromagnetic materials in static magnetic field - Compute the magnetic field due to arbitrary current distributions using vector calculus - Comprehend and apply inductance calculations - Comprehend and compute the magnetostatic energy and forces

v. Students will comprehend and apply the concept of electromagnetic induction

Specific outcomes of instruction
- Comprehend and use of Faraday's law of induction - Calculate the induced voltage due to time varying magnetic field and due to motion

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Vector Algebra (Addition, Subtraction, Products) Orthogonal Coordinate Systems (Cartesian, Cylindrical, Spherical)
Week 2	Vector Calculus Vector and Scalar Fields, Gradient of a Scalar Field, Line/Surface/Volume Integrals
Week 3	Divergence of a Vector Field, Curl of a Vector Field, Divergence Thm, Stoke'sThm
Week 4	Null Identities, Helmholtz Theorem, Static Electric Fields, Coulomb's Law
Week 5	Gauss Law in Free Space, Electrostatic Potential
Week 6	Material Media in Static Electric Field, Boundary Conditions for Electrostatic Field
Week 7	Capacitance and Capacitors, Poisson's and Laplace's Equations
Week 8	Electrostatic Energy and Forces, Method of Images
Week 9	Steady Electric Currents, Current Density and Types of Current, Equation of Continuity and Kirchoff's Current Law, Power Dissipation and Joule's Law, Resistance Calculations
Week 10	Static Magnetic Fields, Ampere's Force Law, Definition of B Field, Biot-Savart Law and Applications
Week 11	Vector Magnetic Potential, Ampere's Circuital Law and Applications Solenoidal Property of B Field, Flux Conservation
Week 12	Magnetization and Equivalent Current Densities, Magnetic Field Intensity and Generalized Ampere's Circuital Law, Behavior of Magnetic Materials, boundary Conditions for Magnetostatic Fields
Week 13	Inductance and Inductors, Magnetic Energy and Forces
Week 14	Faraday's Law of Electromagnetic Induction, Lenz' Law, Motional and Transformer EMF's, A Moving Conductor in a Magnetic Field, A Stationary Circuit in Time-Varying Magnetic Field, A Moving Circuit in Time-Varying Magnetic Field

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670230 Probability and Random Variables

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Elif Uysal

4. **Text book, title, author, and year:**
   Introduction to Probability, 2nd Edition, D. Bertsekas, J. N. Tsitsiklis, Athena Sceintific, 2008
   i. **other supplemental materials:**
   1- *A First Course in Probability*, S. Ross, MacMillan Publishing, 2009
   2- *Probability and Random Processes with Applications to Signal Processing. 3rd Edition*, H. Stark, J.W.Woods, Prentice Hall, 2002.
   3- *Probability Random Variables and Stochastic Processes*, A.Papoulis, McGraw Hill, 2002

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Axiomatic definition of probability spaces. Combinatorial methods. Conditional probability; product spaces. Random variables; distribution and density functions; multivariate distributions; conditional distributions and densities; independent random variables. Functions of random variables; expected value, moments and characteristic functions. The Bernoulli process. Basic introduction to Poisson processes and Markov Chains.
   ii. **prerequisites or co-requisites:** MATH120
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. The students will be able to understand the fundamental concepts related with probability theory.

Specific outcomes of instruction
- Construct a sample space for a probabilistic experiment. Understand the axioms of probability and be able to derive properties of probability. - Compute probabilities and conditional probabilities from an underlying experiment. Identify events as disjoint, mutually exclusive, independent. Know the definition of independence for any number of events. - Solve basic inference problems using the Total Probability Theorem and Bayes's Rule. - Compute probabilities in repeated experiments using the chain rule.

   ii. The students will be able to understand discrete random variable concept with its extensions.

Specific outcomes of instruction
- Determine the probability mass function (PMF) and conditional PMF of a discrete random variable (r.v.) from the underlying experiment.

- Compute expected value, and variance of a discrete r.v. from its PMF. - Calculate the PMF of a discrete r.v. defined as a function of another r.v. - Obtain the joint PMF of two discrete r.v.'s. and compute marginal PMF's from the joint PMF. - Determine independence between discrete r.v's. - Be able to identify and use basic discrete distributions: Bernoulli, Geometric, Binomial, Uniform, Poisson. Understand Indicator Functions and be able to use them in problems.

iii. The students will be able to understand continuous random variables with its extensions.

Specific outcomes of instruction
- Identify continuous r.v.'s through their probability density (PDF) and cumulative distribution (CDF) functions. - Compute the PDF and CDF for basic continuous distributions: Exponential, Uniform, Gaussian. - Solve problems using the conditional and joint PDF and CDF. - Calculate expectation and variance for continuous r.v.'s

iv. Students will be able to interpret more advanced topics about random variables.

Specific outcomes of instruction
- Solve problems of practical interest through functions of r.v.'s. - Relate two r.v.'s based on their correlation. - Utilize transforms of r.v.s in solving particular classes of probability problems. - Derive and utilize Markov and Chebychev Inequalities - Understand basic notions of probabilistic convergence: convergence in probability, convergence in distribution, MSE convergence. Understand the basic Central Limit Theorem. - Use limit theorems to estimate probabilities and calculate bounds. - Understand the basic concepts of a stochastic process through the Bernoulli and Poisson processes.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Sets, Probabilistic Models
Week 2	Conditional Probability, Total Probability and Bayes's Theorem
Week 3	Independence, Counting
Week 4	Basic Concepts of Discrete Random Variables, Probability Mass Function, Functions of Random Variables
Week 5	Expectation, Mean and Variance, Joint PMFs of multiple random variables
Week 6	Conditioning, Conditioning in Action: Markov Chains
Week 7	Independence
Week 8	Continuous Random Variables and PDFs, Cumulative Distribution Functions
Week 9	Normal Random Variables, Joint PDFs of Multiple Random Variables
Week 10	Conditioning, The continuous Bayes's Rule
Week 11	Derived Distributions
Week 12	Covariance and Correlation, Conditional Expectation and Variance
Week 13	Transforms, Sums of Independent Random Variables
Week 14	The Markov and Chebychev Inequalities, Convergence in Probability, The Weak Law of Large Numbers, The Central Limit Theorem

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670301 Signals and Systems I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. A. Aydın Alatan

4. **Text book, title, author, and year:**
   Signals and Systems, 2nd Ed., A.V. Oppenheim, A.S. Willsky, S.H. Nawab, Prentice-Hall, 1997.
   i. **Other supplemental materials:**
      1- *Computer Explorations in Signals and Systems using MATLAB, 2nd Ed.,* Buck, Daniel and Singer, Prentice-Hall, 2001.
      2- *Signals and Systems*, M. Sanjit, Oxford Univ. Press, 2016.
      3- *Signals and Systems: Analysis Using Transform Methods and MATLAB*, M.J. Roberts, McGraw-Hill, 2012.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** System properties; Linear time-invariant systems: impulse response, convolution. Functions of a complex variable, complex series and integrals. Transform methods: Continuous time Fourier series and transform, discrete-time Fourier series and transform, Frequency response. Sampling theory. Laplace and z-transforms, system functions.
   ii. **prerequisites or co-requisites:** MATH 219
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:**Required

6. **Specific goals for the course**

i. Students will be able to comprehend basic systems properties and signals

Specific outcomes of instruction
- Identify and operate on basic signals in continuous time (CT) and discrete time (DT) - Determine properties of a general system - Use the convolution operation to find the output of an LTI system - Find the impulse response of an LTI system specified by a linear, constant-coefficient difference or differential equation

ii. Students will be able to apply Fourier analysis to periodic and aperiodic signals

Specific outcomes of instruction
- Compute the Fourier series representation of a periodic CT signal - Determine the Fourier Transform (FT) of a CT signal - Represent a periodic DT signal through Fourier series - Find the Fourier Transform (FT) of a DT signal - Use and relate the properties of DT/CT Fourier series and transforms

iii. Students will be able to apply transform techniques to signals and systems

Specific outcomes of instruction
- Compute the Laplace transform of a CT signal - Compute the Z transform of a DT signal

- Relate the Fourier and Laplace transforms - Relate the Fourier and Laplace transforms

iv. Students will be able to analyze LTI systems by transform techniques

Specific outcomes of instruction
- Make use of transfer (system) function and frequency response while analyzing LTI systems - State how the stability and causality of an LTI system is related to the poles of its transfer function

v. Students will be able to analyze engineering problems by using properties of transform techniques

Specific outcomes of instruction
- Comprehend the Fourier-domain relation between a CT signal and the DT signal obtained by sampling. - Formulate the Fourier-domain representation of modulation and demodulation operations- Represent a periodic DT signal through Fourier series

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Signals; definitions, transformations on the independent variable, basic continuous and discrete time signals, complex signals.
Week 2	Systems; notation, definitions, system properties: memory, causality, linearity, time invariance, stability; interconnection of systems.
Week 3	Convolution integral and sum; representation in terms of impulses, DT LTI systems and convolution sum, CT LTI systems and convolution integral.
Week 4	Properties of LTI systems, differential & difference equation description, determining impulse response from diff. equations

Week 5	Response to complex exponentials, harmonically related complex exponentials, Fourier series, existence & convergence; Properties of Fourier series;
Week 6	DT Fourier series, response to complex exponentials, properties of DT Fourier series
Week 7	Fourier transform of aperiodic signals, convergence
Week 8	Fourier transform of periodic signals,properties; Linearity, symmetry, time shift, differentiation & integration, time & frequency scaling, duality, modulation, convolution & modulation, Parseval's theorem.
Week 9	DT Fourier Transform; DTFT of aperiodic signals, convergence, DTFT of periodic signals.
Week 10	Properties of DTFT
Week 11	Sampling theorem; sampling and reconstruction, effects of aliasing,
Week 12	Laplace Transform; convergence, inversion, properties.
Week 13	Z Transform definition, concept of region of convergence, inversion, properties.
Week 14	General review

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670302 Feedback Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Mustafa Mert Ankaralı

4. **Text book, title, author, and year:**
   Modern Control Engineering, 5th edition, K. Ogata, Prentice Hall, 2010.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Mathematical modeling: Transfer functions, state equations, block diagrams. System response; performance specifications. Stability of feedback systems: Routh-Hurwitz criterion, principle of argument, Nyquist stability criterion, gain margin and phase margin. Design of dynamic compensators. Analysis and design techniques using root-locus. State-space techniques: Controllability, observability, pole placement and estimator design.
   ii. **prerequisites or co-requisites:** EE 301
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be able to comprehend mathematical modeling and systems concepts

Specific outcomes of instruction
- Understand the relationship between a physical system and its mathematical model. - Write the differential equations describing the behavior of simple mechanical and electrical systems. - Find the transfer function representation of simple mechanical and electrical systems. - Find the state-space representation of simple mechanical and electrical systems. - Understand the relationships between different system representations for a single system.

   ii. Students will be able to understand the relationship between the response of a system and its mathematical model.

Specific outcomes of instruction
- Learn the typical input and response types used to characterize control systems - Understand the behavior of first, second and higher order systems for standard - Learn important performance measures used to characterize control systems - Understand the relationship between the parameters of the systems and the transient response of the systems - Understand the relationship between the parameters of the systems and steady-state response of the systems

   iii. Students will be able to understand the concepts of feedback and stability and make stability analysis for feedback systems using different analysis tools.

Specific outcomes of instruction
- Understand the definition and importance of stability for feedback systems - Understand the relationship between the stability and the poles of the closed loop system. - Understand the concept of relative stability using both polar plots and Bode plots. - Make stability analysis for feedback systems using Routh Hurwitz Criterion. - Make stability analysis for feedback systems using Root-Locus Method. - Make stability analysis for feedback systems using Nyquist Stability Criterion.

iv. Students will be able to design simple compensators to satisfy design requirements.

Specific outcomes of instruction
- Learn about and design PID controllers for simple feedback systems to satisfy design requirements. - Learn about and design phase lead-lag compensators for simple feedback systems using Bode plots to satisfy design requirements.

v. Students will be able to make basic state-space analysis and design.

Specific outcomes of instruction
- Learn about important state-space realization types that can be obtained from transfer functions. - Comprehend the concepts of controllability and observability for state-space representations. - Understand the concept of state feedback and design a state feedback rule to satisfy design requirements. - Understand the concept of a state observer and design an observer to satisfy the design requirements.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, Mathematical models,
Week 2	Transfer functions and block diagrams
Week 3	Equilibrium points and linearization
Week 4	Time Domain Analysis; transient response, steady-state error, effects of PID control
Week 5	Stability; Routh-Hurwitz test
Week 6	Root locus
Week 7	Frequency Response Analysis; Nyquist criterion, relative stability
Week 8	Frequency Response Analysis; Nyquist criterion, relative stability
Week 9	Design in Frequency Domain;
Week 10	Design in Frequency Domain; lead compensation
Week 11	Design in Frequency Domain; lag compensation
Week 12	State Equations; state equations from transfer functions, canonical forms, controllability and observability
Week 13	State Feedback; pole placement
Week 14	State Feedback; observer design

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670303 Electromagnetic Waves

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Gönül Turhan Sayan

4. **Text book, title, author, and year:**
   Fundamentals of Engineering Electromagnetics, Cheng, D. K., Addison-Wesley, 1993, Pearson Education Limited, 2014.
   i. **Other supplemental materials:**
      1- *Elements of Electromagnetics*, M. N. O. Sadiku, Oxford University Press. 2001.
      2- *Introductory Engineering Electromagnetics*, Z. D. Popovic, B. D. Popovic, Prentice Hall, 2000.
      3- *Engineering Electromagnetics*, K.R. Demarest, Prentice Hall, 1998.
      4- *Engineering Electromagnetics*, U.S. Inan, A.S. Inan, Addison-Wesley, 1999.
      5- *Principles and Applications of Electromagnetic Fields*, R. Plonsey and R. Collin, McGraw-Hill, 1961.
      6- *Electromagnetic Fields and Waves*, P. Lorrain and D. Corson, Freeman, 1970.
      7- *Electromagnetics, 5th Ed.*, J. D. Kraus, McGraw-Hill, 1999

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Maxwell's equations in time and frequency domains. Electromagnetic energy and power. Wave equation. Uniform plane electromagnetic waves; reflection and refraction. Introduction to transmission lines, waveguides, antennas and radiation.
   ii. **prerequisites or co-requisites:** EE 224
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will fully understand the time and frequency domain Maxwell's equations

Specific outcomes of instruction
- Use the integral and point forms of Maxwell's equations to derive electromagnetic boundary conditions and wave equations - Comprehend the use of phasor concept in time varying electromagnetics, express Maxwell's equations in phasor domain

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Differential form of Maxwell's equations, Integral form of Maxwell's equations
Week 2	Potential functions, EM boundary conditions, Wave equations
Week 3	Solutions of wave equations, Maxwell's equations in phasor domain
Week 4	Plane waves in lossless media: Maxwell's equations for plane waves, wavelength, wave impedance and velocity
Week 5	Polarization of plane waves
Week 6	Plane waves in conducting media, Poynting's theorem
Week 7	Normal and oblique incidences at a plane conducting boundary
Week 8	Normal incidence at a plane dielectric boundary, normal incidence at multiple dielectric interfaces
Week 9	Oblique incidence at a plane dielectric boundary: Snell and Fresnel equations, Brewster angle and total transmission, critical angle and evanescent wave transmission
Week 10	TEM Waves, General transmission line equations: Circuit model, Telegrapher's equations, characteristic impedance
Week 11	Wave characteristics on finite transmission line: Reflection coefficient and VSWR Impedance characteristics of finite transmission line: Input impedance, measurement of impedance, quarterwave transformers and impedance matching

Week 12	General wave behaviors along uniform guiding structures: TEM waves, TE and TM waves
Week 13	Rectangular waveguides
Week 14	Antennas and Radiation: The elemental electric dipole, antenna patterns and directivity, linear antenna

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670306 Signals and Systems II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Dr. Arzu Koç

4. **Text book, title, author, and year:**
   i. **Other supplemental materials:**
      1. *Communication Systems, 4th edition*, S.Haykin, Wiley, 2001.
      2. *Digital and Analog Communication Systems, 7th edition*, L.W.Couch, II, Prentice Hall, 2006.
      3. *Communication Systems Engineering, 2nd edition*, J.G. Proakis, M. Salehi, Prentice Hall, 2001.
      4. *Probability, Random Processes with Applications to Signal Processing, 3rd edition*, Stark, H. Woods, Prentice Hall, 2001.
      5. *Probability, Random Variables and Stochastic Processes, 3rd edition*, A. Papoulis, McGraw-Hill, 1991.
      6. *Introduction to Probability, 2nd edition*, D.P. Bertsekas, J.N. Tsitsiklis, Athena Scientific, 2002.
      7. *Discrete Random Signals and Statistical Signal Processing*, C.W. Therrien, Prentice Hall, 1992.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Correlation of signals. Energy and power spectral densities. Hilbert transform. Principles of modulation. Stochastic processes: Characterization, correlation functions, stationarity, ergodicity, power spectral density, transmission of random signals through linear systems. Special stochastic processes. Noise.
   ii. **prerequisites or co-requisites:** EE 230 and EE301
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:**Selected Elective

6. **Specific goals for the course**
   i. Students will be able to evaluate random signals.

Specific outcomes of instruction
- Obtain the autocorrelation and cross correlation functions of random signals - Differentiate the stationarity and ergodicity concepts - Use the Fourier transforms efficiently to compute the power spectra

   ii. Students will be able to analyze LTI systems excited by wide sense stationary (WSS) random signals.

Specific outcomes of instruction
- Find the autocorrelation function of the output signal in terms of the input autocorrelation and the impulse response of the system

- Determine the power spectrum of the output from the input power spectrum and the magnitude response of the system - Compute the cross correlation function between the input and the output

iii. Students will learn different kinds of random processes.

Specific outcomes of instruction
- Identify the properties of white noise and use it in modelling - Analyze Gaussian processes - Differentiate between the Poisson process and the Poisson Impulse process - Compare thermal noise and shot noise processes

iv. Students will be able to analyze bandpass signals and systems

Specific outcomes of instruction
- Make use of Hilbert transforms, identify the relation between the pre-envelope, complex envelope and the real envelope - Use the canonical representation of bandpass signals and systems

v. Students will be able to analyze WSS narrowband noise

Specific outcomes of instruction
- Describe the relation between the power spectra of the bandpass signal and its lowpass equivalent - Find the power spectra of the in-phase & quadrature components of narrowband noise

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Review of the Theory of Random Variables and Random Vectors
Week 2	Review of the Theory of Random Variables and Random Vectors
Week 3	Review of the Theory of Random Variables and Random Vectors
Week 4	Random Processes and Correlation Functions

Week5	Random Processes and Correlation Functions,Stationarity and Ergodicity
Week6	Review of Fourier Transforms, Power Spectrum for WSS Signals
Week7	Power Spectrum for WSS Signals, LTI Systems with Random Inputs
Week8	LTI Systems with Random Inputs, Gaussian and Poisson Processes, Poisson Impulses
Week9	Gaussian and Poisson Processes, Poisson Impulses, Noise (White: Thermal, Shot)
Week 10	Noise (White: Thermal, Shot), Sampling of Random Processes, Bandlimited White Noise
Week 11	Sampling of Random Processes, Bandlimited White Noise
Week 12	Hilbert Transforms &Bandpass Signals
Week 13	Narrowband Noise
Week 14	Narrowband Noise

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670311 Analog Electronics

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Haluk Külah

4. **Text book, title, author, and year:**
   Microelectronic Circuits, 6th Ed., A. S. Sedra, K. C. Smith, Oxford University Press, 2011.
   i. **Other supplemental materials:**
      1- *Microelectronic Circuit Design*, R. C. Jaeger, T. N. Blablock, McGraw-Hill, 2003.
      2- *Microelectronic Circuits and Devices, 2nd Ed.*, M. N. Horenstein, Prentice Hall, 1996.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Basic single-stage transistor amplifiers and frequency responses. Multi-stage amplifiers. Feedback in amplifiers. Differential pair stages. Current mirrors. Operational amplifiers.
   ii. **Prerequisites or co-requisites:** Prerequisite: EE201, Co-requisite: EE 313.
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:**Required

6. **Specific goals for the course**
   i. Students will be able to design and analyze single stage BJT amplifiers

Specific outcomes of instruction
- Identify the topology of a BJT amplifier - Determine the DC operating points of a BJT amplifier - Determine the small-signal parameters and amplifier specifications - Design a BJT amplifier to meet specific requirements.

   ii. Students will be able to design and analyze single stage MOSFET amplifiers

Specific outcomes of instruction
- Identify the topology of a MOSFET amplifier - Determine the DC operating points of a MOSFET amplifier - Determine the small-signal parameters and amplifier specifications - Design a BJT amplifier to meet specific requirements.

   iii. Students will be able to design and analyze multistage amplifiers

Specific outcomes of instruction
- Determine the DC operating points of a multistage amplifier - Determine the small-signal parameters and amplifier specifications - Identify and select different amplifier topologies to be used in a multistage amplifier - Design a multistage amplifier to meet specific requirements.

   iv. Students will be able to analyze low and high frequency response of amplifiers

Specific outcomes of instruction
- Determine frequency dependent components - Modify small-signal models to include frequency dependent components - Use various single time constant approximations to model the three frequency bands of amplifiers

v. Students will be able to design and analyze current steering circuits

Specific outcomes of instruction
- Identify and operate on basic mirroring circuits to find DC operating points - Determine mirroring ratios and mirroring errors and design circuits to mitigate the errors - Determine minimum operational range of current mirrors - Use current mirrors to steer the current to construct current sinks and sources

vi. Students will be able to design and analyze differential amplifiers

Specific outcomes of instruction
- Determine the DC operating points of a differential amplifier - Determine the small-signal parameters and amplifier specifications - Design a differential amplifier to meet specific requirements.

vii. Students will be able to design and analyze stable feedback amplifiers

Specific outcomes of instruction
- Determine the type of the feedback and the feedback network - Determine the small-signal parameters of a feedback amplifier - Determine the stability, phase margin and gain margin of a feedback amplifier - Design a feedback network to make the feedback amplifier stable.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Transistor (MOSFET and BJT) operation and biasing
Week 2	Small-signal modelling and Amplification with Transistors

Week 3	MOSFET single stage amplifiers (CS, CD and CG amplifiers)
Week 4	BJT single stage amplifiers (CE, CC and CB amplifiers)
Week 5	Amplifier Frequency Response and Bode Plots
Week 6	Low Frequency Response Calculation and Estimation
Week 7	High Frequency Response Calculation and Estimation
Week 8	Three Frequency Bands of MOSFET and BJT Amplifiers
Week 9	Current Steering Circuits and useful Transistor Pairings
Week 10	The MOS Differential Pair
Week 11	The BJT Differential Pair
Week 12	General Feedback Structure and Properties of Negative Feedback
Week 13	Four Basic Feedback Amplifiers
Week 14	Amplifier Stability Analysis using Bode plots

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670312 Digital Electronics

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours:3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Barış Bayram

4. **Text book, title, author, and year:**
   Microelectronic Circuits, 6th Ed., A. S. Sedra, K. C. Smith, Oxford University Press, 2011.
   i. **Other supplemental materials:**
      1. *Digital Integrated Circuits*, T.A. DeMassa, Z. Ciccone, Wiley, 1996.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Large signal transistor models. TTL, MOS and CMOS logic gates: Inverters, input and output circuits, NAND and NOR gates; static and dynamic analyses. Regenerative circuits: Astable, monostable, bistablemultivibrators and Schmitt triggers. Introduction to VLSI. Static and dynamic memories: RAM, ROM, EPROM, EEPROM, etc. A/D and D/A converters.
   ii. **prerequisites or co-requisites:** Prerequisite: EE 212, Corequisite: EE 314.
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:**Required

6. **Specific goals for the course**
   i. Students will be able to comprehend large signal transistor models and logic gate implementation technologies such as RTL, DTL, TTL, MOS, and CMOS

Specific outcomes of instruction
- Broad understanding of the operation modes of transistors - Broad understanding of the critical parameters for a logic gate - Understanding of the advantages and disadvantages of various logic gate families - Understand static and dynamic analysis of basic logic gates for different technologies.

   ii. Students will be able to analyze and design regenerative circuits, including astable, monostable, and bistablemultivibrators and Schmitt-Triggers.

Specific outcomes of instruction
- Analyze the regenerative circuits using time waveforms. - Design the regenerative circuits to satisfy the specifications of a certain application

   iii. Students will be able to comprehend static and dynamic memory types, such as RAM, ROM, EPROM and EEPROM.

Specific outcomes of instruction
- Comprehend the advantages and disadvantages of static and dynamic memory types -Analyze and design memory types -Understand the limitations of current technology and become aware of contemporary endeavor

iv. Students will be able to comprehend analog-to-digital and digital-to-analog converter concepts and circuits

Specific outcomes of instruction
- Understand the need for converters between analog and digital domains - Comprehend the advantages, limitations, and trade-offs of different converter topologies

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Overview of digital circuit design
Week 2	Bipolar Junction Transistors, The Ebers-Moll Model, RTL
Week 3	RTL, DTL, TTL
Week 4	TTL, MOS transistor overview
Week 5	CMOS logic and CMOS combinational logic gates
Week 6	Pseudo nMOS and pass transistor logic
Week 7	Dynamic logic and comparison of logic families
Week 8	Regenerative circuits and Schmitt-trigger
Week 9	Multivibrator circuits
Week 10	The 555 integrated circuit timer
Week 11	Random Access Memories (RAM), Read-Only Memories (ROM)
Week 12	Random Access Memories (RAM), Read-Only Memories (ROM)
Week 13	Data Converters, Digital-to-Analog (D/A)
Week 14	Analog-to-Digital (A/D) Converters

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670313 Analog Electronics Laboratory

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 0
   Applied/Laboratory Credits: 4
   Total Credits: 2

3. **Instructor's or course coordinator's name:** Prof. Dr. Barış Bayram

4. **Text book, title, author, and year:**
   i. **Other supplemental materials:**
   Laboratory Manuals: 7 different manual for 8 different experiments, last revised in 2014, September.
5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Regulated DC Power Supplies, Multistage Amplifiers. High Frequency Effects. Differential Amplifiers. Feedback Amplifiers. Tuned Circuits. Power Amplifiers. Operational Amplifiers. Optoelectronic Circuits.
   ii. **prerequisites or co-requisites:** EE 311
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be able to design, implement, test, troubleshoot and evaluate single stage MOSFET and BJT amplifiers

Specific outcomes of instruction
- To design a single stage amplifier as the preliminary work to meet given specifications - To design a measurement setup to measure the required performance - To construct own design on a proto-board to measure the performance - Students will gain familiarity with device data sheets - Students will have hand-on experience with single stage amplifiers and troubleshoot their designs

   ii. Students will be able to see the effect of frequency on the amplifier gain, evaluate their bandpass response, take the FFT of an applied signal to see the effect of the bandpass amplification on the output

Specific outcomes of instruction
- To design a single stage amplifier as the preliminary work to meet given specifications - To design a cascode amplifiers as the preliminary work to compare it with a single stage one - To construct the circuits on the proto-board to measure characteristics - Design a measurement system to evaluate the specifications - Design a measurement system and evaluate the FFT of their design

   iii. Students will be able to construct differential amplifiers and work with OPAMPs

Specific outcomes of instruction

- To design a differential amplifiers as preliminary work - To construct the circuits on the proto-board to measure characteristics - Design a measurement system to evaluate the specifications

iv. Students will be able to construct amplifiers with Feedback

Specific outcomes of instruction
- To design feedback amplifiers as preliminary work - To construct the circuits on the proto-board to measure characteristics - Design a measurement system to evaluate the specifications

v. Students will gain experience in a commercial visual programming language to create measurement setups and gain hands on experience with modern test equipment

Specific outcomes of instruction
- Design a measurement system to evaluate the specifications - Evaluate specifications with modern test equipment

vi. Students will gain experience with providing a solution for an engineering problem while making a team project work (with budget limitations) of the lecture at the end of the term

Specific outcomes of instruction
- Design a system to present their project in accurate manner, evaluating specifications - To provide budget management

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	X
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	
Week 2	

Week 3	
Week 4	Experiment 1: Experimenting with HPVEE, Measuring MOSFET Characteristics
Week 5	Experiment 2: DC Regulated Power Supplies
Week 6	Experiment 3: Single Stage MOSFET Amplifiers
Week 7	Experiment 4: Single Stage BJT Amplifiers
Week 8	Experiment 5: Frequency Response
Week 9	Experiment 6: Differential and Operational Amplifiers
Week 10	Experiment 7: Feedback in Amplifiers
Week 11	
Week 12	
Week 13	
Week 14	

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670314 Digital Electronics Laboratory

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 0
   Applied/Laboratory Credits: 4
   Total Credits: 2

3. **Instructor's or course coordinator's name:** Prof. Dr. Ali Özgür Yılmaz

4. **Text book, title, author, and year:**
   i. **Other supplemental materials:**
   Laboratory Manuals: 6 different manual for 6 different experiments, last revised in 2020, February. Tutorials for digital electronics and verilog.
5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   The course will cover CMOS Inverters, introduction to logic circuits, CMOS NAND gates, parallel adders, subtractors, complementers, multiplexers, code converters, flip flops, counters, and introduction to hardware description languages (Verilog-HDL).
   ii. **prerequisites or co-requisites:** EE 312 and EE348
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be able to implement, test, troubleshoot and evaluate basic inverters with CMOS

Specific outcomes of instruction
- To analyze the voltage transfer characteristics (VTC) and the dynamic response of the CMOS inverter and gain experience in some CMOS logic circuits as stated in preliminary work - To implement a measurement setup to measure the required performance - Students will gain familiarity with device data sheets - Students will have hand-on experience with inverters

   ii. Students will learn about basic logic gates, including and, or, nand, and will be able to implement complex equations with the combination of them, including parallel adders, subtractors, and complementors

Specific outcomes of instruction
- To examine basic logic gates with preliminary work and hand-on experiment - To design and implement parallel adder, subtractor and complementor, utilizing basic logic gates, as stated in preliminary work - To construct the circuits on the proto-board with logic gate integrated circuits to examine their outputs - To make gate level design in Xilinx software and implement them in FPGA board to examine their outputs for different input combinations

   iii. Students will be able to design and implement combinational (such as multiplexer and binary to gray convertor) and sequential (JK flip flop and counter) logic circuits both on protoboard with integrated logic circuits and on Xilinx and FPGA environment

Specific outcomes of instruction
- To design a combinational or sequential circuit specified in preliminary work - To construct the circuits on the proto-board in hand-on experiment - To make gate level design and implementation in Xilinx software and FPGA board

iv. Students will gain experience with providing a solution for an engineering problem while making a team project work (with budget limitations) of the lecture at the end of the term

Specific outcomes of instruction
- Design a system to present their project in accurate manner, evaluating specifications - To provide budget management - Learn Verilog programming language and use it to make project

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	X
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	
Week 2	
Week 3	CMOS Inverter Recitation
Week 4	Experiment 1: CMOS Inverting Circuits
Week 5	Verilog Recitation

Week 6	Experiment 2: Introduction to Logic Circuits
Week 7	Experiment 3: Parallel Adders, Subtractors, and Complementers
Week 8	Experiment 4: Elementary Gate Networks
Week 9	Experiment 5: Flip Flops and Sequential Circuits
Week 10	Experiment 6: Introduction to Verilog
Week 11	Project
Week 12	Project
Week 13	Project
Week 14	

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670348 Introduction to Logic Design

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Gözde Bozdağı Akar

4. **Text book, title, author, and year:**
   Digital Design, M. Mano, Michael C., Prentice-Hall, 4th Ed, 2007 or 5th Ed., 2013

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Binary systems and Boolean algebra. Boolean function simplification. Combinational logic. Sequential synchronous logic. Registers and counters
   ii. **prerequisites or co-requisites:** 314
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be able to comprehend the binary number system, Boolean algebra, gates and gate level circuit minimization.

Specific outcomes of instruction
- Be able to perform base conversions - Be able to perform signed arithmetic - Be able to manipulate and prove Boolean expressions - Be able to implement Boolean functions in two-levels and multi-levels using gates - Be able to perform gate level circuit minimization

   ii. Students will be able to analyze and design combinational circuits and will comprehend higher level combinational circuit building blocks.

Specific outcomes of instruction
- Be able to analyze combinational circuits - Be able to design combinational circuits - Be able to build and use adders, decoders, comparators, multiplexers, etc.

   iii. Students will be able to comprehend flip-flops and will be able to analyze and design synchronous sequential circuits.

Specific outcomes of instruction
- Be able to analyze synchronous sequential circuits - Be able to work with different types of flip-flops - Be able to design synchronous sequential circuits

   iv. Students will be able to comprehend and use registers, counters and serial mode of operation.

Specific outcomes of instruction

- Be able to implement and use universal shift register
- Be able to implement and use synchronous and asynchronous counters
- Be able to design a digital circuitry operating in serial mode

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction
Week 2	Number systems, Signed arithmetic
Week 3	Boolean algebra, Operator precedence, Functions, Gates
Week 4	Standard forms, Simplification of Boolean functions, Karnaugh map
Week 5	Two level implementations
Week 6	Design of combinational circuits
Week 7	Design of combinational circuits
Week 8	MSI circuits (decoders, multiplexers, etc.)
Week 9	Basic flip-flops
Week 10	Analysis of synchronous sequential circuits
Week 11	Design of synchronous sequential circuits
Week 12	Design of synchronous sequential circuits
Week 13	Registers, Serial mode of operation
Week 14	Counters, Timing

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670361 Electromechanical Energy Conversion I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Emine Bostancı

4. **Text book, title, author, and year:**
   Electric Machinery, 6th edition, A.E. Fitzgerald, C. Kingsley, S.D. Umans, McGraw Hill, 2005.
   i. **Other supplemental materials:**
      1- *Electric Machinery and Transformers*, B. S. Guru, H. R. Hızıroğlu, Oxford University Press, 2001.
      2- *Electric Machines*, G.R. Slemon, A. Straughen, Addison Wesley, 1980.
      3- *Electrical Safety Notes*.
      4- *Electromechanical energy Conversion Laboratory Manual I*, 2008.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Electrical safety. Electromagnetic circuits. Properties of ferromagnetic materials. Single-phase and three phase transformers. Per Unit System. Principles of electromechanical energy conversion: Linear and nonlinear systems; singly and multiply excited translational and rotational systems. DC machines: Theory, generators, motors, speed control
   ii. **prerequisites or co-requisites:** 5670202 and 5670224
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. Students will be able to comprehend the role of electromechanical energy conversion in power systems

Specific outcomes of instruction
- Why energy conversion & What is a power system - Electromechanical energy conversion in the overall energy conversion problem - A short review of power system and assessment of electric power plants in Turkey

   ii. Students will be able to understand operation principles, analysis and design of magnetic circuits

Specific outcomes of instruction
- Magnetic circuits and methods of analysis - Flux linkage, inductance, stored energy and co-energy - Magnetic materials - AC excitation and losses - Electrical Safety - Design of magnetic circuits containing permanent magnets

- Electrical Safety - Voltage and current waveforms and hysteresis loop of a magnetic core

iii. Students will be able to understand operation principles and analysis of magnetically coupled circuits

Specific outcomes of instruction
- Ideal Transformer - Practical Transformer and the derivation of its equivalent circuits and induced emf expressions - Performance calculations: voltage regulation and efficiency - Variable frequency operation of transformers - Transformers in three-phase circuits - Per-unit system: Single-phase and 3-phase systems - Short-circuit and open-circuit tests and parameter calculation - Determination of equivalent circuit parameters of a transformer by tests

iv. Students will be able to comprehend electromechanical energy conversion principles and devices

Specific outcomes of instruction
- Energy balance equation for quasi-stationary magnetic fields - Derivation of electromechanical force and mechanical power expressions for translational devices with linear and nonlinear magnetic circuits - Derivation of electromechanical torque and mechanical power expressions for rotating devices with linear magnetic circuits - Effects of shape of the air gap on torque expression - Permanent magnet systems - Dynamic equations and analytical solution techniques

v. Students will be able to analyze, control and operate DC machines

Specific outcomes of instruction
- Structure and operational features of a DC machine - Induced EMF, electromechanical torque and gross mechanical output power - Excitation methods and magnetization characteristic - Gross MMF including armature reaction - DC Generators & DC Motors - Power flow and efficiency - Speed control of DC motors - Four-quadrant operation of DC machines - The magnetizing curve of separately and self-excited D.C. generators - The load characteristics of series, shunt and compound D.C. generators - Speed control of D.C. shunt motors

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	

4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	I. Introduction
Week 2-5	Analysis And Design Of Magnetic Circuits
Week 6-9	Operation Principles And Analysis Of Magnetically Coupled Circuits
Week 10-12	Electromechanical Energy Conversion Principles And Devices
Week 12-14	DC Machines

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670362 Electromechanical Energy Conversion II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Ozan Keysan

4. **Text book, title, author, and year:**
   Electric Machinery, 6th edition, A.E. Fitzgerald, C. Kingsley, S.D. Umans, McGraw Hill, 2005.
   i. **Other supplemental materials:**
      1- *Electric Machinery and Transformers*, B. S. Guru, H. R. Hızıroğlu, Oxford University Press, 2001.
      2- *Exciting Electric Machines*, E.R. Laithwaite, Wheaton, 1974.
      3- *Electric Machines and Their Applications*, J. Hindmarsh, Pergamon Press, 1970.
      4- *Electric Machines*, G.R. Slemon, A. Straughen, Addison Wesley, 1980.
      5- *Electromechanical energy Conversion Laboratory Manual II*, 2008.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Electromagnetic fields created by AC electric machine windings: pulsating and rotating magnetic fields, emf induced in a winding. Induction machines: equivalent circuit, steady-state analysis, speed control. Synchronous machines: equivalent circuit, steady-state analysis, stability. Single-phase induction machines. Special electrical machines
   ii. **prerequisites or co-requisites:** 5670361
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. **S**tudents will be able to comprehend the methods for the generation of sinusoidal voltages in AC machines

Specific outcomes of instruction
- Use of AC power in power systems in three phase form with sinusoidal voltages changing at 50/60 Hz - MMF waveforms of concentrated and distributed windings - Static, pulsating and rotating magnetic fields - Sinusoidal voltage generation methods in AC. Machines with uniform and non-uniform air-gaps - Graphical construction of flux density wave from MMF wave in the air-gap - Derivation of induced EMF expression and minimization of harmonics by chording. - MMF waveforms produced by poly-phase windings

ii. Students will be able to analyze, control and operate polyphase induction machines

Specific outcomes of instruction
- Structural aspects and operating principles of polyphase induction machines - Per phase equivalent circuit in the steady state - Determination of equivalent circuit parameters by tests - No-load and locked rotor tests on an induction motor and determination of the parameters - Steady state analysis by the use of equivalent circuit: current, electromechanical torque, gross mechanical output power - Power flow diagram and efficiency - Four quadrant operation: motoring, generating and braking - Dynamic operation: plugging, acceleration and deceleration - Speed control methods - Induction motor torque vs. speed characteristics, the effect of stator voltage and added rotor resistance

iii. Students will be able to analyze, control and operate three-phase synchronous machines

Specific outcomes of instruction
- Structural aspects of salient-pole and cylindrical-rotor synchronous machines and operation principles - Flux and MMF waves and induced EMF - Equivalent circuit of a cylindrical rotor machine and determination of parameters by tests - Operating characteristics of cylindrical-rotor machines - Conventional and modern phasor diagrams for salient-pole synchronous machines - Power/load-angle characteristics of cylindrical rotor and salient-pole synchronous machines - Analysis of synchronous generators in power systems - Stability of synchronous machines: Equal area criterion - Synchronization and V-curve of synchronous machines - Power load angle characteristics of a salient pole synchronous machine

iv. Students will be familiar with operation principles, analysis and starting of small electric motors

Specific outcomes of instruction
- Structural aspects of single phase induction motors - Equivalent circuit and electromechanical torque - Effects of shape of the air gap on torque expression - Operating characteristics and starting methods - Other small motors

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	

4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1-4	Generation of Sinusoidal Voltages In Ac Machines
Week 5-8	Polyphase Induction Machines
Week 9-12	Three-Phase Synchronous Machines
Week 13-14	Small Electric Motors

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670374 Electrical Equipment and Applications

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Nezih Güven

4. **Text books, title, author, and year:**
   1. N. Nohan, Electric Power Systems – A First Course, Wiley, 2012.
   2. W. H. Kersting, Distribution System Modeling and Analysis, CRC Press, 4th Ed., 2017.
   3. A. R. Bergen and V. Vittal, Power System Analysis, Prentice-Hall, 2nd Ed., 2000.
   4. Lecture notes/handouts.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Introduction to power supplies and systems. Short circuit phenomena and analysis in low voltage systems. Protection concept, devices and applications in electrical systems. Characteristics and applications of circuit breakers, relays and fuses. Power and installation cables and applications. Power and energy measurement techniques and devices. Reactive power compensation. Electrical safety and earthing systems.
   ii. **prerequisites or co-requisites:** EE 202 or consent of the department
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Elective

6. **Specific goals for the course**
   i. **S**tudents will be able to understand the structure of electric power systems and to develop models for basic power system equipment (such as lines, cables, transformers, generators, etc)

Specific outcomes of instruction
- Learn the structure of electric power systems, issues, developments and trends for power systems, - Develop electrical models for the basic power system equipment

   ii. **S**tudents will be able to analyze balanced three-phase electric systems.

Specific outcomes of instruction
- Use electrical models of equipment to analyze the balanced three-phase electric systems, - Learn the use of per-unit system in the analysis.

   iii. Students will be able to use and apply these models in the analysis of three-phase short-circuits and learn different electrical protection devices

Specific outcomes of instruction
- Learn the types and impact of faults in a power system, - Learn how to analyze three-phase faults, - Understand the characteristics, operation and applications of electrical protection devices.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction - Structure of power systems & Turkish Electric Network - Contemporary issues in power systems engineering - Conventional energy generation (fossil, hydro, nuclear) - Renewable energy sources (solar, wind, etc.) - Distributed generation, micro grids
Week 2	Power in alternating-current circuits, Active and reactive power concepts
Week 3	Balanced three-phase systems and power-factor correction
Week 4	Review of Transformers - Simplified transformer model - Three-phase transformers - Transformer types (auto-transformers, tap-changers, phase shifters, three-winding)
Week 5	Load models, synchronous machine model, single-line diagrams
Week 6	Analysis of three-phase systems, use of per-unit system

Week 7-8	Transmission Line Parameters - Computing the series resistance and inductance - Computing the shunt capacitance
Week 9	Transmission Line Modeling
Week 10	Power and wiring cables, cable selection
Week 11	Symmetrical Three-Phase Faults, Short-circuit MVA
Week 12-13	Protection: Relays, Fuses, circuit-breakers, load breakers
Week 14	Electrical safety, grounding

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670402 Discrete Control Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Mustafa Mert Ankaralı

4. **Text book, title, author, and year:**
   1- *Discrete Time Control Systems*, Ogata, Prentice Hall, 1995
   2- *Digital Control of Dynamical Systems*, G.F. Franklin, J.D.Powell, M.L.Workman, Addison Wesley, 1997
   i. **Other supplemental materials:**
   Computer Controlled Systems Theory and Design, K.J. Astrom, B. Wittenmark, Prentice Hall, 1996

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Fundamentals of design and analysis of digital control systems. Importance and advantages of discrete time system models in control systems. Time domain, z-plane, and state-space analysis of discrete-time systems. Stability analysis of digital-control systems. Conventional (root-locus, frequency response functions, and bode diagrams) and state-space controller design tools (state-feedback, observer theory, dead-beat control).
   prerequisites or co-requisites: 5670302
   ii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. **S**tudents will be able to comprehend basic systems and signals representations: in continuous space as well as discrete space

Specific outcomes of instruction
- Manipulating Z Transform, its inverse - Relating Complex Operations to Laplace and Z Transforms - Sampling of signals; effect of sampling to transfer functions - Reconstruction of continuous data from sampled ones

   ii. Students will be able to assess Transient response of LTI and be able to know the effect of transient parameters for design

Specific outcomes of instruction
- Transient responses of LTI systems and transient parameters - Steady state error and its relation to system characteristics - System modeling in discrete time and in Z domain

   iii. Students will be able to analyze stability and design a controller

Specific outcomes of instruction

- Using PD, PI, PID controllers and tuning their parameters according to the design specs and stability characteristics. - Using root locus and tuning parameters according to the transient parameters required in the specs and characteristics of relative stability.

iv. Students will be able to design compensators in frequency domain

Specific outcomes of instruction
- System characteristics represented by Bode Plots, Phase margin, gain margin - When to use lead; when to use lag and what lead lag provides. - Design of lag compensators for required system relative stability and transients based on gain margin, phase margin - Design of lead compensators for required system relative stability and transients based on gain margin, phase margin - Design of lead lag compensators for required system relative stability and transients based on gain margin, phase margin

v. Students will be able to model systems in state space and analyze controllability and observability

Specific outcomes of instruction
- Modeling discrete systems in state space and analyzing the model sensitivity to systems parameters - Analyzing controllability and observability in different spaces: normalized systems and nondecoupled systems

vi. Students will be able to estimate states and use it for state feedback

Specific outcomes of instruction
- Design with state feedback - Estimate state by designing an observer - Use estimated state in pole placement: use the state feedback in conjunction with observer design

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction
Week 2	z Transform
Week 3	z Transform
Week 4	z-Plane Analysis of discrete time control systems: Impulse sampling;data hold circuits
Week 5	Block diagram representations,Pulse Transfer Function
Week 6	Pulse Transfer Function;IIR,FIR
Week 7	Design of DTC by conventional techniques:Transient Response, Steady state Error
Week 8	Steady state Error, Stability, JuryTest, Transformed Routh Hurwitz
Week 9	Root Locus, Design with Root Locus
Week 10	Compensator Design in Frequency Domain
Week 11	Compensator Design in Frequency Domain ;State Space Analysis.
Week 12	Controllability, Observability
Week 13	Pole Placement
Week 14	Observer Design

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670404 Nonlinear Control Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Umut Orguner

4. **Text book, title, author, and year:**
   Nonlinear Systems, H.K.Khalil, 2002
   i. **Other supplemental materials:**
      1- *Applied Nonlinear Control*, J.J.E.Slotine,W.Li, Prentice-Hall
      2- *Nonlinear Systems: Analysis*, Stability, and Control, S.S.Sastry, Springer
      3- *Nonlinear System Analysis*, Verlag, M. Vidyasagar, Prentice – Hall
      4- *Stability Theory of Dynamical Systems*, J.L.Willems, Nelson
      5- *Nonlinear Dynamical Systems*, P.A.Cook, Prentice – Hall
      6- *Lecture Notes*, E.Kocaoğlan

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   State-space analysis methods. Isocline Lienard's methods, classification of singularities. Analytic techniques of periodic phenomena: Perturbation method. Stability definitions. Lyapunov's second method; Popov stability criterion. The method of harmonic realization: Describing functions. Dual-input describing functions. Equivalent linearization and oscillations in nonlinear feedback systems
   ii. **prerequisites or co-requisites:** 5670302
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend basic concepts related to nonlinear systems.

Specific outcomes of instruction
- Find the equilibrium points of a nonlinear system. - Classify the equilibrium points of a second-order nonlinear system (node, saddle, centroid etc.) - Draw the approximate trajectories of a second-order nonlinear system on the phase plane.

   ii. Students will be able to understand the concepts related to the periodic trajectories observed in nonlinear systems.

Specific outcomes of instruction
- Know the definition of a limit cycle. - Apply the basic results on the existence and non-existence of limit cycles to predict or rule out limit cycles.

   iii. Students will be able to make describing function analysis.

Specific outcomes of instruction

- Derive the describing functions for common non-linear elements with and without memory (relay, saturation, dead zone, hysteresis, backlash etc.). - Determine the existence and stability of a limit cycle along with its parameters based on the describing function analysis.

iv. Students will be able to comprehend the concept of stability for nonlinear systems.

Specific outcomes of instruction
- Understand the definition of the stability of equilibrium points in nonlinear systems. - Make stability analysis for nonlinear systems based on Lyapunov's indirect method (linearization). - Make stability analysis for nonlinear systems based on Lyapunov's direct method. - Know the distinction between different stability types like local-global stability, asymptotic stability etc. - Determine the stability of nonlinear systems based on Popov's stability criterion.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, Definitions, Terminology to be used.
Week 2	Equilibrium points, Linearization about equilibrium points, examples.
Week 3	Classification of equilibrium points, phase-plane trajectories around equilibrium points, examples.
Week 4	Trajectories for second order piecewise linear systems.
Week 5	Limit cycles, prediction of existance and/or nonexistance of limit cycles, examples.
Week 6	Describing function (DF) technique for the prediction of periodic solutions(limit cycles).

Week 7	Obtaining DF for different nonlinearities using either analytic methods or graphical techniques.
Week 8	Finding the magnitude , frequency and stability of oscillations using the describing function technique.
Week 9	Definitions of stability in the sense of Lyapunov, construction of Lyapunov functions, examples.
Week 10	How Lyapunov stability technique can be used to predict the possible regiod of attraction. Lur'e problem,
Week 11	Popov's stability criteria, extention to Circle criteria, derivation and examples.
Week 12	Introduction to variable structure systems, examples.
Week 13	Introduction to sliding mode control, examples.
Week 14	Induced norm, matrix measure, their use in solution region estimates.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670406 Laboratory of Feedback Control Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 0
   Applied/Laboratory Credits: 4
   Total Credits: 2

3. **Instructor's or course coordinator's name:** Prof. Dr. Afşar Saranlı

4. **Text book, title, author, and year: -**
   i. **Other supplemental materials:**
      1- *EE406 Laboratory Experiment Sheets*
      2- *EE302 Lecture Notes*
      3- *Quanser Hardware Manuals*
      4- *Modern Control Systems*, R. Dorf, R. H. Bishop, 2005
      5- *Modern Control Engineering*, K. Ogata, 2009
      6- *Discrete-Time Control Systems*, K. Ogata, 1995
      7- *Control Systems Engineering*, N. S. Nise, 2010

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Computer based control of linear and nonlinear electromechanical systems. Components of a computer-based control system. Matlab/Simulink models. Proportional-derivative based position control. Lead-compensator based speed control. Pole-placement based state-space control of nonlinear cart-pendulum system. LQR based state-space optimal control of flexible-joint position and nonlinear inverted pendulum systems. Demonstration of more advanced electromechanical control examples.
   ii. **prerequisites or co-requisites:** prerequisite 5670302, co-requisite 5670402
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to derive mathematical models of electro-mechanical systems

Specific outcomes of instruction
- Understand terminal relationships (algebraic and differential equations) of electrical and mechanical components, - Be able to derive system block diagrams from individual component models - Be able to obtain (for linear systems) input-output transfer functions from block diagram models, - Be able to derive linear and nonlinear state-space mathematical models of electro-mechanical systems, - Be able to derive linear approximations to nonlinear state space system models.

   ii. Students will be able to understand basic components of a computer controlled electro-mechanical system including sensors, algorithms and actuators.

Specific outcomes of instruction

- Be able to identify and connect the basic physical components (mechanical components, computer, A/D card, motor driver, sensors and actuators) into a complete system, - Be able to assemble necessary software components (in block-diagram form) to read sensors and drive actuators of the system

iii. Students will be able to apply theory to design control laws for electro-mechanical systems to meet desired performance specifications.

Specific outcomes of instruction
- Be able to analytically design linear control laws for the derived plant models - Be able to use computer analysis tools (e.g. Matlab) to tune parameters of analytically derived control laws,- Relate the Fourier and Laplace transforms - Be able to use computer design tools (e.g. Matlab) to generate linear control laws - Be able to use computer simulation tools to test and validate closed-loop controlled system performance.

iv. Students will be able to conduct experiments on physical systems to test and evaluate closed-loop controlled system performance meeting design specifications.

Specific outcomes of instruction
- Be able to generate programs in the given programming environment, (e.g. Matlab-Simulink) to implement designed control laws, - Be able to integrate computer interfaces (with the controlled physical system) functions with the implementation of the designed control laws, - Be able to use necessary excitation signals to assess the closed-loop system performance against design specifications, - Be able to generate proper plots, tables and interpret them to write proper analysis reports.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Setting up of lab groups and infrastructure. Introduction to Matlab and Simulink for dynamic systems analysis and design.
Week 2	Lecture: Matlab and Simulink for modeling and real-time control. (Part 1)
Week 3	Lecture: Matlab and Simulink for modeling and real-time control. (Part 2)
Week 4	Exp 1: Introduction. Getting acquainted with the experiment environment, mechanical setup, hardware, and software interfaces. Explore hardware interface code fragments and implement small programs that read platform sensors and operatethe actuators.
Week 5	Exp 2: Position Control.
Week 6	Exp 3: Velocity Control using Lead Compensator.
Week 7	Exp 4: Single Pendulum Gantry Control using Pole Placement
Week 8	Lecture:Optimal state-space control using the The Linear Quadratic Regulator
Week 9	Exp 5: Flexible Joint Position Control using LQR.
Week 10	Exp 6: Simple Inverted Pendulum using LQR Control
Week 11	DEMO: Advanced Control System Demo (Self Erecting Inverted Pendulum and/or 3DOF Helicopter Setup).
Week 12-14	-

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670407 Process Control

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

   Instructor's or course coordinator's name: Prof. Dr. Afşar Saranlı

3. **Text book, title, author, and year:**
   No specific Textbook. There are multiple relevant references.
   i. **Textbook: None.**
   ii. **Other supplemental materials:**
      a. *Modeling of Dynamic Systems*, L. Ljung, T. Glad, 1994.
      b. *Process Modeling, Identification and Control*, J.Mikles, M. Fikar, 2007
      c. *Process Control: A First Course with Matlab,* P.C. Chao, 2002,
      d. *Practical Process Control*, D.J.Cooper, (Online-book)
      e. *Process Control I: Fundamentals of Process Control,* E. Tulunay, Lecture Notes. 1990.

4. **Specific course information**
   i. **brief description of the content of the course (catalog description):**

      Modeling of processes other than mechanical and electrical processes including examples of thermal, liquid, economic, biological, chemical processes. Models of distributed parameter systems and their lumped parameter approximations. Models and effects of actuators and measurement devices. Control modes and architectures: On-Off, Proportional, Integral, Derivative control modes and their combinations. PID design methods: Direct Design, IMC based design, Zygler-Nichols closed-loop design. Control loop architectures: Single loop, Cascade, Disturbance Feedforward, Feedforward-Feedback and Internal Model Control (IMC). Modeling, stability effects and compensation methods for pure time-delay inside control loops.

   ii. **prerequisites or co-requisites:** 5670302
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

5. **Specific goals for the course**

   i. To understand and control industrial processes

Specific outcomes of instruction

- Gain ability to model mechanical, electrical, thermal, fluidic and other processes.
- Gain ability to select suitable modes of control like On-off, P, PI, PD, PID controllers. Ability to design such controllers specifically for different industrial processes.
- Gain ability to model distributed-parameter systems, determine and use lumped parameter approximations for such systems.
- Understand the models and practical issues with actuators and measurement devices,
- Understand the effects of and cope with pure time delay in a control loop, compensate for time-delay
- Successfully use different control architectures such as single-loop, cascade, disturbance feedforward, feedforward-feedback and Internal Model Control architectures,
- Gain the ability to design, set up and conduct experiments with pilot scale industrial processes.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

6. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, Motivations for a second course. Different physical process systems and their models, some examples.
Week 2	Lumped Parameter process models: First examples. Different types of models.
Week 3	Model examples continued. Overview of practical control system design.
Week 4	Liquid level system examples. Discretization and simulation of models. System identification using the FOPDT model.
Week 5	Generalization of models for different physical systems. The heat transfer process.
Week 6	Example: Simplified model of an economy. Nonlinear systems, operating point and linear approximations around operating points.
Week 7	Modes of control. on-off, proportional, integral, derivative and combinations of modes (PID). Review of Root-locus to understand PID controllers.

Week 8	Practical/experimental design of PID controllers. Short overview of Optimization based controllers. Examples from industry.
Week 9	“Reaction Curve” (step response) based design formulas. Where do they come from? Derivation using Direct Design Method. Representing pure time delay and Pade Approximation.
Week 10	Internal Model Control (IMC) based derivation of PID design formulas
Week 11	Closed-loop experimental design: Zygler-Nichols continuous oscillations method.
Week 12	Distributed parameter models and lumpled parameter approximations. Heat transfer example.
Week 13	Multi-loop systems: Architectures (types) of control. Feedback, disturbance feedforward, cascade control. Examples.
Week 14	Dealing with the effects of time-delay: The Smith Predictor.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670412 Nonlinear Electronics for Communications

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Şimşek Demir

4. **Text book, title, author, and year:**
   Communication Circuits: Analysis and Design, K.K. Clarke and D.T. Hess, Addison-Wesley, 1971.
   i. **other supplemental materials:**
      J. R. Smith; Modern Communication Circuits; McGraw-Hill, 2nd Ed., 1997.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
      Nonlinear controlled sources: piecewise linear, square-law, exponential and differential pair characteristics. Low level amplitude modulation and analog multiplication. Narrowband transformer like coupling networks. Nonlinear loading of tuned circuits. Tuned large signal transistor amplifiers and frequency multipliers. Sinusoidal oscillators. Frequency mixers and converters.
   ii. **prerequisites or co-requisites:** EE311
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be familiar with the basic communication system components and their analysis.

Specific outcomes of instruction
- Identify narrow band coupling networks, and transformer-like resonance circuits. - Analyze circuits with nonlinear controlled sources and nonlinear components such as diodes and transistors. - Make harmonic analysis for circuits that contain nonlinear sources and loads. - Analyze resistive transistor biasing circuits

   ii. Student will be able to design and implement communication system blocks such as amplifiers, sinusoidal oscillators, modulators, and mixers and know the methods to measure and evaluate such circuits.

Specific outcomes of instruction
- Recognize amplifiers, sinusoidal oscillators, modulators, and mixers in a circuit. - Analyze circuits that contain amplifiers, sinusoidal oscillators, modulators, and mixers. - Gain ability to analyze and interpret measurement data

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction
Week 2	Nonlinear Controlled Sources (Piecewise linear, square-law, exponential)
Week 3	Nonlinear Controlled Sources (differential)
Week 4	Effect of Series Resistance in Exponential NL Capacitive Coupling to NL Elements
Week 5	Inductive Coupling to NL Elements Resistive Biasing of Transistors
Week 6	Narrow Band Coupling Networks, Transformer-like Resonance Circuits
Week 7	Nonlinear Loading of Tuned Circuits
Week 8	Sinusoidal Oscillators (Barkhausen Criterion, Amplitude Limiting Mechanisms)
Week 9	Sinusoidal Oscillators (Colpitts, Hartley, Oscillators)
Week 10	Sinusoidal Oscillators (Pierce Oscillators;)
Week 11	Sinusoidal Oscillators (Total Harmonic Distortion)
Week 12	Crystal Oscillators (Circuit Models of Crystal Resonators, Series and Parallel Mode Oscillators)
Week 13	Mixers (FET and BJT)
Week 14	Mixers (Passive Mixers)

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670413 Introduction to VLSI Design

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3Applied/Laboratory Credits: 0

   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Tayfun Akın

4. **Text book, title, author, and year:**
   CMOS VLSI Design A Circuits and Systems Perspective, Neil H. E. Weste and David Money Harris, Fourth Edition, Addison/Wesley, 2010

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Design techniques for rapid implementations of very large-scale integrated (VLSI) circuits, MOS technology and logic. Structured design. Design rules, layout procedures. Design aids: layout, design rule checking, logic, and circuit simulation. Timing. Testability. Projects to develop and lay out circuits.
   ii. **prerequisites or co-requisites:** EE 312 and EE 348
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to have basic understanding of integrated circuit technology and basic fabrication steps of a CMOS process.

Specific outcomes of instruction
- Understand basic process steps of a CMOS technology - Identify various regions of a CMOS process on the cross-sectional view - Understand mask making process and layout procedure - Understand parasitic devices and their effects

   ii. Students will be able to use an industrial commercial circuit simulation and design tool.

Specific outcomes of instruction
- Understand the basic organization of the industrial commercial design tool - Learn to create schematics - Learn to perform simulations and plot data - Create layout of a circuit and perform various design verification procedures, like Design Rule Checks (DRC) and Layout versus Schematic (LVS) checks

   iii. Students will be able to understand basic electrical properties of MOS circuits.

Specific outcomes of instruction
- Understand basic electrical characteristics of MOS transistors - Understand different use of MOS transistors - Understand the risk of latch-up due to parasitic BJT transistors in CMOS and ways to avoid latch-up.

   iv. Students will be able design logic gates and create layouts of them.

Specific outcomes of instruction

- Understand mask layers - Learn to create stick diagrams - Understand scalable CMOS design rules - Understand symbolic and stick diagrams - Learn Euler path approach for obtaining an efficient layout

v. Students will be understand parasitic effects.

Specific outcomes of instruction
- Understand sheet resistance of metals and capacitive effects - Understand the concept of propagation delays

vi. Students will be able create hierarchical designs.

Specific outcomes of instruction
- Learn to create hierarchical schematics and hierarchical layouts - Understand the importance of hierarchical design

vii. Students will be able design computational elements.

Specific outcomes of instruction
- Learn to understand the difference between the logic design and VLSI design - Learn to implement data path operators efficiently - Learn the importance of regular designs

viii. Students will be able design memory elements and design accurate clock distribution networks.

Specific outcomes of instruction
- Understand elements with memory - Perform standard simulations on memory circuits - Understand the importance of accurate clock distribution - Learn ways to avoid race conditions.

ix. Students will be able to create basic digital circuits with HDL.

Specific outcomes of instruction
- Learn basic HDL language structure - Create basic digital cells with HDL language - Learn to syntheses from HDL

x. Students will be able design for testability.

Specific outcomes of instruction
- Understand the importance of creating testable designs and of the “design for testability” concept - Learn the difference between the functionality test and manufacturing test - Learn system partitioning and other ad-hoc testing methods for simpler testing - Learn to test combinational and sequential logic - Learn scanning based testing techniques.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	

4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1,2	Introduction to CMOS Technology and Layout
Week 3	Basic Electrical Properties of MOS Circuits
Week 4,5	MOS Circuit Design Processes
Week 6,7	Basic Circuit Concepts
Week 8, 9	Subsystem Design and Layout
Week 10,11	Illustration of the Design Process-Computational Elements
Week 12	Memory, registers, and Aspects of System Timing
Week 13	Testability
Week 14	Introduction to Hardware Description Language (HDL)

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670414 Introduction to Analog Integrated Circuits

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Haluk Külah

4. **Text book, title, author, and year:**
   Design of Analog CMOS Integrated Circuits, Behzad Razavi, 2001
   i. **Other supplemental materials:**
      1- *CMOS Analog Circuit Design P. E. Allen*, D. R. Holdberg, 2002
      2- *Analysis and Design of Analog Integrated Circuits,* Paul Gray, 2009

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Analysis and design of BJT and MOS multi-transistor amplifiers. Analog IC building blocks/sub-circuits. Biasing circuits. Differential pairs. CMOS operational amplifier topologies. Stability analysis and pole-zero cancellation in operational amplifiers. Differential and regenerative comparators.
   ii. **prerequisites or co-requisites:** 5670311
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend BJT and MOS transistors and their modeling.

Specific outcomes of instruction
- Understanding of the operation modes of transistors. - Understanding of the second order effects on the transistor operation.

   ii. Students will be able to analyze and design BJT and MOS biasing circuits.

Specific outcomes of instruction
- Analyze the current mirror and current source circuits. - Analyze the voltage and current reference circuits. - Design the current mirror and source circuits to satisfy the specifications of a certain application. - Design the voltage and current reference circuits to satisfy the specifications of a certain application. - Understand the limitations of current technology and become aware of contemporary endeavor.

   iii. Students will be able to analyze and design CMOS Operational Amplifier circuits.

Specific outcomes of instruction
- Comprehend the advantages and disadvantages of single-stage and multi-stage opamps. - Analyze and design input stages of the opamps - Analyze and design output stages of the opamps - Analyze and design of Fully differential and rail-to-rail opamps

- Design of multi-stage opamps to satisfy the specifications of a certain application.

iv. Students will be able to comprehend Comparator circuits.

Specific outcomes of instruction
- Analyze different types of comparator circuits. - Characterization and design of comparator types.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	BJT and MOS transistors and modeling
Week 2-3	BJT and MOS biasing circuits, current mirrors and current sources, voltage and current references, bandgap circuits
Week 4-5	MOS gain stages, MOS differential amplifiers,
Week 6-8	Single-stage opamps, two-stage opamps, input common mode, dynamic range, frequency response, stability and compensation, noise, output stages,
Week 9	Various output stage architectures for amplifiers
Week 10-11	Fully Differential Opamps
Week 12	Rail-to-rail Opamps
Week 13-14	Comparators, Single-ended auto-zeroing comparators, differential comparators, regenerative (Schmitt Triggers) comparators, fully differential comparators, latches,

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670415 Introduction to Medical Imaging

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Nevzat G. Gençer

4. **Text book, title, author, and year:**
   Principles of Medical Imaging, K. Kirk Shung, Michael B. Smith, Benjamin Tsui, Academic Press, Inc., London, 1992

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Fundamentals of X-ray, generation and detections of X-rays, X-ray diagnostic methods, X-ray image characteristics, biological effects of ionizing radiation. Fundamentals of acoustic propagation, generation and detection of nuclear emission, radionuclide imaging methods, radiation dosimetry and biological effects. Fundamentals of magnetic resonance imaging, generation and detection of NMR signal, imaging methods, biological effects of magnetic fields.
   ii. **prerequisites or co-requisites:** EE301
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. To present the fundamentals of four major medical imaging modalities, namely, X-ray CT and digital radiography, ultrasound, radionuclide imaging, and magnetic resonance imaging.

Specific outcomes of instruction
- Understanding of the fundamentals of major medical imaging modalities, - Ability to understand and use the newly developed medical imaging modalities and related technology, - Problem solving skills, - Analytical thinking ability. - Develops numerical models (and makes simulations) to validate a theory. - Integrates and uses knowledge from various courses including Engineering, Physics and Mathematics, - Uses computer-based resources effectively, - Sets goals to accomplish task on time

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Review of Medical Imaging Systems
Week 2	Fundamentals of X-ray: electromagnetic radiation, interactions between X-rays and matter, intensity of an X-ray beam, attenuation.
Week 3	Generation and detection of X-rays: X-ray generators, filters, beam restrictors and grids, intensifying screens, fluorescent screens, X-ray films.
Week 4	X-ray diagnostic methods: conventional X-ray radiography, fluoroscopy, angiography, mammography, image subtraction, conventional tomography.
Week 5	Computed tomography: projection function, Radon integral, parallel projection, backprojection, filtered backprojection, Fourier slice theorem, convolution backprojection.
Week 6	X-ray image characteristics: spatial resolution (point spread function, line spread function, edge spread function), image noise, image contrast. Biological effects of ionizing radiation: threshold, exposure time, exposure area.
Week 7	Fundamentals of Acoustic Propagation: stress and strain relationship, equation of motion, characteristic impedance, intensity, radiation force, reflection and refraction, attenuation, absorption, scattering, Doppler effect and Doppler methods.
Week 8	Generation and detection of ultrasound: piezoelectric effect, ultrasonic transducers (mechanical and electrical matching), transducer beam characteristics, axial and lateral resolution, focusing, arrays.
Week 9	Ultrasonic Diagnostic methods: pulse-echo systems (A or amplitude mode, B or brightness mode, M or motion mode and C-mode), Ultrasonic transmission methods and transmission tomography. Biological effects of ultrasound: acoustic phenomena at high intensity levels, ultrasound bio effects.

Week 10	Fundamentals of nuclear medicine: Nuclear particles, nuclear activity and Half-life, units for measuring nuclear activity, interaction of nuclear particles and matter (alpha particles, beta particles, gamma Rays), attenuation of gamma radiation, radio nuclides, counting statistics.
Week 11	Generation and detection of nuclear emission: nuclear sources, radionuclide generators, nuclear radiation detectors, collimators. Radionuclide Imaging Systems: rectilinear scanner, scintillation scanner, single photon emission tomography, positron emission tomography Internal radiation dosimetry and biological effects.
Week 12	Fundamentals of Nuclear magnetic resonance: angular momentum, magnetic dipole moment, magnetization, Larmor frequency, rotating frame of reference and the RF magnetic field, Free Induction Decay (FID), Fourier Spectrum of the NMR signal, Spin Density, Relaxation Times, Pulse Sequences
Week 13	Generation and detection of NMR signal: the magnet (superconducting magnets, permanent magnets), magnetic field gradients, the NMR coil/probe, data acquisition.
Week 14	Imaging methods: slice selection, frequency encoding, phase encoding, spin-echo imaging, gradient-echo imaging, and blood flow imaging. Biological effects of magnetic fields: static magnetic fields, radio frequency fields, gradient magnetic fields.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670416 Biomedical Signals, Instrumentation and Measurement

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Murat Eyüboğlu

4. **Text book, title, author, and year:**
   1- *Introduction to Biomedical Engineering*, J.D. Enderle, and J.D. Bronzino, 2012.
   2- *Medical Instrumentation, Application and Design*, John G. Webster, 2010.
   3- *Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation*, Robert B. Nortrop, 2004.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Fundamentals of biomedical signals, measurement and instrumentation; biomedical transducers; membrane biophysics, electrophysiology of excitable cells, membrane models; theory of bioelectrical signals, ECG, EEG, EMG; biopotential electrodes; biopotential amplifiers and instrumentation techniques, electrical and patient safety; examples of monitoring, therapeutic and prosthetic devices.
   ii. **prerequisites or co-requisites:** EE311
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will learn basic physiology of the human body from an electrical engineering and mathematical modeling point of view.

Specific outcomes of instruction
- Gain a broad understanding of the membrane electrophysiology. - Learn the fundamentals of bioelectric fields, theory of ECG, EEG, ENG and EMG. - Build knowledge on measurement issues and related instrumentation for bioelectrical signals. - Develop a basic understanding of the physiology and modeling of respiratory and circulatory systems. - Develop problem solving skills. - Develop analytical thinking ability. - Build modeling and interpretation skills. - Integrate and use knowledge from various courses including Engineering, Physics and Mathematics. - Use computer-based resources effectively. - Set goals to accomplish task on time.

   ii. Students will gain knowledge on measurement issues, related instrumentation and devices for biomedical signals.

Specific outcomes of instruction

- Gain knowledge on different types of transducers, their operating principles and measurement techniques.
- Understand the origins of bioelectrical signals,
- Learn and practice related transducers and measurement equipment,
- Understand and measure ECG, EMG and nerve conduction velocity.
- Understand and measure respiratory parameters

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to Biomedical Engineering with Electrical Engineering perspective. Elements of a generalized Medical Instrumentation System
Week 2	Properties of biomedical signals and measurement constraints. Static and dynamic performance characteristics of measurements (absolute/relative error, accuracy, precision, sensitivity, resolution, reliability, repeatability systematic/random error). Design constraints and process for medical instruments.
Week 3	Resistive, capacitive, inductive, optical and ultrasonic sensors (transducers) to measure biophysical parameters such as force, displacement, temperature and velocity.
Week 4	Resting electrical properties of cells and electrical equivalent model for the excitable cell membrane.
Week 5	Action potential generation, voltage clamp experiment and Hodgkin-Huxley model of the action potential generation. Action potential propagation and cable model.
Week 6	Synaptic transmission and neuromuscular junction. Electroneurogram (ENG) and Electromyogram (EMG).

Week 7	Anatomy and function of the heart, electrical behavior of cardiac cells, electrical activation of the heart.
Week 8	Dipole theory of Electrocardiogram (ECG) and Vector cardiogram. Unipolar and Bipolar measurement techniques. Wilson's central and augmented lead terminal common.
Week 9	Basic anatomy and function of the brain, cerebrum, cerebellum, brain stem, cerebral cortex, electrical potentials from the brain, resting rhythms of the brain, clinical Electroencephalography (EEG).
Week 10	Polarization, polarizing and non-polarizing electrodes, Electrode-electrolyte interface and electrode circuit models, Electrode-skin interface and motion artifact. Modifying and interfering signals.
Week 11	Specific requirements to measure low level signals in noise, Biopotential (Instrumentation) amplifiers, Interference reduction techniques, Common mode reduction (Driven-Right-Leg) circuits.
Week 12	Noise and noise reduction techniques. Isolation, grounding and shielding in biomedical instrumentation. Electrical and Patient safety.
Week 13	Neural stimulator, pacemaker, defibrillator, respirator, etc.
Week 14	Measurement of blood pressure and related equipment. Doppler effect and measurement of blood flow and velocity. Measurement of respiratory volumes and flow, related devices.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670419 Solid State Devices

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Cengiz Beşikci

4. **Text book, title, author, and year:**
   1- Lecture Notes
   2- *Advanced Semiconductor Fundamentals*, R. F. Pierret , 2002,

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Introduction to quantum theory of solids, semiconductor fundamentals and carrier transport, p-n and metal-semiconductor junctions, BJTs and MOSFETs: principles, modeling and advanced issues, heterojunctions and advanced electron devices, optical properties of semiconductors, optical devices: photodetectors, solar cells, light emitting diodes and lasers.
   ii. **prerequisites or co-requisites:** EE212
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend the quantum theory of solids and semiconductor fundamentals at a depth sufficient to understand the principles of modern electronic and photonic semiconductor devices.

Specific outcomes of instruction
- Understand the quantum theory of solids - Understand the formation of energy bands in solids - Read the energy band structure of semiconductors to predict transport properties - Understand important recombination-generation mechanisms in semiconductors - Understand and model carrier transport in submicron semiconductor devices - Understand optical properties of semiconductors - Choose a proper semiconductor material for a specific application

   ii. Students will be able to develop and use advanced equivalent circuit models for semiconductor electron devices and design the structures of these devices.

Specific outcomes of instruction
- Understand the characteristics of diodes, BJTs and MOSFETs in depth including nonideal (secondary) effects - Understand the characteristics of advanced compound semiconductor transistors for high speed electronics - Develop and utilize advanced equivalent circuits for diodes, BJTs and MOSFETs - Design BJTs and MOSFETs at discrete and integrated circuit levels - Utilize semiconductor electron devices efficiently in the design of electronic circuits

iii. Students will be able to understand the operational principles and characteristics of photonic semiconductor devices and utilize these devices efficiently in optoelectronics applications.

Specific outcomes of instruction
- Understand the physics and characteristics of photodetectors, solar cells, LEDs and Lasers - Utilize and design photodetectors and photoemitters for optoelectronic applications

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Principles of Quantum Mechanics, Schrodinger's Equation and applications
Week 2	Energy Band Theory: formation of energy bands, Kronig-Penney Model, Brillouin zones
Week 3	Particle motion and effective mass, density of states and Fermi-Dirac functions
Week 4	Review of semiconductor fundamentals: equilibrium distribution of carriers, intrinsic and doped semiconductors
Week 5	Recombination-Generation processes in semiconductors
Week 6	Drift and diffusion, current and continuity equations, carrier scattering and high field transport
Week 7	Secondary effects in p-n junctions, metal-semiconductor junctions: Schottky barrier diode and ohmic contacts

Week 8	Advanced equivalent circuit models and frequency limitations of BJTs, nonideal effects in BJTs
Week 9	MOS structure: basic properties and C-V characteristics, Advanced MOSFET fundamentals
Week 10	Nonideal effects in MOSFETS, MOSFET scaling, threshold voltage modification, hot-electron effects
Week 11	Semiconductor heterojunctions, heterojunction bipolar transistor, MESFET and high electron mobility transistor
Week 12	Optical properties of semiconductors, Photodetectors: photoconductor, photodiode, infrared photodetectors
Week 13	Solar cells and LEDs
Week 14	Semiconductor lasers: basic principles, laser structure, absorption, loss and gain, laser design issues

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670426 Antennas and Propagation

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Lale Alatan

4. **Text book, title, author, and year:**
   Antenna Theory, Analysis and Design, C.A. Balanis, 3rd Ed., John Wiley&Sons, 2005.
   i. **other supplemental materials:**
   Antennas and Radiowave Propagation, R.E.Collin, McGraw-Hill, 1985.
   Antenna Theory and Design, W.L. Stutzman, G.A. Thiele, 2nd Ed., John Wiley & Sons, 1998.
   Antennas, J.D. Kraus, 2nd Edition, McGraw Hill, 1988.
   Antenna Theory and Design, R.S.Elliot, Pentice-Hall, 1981.
   Foundations of Antennas, P.S. Kildal, Studentlitteratur, 2000.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Antenna parameters. Linear antennas. Influence of earth on antenna radiation pattern and impedance. Radiation from slot and aperture antennas. Antenna arrays and the general array formula. Baluns. Receiving antenna theory. Elements of ground wave, tropospheric and ionospheric propagation.
   ii. **prerequisites or co-requisites:** EE303
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be familiarized with the basic antenna concepts and the antenna subsystems (radiating element, feed networks) as a part of communication, broadcasting, radar, navigation and similar systems.

Specific outcomes of instruction
- Understand the basic antenna parameters - Understand antenna modeling as a system element - Learn and become experienced with antenna array analysis - Understand radiation principles and basic analytical methods for radiation calculation

   ii. Students will be familiarized with the common antenna types and structures, their parameters and properties along with an understanding of RF measurement technique

Specific outcomes of instruction
- Gain ability to conduct experiments - Gain experience on RF measurement techniques - Gain ability to analyze and interpret measurement data - Gain ability to report the results effectively

- Understanding of basic antenna structures and radiation properties

iii. Students will be familiarized with basic wave propagation concepts

Specific outcomes of instruction
- Understand basic modes of EM Wave propagation - Understand ground wave propagation - Understand tropospheric propagation - Understand ionospheric waves

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Radiation mechanism, Types of antennas, Electromagnetic fundamentals, Radiation from a short current filament
Week 2	Radiation pattern, Radiation power density, radiation intensity
Week 3	Directivity and gain, Radiation efficiency
Week 4	Antenna input impedance, Radiation resistance, Polarization
Week 5	Effective height, Effective aperture, Bandwidth, Antenna noise
Week 6	Fields radiated by electric and magnetic type currents, Duality principle, Far-field approximations
Week 7	Infinitesimal dipole, Small dipole, Dipole of arbitrary length
Week 8	Travelling wave antennas, Small loop antenna, Antennas above or on an infinite plane conductor, Monopole antenna
Week 9	Linear, planar, circular arrays, Array factor, principle of pattern multiplication
Week 10	N element linear array, Binomial array, Array of arrays
Week 11	Field equivalence principles

Week 12	Calculation of radiation fields from aperture fields, Rectangular apertures, Circular apertures
Week 13	Basic modes of EM wave propagation, Direct wave, Grounded reflected wave, Fresnel formulas
Week 14	Surface wave, Tropospheric refraction, Effective earth radius, Ionospheric waves

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670427 Microwaves I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Şimşek Demir

4. **Text book, title, author, and year:**
   Microwave Engineering, David M. Pozar, John Wiley & Sons, 3nd ed. 2009.
   i. **other supplemental materials:**
   1- *Foundations for Microwave Engineering*, R. E. Collin, Mc Graw Hill Int. Editions, 2nd ed., 1992.
   2- *Microwave Engineering*, A. Das and S. K. Das, Mc Graw Hill, 1st ed., 2007.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   TEM mode transmission lines. Field and distributed circuit analysis. Frequency and time domain analysis. Waveguiding structures. Rectangular and circular waveguides. Impedance transformations and matching techniques. Scattering matrix of microwave junctions.
   ii. **prerequisites or co-requisites:** EE303
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend voltage/current waves on transmission lines.

Specific outcomes of instruction
- Calculate the impedance, voltage, current observed at an arbitrary point on the transmission line - Identify the parameters of a transmission line - Determine the voltage and current wave properties of a transmission line - Use the standing wave pattern for identifying the load impedance

   ii. Students will be able to apply impedance matching techniques.

Specific outcomes of instruction
- Use the Smith Chart for impedance/admittance transformations - Build impedance matching distributed circuits - Calculate parameters of an impedance matching network - Identify the properties of time domain reflections on transmission lines

   iii. Students will be able to comprehend modes of waves in wave guiding structures.

Specific outcomes of instruction
- Solve Maxwell's equations for wave guiding structures - Compute electric and magnetic fields in a circular wave guide for TE and TM modes - Calculate the losses in the guiding structures

- Compute electric and magnetic fields in a rectangular wave guide for TE and TM modes - Solve the phase and groups velocities of waves in the guiding structures

iv. Students will be able to comprehend matrix representation of two ports.

Specific outcomes of instruction
- Construct matrix representations (Z, Y, S, ABCD) of microwave networks - Transform matrix representations from one form to another

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction and review
Week 2	TEM Transmission lines (circuit analysis)
Week 3	Terminated transmission line (reflection coefficient, VSWR, loads)
Week 4	Introduction and use of Smith Chart
Week 5	Impedance transformation and matching with transmission lines
Week 6	Matching involving lumped elements
Week 7	Time domain analysis of reflections on lossless transmission lines
Week 8	Solution of Helmholtz Equations in guided structures (TEM, TE, and TM modes)
Week 9	Perturbation method for low loss lines
Week 10	Field solutions for coaxial lines and losses
Week 11	Rectangular waveguides, modes of propagation, losses
Week 12	Phase and group velocities of guided waves
Week 13	Circular waveguides
Week 14	Matrix Representation of Microwave Junctions (S, Z, Y)

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670428 Microwaves II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Şimşek Demir

4. **Text book, title, author, and year:**
   Microwave Engineering, David M. Pozar, John Wiley & Sons, 3nd ed. 2009.
   i. **other supplemental materials:**
      1- *Foundations for Microwave Engineering*, R. E. Collin, Mc Graw Hill Int. Editions, 2nd ed., 1992.
      2- *Microwave Engineering*, A. Das and S. K. Das, Mc Graw Hill, 1st e., 2007.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Passive reciprocal and nonreciprocal devices. Electromagnetic resonators. Periodic structures and microwave filters. Microstripline structures and coupled lines. Solid state microwave devices.
   ii. **prerequisites or co-requisites:** EE427
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to use matrix representations of microwave networks.

Specific outcomes of instruction
- Identify the properties of a network from its matrix representation - Determine the missing components of the networks by examining the physical structure - Determine the matrix representation of connected network

   ii. Students will be able to apply even/odd mode analysis.

Specific outcomes of instruction
- Determine even and odd mode parts of the excitations - Analyze the multiport networks for even and odd mode excitations - Compute S-parameters of microwave networks such as coupled line networks, hybrid couplers and power dividers

   iii. Students will be able to design broadband impedance matching networks.

Specific outcomes of instruction
- Comprehend theory of small reflections and its limitations and apply to impedance matching network design - Compute parameters of an impedance matching network for maximally flat and equi-ripple responses - Compute parameters of a tapered line impedance transformer

   i. Students will be able to analyze microwave resonators.

Specific outcomes of instruction

- Comprehend the resonance in distributed networks and waveguide structures - Compute the resonance frequency and Q factor of a resonator

ii. Students will be able to design basic microwave filters.

Specific outcomes of instruction
- Comprehend the maximally flat and equi-ripple frequency responses for low pass prototype - Transform the low pass prototype to low pass, high pass and band pass frequency responses - Apply basic implementation methods to filter designs

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	S-Matrix of Lossless Junctions (T-line, Waveguide, Magic-Tee, Rat-race)
Week 2	Even and Odd Mode Analysis of TEM Coupled Lines
Week 3	Even and Odd Mode Analysis of TEM Coupled Lines
Week 4	Phase shifters, 3dB Hybrids, Power Dividers
Week 5	Broadband matching techniques, theory of small reflections
Week 6	Quarter-wave multisection impedance transformers
Week 7	Quarter-wave multisection impedance transformers
Week 8	Tapered transmission lines
Week 9	Cavities (Rectangular, Circular, TEM Line, Q factor, equivalent circuits)
Week 10	Cavities (Rectangular, Circular, TEM Line, Q factor, equivalent circuits)
Week 11	General Filter Design from prototype
Week 12	General Filter Design from prototype
Week 13	Transmission line filters, coupled line filters, cavity coupled filters
Week 14	Introduction to active and passive microwave semiconductor devices

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670430 Digital Signal Processing

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Tolga Çiloğlu

4. **Text book, title, author, and year:**
   Oppenheim, Schafer, *Discrete-Time Signal Processing*, Pearson, 2010, 3rd ed..

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Discrete-time signals and systems. Discrete Fourier transform. Sampling and reconstruction. Linear time-invariant systems. Structures for discrete-time systems. Filter design techniques. Fast Fourier Transform methods. Fourier analysis of signals using discrete Fourier transform. Optimal filtering and linear prediction.
   ii. **prerequisites or co-requisites:** EE301
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to demonstrate their understanding of fundamental discrete-time signal and system concepts

Specific outcomes of instruction
- Differentiate between various types of discrete-time (DT) systems and sequences. - Characterize and utilize eigenproperty of DT linear time-invariant (LTI) systems. - Compute convolution for DT LTI systems. - Determine the impulse response of a DT LTI system represented by an LCCDE.

   ii. Students will be able to interpret Fourier analysis of periodic and aperiodic discrete-time signals with an extension to z-transform.

Specific outcomes of instruction
- Compute DFT in a computationally efficient manner - Determine the discrete-time Fourier Transform (DTFT) of a sequence. - Represent a periodic sequence through discrete Fourier series (DFS). - Characterize the relation of Discrete Fourier Transform (DFT) to DFS and DTFT. - Compare z-transform with DTFT and explain region of convergence. - Compute (linear) convolution by using DFT.

   iii. Students will be able to understand sampling, reconstruction and rate conversion concepts for sequences and analyze such systems with processing modules.

Specific outcomes of instruction

- Describe the mathematical model of sampling and reconstruction, indicating the frequency behavior and its limits. - Analyze a signal processing system that contains sampling and reconstruction stages. - Construct rate-conversion systems to reach a desired rate and frequency response. - Describe practical issues in sampling & reconstruction

iv. Students will be able to interpret transform domain behavior of discrete-time systems with emphasis on their frequency response.

Specific outcomes of instruction
- Determine the frequency response (magnitude and phase) of DT systems from its poles and zeros. - Characterize the properties of minimum-phase, all-pass and linear phase systems.

v. Students will be able to formulate a solution for designing discrete-time filters based on some constraints using different structures.

Specific outcomes of instruction
- Apply filter design techniques based on a set of constraints on frequency response - Construct different representations of the same DT system.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to DSP, Discrete-Time Signals and Systems
Week 2	Discrete-Time Signals and Systems, *cont'd*
Week 3	Z-transform
Week 4	Discrete Fourier Transform
Week 5	Discrete Fourier Transform, *cont'd*
Week 6	Sampling of Continuous-Time Signals

Week 7	Sampling of Continuous-Time Signals, *cont'd*
Week 8	Transform Analysis of LTI systems
Week 9	Transform Analysis of LTI systems*, cont'd*
Week 10	Transform Analysis of LTI systems, *cont'd*
Week 11	Structures for Discrete-time Systems
Week 12	Filter Design Techniques
Week 13	Filter Design Techniques, *cont'd* - Computation of DFT
Week 14	Computation of DFT, *cont'd*

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670433 Real-time Applications of Digital Signal Processing

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 1
   Applied/Laboratory Credits: 2
   Total Credits: 3
   Engineering Topics: 3

3. **Instructor's or course coordinator's name:** Prof.Dr.T.Engin Tuncer

4. **Text book, title, author, and year:**
   Digital Signal Processing System-Level Design Using LabVIEW, N.Kehtarnavaz, N. Kim Elsevier, 2005.
   a. **other supplementary material**
      Hands-On Introduction to LabVIEW for Scientists and Engineers,John Essick,2013.
      LabVIEW Digital Signal Processing and Digital Communications, C. L. Clark, 2005

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   This course teaches the theory and practice of signal processing on real world problems. Particular emphasis is given to the practical applications and real-time processing in embedded systems. Students will apply the Signal Processing theory on real world problems and hence this course will provide extensive hands-on experience for real-time processing with embedded systems. The course aims to strengthen the student's understanding of the foundations of Digital Signal Processing. Students will get acquainted with the professional hardware and software. This course allows students to gain knowledge and experience to implement complete DSP projects and improve skills on embedded platforms through intense laboratory experiments. Interactive teaching of the DSP applications and practical evaluation of the students' progress will improve students' background continuously. Students are expected to gain important engineering skills by implementing signal processing systems in MATLAB and real-time embedded hardware by writing efficient programs in LabVIEW and C.
   ii. **prerequisites or co-requisites:** EE301
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to understand the difference between the offline and real-time implementations for DSP systems. Implement systems in embedded system hardware.

Specific outcomes of instruction
- Learn the operating system effects on real-time performance. - Learn the hardware components in DSP implementations. - Learn to program DSP systems in CPU. - Learn to program DSP systems in FPGA -Learn to transfer data between CPU and FPGA -Learn the constraints in real-time implementations

   ii. Learn the theory and practice for multi-rate DSP systems and phase-locked loops.

Specific outcomes of instruction
- Learn the theory of decimation, interpolation and phase-locked loops. - Design and implement multi-rate DSP systems in embedded system hardware in real-time. - Evaluate the results by comparing with the theoretical expectations.

iii. Learn optimum filter theory and implement it in embedded system hardware

Specific outcomes of instruction
- Understand the optimum filter theory and formulate the filter design. Obtain the optimum filter design algorithm. - Implement the optimum filter in hardware -Evaluate the results and compare them with the theory.

iv. Learn the system identification and implement the adaptive filter structures.

Specific outcomes of instruction
- Learn the adaptive filter theory. - Understand and design adaptive filter structures. -Implement the adaptive filter structure in real-time on the embedded system by using a microphone as the input source. -Compare the adaptive filter result with the theoretical expectations.

v. Learn the image processing low level functions and implement them in real-time.

Specific outcomes of instruction
- Learn the difference between high and low level image processing functions. - Learn 2D FFT, IFFT, filtering, and edge detection - Design 2D filters for lowpass, highpass and bandpass characteristics - Implement the 2D image processing systems by using a camera on the embedded platform.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	

5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	X

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to real-time software and hardware systems
Week 2	Real-time system design and implementation on CPU and FPGA
Week 3	Experiment 1: Programming simple functions in LabVIEW on a PC
Week 4	Experiment 2: Programming both myRIO cpu and FPGA
Week 5	Experiment 3 Part1:Signal generation, filtering, cross correlation, A/D, D/A, DMA, MATLAB implementation.
Week 6	Experiment 3 Part2: Realization of the experiment in real-time, demo and evaluation.
Week 7	Experiment 4 Part1: Decimation, Interpolation, Phase-Locked Loop, MATLAB implementation.
Week 8	Experiment 4 Part 2: Realization of the experiment in real-time, demo and evaluation.
Week 9	Experiment 5 Part 1: Optimum filtering: FIR Wiener filter implementation for noise removal, MATLAB implementation.
Week 10	Experiment 5 Part 2: Realization of the experiment in real-time, demo and evaluation.
Week 11	Experiment 6 Part1: System Identification with Adaptive Processing, design and implementation of LMS filter. MATLAB implementation.
Week 12	Experiment 6 Part 2: Realization of the experiment in real-time, demo and evaluation
Week 13	Experiment 7 Part 1: Image processing, 2D FFT, filtering, edge detection, MATLAB implementation
Week 14	Experiment 7 part 2: Realization of the experiment in real-time, demo and evaluation

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670435 Telecommunications I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 1
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Elif Uysal

4. **Text book, title, author, and year**
   Proakis & Salehi, *Fundamentals of Communication Systems, 2/E*
   Software Defined Radio using MATLAB & Simulink and the RTL-SDR
   (available for free download at http://www.desktopsdr.com/)
   i. **other supplemental materials:**
   1- L. W. Couch,II , *Digital and Analog Communication Systems*, Prentice Hall, 2002, 7th Edition
   2- *Communication Systems*, Simon Haykin, John Wiley & Sons, 4th Ed.
   3- *Communication Systems*, Bruce Carlson, McGraw Hill, 3rd Ed.
   4- *Modern Digital and Analog Communication Systems*, P. Lathi, HRW Inc. 2nd Ed.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Amplitude and angle modulation techniques: Amplitude Modulation, Double Side Band, Single Side Band, Vestigial Side Band, Quadrature Amplitude Modulation, Frequency Modulation, Pulse Modulation. Phase-locked loops. Superheterodyne receivers. Frequency division multiplexing. Noise analysis in CW systems. Link Budget. Introduction to Digital Communication. Geometric Signal Space representation. Orthogonal and Antipodal binary signaling. BER analysis of binary modulation schemes.
   ii. **prerequisites or co-requisites:** EE306
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to apply basic time/frequency analysis techniques to communication systems.

Specific outcomes of instruction
- Identify and discuss basic goals in modulation - Analyze the transmitter and receiver operations for amplitude modulation types - Analyze the transmitter and receiver operations for phase/frequency modulation types - Analyze the effects of noise for various modulation types - Recognize differences between objective and subjective performance criteria in communication - Choose a modulation type and design an analog or binary digital communication system for a set of specified SNR, BER, transmit power, etc requirements.

   ii. Students will have an operational knowledge of basic communication system design techniques

Specific outcomes of instruction
- Develop an understanding of typical design requirements - Have a working knowledge of practical implementation constraints - Be aware of compatibility issues and impact of human audio and visual perception mechanisms in design of communication systems. - Propose an initial design of a communication system based on link budget analysis

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, Amplitude Modulation: Double Sideband Modulation
Week 2	DSB-SC, Coherent detection, squaring loop, Conventional AM
Week 3	Conventional AM: Time/frequency domain representations, Detection – envelope detector, Power efficiency
Week 4	SSB: Representation, filter based generation, two-stage modulation, demodulation with offsets, envelope detection with carrier QAM, VSB: Representation
Week 5	ANGLE MODULATION Definitions, single tone narrowband FM Wideband FM: bandwidth, Carson's rule, Woodward's theorem
Week 6	FM Generation: Direct/Armstrong methods, mixer FM Demodulation: FM through linear systems, FM-to-AM detector, Limiter/Discriminator, PLL
Week 7	Applications: Superhet receiver, frequency division multiplexing
Week 8	EFFECT OF NOISE ON CW SYSTEMS: Thermal noise review, Noise analysis in AM and FM systems
Week 9	FM types: analysis, preemphasis-deemphasis

Week 10	Transmission: Friis' formula, noise figure, Link Budget
Week 11	SAMPLING & QUANTIZATION
Week 12	Pulse code modulation, TDM: mu-law, A-law, differential PCM, sigma/delta modulation, TDM
Week 13	BINARY DIGITAL MODULATION: Orthogonal waveforms, Baseband/bandpass, Geometric representation
Week 14	Optimum receiver, error analysis

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670436 Communications II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 1
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Gökhan Muzaffer Güvensen

4. **Text book, title, author, and year:**
   Fundamentals of Communication Systems, Proakis & Salehi, 2/E
   Software Defined Radio using MATLAB & Simulink and the RTL-SDR
   (available for free download at http://www.desktopsdr.com/)
   i. **other supplemental materials:**
      1- *Communication Systems Engineering*, J. G. Proakis, M. Salehi, Prentice Hall, 2002, 2nd Edition
      2- *Communication Systems*, Simon Haykin, John Wiley & Sons, 4th Ed.
      3- *Communication Systems*, Bruce Carlson, McGraw Hill, 3rd Ed.
      4- *Modern Digital and Analog Communication Systems*, P. Lathi, HRW Inc. 2nd Ed.
      5-*Digital and Analog Communication Systems*, Leon W. Couch, II, Prentice Hall, 2013, 8th Edition

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** M-ary digital modulation. Spectrum of digital modulation schemes. Transmission in band-limited channels. Synchronization. Wireless channel models. Multi-carrier modulation. Multi-antenna communication. Introduction to information theory.Introduction to coding theory
   ii. **prerequisites or co-requisites:** EE435
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**

Specific outcomes of instruction

- Recognize differences between objective and subjective performance criteria in communication
- Describe and contrast basic digital modulation methods
- Compare and contrast digital communication signals based on basic properties such as PSD, BER performance
- Integrate blocks such as pulse shapers, modulators, matched filters, synchronizers, detectors in order to construct a digital communication system
- Propose working solutions to a real-world communication problem through digital communication techniques
- Analyze and measure signal properties experimentally

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week		Subject	HW due	Midterm	Lab+DEMO*
1		0) Introduction 1)M-ary Modulation			
2		Cont'd			
3		Cont'd	X		X
4		Cont'd 2) Spectrum of Digital Modulation Schemes			

5		Cont'd	X		
6		3) Transmission in Band-Limited Channels			X
7		Cont'd	X	X	
8		Cont'd 4) Synchronization			
9					X
10		5) Wireless Channel Models	X		
11		6) Multi-Carrier Modulation			X
12		7) Multi-Antenna Communication	X	X	
13		8) Intro to Information Theory			
14		9) Intro to Coding Theory	X		X

8. MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670438 Optical Communication Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Serdar Kocaman

4. **Text book, title, author, and year:**
   B. Saleh & M. Teich, *Fundamentals of Photonics*, Wiley, 2007
   i. **other supplemental materials:**
      1- *Optical Fiber Communications*, Gerd Keiser, McGraw-Hill Science, 2010
      2- *Fiber-Optic Communication Systems*, Govind P. Agrawal, Wiley, 2010

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Introduction to geometric optics; ray theory and electromagnetic wave theory of optical propagation in fibers. Optical fibers and their transmission characteristics. Cables, connectors and couplers. Introduction to optical sources and detectors. Principles of optical communication systems, performance analysis and design.
   ii. **prerequisites or co-requisites:** EE303
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend the fundamental principles of fiber optics.

Specific outcomes of instruction
- Learn the essential knowledge of fiber optics components such as fiber types, waveguides, rays and modes. - Learn the properties of single mode fibers, multi-mode fiber and their usage in the short / long distance networks. - Understand the basics of the attenuation and absorption in the fibers and learn the fundamental causes of loss such as scattering losses, bending losses, core/cladding losses. - Learn the concepts of signal distortion in optical fibers, mode-field parameter and propagation modes in optical fibers.

   ii. Students will be able to comprehend the fundamental principles of guided wave optics and photonic components.

Specific outcomes of instruction
- Gain essential knowledge on the transmitting light through dielectric medium and how planar dielectric waveguides and photonic crystal waveguides work. - Learn the principles of optical coupling between waveguides. - Apply their knowledge on optics and mathematics to develop a solution to an electromagnetic problem into modes using coupled mode theory.

- Learn the photonic components used in the optical communication systems such as ring resonator, directional couplers, multi-mode interference couplers and integrated and fiber based interferometers. - Comprehend the fundamentals of second order and third order nonlinear optics and be able to apply nonlinearity on the Coupled-Mode –Theory equations.

iii. Students will be able to comprehend the fundamental principles of optical communication systems.

Specific outcomes of instruction
- Understand the fundamentals of lightwave systems and the system architecture. - Learn the state-of-the-art and the future techniques for high performance fiber optic systems. - Apply the principles of wave propagation to understand how dispersion management is done, how dispersion compensated fibers work. - Gain the essential knowledge of optical amplifiers, doped fiber amplifiers and how an EDFA is incorporated into a system. - Gain the introductory knowledge on fiber solitons, loss-managed and dispersion managed solitons. -Understand the basic principles of coherent lightwave systems and gain essential knowledge on modulation formats, demodulation schemes and bit-error rate.

iv. Students will be able to apply their theoretical knowledge to conduct experiments related to fiber optic systems.

Specific outcomes of instruction
- Familiarize with components and devices such as 1550nm Laser, photo-receiver, EDFA and associated pump system, OTDR, optical attenuator, fiber patchcords, fiber isolator, optical power meter, digital oscilloscope, pattern generator, error detector, pulse generator, etc,. - Conduct experiments on optical systems applications such as optical time-domain reflectometry, amplification with an EDFA, electro-optic modulation and digital transmission.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to Optical Communications
Week 2	Guided Wave Optics
Week 3	Resonator Optics
Week 4	Photonic Components
Week 5	Nonlinear Optics
Week 6	Photonic Switching
Week 7	Fiber Optics
Week 8	Fiber Optics
Week 9	Fiber Optics
Week 10	Lightwave Systems
Week 11	Lightwave Systems
Week 12	Optical Amplifiers
Week 13	Soliton Communication Systems
Week 14	Coherent Lightwave Systems

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

8. **Course number and name:** 5670441 Data Structures

9. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3
   Engineering Topics: 3

10. **Instructor's or course coordinator's name:** Prof. Dr. Klaus Werner Schmidt

11. **Text book, title, author, and year:**
    Data Structures and Algorithms with Object-Oriented Design Patterns in C++, B. R. Preiss, Wiley, 1999.
    Data Structures with C++, William H. Ford, William R. Topp, Prentice-Hall, 1996.
    Data Structures & Algorithms Analysis in C++, C. Shaffer, Dover Publications, 2012.
    b. other supplementary material
    Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Edition, MIT Press, 2009.

12. **Specific course information**
    i. brief description of the content of the course (catalog description): Arrays, stacks, queues, linked lists, trees, hash tables, graphs: Algorithms and efficiency of access. Searching and sorting algorithms.
    ii. prerequisites or co-requisites: CENG230 (prerequisite) or CENG229 (prerequisite)
    iii. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Elective

13. **Specific goals for the course**
    i. Create awareness of and experience in object-oriented programming discipline.

Specific outcomes of instruction
- Understand the meaning of and the usage of object oriented programming - Learn basics of object oriented programming and class definition. - Learn recursive algorithms and argument passing

    ii. Create awareness of and experience in dynamic memory management.

Specific outcomes of instruction
- Understand the meaning of and the usage of memory and dynamic memory. - Learn to create and delete dynamic memory. - Use dynamic memory in various data structures.

    iii. Learn fundamental data structures with their searching, insertion and deletion capabilities.

Specific outcomes of instruction
- Learn array data structure. - Learn stack and queue data structure. - Learn linked list and tree data structure. - Learn graph data structure. - Learn hash coding.

- Learn searching, insertion and deletion in the covered data

iv. Learn fundamental sorting algorithms with their complexity analysis.

Specific outcomes of instruction
- Understand the meaning of sorting. - Learn sorting algorithms (selection sort, bubble sort, quick sort, radix sort). - Compare the algorithms in terms of their complexity.

v. Create awareness of and experience in algorithm complexity.

Specific outcomes of instruction
- Understand the meaning of algorithm complexity. - Learn Big-O, Ω, Θ complexity analysis details. - Perform complexity analysis for various algorithms.

vi. Create awareness of and experience in computational complexity.

Specific outcomes of instruction
- Understand the meaning of computational complexity - Learn decisison problems, P, NP, NP complete, NP hard problem classes, relation betwwen these classes and problem reduction

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

14. Brief list of topics to be covered

Week	Topic
Week 1	Object-Oriented Programming, Classes
Week 2	Argument passing, references
Week 3	Pointers, arrays
Week 4	Algoritmic Complexity
Week 5	Stacks and Queues
Week 6	Dynamic Memory
Week 7	Linked Lists
Week 8	Trees
Week 9	Graphs
Week 10	Graphs
Week 11	Sorting
Week 12	Hashing
Week 13	Computational Complexity
Week 14	Computational Complexity

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670442 Operating Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Uğur Halıcı

4. **Text book, title, author, and year:**
   Modern Operating Systems, A. Tanenbaum and H. Boss, 4th ed., Pearson, 2015.
   i. **other supplemental materials:**
   1. Uğur Halıcı, Lecture Notes on Operating Systems, available online
   2. Operating Systems – Internals and Design Principles, W. Stallings, 8th ed., Pearson, 2015.
   3. Operating System Concepts, A. Silberschatz, P. B. Galvin, G. Gagne, 9th ed., Wiley, 2013.
   4. Unix for Programmers and Users, G. Glass, 3rd ed., Pearson, 2003.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Introduction to operating systems, process scheduling, concurrent processes, critical section and synchronisation, deadlock prevention/avoidance/detection memory management, virtual memory, file systems, input/outputs
   ii. **prerequisites or co-requisites:** CENG230/CENG240
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. To make the students aware of basic concepts related to Operating Systems, to be able to develop some subsystems of it.

Specific outcomes of instruction
Know general properties of Operating Systems - Understand how the processes are scheduled for processor, know various processing scheduling algorithms, apply rules to measure their performances, judge their adequacy in different situations - Understand critical section and synchronization problems for Concurrent Processing and learn various ways to handle it - Understand deadlock problem and know various ways to handle it, judge their adequacy in different situations -Understand memory management, know various memory management strategies, apply rules to measure their performances, judge their adequacy in different situations - Understand file management, know various file management strategies - Understand how to handle input/output

   ii. To make the students to implement or simulate some basic parts of operating systems

Specific outcomes of instruction
- to be able to write codes for some specific parts of the OS and/or simulate its behaviours for some of the basic management algorithms through programming assignments.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to Operating Systems
Week 2	Processor Scheduling concepts
Week 3	Processor Scheduling algorithhms
Week 4	Concurrent Processes – Critical section
Week 5	Concurrent Processes – Synchronization
Week 6	Deadlock concepts, prevention
Week 7	Deadlock avoidance, detection
Week 8	Memory management concepts
Week 9	Memory management approaches
Week 10	Virtual Memory
Week 11	File systems
Week 12	File systems
Week 13	Input/Output
Week 14	Input/Output

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670443Numerical Methods and Introduction to Optimization

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Lale Alatan

4. **Text book, title, author, and year:**
   Numerical methods and optimization: An Introduction, Sergiy Butenko, Panos Pardalos, CRC press, 2014
   i. **other supplemental materials:**
      1- *Numerical methods and optimization: A consumer guide*, Eric Walter, Springer, 2014.
      2-*Engineering Optimization: Theory And Practice*, Singiresu S. Rao, 4th Edition, John Wiley and Sons, 2009.
      3- *Numerical Methods: An Introduction with Applications Using MATLAB®*, Amos Gilat, Vish Subramaniam, John Wiley and Sons, 2011.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
      Finite precision arithmetic and numerical errors. Solution of linear system of equations. Numerical solution of nonlinear equations, interpolation, numerical differentiation and integration. Basic concepts of optimization, local and global optimality, convexity. Optimality conditions for unconstrained optimization; method of steepest descent, Newton's method, conjugate direction methods; least-squares solutions. Optimality conditions for problems with equality and inequality constraints; method of Lagrange multipliers and penalty function method.
   ii. **prerequisites or co-requisites:** MATH120, MATH260, CENG240 or CENG229 or CENG230
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend finite precision arithmetic and numerical errors.

Specific outcomes of instruction
- Explain how numbers are represented in computers - Classify numerical errors such as storage and truncation errors - Discuss the effects of arithmetic operations on the propagation of numerical errors - Describe numerical instability

   ii. Students will be able to solve nonlinear equations numerically.

Specific outcomes of instruction

- Give examples of numerical methods (Bisection, false position, secant, Newton's method) used to solve nonlinear equations. - Choose the appropriate method for a given problem - Use the build-in functions fzero and roots in MATLAB

iii. Students will be able to solve linear systems of equations.

Specific outcomes of instruction
- Solve a linear system of equations by Gaussian elimination and LU decomposition - Use the build-in functions inv, linsolve and lu in MATLAB

iv. Students will be able to construct an interpolating polynomial that fits to given data points

Specific outcomes of instruction
- Construct a polynomial that fits the given data points by using divided differences - Use the build-in functions polyfit, polyval and spline in MATLAB

v. Students will be able to compute derivatives and integrals numerically.

Specific outcomes of instruction
- Compute first order and higher order derivatives numerically - Give examples of numerical integration rules (Trapezoidal, Simpson's, Gauss quadrature) - Choose the appropriate method for a given problem - Use the build-in functions polyder, trapz and integral in MATLAB

vi. Students will be able to solve constrained and unconstrained optimization problems

Specific outcomes of instruction
- Identify local and global optimality and convex problems - Solve unconstrained optimization problems with a single variable - Apply steepest descent, Newton's and conjugate direction methods to solve multivariable unconstrained optimization problems - Solve linear system of equations in least squares sense - Apply Lagrange multiplier method and penalty function method to solve constrained optimization problems -Use the build-in functions pinv, fminbnd and fminsearch in MATLAB

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	

7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Finite precision arithmetic and numerical error: Conversion between different number systems, floating point representation of numbers, numerical error types and sources, propagation of errors
Week 2	Solution of linear system of equations: Review of linear algebra, Gauss Elimination Method
Week 3	LU decomposition Solution of nonlinear equations: Bisection method, False position method
Week 4	Secant and Newton's Methods, Fixed point iteration and Müller's method
Week 5	Numerical interpolation: Polynomial forms, the method of undetermined coefficients, Lagrange method, divided difference method
Week 6	Cubic splines Numerical differentiation: Forward, backward and central differencing, higher order derivatives
Week 7	Numerical integration, Newton-Cotes formulas; Trapezoidal rule, Simpson's rule, Boole's rule
Week 8	Composite rules and Romberg integration Gaussian quadrature
Week 9	Basic concepts of optimization: Formulating an optimization problem, local and global optimality, existence of an optimal solution, convex sets, functions and problems
Week 10	Optimality conditions, optimization problems with a single variable (One dimensional search concept and methods)
Week 11	Multivariable unconstrained optimization: Method of steepest descent Newton's method, conjugate direction methods
Week 12	Least square solution of linear system of equations and generalized inverse of a matrix
Week 13	Optimality conditions for problems with equality and inequality constraints
Week 14	Method of Lagrange multipliers, penalty and barrier function methods

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670444 Introduction to Computer Networks

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Ece Guran Schmidt

4. **Text book, title, author, and year:**
   Computer Networking: A Top Down Approach ,
   7th edition, Jim Kurose, Keith Ross, Pearson, 2017.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Seven layered ISO-OSI model, the medium access sublayer, ALOHA and local area network protocols, IEEE 802.2 and ethernet, the data link layer, error detection and correction, data link protocols, the network layer, routing, congestion control, internetworking, the transport layer, Internet and Internet tools.
   ii. **prerequisites or co-requisites:** EE230
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be acquainted with basic computer network terminology regarding computer networks and able to comprehend layered network architectures and the layer interfacing.

Specific outcomes of instruction
-Learn names and basic functionality of network devices. Grasp the hierarchical architecture of Internet -Comprehend peering and service relations between network layers, protocols and encapsulation -Identify the performance metrics for computer networks

   ii. Students will be able to identify the queuing systems in computer networks and apply M/M/1 Queue analysis to assess the performance of computer networks with metrics of throughput, delay and buffer requirement

Specific outcomes of instruction
-Identify the queueing systems in computer networks. -Understand basic parameters and performance metrics for queuing systems in computer networks -Analyze M/M/1 Queue Systems -Apply the queuing analysis to computer network systems at different layers

   iii. Students will be understand the Application, Transport, Network, Data Link and Physical Layers contemporary TCP/IP based computer networks

Specific outcomes of instruction
-Learn the functionality of the layer with its encapsulation in detail

-Understand the interfaces with the upper and lower layers as well as the peer interfaces.
-Evaluate and analyze the performance of different contemporary computer networking protocols at each layer
-High level network design by being aware of the layered architecture and end-to-end communication

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, Layered network architectures, overview of the contemporary Internet
Week 2	Basic queuing theory
Week 3	Basic queuing theory
Week 4	Application Layer
Week 5	Application Layer
Week 6	Transport Layer Overview
Week 7	Techniques of Reliable Transmission
Week 8	Techniques of Reliable Transmission
Week 9	Transport Layer: TCP/UDP
Week 10	Network Layer
Week 11	Network Layer
Week 12	Data Link Layer
Week 13	Data Link Layer
Week 14	Physical Layer and end-to-end network functionality

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670445 Computer Architecture I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Ece Guran Schmidt

4. **Text book, title, author, and year:**
   Digital Design, 4th Edition, M. M. Mano, Prentice Hall International, 2006.
   Computer System Architecture, M. Mano, Prentice Hall International, 1982
   Digital Design and Computer Architecture: ARM Edition,Sarah Harris, David Harris profile imageDavid Harris, Morgan Kaufmann, May 2015

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Algorithmic state machines. CPU organization. Construction of arithmetic logic unit. Process control architectures. Instruction modalities. Microprogramming.Arithmetic Logic Unit.
   ii. **prerequisites or co-requisites:** EE348
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Provide the students with an understanding of the analysis and synthesis of asynchronous sequential digital systems.

Specific outcomes of instruction
- Ability to analyze and design of asynchronous sequential circuits. - Design oriented thinking - Develop problem solving skills - Develop thinking ability

   ii. Provide the students the top-down digital system design procedure using algorithmic state machine approach and in dept understanding of basic computer architecture in register and instruction execution phases levels.

Specific outcomes of instruction
- Ability of digital system modeling. - Ability of top-down design of digital systems. - Ability of understanding of basic digital computer architecture. - Ability of top-down design of digital systems. - Provide understanding of basic digital computer architecture - Develop problem solving skills - Develop basic computer understanding skills.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Algorithmic state machine
Week 2	Algorithmic state machine
Week 3	Registers and register operations, design language
Week 4	Basic computer organization and operation
Week 5	Basic computer organization and operation
Week 6	Basic computer organization and operation
Week 7	CPU organization
Week 8	Microprogramming
Week 9	Microprogramming
Week 10	Microprogramming
Week 11	Arithmetic Logic Unit Design
Week 12	Arithmetic Logic Unit Design
Week 13	Arithmetic Logic Unit Design
Week 14	Introduction to ARM ISA

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670446 Computer Architecture II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Ece Guran Schmidt

4. **Text book, title, author, and year:**
   Digital Design and Computer Architecture: ARM Edition,Sarah Harris, David Harris profile imageDavid Harris, Morgan Kaufmann, May 2015
   i. **other supplemental materials:**
      1- *Computer Organization and Design ARM Edition: The Hardware Software Interface*,David A. Patterson, John L. Hennessy Morgan Kaufmann, 2017
      2- *Computer Organization and Architecture, Designing for Performance*, 11th Edition, William Stallings, Pearson, 2019

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Arithmetic processor design, arithmetic algorithms. Memory organization, parallel processing, multiprocessors systems. Peripheral organization. I/O processing. I/O controllers.
   ii. **prerequisites or co-requisites:** EE445
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Make student competent with basic CPU structures and microarchitecture concepts

Specific outcomes of instruction
- Understanding of the operation of single-cycle, multi-cycle and pipelined processors - Ability to understand performance modeling - Design oriented thinking - Ability to conduct hands-on experiments. - Working and debugging of relatively large logic circuits. - Ability to design and operate logic circuits

   ii. Make students familiar with different memory organizations and superscalar Processor design

Specific outcomes of instruction
- Understanding memory hierarchy -Ability to understand Cache and Virtual Memory Operation -Abiility to understand the performance improvements of advanced processor designs - Design oriented thinking - Problem solving skills - Ability to conduct hands-on experiments. - Working and debugging of relatively large logic circuits.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Review of general CPU organization
Week 2	Performance Models for Computer Architecture
Week 3	ARM Microarchitecture-single cycle
Week 4	ARM Microarchitecture-multi cycle
Week 5	ARM Microarchitecture-pipelined
Week 6	ARM Microarchitecture-pipelined
Week 7	Memory systems, memory hierarchy
Week 8	Caches
Week 9	Virtual Memory
Week 10	Cache Performance
Week 11	Memory Mapped I/O
Week 12	Virtual Memory
Week 13	Superscalar Processor and Out of Order Execution
Week 14	Superscalar Processor and Out of Order Execution

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670447 Introduction to Microprocessors

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Gözde B. Akar

4. **Text book, title, author, and year:**

   - Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, Fifth Edition, 2017, Jonathan W Valvano
   - The Definitive Guide to ARM Cortex M3 and Cortex M4 Processors, Third Edition, 2014, Joseph Yiu
   - Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Second Edition), Oct 2015, Yifeng Zhu.
   - Digital Design and Computer Architecture, ARM Edition, 2015, Harris and Harris.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Microprocessor architecture; a particular microprocessor software. I/O interfacing. Interrupt processed I/O. Direct memory access. Microprocessor based communications.
   ii. **prerequisites or co-requisites:** EE 314 and EE 348
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to understand the fundamentals of microprocessors, microcontrollers, hardware interfacing and system design techniques.

Specific outcomes of instruction
- Understand the operation of microprocessors and microcontrollers - Understand hardware interfacing techniques - Be able to design the hardware and software of microprocessor based systems

   ii. Make students competent in assembly language programming on a selected microprocessor/microcontroller to prepare them to be able to apply this knowledge to other architectures.

Specific outcomes of instruction
- Learn instruction set, addressing modes register set and memory map - Learn the concepts of stacks, subroutines, interrupts - Be able to write assembly language programming

iii. Make students competent on hardware interfacing using a selected microprocessor.

Specific outcomes of instruction
- Learn address decoding - Learn interfacing memory and I/O to the selected microprocessor - Be able to write assembly language programming to utilize the interfaced memory or I/O

iv. Make students competent on hardware interfacing using a selected microcontroller.

Specific outcomes of instruction
- Learn parallel and serial I/O interfacing - Learn A/D and D/A conversion and how to digitize analog signals at required rates - Learn how to use timer and interface a step motor

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction, Microcontroller Basics, ARM Architecture
Week 2	Memory concepts, address decoding
Week 3	Programming Model, Addressing Modes
Week 4	Assembly Programming
Week 5	Detailed Instruction Set
Week 6	Programming Examples
Week 7	Stack, Subroutines, Interrupts and Resets
Week 8	Parallel I/O
Week 9	Systick timer
Week 10	General Purpose Timer
Week 11	A/D and D/A Conversion

Week 12	Serial I/O
Week 13	Project Work
Week 14	Project Work

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670449 Computational Intelligence

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3
   Engineering Topics: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Uğur Halıcı

4. **Text book, title, author, and year:**
   Computational Intelligence: A Methodological Introduction, R. Kruse, C. Borgelt, F. Klawonn, C. Moewes, M. Steinbrecher, P. Held, 2013, Springer ISBN: 978-1-4471-5013-8
   - **i. other supplemental materials:**
   1. Computational Intelligence: An Introduction, A. P. Engelbrecht, 2007, Wiley, ISBN: 978-0-470-03561-0
   2. Computational Intelligence: A Logical Approach, D. Poole, A. Mackworth, R. Goebel, 1998, MIT, ISBN: 978-0195102703
   3. An Introduction to Natural Computation (Complex Adaptive Systems), D. H. Ballard, 1999, MIT, ISBN: 978-0262522588

5. **Specific course information**
   - **i. brief description of the content of the course** (catalog description)
   Various aspects of modeling and transformation of information and knowledge in computers; computational intelligence paradigms: neural networks, reinforcement learning, evolutionary algorithms, fuzzy systems, deep learning, machine learning; intelligent algorithms; biologically inspired computation.
   prerequisites or co-requisites: CENG230/CENG229/CENG240, EE230/STAT201 /STAT153/STAT221/MATH301/MATH401

   - **ii. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   - **i.** The course aims to give an insight on various aspects of computational intelligence:

Specific outcomes of instruction
- Modeling and transformation of information and knowledge in computers - Sub-symbolic and nature-analogous paradigms and algorithms that exhibit intelligent behavior - Tolerating incomplete, imprecise and uncertain knowledge - The use of computational intelligence algorithms in practice.

   - **ii.** At the end of the course, the students will have gained

Specific outcomes of instruction
- An overall view of a wide range of algorithms having intelligent characteristics

- Practical applications of computational intelligence in various areas, such as pattern recognition, regression, combinatorial optimization and other areas requiring decision making.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	X

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to Computational Intelligence;
Week 2	Introduction to Neural Networks:
Week 3	Multi Layer Perceptrons (MLP)
Week 4	Reinforcement Learning
Week 5	Introduction to Evolutionary Algorithms
Week 6	Elements of Evolutionary Algorithms
Week 7	Fundamental Evolutionary Algorithms
Week 8	Other Population-Based Approaches
Week 9	Other Population-Based Approaches
Week 10	Fuzzy Sets and Fuzzy Logic
Week 11	Fuzzy Relations
Week 12-14	Various extensions in specialized areas

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

2. **Course number and name:** 5670462 Utilization of Electrical Energy

3. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

4. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Emine Bostancı

5. **Text book, title, author, and year:**
   Power Semiconductor Drives, Dewman S.B., Slemon G.R. and Straughen A., John Wiley and Sons, 1984
   i. **other supplemental materials:**
      1- *Solid State DC Motor Drives*, Kusko A. the M.I.T. Press, 1979.
      2- *Thyristor Control of AC Motors*, Murphy J.M.D., Pergamon Press, 1975.
      3- *Electric Drives An Integrated Approach*, N.Mohan, MNPERE, 2003.
      4- *Electric Motor Drives: Modeling, Analysis, and Control*, Krishnan, R., Prentice Hall, 2001
      5- *Power Electronics: Converters, Applications, and Design*, N.Mohan, T.Undeland, W.Robbins, John Wiley and Sons, 2003.

6. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Basic operating characteristics and classification of electrical drives. Solid state DC motor control. Solid state AC motor control. Dynamic behavior of electrical machines. Electric braking. Starting of electrical machines. Intermittent loads. Drive applications. Modern methods of reactive power compensation. Electrical energy saving.
   ii. **prerequisites or co-requisites:** EE362 and EE463
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

7. **Specific goals for the course**
   i. Students will learn the use and the significance of electrical energy. They will also understand the role of electric motor drives in utilization of electrical energy.

Specific outcomes of instruction
- What is the installed capacity of electrical power sources? - What are the major electrical loads? - What is an electric motor drive? - A brief classification of electrical drives - Examples that illustrate the energy saving by electrical drives.

   ii. Students will be able to understand fundamental principles of mechanical system for the electric motor drives.

Specific outcomes of instruction
- Definitions of linear and rotational motion - Torque balance equation and its utilization in electrical drives - Components of load torques - Analogy between mechanical and electrical systems - Mechanical couplings in electrical drives

   iii. Students will learn typical mechanical loads and their toque-speed characteristics.

Specific outcomes of instruction
- Centrifugal loads, constant power loads, constant torque loads - Experiment 1. Fan load driven by Variable Frequency Drive (VFD) - Experiment 2. VFD driven Crane Hoist with Speed Feedback - Experiment 3. Centrifugal pump load driven by VFD

iv. Students will be able to understand four quadrant operation of electrical drives.

Specific outcomes of instruction
- Definition of speed control for steady and dynamic state by using speed-torque loci - 4-quadrant operation of electrical drive in view of mechanical and electrical system - Experiment 2. VFD driven Crane Hoist with Speed Feedback

v. Students will be able to analyze, control and operate DC motor drives.

Specific outcomes of instruction
- A brief review of DC motors: their structures, operating principles, types - Speed control methods of DC motors - DC-DC power converters for dc motor drives - Line-commutated single and three phase power converters for dc motor drives

vi. Students will be able to analyze, control and operate induction motor drives.

Specific outcomes of instruction	
- A brief review of induction motors: their structures, operating principles, types - Speed control methods of wound rotor and squirrel cage induction motors - Analysis of three-phase voltage source inverter for induction motor drives	
- Experiment 1-3	

vii. Students will be able to analyze, control and operate synchronous motor drives.

Specific outcomes of instruction
- A brief review of synchronous motors: their structures, operating principles, types - Speed control methods of synchronous motors - Analysis of load commutated power converters for synchronous motor drives

viii. Students will learn practical aspects in selection and designing electrical drives.

Specific outcomes of instruction
- Operating duty of electrical drives - Determination of current, voltage and power ratings of the electrical drive - Experiment 1-3

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	

6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

8. Brief list of topics to be covered

Week	Topic
Week 1	Introduction
Week 2	Mechanical System
Week 3	Mechanical Load Characteristics
Week 4	4-Quadrant Drive Characteristics
Week 5-6	DC Motor Drives
Week 7	**First Midterm Examination**
Week 8-10	Induction Motor Drives
Week 11	Synchronous Motor Drives
Week 12	**Second Midterm Examination**
Week 13	Practical Aspects in Selection of Electric Motor Drives
Week 14	**Experiments**

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670463 Static Power Conversion I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Ozan Keysan

4. **Text book, title, author, and year:**
   1- *Power Electronics*, Cyril W. Lander, McGraw-Hill, 1993, Third Edition.
   2- *Power Electronics*, N. Mohan, T. M. Undeland, W.P. Robbins, John Wiley Publishing Co., 2003.
   i. **other supplemental materials:**
   1- *Elements of Power Electronics*, P. T. Krein, Oxford University Press, 1998.
   2- *Principles of Power Electronics*, J.G. Kassakian, M.F. Schlecht, G.C. Verghese, Addison Wesley, 1992.
   3- *Fundamentals of Power Electronics*, R.W. Erickson and D. Maksimovic, Kluwer, 2001.
   4- *Power Semiconductor Devices*, B. J. Baliga, PWM Publishing Co., 1996.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Power switches and their characteristics. Power converter definitions, classification. VTA method. Midpoint and bridge rectifiers: non-ideal commutation, harmonics, input power factor, utility-factor, winding utilization and unbalances in rectifier transformers. Applications.
   ii. **prerequisites or co-requisites:** EE 212 and EE 361
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend basic power electronics conversion principles.

Specific outcomes of instruction
- Determine the basic components of switching matrix - Determine the periodic switching rules - Use the switching rules to achieve a specific power conversion target

   ii. Students will be able to understand and characterize the terminal properties of power semiconductor devices and use these characteristics in design of power converters

Specific outcomes of instruction
- Evaluate the structure, material, and control properties of the power semiconductors - Determine the terminal properties of power semiconductors - Experimental characterization of the power semiconductor terminal properties: measure v-i curves, determine the parasitic effects - Cross-compare characteristic parameters for trade-off relations

iii. Students will be able to characterize the input and output characteristics of rectifiers and use the characteristics in power converter design and control.

Specific outcomes of instruction
- Characterize the rectifier output voltage waveforms, calculate the average and ripple values - Characterize the rectifier input current waveforms, calculate the harmonic and rms values - Evaluate the harmonics ad distortion values and compare with standards

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction: applications, multidisciplinary nature of power electronics, fields of power electronics, etc. (Chapter 1 of Mohan)
Week 2	Principles of Power Electronics: Switching rules, basic operating rules for switching circuits, volt-seconds rule, ampere-seconds rule, periodical solutions, the switching matrix, switch requirements, unidirectional and bidirectional switches, etc. (Chapter 1 and chapter 3 of Mohan)
Week 3	Semiconductors: Power Diodes (Chapter 2, 19,20 of Mohan)
Week 4	Semiconductors: Thyristors (Chapter 2, 19,23 of Mohan)
Week 5	Introduction to Rectifiers (Chapter 5,6 Mohan, 2,3 Lander): Rectifier principles, single switch, uncontrolled, semi controlled, analysis
Week 6	Rectifiers (Chapter 5,6 of Mohan, 2,3 of Lander)
Week 7	Rectifiers (Chapter 5,6 of Mohan, 2,3 of Lander)
Week 8	Rectifiers (Chapter 5,6 of Mohan, 2,3 of Lander) **(Midterm Exam 1)**
Week 9	Input/Output Harmonics and Filtering (Chapter 7 of Lander and 5,6,16,17,18 of Mohan)

Week 10	Filtering Continued and Computer Simulations of Power Electronic Circuits with Simplorer/PSpice/Simulink** (Chapter 4 of Mohan)
Week 11	Precharge Circuits, Inrush Currents, Thermal Management and Design (Mohan Chapter 29)
Week 12	Thermal Management (Mohan Chapter 29) **(Midterm Exam 2)**
Week 13	Control of Rectifiers (Handouts)
Week 14	Protection, snubbers, gate driving, and other issues of rectifiers (Handouts)

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670464 Static Power Conversion II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assist. Prof. Dr. Ozan Keysan

4. **Text book, title, author, and year:**
   Power Electronics, N. Mohan, T. M. Undeland, W.P. Robbins, John Wiley Publishing Co., 2003.
   a. **other supplementary material**
      1- *Elements of Power Electronics*, P. T. Krein, Oxford University Press, 1998.
      2- *Principles of Power Electronics*, J.G. Kassakian, M.F. Schlecht, G.C. Verghese, Addison Wesley, 1992.
      3- *Fundamentals of Power Electronics*, R.W. Erickson and D. Maksimovic, Kluwer, 2001.
      4- *Power Semiconductor Devices*, B. J. Baliga, PWM Publishing Co., 1996.
      5- *Power Electronics*, Cyril W. Lander, McGraw-Hill, 1993, Third Edition.
      6- *Switching Power Supply Design*, Abraham I. Pressman, 1998.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Introduction to forced commutated circuits, analysis, classification of techniques. Centretap inverter. Voltage-fed inverters; waveshaping; PWM, stepped and square-waveforms, voltage regulation, harmonics. Current-fed inverters; analysis, effect of SCR turn-off time on voltage waveform, overlap. DC-DC switching converters; time-ratio control, effect of loading, parameter optimization. Device failure mechanisms. Thermal considerations, maximum ratings, protection of switching elements. Series and parallel operation of switching elements.
   ii. **prerequisites or co-requisites:** EE463
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend basic dc-dc converter topologies and their operating characteristics.

Specific outcomes of instruction
- Determine the basic dc-dc converter topologies, obtain their pwm waveforms and derive their voltage transfer characteristics - Determine continuous and discontinuous operation modes and their conditions - Size filter components for mode of operation

   ii. Students will be able to comprehend the need for and the utilization of isolated dc-dc converter topologies and their operating characteristics.

Specific outcomes of instruction

- Determine the basic isolation requirements and derive the isolated converter topologies from the basic topologies and derive their voltage transfer characteristics - Determine continuous and discontinuous operation modes and their conditions - Size the isolation transformers and filter components for given mode of operation

iii. Students will be able to comprehend basic dc-ac converter topologies and their operating characteristics, harmonic characteristics.

Specific outcomes of instruction
- Characterize the inverter output voltage waveforms, calculate the fundamental component and for square wave mode of operation, evaluate the distortion - Characterize the inverter output voltage waveforms for pwm mode of operation, investigate the harmonic spectrum - Extend the concept from single to three-phase applications and evaluate the control and power flow issues

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to forced commutated circuits, Gate Turn-Off devices, DC/DC, DC/AC, AC/AC conversion, review of basic power electronics concepts
Week 2	Gate Turn Off Power Semiconductors - Power Transistors: BJT, MOSFET, IGBT, IGCT, Switching pole, hard switching v-i trajectories
Week 3	DC/DC Converters - Basic converter topologies, Voltage input-output function derivations
Week 4, 5	DC/DC Converters - Converter behavior
Week 6	DC/DC Converters - Full-bridge DC/DC converter, Unipolar/Bipolar Modulation

Week 7	DC/DC converters - SMPS: DC/DC converters with isolation
Week 8	DC/DC converters - Modelling and control of DC/DC converters: state-space averaging, voltage/current mode control, cascade control (H-bridge converter controlled DC motor drive)
Week 9	DC/AC Converters (Inverters) Basics voltage source inverter, current source inverter, single phase half and full (H) bridge inverter
Week 10	DC/AC Converters (Inverters) H-bridge inverter analysis, modulation, sinusoidal PWM, harmonic spectrum, optimal PWM, phase displacement control
Week 11	DC/AC Converters (Inverters) Three phase voltage source inverters, basic topology, six step operating mode, scalar modulation, sinusoidal PWM, voltage linearity, harmonics spectrum, triplen harmonic injection PWM
Week 12	DC/AC Converters (Inverters) Space vector modulation, switching pattern optimization, optimal PWM, PWM rectifier, single switch boost PFC rectifier, inverter and rectifier applications, industrial inverter drives, UPS systems, control of inverters.
Week 13	Hard/Soft Switching Concepts, Transistor Snubbers
Week 14	DC/DC Converters - Snubbers continued, Commutation techniques: Hard switching and soft switching, ZVS, ZCS, Resonant Converters (resonant load, quasi-resonant, resonant transition), other commutation techniques

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670471 Power System Analysis I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Prof. Dr. Nezih GÜVEN

4. **Text book, title, author, and year:**
   1- *Power System Analysis*, J. J. Grainger and W. D. Stevenson, McGraw-Hill, 1994
   2- *Power System Analysis, 2nd ed.*, A. R. Bergen and V. Vittal, 2000

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Basic structure of electrical power systems. Electrical characteristics of transmission lines, transformers and generators. Representation of power systems. Per Unit System. Symmetrical three-phase faults. Symmetrical components. Unsymmetrical faults.
   ii. **prerequisites or co-requisites:** EE361
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to determine the transmission line parameters, develop and employ proper transmission line models in the analysis of power networks.

Specific outcomes of instruction
- Compute the series resistance and inductance of a single/multi phase transmission line - Compute the shunt capacitance of a single/multi phase transmission line - Develop and apply short-line, medium-length line and long-line models

   ii. Students will be able to develop and employ models for electric machines commonly used in power systems and analyze the single-phase equivalent circuits of the system.

Specific outcomes of instruction
- Describe the structure, operation and model for synchronous machines - Describe the structure, operation and model for different transformer types and connections (such as two-winding, three-winding, autotransformers, Y-connection, Delta-connection, etc) - Employ per-unit system in the analysis of three phase circuits - Describe and assess active and reactive power concepts in three phase networks

   iii. Students will be able to analyze symmetrical and unsymmetrical faults in a power network.

Specific outcomes of instruction
- Compute and analyze three-phase faults in a power system - Explain and derive symmetrical component transformation - Construct positive, negative and zero-sequence equivalent circuits of a power network - Compute and analyze unsymmetrical faults in a power system

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1 - 2	Introduction to power systems, Turkish Electric Network, Basic Concepts
Week 3	Power in Three-Phase Circuits
Week 4	Transmission Line Parameters
Week 5 - 6	Transmission Line Modeling
Week 7 - 8	Review of Transformers and Synchronous Machines
Week 9 - 10	System Modelling, Bus Admittance and Impedance Matrices
Week 11- 12	Symmetrical Three-Phase Faults
Week 13	Symmetrical Components and Sequence Networks
Week 14	Unsymmetrical Faults

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670472 Power System Analysis II

1. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

2. **Instructor's or course coordinator's name:** Prof. Dr. Nezih GÜVEN

3. **Text book, title, author, and year:**
   1- *Power system analysis*, J. J. Grainger and W. D. Stevenson, McGraw-Hill, 1994
   2- *Power system analysis, 2nd ed.*, A. R. Bergen and V. Vittal, 2000

4. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Matrix analysis of power systems networks and methods of solution. Load flow and short circuit analysis. Economic operation of power systems. Transient stability analysis.
   ii. **prerequisites or co-requisites:** EE471
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

5. **Specific goals for the course**
   i. Students will be able to describe computer modeling of large power systems and construct and revise related network matrices.

Specific outcomes of instruction
- Describe, construct and revise the bus admittance matrix of a power system - Describe, construct and revise the bus impedance admittance matrix of a power system

   ii. Students will be able to apply numerical solution techniques to typical power system problems.

Specific outcomes of instruction
- Solve a linear system of equations by iterative and direct methods such as LDU factorization and describe and interpret the effects of sparsity - Solve a set of nonlinear algebraic equations (arising from load flow analysis) by iterative techniques - Solve differential equations (arising from stability analysis) by numerical integration techniques

   iii. Students will be able to formulate and solve the load flow problem, interpret the results and assess the effect of controlling parameters in the operation and design of power systems.

Specific outcomes of instruction
- Describe and formulate the load flow problem - Solve the load flow problem by numerical techniques (Gauss-Seidel, Newton Raphson, FDLF) and interpret the results - Identify and explain the impact of controlling parameters in a load flow problem - Use a professional power system analysis software

- Analyze and redesign a power system based on technical and economic criteria, generate (propose) alternative solutions and justify their proposals

iv. Students will be able to solve unbalanced faults by using bus impedance matrices and describe the approach employed in computer solutions.

Specific outcomes of instruction
- Employ sequence bus impedance matrices in the solution of unbalanced faults - Solve and analyze unbalanced faults through impedances

v. Students will be able to describe, formulate and solve the power system stability problem based on equal area criterion.

Specific outcomes of instruction
- Describe and formulate the stability problem in a power system and explain the Swing equation - Describe the equal area criterion for stability determination - Apply numerical integration techniques and/or equal area criterion to determine the transient stability of one- or two-machine systems

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

6. Brief list of topics to be covered

Week	Topic
Week 1	Introduction: Generation, Transmission and Distribution systems, Structure of Turkish Electric Network Modern Power System
Week 2	Operation Review of Power System Modeling: Transmission Line models, Generators, Transformers
Week 3	Network Matrices: Bus Admittance Matrix
Week 4	Network Matrices: Bus Impedance Matrix

Week 5	Solution of Linear System of Equations: Iterative Techniques, Direct Methods
Week 6	Sparse Data Structures, Fill-ins, Ordering Techniques
Week 7	Solution of Nonlinear Algebraic Equations: Gauss-Seidel Method
Week 8	Solution of Nonlinear Algebraic Equations: Newton-Raphson Method
Week 9	Load Flow Solutions and Control: Formulation of Load Flow Problem, Solution of Nonlinear Algebraic Equations
Week 10	Solution Techniques, Computer Studies, Control of Power into a Network
Week 11	Computer Calculation of Fault Currents, Review of Sequence Networks and Unsymmetrical Faults
Week 12	Analysis Using Bus Impedance Matrix, Faults Through Impedances
Week 13	Power System Stability: Formulation of the Stability Problem, Equal Area Criterion of Stability
Week 14	Numerical Integration Techniques, Multimachine Stability Studies, Computer Solution Techniques

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670474 Distribution Systems

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Murat Göl

4. **Text book, title, author, and year:**
   Published Lecture Notes
   a. **other supplementary material**
      Electric Power Distribution System Engineering, T. Gönen, McGrawHill, 1986

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
      Basic considerations. Load characteristics and forecasting methods. Distribution substations. Subtransmission, primary and secondary distribution. Choice of voltage levels. Operational characteristics of cables, aerial lines and transformers. System voltage regulation. Power factor correction. Fusegear, switchgear, current and voltage transformers. Overcurrent and thermal protection. Earthing methods. Economics of distribution systems.
   ii. **prerequisites or co-requisites:** -
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to specify the loads and prepare tables as required by system design.

Specific outcomes of instruction
- Learn the general outline of the Turkish electrical power system and identify the generation, transmission and distribution systems and principles involved - Learn to identify the existing loads, methods of addition of loads, load factor, diversity and simultaneity factors for an existing plant - Learn the characteristics of various distributed loads, load growth and future system considerations - Learn to prepare tables necessary for the planning of the design of the system with distribution boards

   ii. Learn the characteristics of distribution system equipment.

Specific outcomes of instruction
- Learn the switch-gear used in distribution systems and differentiate between disconnect switch, load-break switch and circuit breaker in application - Learn the factors involved in the cable choice of power cables and protection of cable by switch-gears and fuse-gear. Provide examples of voltage drop and low voltage system design - Learn the characteristics of power and distribution transformers, losses involved, protection gear used for distribution transformers - Learn the characteristics of voltage and current transformers.

- Learn the low voltage distribution systems as TN, TT and IT systems

iii. Learn the medium voltage distribution system.

Specific outcomes of instruction
- Learn the difference between low and medium voltage (MV) distribution systems, distribution voltage levels - Learn the design of MV distribution systems with cables and overhead lines - Learn the medium voltage feeder protection and application of overcurrent relays

iv. Learn the set-up of distribution substations.

Specific outcomes of instruction
- Learn to discriminate between indoor and outdoor and pole-top substations with the choice of the equipment characteristics - Learn the switching requirements for the usage of circuit-breakers and load-break switches - Learn the grounding principles, touch and step voltage and means of protection against electrical shocks - Learn the internal equipment placement of metal clad and metal enclosed medium voltage panel-boards

v. Learn the design of practical power factor correction schemes.

Specific outcomes of instruction
- Learn the difference between parallel resonance circuits and power factor compensated systems - The advantages gained by power factor compensation and the levels required by the Turkish Electricity Authority - Learn the application of different methods of reactive power compensation and general, group and individual compensation - Learn to compensate special loads which are motors and transformers

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Power system in relation to the distribution system
Week 2	Distribution system principles
Week 3	Loads, estimation, diversity and forecasting
Week 4	Factors affecting the choice of cables and overhead lines
Week 5	Principles of current interruption, HV and LV switcgear and fuses
Week 6	Distribution boards, Supply back-ups, generators and UPS systems
Week 7	Power factor correction, Grounding
Week 8	Protection against electrical shocks, residual current protection
Week 9	MV Distribution systems
Week 10	Power, voltage and current transformers
Week 11	Loss analysis in distribution systems
Week 12	Distribution automation
Week 13	Distribution system protection
Week 14	Reliability of distribution systems

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670475 High Voltage Techniques I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Ahmet Rumeli

4. **Text book, title, author, and year:**
   Lecture Notes

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Field analysis: experimental and numerical (finite difference, finite element and charge simulation) methods and applications. Electrical breakdown in gases: ionization processes. Townsend's breakdown criterion, Paschen's Law, bread-down in electronegative gases, time lags. Streamer-Kanal mechanism, breakdown in non-uniform field and corona. Electrical break-down of liquids: breakdown mechanism of pure and commercial liquids. Electrical breakdown of solids: Intrinsic, electromechanical, thermal and erosion mechanism. Insulating materials: dielectric gases; insulating oils and solid dielectrics.
   ii. **prerequisites or co-requisites:** EE224
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend principles of breakdown in gases.

Specific outcomes of instruction
- Identify basic concepts related to electrical breakdown of insulating gases - Understand Townsend Breakdown Mechanism - Understand Streamer (or Kanal) Mechanism of Spark - Understand Corona Discharge

   ii. Students will be able to comprehend principles of breakdown in liquids.

Specific outcomes of instruction
- Identify basic concepts related to electrical breakdown of insulating liquids - Understand the electrical breakdown of liquids under Practical (Industrial) conditions - Understand the electrical breakdown of liquids under Laboratory conditions and breakdown theories - Identify dielectric tests of insulating liquids

   iii. Students will be able to comprehend principles of breakdown in solids.

Specific outcomes of instruction
- Identify basic concepts related to electrical breakdown of insulating solids - Identify different breakdown mechanisms in solids

   iv. Students will be able to understand application of Insulation materials for the insulation of High Voltage System and discharge detection in high voltage equipments

Specific outcomes of instruction
- Understand the characteristics and application of Dielectric Gases - Understand the characteristics and application of Insulating Liquids - Understand the characteristics and application of solid dielectric materials - Identify methods of discharge detection in high voltage equipment

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1 - 2	Electric potential and field. Uniform, semi-uniform, and non-uniform field insulating systems. Experimental and numerical field analysis methods. Insulating mediums. Dielectric strength and breakdown.
Week 3 - 8	General gas laws. Ionization and decay processes. Towsend's current growth equations. Paschen's Law. Effects of pressure, temperature, humidity, and space charge on breakdown voltage. Breakdown of electronegative gases. Breakdown under surge voltages. Streamer breakdown mechanism. Breakdown in non-uniform field. Post-breakdown phenomena and applications.
Week 9 - 10	Pure and commercial liquids. Conduction and breakdown in pure and commercial liquids. Electronic cavitation and suspended particle breakdown mechanisms.
Week 11 - 12	Types of breakdowns in solid dielectrics: Intrinsic, Electromechanical, Streamer, Thermal, and Erosion breakdowns, Surface flashover.
Week 13 - 14	Normal and electronegative gases. Mineral insulating oil. Oil oxidation and purification techniques. Electrical testing of insulating oil. Insulating solids: Paper, Fiber, Mica and its products, Glass, Ceramics, Plastics, and Epoxy resins. Electric testing of insulating liquids and solid dielectrics.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670476 High Voltage Techniques II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Prof. Dr. Ahmet Rumeli

4. **Text book, title, author, and year:**
   Lecture Notes

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Generation and measurement of high AC, DC and impulse voltages and impulse currents: AC to DC conversion and electrostatic generators. Testing transformers and series resonant circuits. Impulse voltage generator circuits. Operation, design and construction of impulse generators. Impulse current generator circuits. Sphere and uniform fieldgaps. Electrostatic, generating and peak voltage measuring voltmeters. Voltage dividers. Measurement of impulse voltages and currents. Dielectric measurements.
   ii. **prerequisites or co-requisites:** EE361
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend generation and measurement techniques of high DC voltage.

Specific outcomes of instruction
- Identify basic concepts related to high voltage DC generation and measurement - Understand high DC voltage generation in single stage DC circuits - Understand high voltage DC generation in voltage multiplying circuits - Understand the principles of electrostatic generators - Understand voltage stabilization techniques

   ii. Students will be able to comprehend generation and measurement techniques of high AC voltage.

Specific outcomes of instruction
- Identify basic concepts related to related to high voltage AC generation and measurement - Understand the techniques of high AC voltage generation using single-stage circuits - Understand the techniques of high AC voltage generation using multi-stage (cascade) circuits - Identify the Tesla transformer and series resonant testing circuits and voltage regulation of HV test circuits

   iii. Students will be able to comprehend generation of high impulse voltages and currents.

Specific outcomes of instruction
- Identify basic concepts related to generation of high impulse voltages and currents - Identify impulse voltage generating systems and operational and constructional features of them - Understand high impulse voltage generation using single-stage circuits - Understand high impulse voltage generation using multi-stage circuits. Modern impulse voltage generators - Understand operational, design and calculation of impulse voltage generating circuits and wave shapes

iv. Students will be able to understand measurement of high voltages and non-destructive insulation tests.

Specific outcomes of instruction
- Identify basic concepts related to measurement of high voltages and non-destructive insulation tests - Understand loss and capacitance measurement using the Schering Bridge - Understand partial discharge measurement and discharge detection in high voltage equipments

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Generation and transmission of electric energy. Testing voltages. Testing with DC, power frequency AC, and lightning and switching impulse voltages.
Week 2 - 7	Generation of high DC voltages. AC to DC conversion. Electrostatic machines. Voltage stabilization. Generation of high AC voltages. Single stage transformers. Cascade connections. The series resonant

	circuit for HVAC testing. Generation of high surge voltages. Generation of high impulse voltages and currents. Impulse voltage generating circuits and wave shape calculations. Operation, design, and construction of impulse generators. Impulse current generators.
Week 8 - 10	Peak voltage measurements by spark gaps. Electrostatic and generating voltmeters. The measurement of peak voltages. Voltage dividing systems and impulse voltage measurements.
Week 11 - 14	Loss and capacitance measurements. The Schering bridge. Measurement of large capacitance. Inductively coupled ratio-arm bridge. Partial discharge measurements. Layout, grounding, and screening of high voltage labs.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670478 Power System Protection

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Murat Göl

4. **Text book, title, author, and year:**
   1- *Power system protection, Lecture Notes*, Prof. Dr. A.Türeli
   2- *Power system relaying, 2nd ed.*, Horowitz & Phadke, 1995
   3- *Protective relaying, 3rd ed.*, Blackburn & Domin, 2006
   4- Network protection and automation guide, 3rd ed., Alstom, 2002

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Current and voltage transformers. Overcurrent protection. Comparators and static relay circuits. Differential protection and its application to generators, transformers and bus bars. Motor protection. Pilot wire protection of feeders. Introduction to distance and other protection systems.
   ii. **prerequisites or co-requisites:** EE471
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend basic power system properties.

Specific outcomes of instruction
- Learn the fundamental theory of protection and discriminate between protective system, equipment and schemes - Review the equivalent circuits and parameters of a power system plant - Review fault calculation, phase-ground and phase-phase faults - Learn the performance and application of voltage and current transformers

   ii. Learn the performance and application of voltage and current transformers.

Specific outcomes of instruction
- Learn the behavior of electromagnetic voltage transformers under steady-state and faulted conditions, and the national and international standards, disconnect switch, load-break switch and circuit breaker in application - Learn the behavior of current transformers for metering and protection systems, effects of saturation, rated burden and standards - Learn the application of protection current transformers with different accuracy limits - Learn current transformer winding arrangements, wound primary, summation transformer, zero sequence measurement

   iii. Learn the principles and applications of overcurrent protection.

Specific outcomes of instruction
- Learn the coordination procedure, the data required

- Learn the principles of time-current grading, discrimination by time, by current and both time and current - Learn and apply the standard inverse definite minimum time overcurrent relays and the high set instantaneous overcurrent relays - Learn grading of ground faults and ring mains

iv. Learn the protection systems applied to power transformers.

Specific outcomes of instruction
- Learn the protection systems applied to power transformers. - Learn transformer overcurrent protection by fuses, overcurrent relays and restricted earth fault schemes - Learn the differential protection of large transformers; basic considerations, current transformer primary ratings, filtering zero sequence and bias settings - Learn differential protection stabilization during magnetizing inrush conditions time delays, harmonic restrains

v. Learn the conventional time-stepped distance protection and applied to the distribution systems and electrified railways.

Specific outcomes of instruction
- Learn the conventional time-stepped distance protection and applied to the distribution systems and electrified railways - Learn the feeding arrangements in electrified railroads and the protection philosophy - Learn the distance protection zone reaches in electrified railroads, the zone time delays. - Learn the back-up protection of cutenery using definite time overcurrent relays

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic

Week 1	Power system relaying
Week 2	Transducers: Current transformers
Week 3	Transducers: Voltage transformers
Week 4	Feeder protection: Definite minimum type, IDMT relays
Week 5	Feeder protection: Distance relays, Surge relays
Week 6	Transformer protection: Overcurrent
Week 7	Transformer protection: Restricted earth fault
Week 8	Transformer protection: Differential
Week 9	Motor protection: Overloads and thermal relays
Week 10	Motor protection: Overcurrent
Week 11	Motor protection: Differential
Week 12	Generator protection: Voltage, Frequency
Week 13	Generator protection: Reverse power, Differential protertion
Week 14	Generator protection: Ground fault

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670493 Engineering Design I

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 1
   Applied/Laboratory Credits: 2
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Emre Özkan

4. **Text book, title, author, and year:**
   NA

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Fundamentals of design, project management, design tools, simulation, standards and safety, quality concepts, design experience through a team project.
   ii. **prerequisites or co-requisites:** EE311 and two courses among EE 302, EE 314 and EE 361
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. To provide engineering design experience for our students through intra and inter-team collaboration, physical project work and process documentation.

Specific outcomes of instruction
- Understand the fundamentals of the design process - Gain experience in project management, problem solving, design and simulation tools, standards, ethics and quality concepts. - Gain experience on the tools and approaches taught during the lectures. - Reinforce methodologies and introduce additional design and problem solving approaches. - Be able to consult with the studio coordinator (course instructor). - Gain experience in inter-team communication and collaboration and the development of engineering standards. - Gain the ability to apply the project management tools and methodologies on a specific design project. - Gain the ability to share responsibilities within a team. - Gain the appreciation of the need for self and continuous learning.

   ii. To provide the ability to understand and redefine a given engineering problem and the ability to develop a conceptual design.

Specific outcomes of instruction
- Understand fundamentals of design process such as problem redefinition, idea generation, idea evaluation - Gain experience on problem redefinition, idea generation and idea evaluation methods - Develop the ability to communicate and discuss design ideas - Gain the ability to analyze a design problem to resolve interface elements and to develop an engineering standard document

- Apply creative thinking for the design of a product - The ability to share responsibilities within a team - The ability to design according to defined standards - Appreciation of the need for self and continuous learning

iii. To provide students the ability to communicate effectively.

Specific outcomes of instruction
- Understand fundamentals of written and oral presentation techniques, - Observe effective and not so effective presentation examples - Gain experience on written and oral presentation techniques - Appreciate compare/contrast other team members' and coordinator's line of thinking - Gain the ability to discuss and resolve conflicting interests and ideas in order to develop an engineering standard document - Gain experience on written and oral presentation techniques

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	X
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	X
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	X

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction
Week 2	Meeting with DS coordinators
Week 3	Fundamentals of Design **BUSINESS STATEMENT REPORT**
Week 4	Project Management
Week 5	Concept generation, design tools and problem solving techniques
Week 6	**PROPOSAL REPORT**
Week 7	Basics of Mechanical Design
Week 8	Image Processing
Week 9	Embedded Systems

Week 10	Practical Aspects of Electrical Motor Drive
Week 11	
Week 12	**MODULE DEMO to DS Coordinator**
Week 13	**CONCEPTUAL DESIGN REPORT**
Week 14	**ORAL PRESENTATIONS**

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670494 Engineering Design II

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 1
   Applied/Laboratory Credits: 2
   Total Credits: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Emre Özkan

4. **Text book, title, author, and year:**
   NA

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):** Continuation of Engineering Design I with topics covering statistics, reliability, engineering economics, ethics and completion of a team project with a final report and presentation.
   ii. **prerequisites or co-requisites:** EE 493
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**
   i. To provide engineering design experience for our students through intra and inter-team collaboration, physical project work and process documentation.

Specific outcomes of instruction
- Understand professional ethics, fundamentals of statistical methods, reliability - Understand the impact of engineering in a global and societal context - Appreciation of the need for self and continuous learning - Share design and innovation experiences of engineers from industry - Gain experience on the concepts and approaches taught during the lectures - Reinforce methodologies and introduce additional approaches - Appreciation of the need for continuously monitoring of the progress in the project - Critical evaluation of the subsystems of the design - Ability to apply the project management tools and methodologies on a specific design project - Ability to apply theoretical knowhow to overcome design issues and problems, - Ability to schedule and share responsibilities and workload within a team - Appreciation of the need for self and continuous learning

   ii. To provide students with the experience of the realization of a product from conceptual design to working model.

Specific outcomes of instruction
- Understand fundamentals of statistical methods, reliability, EMC (Electromagnetic Compatibility) - Share experience of engineers from industry - Appreciate of the need for self and continuous learning - Gain experience on solving problems faced during realization - Gain the ability to cope with conflicting requirements and constraints, - Appreciate of the need for continuously monitoring the progress in the project

- Gain experience on application of engineering knowledge to practice, - Gain experience on solving problems faced during realization - Gain hands-on experience on planning experiments for design testing, evaluation of results and design modification

iii. To provide students the ability to communicate effectively.

Specific outcomes of instruction
- Gain experience on written presentation techniques - Gain experience in oral presentation techniques - Gain the ability to prepare a well-organized technical report, - Gain the ability to justify and defend design decisions

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	X
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	X
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	X

7. Brief list of topics to be covered

Week	Topic
Week 1	
Week 2	Engineering Ethics (& **QUIZ**)
Week 3	Engineering Statistics
Week 4	**CRITICAL DESIGN REVIEW REPORT**
Week 5	
Week 6	Meetings with Professionals
Week 7	Meetings with Professionals
Week 8	EMI/EMC
Week 9	Meetings with Professionals
Week 10	Meetings with Professionals
Week 11	**IMPLEMENTATION DEADLINE**
Week 12	Panel: Engineering & Society
Week 13	**FINAL REPORT**
Week 14	**FINAL DEMO**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670495 Fundamentals of Photonics

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 2
   Total Credits: 4

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Selçuk Yerci

4. **Text book, title, author, and year:**
   Fundamentals of Photonics, B. Saleh & M. Teich, 2007
   a. **other supplemental materials**
      1- *Photonics: Optical Electronics in Modern Communications*, A. Yariv & P. Yeh, 2006
      2- *Optics*, E. Hecht, 2001

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Ray optics, ray transfer matrix; wave optics, interference and diffraction; beam optics; electromagnetic optics; electromagnetic waves in nonlinear, inhomogeneous, and dispersive media; Lorentz and Drude models; polarization optics; Jones matrix representation of polarization; interaction of photons with atoms; Einstein coefficients; light amplification and lasers; laser types.
   ii. **prerequisites or co-requisites:** EE303
   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will be able to comprehend the fundamental principles and limitations of ray optics and wave optics with the following.

Specific outcomes of instruction
- Gain essential knowledge of ray transfer matrix method to analyze and design ray optics systems - Learn the properties of ray optics components such as mirrors, lenses and prisms; and learn how to use these properties to design devices such as microscopes, telescopes and slide projectors - Apply the principles of wave optics theory to understand important phenomena such as interference and diffraction; and to design devices such as interferometers and gratings - Gain essential knowledge of beam optics to be able to compute optical beam parameters in the applications of optical transmission

   ii. Students will be able to comprehend the fundamental principles of electromagnetic optics theory with the following.

Specific outcomes of instruction
- Understand the electromagnetic principles of reflection, refraction and scattering phenomena - Understand the electromagnetic principles of absorption and dispersion phenomena. Learn Lorentz model and Drude model of materials - Understand the behavior of light waves in non-linear media - Understand the polarization phenomenon, learn about polarization matrix representation

- Gain essential knowledge on polarization devices such as polarizers and wave retarders; and liquid crystals

iii. Students will be able to comprehend the fundamental principles of light-matter interactions, light amplification and lasers with the following.

Specific outcomes of instruction
- Gain essential knowledge on the phenomenon of light-matter interaction - Learn the basics of light amplification - Comprehend the fundamentals of laser operation.

iv. Students will be able to apply their theoretical knowledge to conduct experiments related to optics and photonics with the following.

Specific outcomes of instruction
- Familiarize with components and devices such as mirrors, lenses, prisms, polarizers, optical power sources, lasers, detectors, optical power meters etc. - Familiarize with general experimentation techniques in an optics/photonics lab - Conduct experiments, which are focused on engineering applications such as construction of a projector, measurement of Doppler effect, construction of a spectrometer, spectroscopy of absorbing media, measurements of spectral characteristics of light sources

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

7. Brief list of topics to be covered

Week	Topic
Week 1	Review of electromagnetic theory
Week 2	Ray optics I: simple optical components: mirrors, lenses, prisms, microscopes, telescopes, slide projectors
Week 3	Ray optics II: The ray matrix method and ray optics analysis of optical systems
Week 4	Wave Optics I: Wave optics analysis of simple optical components

Week 5	Wave Optics II: Wave optics analysis of optical systems and graded refractive index lenses
Week 6	Interferometers: Interference of multiple beams, Interference in thin films, Bragg reflection, interferometers
Week 7	Diffraction of light
Week 8	Beam optics
Week 9	Electromagnetic Optics I: electromagnetic wave solutions in linear, homogeneous, isotropic and lossless media. Characteristics of nonlinear, inhomogeneous, and dispersive media
Week 10	Electromagnetic Optics II: Lorentz model. Optics of conductive media: Drude model.
Week 11	Polarization I: polarization, the Jones matrix representation Fresnel Equations
Week 12	Polarization II: polarizers and wave retarders, liquid crystals
Week 13	Lasers I: Absorption; spontaneous and stimulated emission. Einstein coefficients, population inversion, gain and bandwidth
Week 14	Lasers II: Laser amplification, rate equations, common laser types, semiconductor lasers.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

15. Course number and name: 5670498 Special Topics: Control System Design and Simulation

16. Credits and contact hours:
Theoretical Credits and Contact Hours: 3
Applied/Laboratory Credits: 0
Total Credits: 3
Engineering Topics: 3

17. Instructor's or course coordinator's name: Prof. Dr. Klaus Werner Schmidt

18. Text book, title, author, and year:
Control System Design, Graham Goodwin, Stefan Graebe, Mario Salgado, Prentice-Hall Inc., 2001
Analytical System Dynamics – Modeling and Simulation, Brian C. Fabien, Springer US, 2009.

c. other supplementary material
Feedback Systems: Introduction for Scientists and Engineers, Karl Astrom and Richard Murray, Princeton University Press, 2008.
Modeling and Simulation – Exploring Dynamic System Behaviour, Louis G. Birta and Gilbert Arbez, Springer Verlag London, 2007.

19. Specific course information

i. brief description of the content of the course (catalog description): Fundamental limits in the feedback loop, advanced controller design techniques, PID design, polynomial approach, Smith predictor, anti-windup, model predictive control, control design examples, numerical solution of ordinary differential equations, explicit and implicit numerical solution methods, numerical stability.

ii. prerequisites or co-requisites: EE302 (prerequisite)

iii. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Selected Elective

20. Specific goals for the course

i. Students will be able to understand fundamental limitations for the design of control systems.

Specific outcomes of instruction
- Learn about the effect of integrators in the open-loop transfer function on the closed-loop step response - Learn about the effect of open-loop poles and zeros in the open-loop transfer function on the closed-loop step response - Learn about the effect of time-delays in the open-loop transfer function on the closed-loop step response - Learn about the effect of sensor noise in the open-loop transfer function on the closed-loop step response

ii. Students will be able to apply various controller design methods.

Specific outcomes of instruction
- Learn about controller design in the Bode plot - Learn about algebraic controller design - Learn about controller design for time-delay systems - Learn about linear quadratic regulation - Learn about model predictive control

iii. Students will be able to identify suitable control methods for different control problems.

Specific outcomes of instruction
- Learn about the effect of actuator saturation - Learn about how to relate the open-loop dynamics to the desired closed-loop dynamics - Learn about how to relate fundamental limits and the control methods

iv. Students will be able to perform numerical simulation of dynamic systems.

Specific outcomes of instruction
- Learn about explicit and implicit simulation methods - Learn about consistent methods, convergent methods, order of methods - Learn about numerical stability

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

21. Brief list of topics to be covered

Week	Topic
Week 1	Introduction and Background
Week 2	Fundamental Performance Limits in the Feedback Loop
Week 3	Design methods: Bode plot
Week 4	Design methods: Algebraic design
Week 5	Design methods: Time-delay systems
Week 6	Design methods: anti-windup
Week 7	Design methods: optimal control
Week 8	Design methods: MPC
Week 9	Design methods: MPC
Week 10	Design examples
Week 11	Background on ordinary differential equations (ODEs)
Week 12	Explicit methods for the numerical solution of ODEs
Week 13	Implicit methods and multistep methods for the numerical solution of ODEs
Week 14	Numerical stability analysis

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. **Course number and name:** 5670499 Vector Space Methods in Signal Processing

2. **Credits and contact hours:**
   Theoretical Credits and Contact Hours: 3
   Applied/Laboratory Credits: 0
   Total Credits: 3
   Engineering Topics: 3

3. **Instructor's or course coordinator's name:** Assoc. Prof. Dr. Sevinç Figen Öktem

4. **Text books, title, author, and year:**
   Martin Vetterli, Jelena Kovacevic, Vivek K. Goyal, Foundations of Signal Processing, Cambridge University Press, 2014.
   Todd K. Moon, Wynn C. Stirling, Mathematical Methods and Algorithms for Signal Processing, Prentice Hall, 2000.
   Yoram Bresler, Samit Basu, Christophe Couvreur, Hilbert Spaces and Least Squares Methods for Signal Processing, in press.

5. **Specific course information**
   i. **brief description of the content of the course (catalog description):**
   Vector-space concepts in relation to signals and systems; signal subspaces; signal representation in different bases; norms and inner products; systems as operators; projectors; linear algebraic and statistical approaches to solving linear equations; least-squares problems; linear minimum mean square error estimation; solving large-dimensional linear equation systems; applications in signal processing including filter design, approximation, interpolation, data compression, signal estimation and inverse problems.

   ii. **prerequisites or co-requisites:**
   Prerequisites: 2360260 Basic Linear Algebra, 5670230 Probability & Random Variables
   Co-requisite: 5670430 Digital Signal Processing

   iii. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Selected Elective

6. **Specific goals for the course**
   i. Students will gain an understanding of basic vector space methods prevalent in signal processing research and practice.

Specific outcomes of instruction
- Demonstrate a knowledge of vector-space concepts in relation to signals and systems - Gain essential knowledge for solving linear equations using linear algebraic approaches as well as statistical approaches

   ii. Students will be able to apply the learned mathematical tools and algorithms to real-world signal processing problems.

Specific outcomes of instruction
- Integrate and use vector space tools for signal processing applications - Develop realistic solutions for important signal processing and estimation problems

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	X

7. Brief list of topics to be covered

Week	Topic
Week 1	Introduction to vector-space concepts
Week 2	Subspace
Week 3	Basis, signal representation in different bases
Week 4	Norms
Week 5	Inner-products
Week 6	Inner-products, operators
Week 7	Operators
Week 8	Projections
Week 9	Linear algebraic approach to solving linear equations
Week 10	Signal processing applications
Week 11	Vector space of random variables

Week 12	Statistical approaches to solving linear equations
Week 13	Signal processing applications -revisited
Week 14	Solving large-dimensional signal processing problems

COURSE SYLLABI

1. Course number and name

2300105 GENERAL PHYSICS I

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).

METU Credit (Theoretical-Laboratory hours/week): 4(3-2)

ECTS Credit: 6,5

3. Instructor's or course coordinator's name

Course Coordinator: Assoc. Prof. Dr. YUSUF İPEKOĞLU

4. Text book, title, author, and year

Physics for Scientists and Engineers with Modern Physics, 4th Ed., Giancoli, 2014

a. other supplemental materials

None

5. Specific course information

a. brief description of the content of the course (catalog description)

Vectors; kinematics; particle dynamics work and energy; conservation of energy; system of particles; collisions; rotational motion; oscillations.

b. prerequisites or co-requisites

None

c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

None

6. Specific goals for the course

a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

1. Can understand, model and analyze the fundamental physical processes of nature.
2. Can suggest mathematical models to problems they face and solve them by various (approximate/analytical/numerical) approaches.
3. Can use basic measurement devices; can choose and apply the best measurement technique.
4. Can adequately record their observations, e.g., in a lab book.
5. Can design and carry out experiments.
6. Can access scientific information sources.
7. Can critically analyze and contribute to scientific information.
8. Can present scientific information clearly.
9. Can analyze systems that contain probabilistic parts; can do error analysis.
10. Has the basic programming skills; can solve a simple physical problem or can simulate one with an appropriate language they choose.
11. Can actively and skillfully conceptualize, apply, analyze, synthesize and evaluate information.

12. Can produce new ideas and products by using their background in physics.
13. Can systematically design, evaluate, and implement a strategy to respond to an existing problem.
14. Is effective in oral and written communication skills by using both Turkish and English languages.
15. Can do leadership and take initiative.
16. Tries to find physics based solutions to the problems of the world that we live in.
17. Obeys the ethical rules in the workplace and the society and ascertains that they are obeyed by others.
18. Can use the digital communication and computation tools in the most efficient and effective way.
19. Can effectively use the knowledge and skills they gained in physics, in observing, analyzing, modeling and solving other societal problems.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

1. Understand how phycists approach and solve problems in mechanics,
2. Apply those methods to solve problems of mechanics,
3. Use inductive reasoning and calculus level mathematics to solve problems in mechanics,
4. Engage in independent and collaborative learning,
5. Identify, find, and use the tools of information science as it relates to mechanics,
6. Critically evaluate both source and content of scientific information.

7. Brief list of topics to be covered

Introduction, Measurement, Estimating
Describing Motion: Kinematics in One Dimension
Kinematics in Two or Three Dimensions; Vectors
Dynamics: Newton's Laws of Motion
Using Newton's Laws: Friction, Circular Motion, Drag Forces
Gravitation and Newton's Synthesis
Work and Energy
Conservation of Energy
Linear Momentum
Rotational Motion
Angular Momentum; General Rotation
Static Equilibrium

EXPERIMENTS:

ME–0 Measurements, Errors and Graphs
ME–1 Analysis of Straight Line Motion with Constant Velocity
ME–2 Straight Line Motion with Constant Acceleration and Motion in a Plane
ME–3 Newton’s Law of Motion: An application with the Atwood’s machine
ME–4 Collisions and Conservations of Linear Momentum
ME–5 Rotational Motion

1. Course number and name: 2340107, CHEM 107, General Chemistry
2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).: It is a basic science category course.
   Credit: 4 ECST: 6 Students have 3 hours class and 2 hours of General Chemistry Laboratory in addition to 1 office hours. 6 hours of contact in a week.
3. Instructor's or course coordinator's name: Okan Esentürk **(course coordinator),** Görkem Günbaş, Tarık Baytekin, Demet Asil Alptekin, Tarık Baytekin, Erol Yıldırım
4. Text book, title, author, and year: Chemistry: The Central Science, 13/E, Brown, LeMay, Bursten, Murphy, Woodward, Stoltzfus, Pearson.
   a. other supplemental materials: Any General Chemistry Book available in the Library.: Chemistry for Engineering Students, 2nd edition, Lawrence Brown and Thomas Holme, Brooks/Cole, Chemistry, The Central Science, Brown, Lemay, Bursten, Murphy, 11th Int. Ed., Pearson., Principles of Modern Chemistry, Oxtoby, Gillis, Campion, 7th Ed. Brooks/Cole.
5. Specific course information
   a. brief description of the content of the course (catalog description): Providing a concise but through introduction on structure of matter and its interactions and connecting with virtually everything in our daily life for engineering students in their first year.
   b. prerequisites or co-requisites: None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required course
6. Specific goals for the course:

   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.):

   General chemistry courses cover concepts such as thermodynamics, chemical kinetics, and many of the rudiments of physical chemistry. Important concepts are:
   - the electronic structure of atoms and its influence on chemical properties
   - thermochemistry and first law of thermodynamics including calorimetry
   - molecular geometries of selected molecular species
   - current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters
   - general periodicity patterns of (organic/inorganic) molecules, and the ability to design synthetic approaches to such species.
   - the basic (colligative) properties of solutions
   - the thermodynamic and kinetic forces involved in chemical reactions which determine how much and how soon products are formed

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.:

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Yes

2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Yes
3	an ability to communicate effectively with a range of audiences	No
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Yes
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Yes
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Yes
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	No

7. Brief list of topics to be covered

Chp.	**Title**	**Class hours**
5*	Thermochemistry	3
6	Electronic Structure of Atoms	4
7	Periodic Properties of the Elements	3
8	Basic Concepts of Chemical Bonding	6
9	Molecular Geometry and Bonding Theories	4
11	Liquids and Intermolecular Forces	2
12	Solids and Modern Materials	4
14	Chemical Kinetics	4
15	Chemical Equilibrium	4
19	Chemical Thermodynamics	4
20	Electrochemistry	4

**Chapters 1 to 4 of the books is considered to be covered in high school and will not be discussed in the class.*

Course Syllabi

1. **Course number and name**: MATH 119 Calculus with Analytic Geometry
2. **Course Credit**: 5 (4+2)
   Course ECTS: 7.5
3. **Coordinator Name:** Muhiddin Uğuz
4. **Textbook**: Robert A. Adams, Christopher Essex CALCULUS
   A Complete Course Calculus. Eight Edition.
   ISBN 978 0-321-78107-9 QA303.2.A33 2013

5. a. **Course Catalog Description**:

Functions. Limits and Continuity. Tangent lines and derivatives. Chain rule. Implicit differentiation. Inverse functions. Related rates. Linear approximations. Extreme values. Mean Value Theorem and its applications. Sketching graphs. Indeterminate forms and L Hospital s rules. Definite integral. Fundamental Theorem of Calculus. Substitution. Areas between curves. Formal definition of natural logarithm function. Techniques of integration. Improper integrals. Arc length. Volumes and surface areas of solids of revolution. Parametric plane curves. Polar coordinates. Arc length in polar coordinates.

b**. Prerequisites**: No prerequisites

c. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
Required

6. **a** specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

At the end of the course students are expected to:

- Compute limits and carry out some basic proofs about limits and continuty,
- Compute derivates and use it in applications such as computing rates of change, finding extreme values,
- Sketch graphs of functions by finding intervals of increase /decrease, concavity and asymptotes,
- Use transcendental functions including logarithms, exponentials and inverse trigonometric functions effectively,
- Compute integrals by the Riemann Sum defintion and use it to make approximations,
- Make use of various techniques to compute proper and improper integrals,
- Use integration to compute area, volume, arc lenght and surface area,
- Make and use parametrizations of plane curves in Cartesian an polar coordinates.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	YES
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	YES

3	an ability to communicate effectively with a range of audiences	YES
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	YES
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	NO
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	YES
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	YES
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

- 7. **Topics covered**:

Week	Syllabus(Math 119)
1	Ch 0: Preliminaries *0.1 Real Numbers and the Real* *0.2 Cartesian Coordinates in the Plane* *0.3 Graphs of Quadratic Equations* *0.4 Functions and Their Graphs* *0.5 Combining Functions to Make* *0.6 Polynomials and Rational Functions* *0.7 The Trigonometric Functions*
2	Ch 1: Limits and Continuity 1.2 Limits of Functions 1.3 Limits at Infinity and Infinite Limits 1.4 Continuity
3	1.5 The Formal Definition of Limit Ch 2: Differentiation 2.1 Tangent Lines and Their Slope 2.2 The Derivative 2.3 Differentiation Rules
4	2.4 The Chain Rule 2.5 Derivatives of Trigonometric Functions 2.6 Higher-Order Derivatives
5	2.8 The Mean-Value Theorem 2.9 Implicit Differentiation Ch 3: Transcendental Functions 3.1 Inverse Functions 3.2 Exponential and Logarithmic Functions 3.3 The Natural Logarithm and Exponential
6	3.3 The Natural Logarithm and Exponential 3.5 The Inverse Trigonometric Functions 3.6 Hyperbolic Functions Ch 4: More Applications of Differentiation 4.1 Related Rates
7	4.3 Indeterminate Forms **Midterm 1**
8	4.4 Extreme Values 4.5 Concavity and Inflections 4.6 Sketching the Graph of a Function 4.8 Extreme-Value Problems
9	4.9 Linear Approximations Ch 5: Integration 5.1 Sums and Sigma Notation 5.2 Areas as Limits of Sums 5.3 The Definite Integral 5.4 Properties of the Definite Integral
10	5.5 The Fundamental Theorem of Calculus 5.6 The Method of Substitution Ch 6: Techniques of Integration 6.1 Integration by Parts
11	6.2 Integrals of Rational Functions 6.3 Inverse Substitutions
12	6.5 Improper Integrals **Midterm 2**
13	Ch 7: Applications of Integration 5.7 Areas of Plane Regions 7.1 Volumes by Slicing-Solids of Revolution 7.3 Arc Length ~~and Surface Area~~
14	8.5 Polar Coordinates and Polar Curves **Final Exam**

571240 PROGRAMMING WITH PYTHON FOR ENGINEERS

1. Course credit: 3(2-2), Contact hours 2, Engineering.

2. Instructor's or course coordinator's name: Göktürk Üçoluk

3. Textbook: Programming with Python for Engineers, Sinan Kalkan, Onur Tolga Şehitoğlu, Göktürk Üçoluk, 2020, METU
    a. Workbook of the course textbook

4. Specific course information
    a. Catalog description: Basic computer organization; binary data representation; introduction to Python; basic and container data types; variables, expressions, statements; repetitive programming; algorithmic thinking; functions; working with files; exception handling and debugging; scientific programming.
    b. No prerequisites
    c. Service course

5. Specific goals for the course
    a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	**X**
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	**X**

7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
8	An ability to apply design and development principles in the construction of software-intensive systems of varying complexity.	**X**

6. Brief list of topics to be covered

Week	*Course Material*
1	• **Basic computer organization** *Von Neumann arch, CPU, RAM and their interaction during program execution, stored program, Peripherals, OS*
2	• **A Broad Look at Programming and PL** *Concept of Algorithm, Comparing algorithms, World of PLs, Low-High level PL, Interpreter vs Compiler, Programming Paradigms, Python as a PL* • **Representation of data in computers** *Two's complement representation of integers, IEEE floating-point representation, Information loss with Floating Points, representation of characters, text and Boolean.*
3-4	• **Introduction to Python** *Numbers and Boolean values in Python, Container data in Python (str, tuple, list, dict, set); Mutable - immutable data; aliasing problem;* • *Operators and Expressions; Type casting; Statement in Python; Variables and Assignment; Basic I/O in Python;*
5	• **Conditional & repetitive execution in Python** *if statements; conditional expression; while & for statements; continue & break; List comprehension; Example problems*
6-7	• **Functions** *Defining functions; Passing parameters; Scope of variables; Recursion; Example definitions*
8	• **Object-oriented Programming Concepts** *Class definition; Member functions & variables; Message passing; Encapsulation; Inheritance; Polymorphism; Basics of OOP in Python*
9	• **File handling** *Files and Sequential access; Parsing; Termination of Input; Formatting output; binary files*
10	• **Exception handling and Debugging** *Kind of errors; Exceptions; Debugging techniques*

11-14	• **Engineering and scientific libraries for Python** *Libraries and tools for numerical & scientific calculations (arrays, n-D arrays, slicing, basic operations on arrays, commonly used functions, algebraic functions etc.), data handling & analysis, and plotting. Illustration of these tools with examples.*

Course Syllabi

Course number and name: **6390101 English for Academic Purposes 1**

1. Credits, contact hours, and categorization of credits in Table 5-1: **4 credits, 4 hours per week, ECTS credits: 3**

2. Course coordinator's name: **Derem Çanga**

- Text book, title, author, and year: **Gülcü, M., Gülen, G., Şeşen, E., & Tokdemir, G. (2015).** ***The compass: Route to academic English 2*****. Ankara, Turkey: Nüans Press.**

   a. other supplemental materials: **Course Booklet, supplementary material prepared by section instructor**

3. Specific course information
   a. brief description of the content of the course (catalog description)

   English 102 is a learner-centered, integrated-skills based course that will develop students in the four skills (reading, writing, listening and speaking) in an academic context. Tasks involving higher order thinking skills will require students not only to understand, but also to synthesize and evaluate information, ideas and judgments as well. The variety of texts and perspectives presented through themes in and outside the class will facilitate their critical thinking process and thus enable students to become active and autonomous learners.

   b. prerequisites or co-requisites
   None

   c. indicate whether a required, elective, or selected elective course in the program
   Required

4. Specific goals for the course
   a. specific outcomes of instruction

WRITING

Students will:

1. **identify the distinguishing features of academic writing**
2. **use appropriate style, language structures, vocabulary and discourse markers in academic context**
3. **respond to prompt(s) in academic context**
4. **follow the stages in process writing approach while writing paragraphs**
5. **produce academic, documented paragraphs**
6. **identify reference information**
7. **practise using APA citation rules**
8. **practise borrowing ideas by quoting, paraphrasing, and summarizing,**

SPEAKING

Students will practise:

1. **expressing and justifying their opinion in class discussions**
2. **reacting to different ideas**
3. **synthesizing information from different sources**
4. **justifying their opinions/arguments by providing supporting details**

READING

Students will practise:

1. **pre-reading strategies (i.e. skimming, scanning, previewing)**
2. **identifying points of reference**
3. **guessing the meaning of unknown words**
4. **making inferences from a reading text**
5. **identifying key ideas in a text**
6. **recognizing the relationship between ideas in and among texts**
7. **identifying the writer's technique**
8. **evaluating information by adopting critical reading skills**
9. **reflecting on and reacting to the ideas in a text**

LISTENING

Students will practise:

1. **listening for a specific purpose**
2. **listening for main ideas**
3. **listening for supporting ideas/details**
4. **listening for implied ideas**
5. **listening and note-taking**
6. **recognizing the relationship between a recording/video and a reading text**
7. **reflecting on and reacting to ideas in a recording/video**
8. **evaluating ideas in a recording/video**

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. **The course addresses <u>all</u> the students outcomes listed in the previous item.**

5. Brief list of topics to be covered

- **Leadership**
- **Media and Power**
- **Academic Writing Conventions**
- **Formal Writing**
- **Writing in response to a prompt**
- **APA citation rules**
- **Paraphrasing, summarizing, direct quoting**

1. Course number and name: **OHS 101 - Occupational Health and Safety-I**

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): **(0,0) 0 - Other**

3. Instructor's or course coordinator's name: **Mahmut Parlaktuna**

4. Text book, title, author, and year: **No unique textbook**
   a. other supplemental materials: **Online lecture materials provided weekly**

5. Specific course information
   a. brief description of the content of the course (catalog description): **The course is designed to assist the student with the implementation of safe and healthy practices at laboratories and university campus. This course enables students to learn safe work practices as well as how to identify and prevent or correct problems associated with safety and health in these locations.**
   b. prerequisites or co-requisites: **No prerequisite**
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: **Required**

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.):
      i. identify types of hazards in laboratories that pose a danger or threat to their safety and/or health,
      ii. gain awareness about unsafe and unhealthy acts and conditions and their associated consequences and adopt safe work practices,
      iii. learn how to communicate in safety and emergency situations,
      iv. internalize safety culture in their life.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	ABET Student Outcomes	
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	X
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

7. Brief list of topics to be covered

Week	Topics	Level of detail
1	Health and Safety at Laboratories-I	Basic concepts in health and safety Identification of hazards and risk at laboratories ▪ Chemical hazards ▪ Physical hazards ▪ Biological hazards ▪ Ergonomic hazards
2	Health and Safety at Laboratories-II	Learn safe and healthy acts, rules, and safe working practices, Learn how to take counter measures against risks and project consequences of unsafe and unhealthy working conditions, Learn how to communicate in emergency situations.
3	Health and Safety at Laboratories-III	Case Studies ▪ Chemical burns ▪ Electrical shocks ▪ Injuries
4	Emergency Situations	Fire hazards, Toxic Release, Chemical Spills
5	First Aid	Definition of first aid Learn what to do (i.e. communications) and what not to do for the first aid
6	Causes of Accidents	Basic, direct and indirect causes Costs of accidents Statistical data
7	Accident Prevention	Fundamental information about accident prevention
8	Hazardous material information system - I	Routes of entry of toxic materials into the body General safety precautions Cleaning chemical spills
9	Hazardous material information system - II	SDS sheets Sign and labels
10	Health Promotion-I	Drug and Alcohol Use Blood borne pathogens, HIV, Hepatitis B, C
11	Health Promotion-II	Stress management Adequate and balanced nutrition Physical exercise
12	Traffic Safety	Traffic system components Human factors in driving 7E s in road safety
13	Safety Culture-I	Definition of safety culture Elements of safety culture Role of participation
14	Safety Culture-II	Positive safety culture Observation and correction

Course Syllabi

1. Course number and name
   IS100 (9010100) - Introduction to Information Technologies and Applications

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).
   0 (ECTS Credit 1.0), Online course (no contact hours), Basic science

3. Instructor's or course coordinator's name
   Course coordinator's name: Prof. Dr. Sevgi ÖZKAN YILDIRIM

4. Text book, title, author, and year
   a. other supplemental materials
      No text book
      Supplemental materials: https://ii.metu.edu.tr/presentations-and-notes

5. Specific course information
   a. brief description of the content of the course (catalog description)
      This course provides an overview of business information systems. Topics include information and computer literacy, hardware and software fundamentals, use of software packages, effective use of networks, Internet, and other communication tools, computer maintenance and security, as well as ethical and legal issues regarding computers in business and society. Hands-on experience is provided.
   b. prerequisites or co-requisites
      No prerequisites
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      Required

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	✓

4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	✓
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	✓

Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*

At the end of this course, students will be able to

O1: Describe and link the basic concepts of information technology and adapt to using the emerging technologies effectively
O2: Identify the nature and extent of the information they need
O3: Search, access, collect, assess, criticize, compare, analyze, locate and present the information they require
O4: Identify, demonstrate and describe ethical issues, regulations and laws to use information, software and technology systems
O5: Practice health and safety issues involved in using computers
O6: Compose, edit and revise a document using a word processing tool including Microsoft Word
O7: Manipulate, organize, filter and analyze data using spreadsheets
O8: Communicate, interact and collaborate with peers, experts and other audiences through various media including NetMeeting and applications including Microsoft Outlook and web browsers
O9: Investigate, define and solve basic computer problems, provide maintenance and security of computers
O10: Use technology to support decision making process for real world problems
O11: Construct personal knowledge and meaning using electronic research techniques
O12: Apply technology to increase productivity
O13: Organize and present information by combining different media

7. Brief list of topics to be covered
   W1: Introduction to information and computer literacy
   W2: Basic concepts in information technology
   W3: Human computer interaction
   W4: File and directory management
   W5: Digital Information Resources
   W6: Information quality assessment and ethical/legal issues
   W7: Information quality assessment and ethical/legal issues
   W8: Data analysis
   W9: Data analysis

W10: Presentation
W11: Computer maintenance, security and problem solving
W12: Multimedia

COURSE SYLLABI

1. Course number and name

2300106 GENERAL PHYSICS II

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).

METU Credit (Theoretical-Laboratory hours/week): 4(3-2)

ECTS Credit: 6,5

3. Instructor's or course coordinator's name

Course Coordinator: Assoc. Prof. Dr. YUSUF İPEKOĞLU

4. Text book, title, author, and year

Physics for Scientists and Engineers with Modern Physics, 4th Ed., Giancoli, 2014

a. other supplemental materials

None

5. Specific course information

a. brief description of the content of the course (catalog description)

Electric charge; electric field; Gauss` law, electric potential; capacitance; current and resistance; circuits; magnetic field; Ampere`s law; Faraday`s law of induction; electro-magnetic oscillations; alternating currents.

b. prerequisites or co-requisites

None

c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

None

6. Specific goals for the course

a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

1. Can understand, model and analyze the fundamental physical processes of nature.
2. Can suggest mathematical models to problems they face and solve them by various (approximate/analytical/numerical) approaches.
3. Can use basic measurement devices; can choose and apply the best measurement technique.
4. Can adequately record their observations, e.g., in a lab book.
5. Can design and carry out experiments.
6. Can access scientific information sources.
7. Can critically analyze and contribute to scientific information.
8. Can present scientific information clearly.
9. Can analyze systems that contain probabilistic parts; can do error analysis.
10. Has the basic programming skills; can solve a simple physical problem or can simulate one with an appropriate language they choose.
11. Can actively and skillfully conceptualize, apply, analyze, synthesize and evaluate information.

12. Can produce new ideas and products by using their background in physics.
13. Can systematically design, evaluate, and implement a strategy to respond to an existing problem.
14. Is effective in oral and written communication skills by using both Turkish and English languages.
15. Can do leadership and take initiative.
16. Tries to find physics based solutions to the problems of the world that we live in.
17. Obeys the ethical rules in the workplace and the society and ascertains that they are obeyed by others.
18. Can use the digital communication and computation tools in the most efficient and effective way.
19. Can effectively use the knowledge and skills they gained in physics, in observing, analyzing, modeling and solving other societal problems.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

1. Understand how phycists approach and solve problems in mechanics,
2. Apply those methods to solve problems of mechanics,
3. Use inductive reasoning and calculus level mathematics to solve problems in mechanics,
4. Engage in independent and collaborative learning,
5. Identify, find, and use the tools of information science as it relates to mechanics,
6. Critically evaluate both source and content of scientific information.

7. Brief list of topics to be covered

Electric Charge and Electric Field
Gauss' Law
Electric Potential
Capacitance, Dielectrics, Electric Energy Storage
Electric Currents and Resistance
DC Circuits
Magnetism
Sources of Magnetic Field
Electromagnetic Induction and Faraday's Law
Inductance

EXPERIMENTS:

EM–0 Measuring Instruments
EM–1 Ohm’s law, Parallel and Series Combination of Resistors
EM–2 Equipotential and Electric Field Lines
EM–3 Constructing an Ammeter and a Voltmeter Using a Movement
EM–4 Charging and Discharging a Capacitor
EM–5 Magnetic Force on a Conductor: Current Balance

Course Syllabi

1. Course number and name: Math 120 , Calculus of functions of several variables

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).

   Metu Credits 5, ETCS Credits 7.5 , Lecture Hours: 4 Recitation Hours: 2

3. Instructor's or course coordinator's name
   Instructor: Yıldıray Ozan Coordinator: Muhiddin Uğuz

4. Text book, title, author, and year

   CALCULUS A Complete Course. Eight Edition. Robert A. Adams, Christopher Essex
   ISBN 978 0-321-78107-9

5. Specific course information
   a. brief description of the content of the course (catalog description)

      Sequences and infinite series. Power series. Taylor series. Vectors and analytic geometry in 3-space. Functions of several variables: limits, continuity, partial derivatives. Chain rule. Directional derivatives. Tangent planes and linear approximations. Extreme values. Lagrange multipliers. Double integrals. Double integrals in polar coordinates. General change of variables in double integrals. Surface parametrization and surface area in double integrals. Triple integrals in Cartesian, cylindrical and spherical coordinates. Parametrization of space curves. Line integrals. Path independence. Green's theorem in the plane.

   b. prerequisites or co-requisites

      Math 119

6. Specific goals for the course

   The sequence Math 119-120 is the Standard complete introduction to the concepts and methods of calculus. It is taken by all engineering students. The emphasis is on concepts, solving problems, theory and proofs. All sections are given a uniform midterm and a final exam. Students will develop their reading, writing and questioning skills in Mathematics.

	ABET Student Outcomes	Check if this student outcome is addressed by this course

1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	x
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	x
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

7. Brief list of topics to be covered

Course Syllabi

1. **Course number and name**: 2360260-Basic Linear Algebra
2. **Course Credit**: 3 (3+0)
   Course ECTS: 5.0
3. **Coordinator Name:** Mustafa Korkmaz
4. **Textbook**: Cemal Koç, Basic Linear Algebra, 2009
5. a. **Course Catalog Description**:

Matrices, determinants and systems of linear equations. Vector spaces, the Euclidean space, inner product spaces, linear transformations. Eigenvalues, diagonalization.

b**. Prerequisites**: No prerequisites

6. **a.** Students will gain certain experience in recognizing/expressing problems of linear nature in terms of linear algebra and in solving them by using linear methods, when available. On this way the students will have to attain certain theoretical background in basic linear algebra.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering ' problems by applying principles of engineering, science, and mathematics	Yes
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Yes
3	an ability to communicate effectively with a range of audiences	Yes
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Yes

	ABET Student Outcomes	Check if this student outcome is addressed by this course
5	an ability to function effectively on a team whose members together provide leadership,create a colloborative and inclusive enviroment,establish goals,plan tasks,ane meet objectives	No
6	an ability to develop and conduct appropriate experimentation and analyze and interpret data and use engineering judgement to draw conclusions	Yes
7	an ability to acquire and apply new knowledge as needed,using appropriate learning strategies	Yes

- 7. **Topics covered**:

- Matrices.
- Row Equivalence and Elementary Matrices.
- Invertibility of Matrices.
- Systems of Linear Equations.
- Homogeneous Linear Systems.
- Determinants and Cofactors.
- Further Properties of Determinants. Other Functions of Square Matrices.
- Vector Spaces. Linear Independence.
- Basis. Dimension.
- Inner Products. Orthogonality.
- Orthogonal and Orthonormal Bases. Orthogonal projections.
- Diagonalization
- Diagonalization of Real Symmetric Matrices.
- Linear Transformations and Matrix Representation.

1. Course number and name: 5690105, Computer Aided Engineering Graphics
2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): 3 (2-2), 4, Engineering Topic
3. Instructor's or course coordinator's name: Lecturer Muhtar Ural Uluer
4. Textbook, title, author, and year: Engineering Drawing and Design, Cecil Jensen, Jay Helsel, Dennis Short, 2007, ISBN 978-0073521510.
   a. other supplemental materials: ME105 Lecture Notes (Online Course Content)
5. Specific course information
   a. brief description of the content of the course (catalog description): Introduction to computer aided design. Two dimensional geometrical construction. Multiview orthographic projections. Solid modeling. Technical drawing standards. Auxiliary views. Section views.
   b. prerequisites or co-requisites: none
   c. indicate whether a required, elective, or selected elective course (as per Table 5-1) in the program: required course
6. Specific goals for the course
   a. specific outcomes of instruction:
      - Ability to use and understand engineering drawing terminology.
      - Ability to interpret technical drawings and visualize objects.
      - Ability to communicate ideas as a technical drawing.
      - Ability to use CAD software for generating 2-D sketches and 3-D solid models.
      - Ability to make Geometric Constructions.
      - Ability to make Multiview Orthographic Projections.
      - Ability to prepare Auxiliary Views.
      - Ability to prepare Sectional Views.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	√
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	√
3	an ability to communicate effectively with a range of audiences	√
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must	

	consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	√
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	√
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
-		

7. Brief list of topics to be covered

Week	Topic
1	Chapter 0: Course Introduction Chapter 1: Introduction to Engineering Graphics & CAD Chapter 2: Geometric Construction & Tangencies
2	Chapter 2: Geometric Construction & Tangencies
3	Chapter 2: Geometric Construction & Tangencies
4	Chapter 3: Multiview Orthographic Projection
5	Chapter 3: Multiview Orthographic Projection
6	Chapter 3: Multiview Orthographic Projection
7	Chapter 5: Solid Modeling
8	Chapter 5: Solid Modeling
9	Chapter 6: Auxiliary Views
10	Chapter 6: Auxiliary Views
11	Chapter 7: Section Views
12	Chapter 7: Section Views
13	Chapter 7: Section Views
14	Chapter 7: Section Views

Course Syllabi

1. Course number and name: **6390102 English for Academic Purposes 2**

2. Credits, contact hours, and categorization of credits in Table 5-1: **4 credits, 4 hours per week, ECTS credits: 3**

3. Course coordinator's name: **Derem Çanga**

- Text book, title, author, and year: **Gülcü, M., Gülen, G., Şeşen, E., & Tokdemir, G. (2015).** ***The compass: Route to academic English 2*****. Ankara, Turkey: Nüans Press.**

   a. other supplemental materials: **Course Booklet, supplementary material prepared by section instructor**

4. Specific course information
   a. brief description of the content of the course (catalog description)

   English 102 is a learner-centered, integrated-skills based course that will develop students in the four skills (reading, writing, listening and speaking) in an academic context. Tasks involving higher order thinking skills will require students not only to understand, but also to synthesize and evaluate information, ideas and judgments as well. The variety of texts and perspectives presented through themes in and outside the class will facilitate their critical thinking process and thus enable students to become active and autonomous learners.

   b. prerequisites or co-requisites
   ENG 101

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program **Required**

5. Specific goals for the course
   a. specific outcomes of instruction

READING

Students will practise:

1. **identifying key ideas in a text**
2. **recognizing the relationship between ideas in and among texts**
3. **identifying the writer's technique**
4. **evaluating information by adopting critical reading skills**
5. **making inferences**
6. **reflecting on and reacting to the ideas in a text**

LISTENING

Students will practise:

9. **listening for a specific purpose**
10. **listening for main ideas**
11. **listening for supporting ideas/details**
12. **listening for implied ideas**
13. **listening and note-taking**
14. **recognizing the relationship between a recording and a reading text**
15. **reflecting on and reacting to ideas in a recording**
16. **evaluating ideas in a recording**

SPEAKING

Students will practise:

10. **expressing and justifying their opinion in class discussions**
11. **reacting to different ideas**
12. **synthesizing information from different sources**
13. **justifying their opinions/arguments by providing supporting details**

WRITING

Students will:

9. **use appropriate style, language structures, vocabulary and discourse markers in academic context**
10. **respond to prompt(s) in academic context**
11. **follow the stages in process writing approach while writing essays**
12. **do research**
13. **evaluate sources for relevance and reliability**
14. **identify and select relevant sources**
15. **identify reference information**
16. **practise using APA citation rules**
17. **practise borrowing ideas by quoting, paraphrasing, summarizing, and synthesizing**

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. The course addresses <u>all</u> the students outcomes listed in the previous item.

6. Brief list of topics to be covered

- Power and Money
- Hard power vs. Soft Power
- Academic Writing Conventions
- Formal Writing
- Writing in response to a multi-part prompt
- APA citation rules
- Paraphrasing, summarizing, direct quoting
- Synthesizing
- Research

Course Syllabi

1. Course number and name: MATH 219 – Introduction to Differential Equations

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).

   Credits: (4-0) 4
   Contact Hours: 4
   ECTS Credit: 7
   Math and basic science

3. Instructor's or course coordinator's name: Ali Ulaş Özgür Kişisel

4. Text book, title, author, and year
   a. other supplemental materials

   "Elementary Differential Equations and Boundary Value Problems", Boyce, W. E., DiPrima, R. C., 10th ed.

5. Specific course information
   a. brief description of the content of the course (catalog description)
   b. prerequisites or co-requisites
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

   a. First order equations and various applications. Higher order linear differential equations. Power series solutions. The Laplace transform. Solutions of initial value problems. Systems of linear differential equations. Introduction to partial differential equations.
   b. Prerequisite: MATH 118 or MATH 120
   c. Required course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

   a. By the end of this course, a student will: Classify and identify different types of differential equations, explicitly solve several important classes of ordinary differential equations and interpret their qualitative behaviour, apply ideas from linear algebra in order to solve single linear ordinary differential equations and systems of such equations, model certain physical phenomena using differential equations and reinterpret their solutions physically, use power series methods to solve second order linear differential equations, apply the Laplace transform for solving differential equations, use the method of separation of variables in order to solve some basic partial differential equations via Fourier series.

	ABET Student Outcomes	Check if this student outcome is addressed by this course

1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	x
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	x
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

7. Brief list of topics to be covered: First Order Differential Equations, Systems of First Order Linear Equations, Higher Order Linear Equations, Series Solutions of Second Order Linear Equations, The Laplace Transform, Partial Differential Equations and Fourier Series

Course Syllabi

1. Course number and name **6390211 Academic Oral Presentation Skills**

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other). **3 credits, 3 hours per week, ECTS Credit: 2**

3. Course coordinator's name: **Meriç Gülcü Kurç**

4. Text book, title, author, and year **Duzan, C., & Yalçın, E. (2014).** ***The compass*****: *Route to academic speaking.* Nüans Press.**

    a. other supplemental materials **No**

5. Specific course information
    a. brief description of the content of the course

English 211 is an oral presentation course designed with the aim of equipping students with the essential speaking skills they need to cope with the English language as medium of instruction. Therefore, the course revolves around two main focuses: Academic speaking and presentation skills. To this end, the course offers a theme-based approach where all four skills are integrated to foster various speaking opportunities.

    b. prerequisites or co-requisites
    ENG 101, ENG 102

    c. indicate whether a required, elective, or selected elective course in the program
    Required

6. Specific goals for the course
    a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

SPEAKING

- **Building speaking confidence**
- **Adjusting language to spoken discourse**
- **Using appropriate transitions and signposts Integrating literature research into a presentation**
- **Expressing and supporting opinions Preparing & using audio-visual aids**
- **Delivering a speech/presentation**
- **Presenting information in an organized way**
- **Asking and answering questions**
- **Giving an oral synthesis**
- **Reacting to an idea**
- **Taking part in discussions and debates**
- **Using correct pronunciation, stress and intonation**

READING

- **Reading for the main idea**

- **Reading for specific information**
- **Making inferences & interpretations**
- **Reading between the lines**
- **Identifying different opinions**
- **Evaluating different viewpoints**
- **Making connections between ideas**
- **Reading extensively to gather data**
- **Expanding vocabulary & activating passive vocabulary**

LISTENING

- **Listening between the lines**
- **Listening for specific information**
- **Listening for the main idea**
- **Note taking**

WRITING

- **Synthesizing**
- **Paraphrasing**
- **Summarizing**

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. **The course addresses <u>all</u> the students outcomes listed in the previous item.**

7. Brief list of topics to be covered

- **The mind**
- **Art**
- **Marketing**
- **Science and Technology**
- **Preparing Audio Visual Aids**
- **Vocal and Physical Delivery**
- **Integration of Literature Research**
- **Oral Citation**
- **Use of Signposts**
- **Discussion Skills**

1. Course number and name: **OHS 301 - Occupational Health and Safety-II**

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): **(0,0) 0 - Other**

3. Instructor's or course coordinator's name: **Mahmut Parlaktuna**

4. Text book, title, author, and year: **No unique textbook**
   a. other supplemental materials: **Weekly provided online lecture materials**

5. Specific course information
   a. brief description of the content of the course (catalog description): **OHS management system, industrial hygiene, risk management, root-cause analysis of accidents, cost of accidents, occupational diseases and work-related diseases, case studies**
   b. prerequisites or co-requisites: **OHS 101 – Occupational Health and Safety - I**
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: **Required**

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.):
      At the end of this course, students will be able to:
      i. know legal legislations about occupational health and safety,
      ii. conduct risk assessment and risk management,
      iii. understand causes of accidents, emergency situations, and carry out root-cause analysis, and
      iv. identify occupational and work-related diseases.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	ABET Student Outcomes	
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	X
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

7. Brief list of topics to be covered

Week	Topics	Level of detail
1	Safety Leadership and Management - 1	Duties, rights and responsibilities of safety professionals.
2	Safety Leadership and Management - 2	Systematic approach, planning and implementation
3	Industrial Hygiene - 1	Recognition of Hazards • Physical hazards • Chemical hazards • Biological hazards • Ergonomic, physico – social hazards
4	Industrial Hygiene - 2	Identification of hazards
5	Industrial Hygiene - 3	Control of hazards
6	Risk Management -1	Principles of Risk Management
7	Risk Management -2	Qualitative and Quantitative Risk Assessment Methods
8	Risk Management -3	Risk Response and Control
9	Root- Cause Analysis of Accidents	Fish-bone, Five Whys, Swiss Cheese, Domino Theory
10	Cost of Accidents	Direct and Indirect Costs of Accidents, Conformacy and non-conformacy Costs
11	Occupational Diseases and Work Related Diseases	Definitions, Relationships between exposures and diseases
12	Case study -1	Fire and Explosion
13	Case study -2	Sectoral cases - 1 (worst cases)
14	Case study -3	Sectoral cases - 2 (best practices)

MIDDLE EAST TECHNICAL UNIVERSITY

COURSE SYLLABUS

(2402201) PRINCIPLES OF KEMAL ATATÜRK I

Course Information

Course Code
2402201

Course Title
PRINCIPLES OF KEMAL ATATÜRK I

Course Credit
0

Course ECTS
2

Course Catalog Description
A history of the foundation of the Turkish Republic in the light of Kemal Atatürk`s principles. A required course for all second-year students.

(This course is given in Turkish)

Prerequisites
No prerequisites found.

Course Objectives

By the end of this course the students will be able to;

- Know basic terms, concepts and events of History of Turkish Republic, in a period covering roughly 16-20th centuries.
- Interpret various events and/or developments that taken place throughout the period that the course covered.
- Apply their knowledge to their personal/academic improvement process.
- Analyze the historical events in an reason and result relation.
- Show awareness about historical issues as well as historical heritage in various forms.
- Participate in general discussion on issues regarding History of Turkish Republic.
- Show concern for historical heritage of Turkish Republic.

Course Learning Outcomes

- Specific outcomes of instruction: After taking this course, the students are expected to have:
    - A sufficient knowledge of the History of Turkish Republic.
    - An ability to analyze issues discussed during the course.
    - A detailed understanding of the Principles of Kemal Atatürk via the knowledge of his life.
    - An awareness of the necessity of being a society with a rich historical background as well as the conscious of being a citizen in a society of different background.
    - An ability to analyze current problems by making their connections and/or roots to historical events taken place in the past.

- Explicit outcomes of the course listed in Criterion 3 and others addressed by the course:
    - An ability to apply knowledge of the course to his/her academic and personal life.
    - An ability to analyze and interpret knowledge given throughout the course.
    - An ability to function on multidisciplinary teams.
    - An ability to identify, formulate, and solve topics addressed in the course.
    - An understanding of professional and ethical responsibility
    - An ability to communicate effectively (3g1 orally, 3g2 written)
    - The broad education necessary to understand the impact of historical knowledge in a global, economic, environmental, and societal context.
    - A recognition of the need for, and an ability to engage in life-long learning
    - A knowledge of contemporary issues
    - An ability to use the historical knowledge and understanding necessary for life long experience.

Program Outcomes Matrix

Undergraduate

		Level of Contribution			
	Program Outcomes	**0**	**1**	**2**	**3**
1	are familiar with general world historical periods and trends; demonstrate knowledge of key facts, ideas, societies, organizations, cultures, structures and processes related to a variety of historical contexts.				**X**
2	are familiar with existing scholarly literature, historiography and historical methodology; and have developed the ability to approach them critically.			**X**	
3	are acquainted with interdisciplinary approaches.			**X**	
4	are able to generate research questions and conduct independent historical research by locating and analyzing primary and/or secondary sources; can construct viable arguments based on source interpretation.			**X**	
5	have developed sufficient English language skills; additionally, they have acquired the skill to read both printed texts and manuscripts in Ottoman Turkish.	**X**			
6	are able to present research results both in oral and written form.	**X**			
7	are able to work individually or as part of a team.		**X**		
8	are equipped with academic ethics.				**X**
9	are aware of modern day issues and current events; have the skills and knowledge to generate informed opinions.		**X**		

0: No Contribution **1:** Little Contribution **2:** Partial Contribution **3:** Full Contribution

Instructional Methods

- PPT presentation and/ or verbal presentation
- Class discussion and informal debate
- Question – Answer

Tentative Weekly Outline

Brief list of topics to be covered:

Week	Topic
Week 1	**WEEK 1** General Introduction: Why to study History – Republic History? Where to Start? Brief Info on First Semester
Week 2	**WEEK 2** A background info: World and the Ottoman Empire from 16th to 20th century / Part 1
Week 3	**WEEK 3** A background info: World and the Ottoman Empire from 16th to 20th century / Part 2
Week 4	**WEEK 4** World and the Ottoman Empire in the beginning 20th century
Week 5	**WEEK 5** Tripoli War
Week 6	**WEEK 6** Balkan Wars
Week 7	**WEEK 7** World War I
Week 8	**WEEK 8** End of World War I
Week 9	**WEEK 9** Anatolia under foreign occupation
Week 10	**WEEK 10** War of Independence – the preparation
Week 11	**WEEK 11** War of Independence – the fronts
Week 12	**WEEK 12** End of War of Independence **General Evaluation**

Course Textbook(s)

- *NA*

Course Material(s) and Reading(s)

a. Course Reading Materials:
   i. **Bernard Lewis** – Modern Türkiye'nin Doğuşu
   ii. **Feroz Ahmad** – Demokrasi Sürecinde Türkiye (1945–1980)
   iii. **Feroz Ahmad** – Modern Türkiye'nin Oluşumu
   iv. **H.Kinder & W.Hilgemann** - Dünya Tarihi Atlası (2 Cilt) (ODTÜ Yayıncılık)
   v. **N. İlter Ertuğrul** – Cumhuriyet Tarihi El Kitabı
   vi. **Seçil Karal Akgün** – Halifeliğin Kaldırılması ve Laiklik (1924 – 1928)
   vii. **Sina Akşin** – Kısa Türkiye Tarihi

viii. **Stanford Shaw** – Osmanlı İmparatorluğu ve Modern Türkiye/1
ix. **Stanford Shaw, Ezel Kural Shaw** – Osmanlı İmparatorluğu ve Modern Türkiye/2
x. **Suna Kili** – Türk Devrim Tarihi
xi. **Şerafettin Turan** – Türk Devrim Tarihi
xii. **Taner Timur** – Türk Devrimi ve Sonrası
xiii. **Toktamış Ateş** – Türk Devrim Tarihi

b. PPT slides stored in LMS (ODTÜ Class).

Supplementary Readings / Resources / E-Resources

- *NA*

Assessment of Student Learning

- Will be made via
    - Informal question and answer sessions
    - Informal debates and class discussions

Course Grading

- Attendance (%50) + Final Exam Grade (%50)
- The student will get S (Satisfactory) or U (Unsatisfactory) for grading.

Course Policies

The course is aimed at;

- Providing students an efficient and physically comfortable, technically well equipped class
- Creating a self-confident atmosphere of learning
- Setting a prosperous interaction between the instructors and students
- Freeing students from stressful limitations of seeing a lecture wğithin frames of grading

Information for Students with Disabilities

To obtain disability related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the ODTÜ Disability Support Office as soon as possible. If you need any accommodation for this course because of your disabling condition, please contact me. For detailed information, please visit the websie of Disability Support Office: http://engelsiz.metu.edu.tr/

Academic Honesty

The METU Honour Code is as follows: *"Every member of METU community adopts the following honour code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."*

MIDDLE EAST TECHNICAL UNIVERSITY

COURSE SYLLABUS

(2402202) PRINCIPLES OF KEMAL ATATÜRK II

Course Information

Course Code

2402202
Course Title

PRINCIPLES OF KEMAL ATATÜRK II
Course Credit 0

Course ECTS 2

Course Catalog Description

Continuation of HIST 2201.
(This course is given in Turkish)
Prerequisites

Students must complete one of the following sets to take this course.

Set	Prerequisites
1	2402201
2	3620201

Course Objectives

By the end of this course the students will be able to;

- Know basic terms, concepts and events of History of Turkish Republic, in a period covering roughly 16-20th centuries.
- Interpret various events and/or developments that taken place throughout the period that the course covered.
- Apply their knowledge to their personal/academic improvement process.
- Analyze the historical events in an reason and result relation.
- Show awareness about historical issues as well as historical heritage in various forms.
- Participate in general discussion on issues regarding History of Turkish Republic.
- Show concern for historical heritage of Turkish Republic.

Course Learning Outcomes

- Specific outcomes of instruction: After taking this course, the students are expected to have:
  - A sufficient knowledge of the History of Turkish Republic.
  - An ability to analyze issues discussed during the course.
  - A detailed understanding of the Principles of Kemal Atatürk via the knowledge of his life.
  - An awareness of the necessity of being a society with a rich historical background as well as the conscious of being a citizen in a society of different background.
  - An ability to analyze current problems by making their connections and/or roots to historical events taken place in the past.
- Explicit outcomes of the course listed in Criterion 3 and others addressed by the course:
  - An ability to apply knowledge of the course to his/her academic and personal life.
  - An ability to analyze and interpret knowledge given throughout the course.
  - An ability to function on multidisciplinary teams.
  - An ability to identify, formulate, and solve topics addressed in the course.
  - An understanding of professional and ethical responsibility
  - An ability to communicate effectively (3g1 orally, 3g2 written)
  - The broad education necessary to understand the impact of historical knowledge in a global, economic, environmental, and societal context.
  - A recognition of the need for, and an ability to engage in life-long learning
  - A knowledge of contemporary issues
  - An ability to use the historical knowledge and understanding necessary for life long experience.

Program Outcomes Matrix

Undergraduate

	Program Outcomes	**Level of Contribution**			
		0	**1**	**2**	**3**
1	are familiar with general world historical periods and trends; demonstrate knowledge of key facts, ideas, societies, organizations, cultures, structures and processes related to a variety of historical contexts.				**X**
2	are familiar with existing scholarly literature, historiography and historical methodology; and have developed the ability to approach them critically.			**X**	
3	are acquainted with interdisciplinary approaches.			**X**	
4	are able to generate research questions and conduct independent historical research by locating and analyzing primary and/or secondary sources; can construct viable arguments based on source interpretation.			**X**	

	Program Outcomes	Level of Contribution			
		0	1	2	3
5	have developed sufficient English language skills; additionally, they have acquired the skill to read both printed texts and manuscripts in Ottoman Turkish.	X			
6	are able to present research results both in oral and written form.	X			
7	are able to work individually or as part of a team.		X		
8	are equipped with academic ethics.				X
9	are aware of modern day issues and current events; have the skills and knowledge to generate informed opinions.			X	

0: No Contribution **1:** Little Contribution **2:** Partial Contribution **3:** Full Contribution

Instructional Methods

- PPT presentation and/ or verbal presentation
- Class discussion and informal debate
- Question – Answer

Tentative Weekly Outline

Brief list of topics to be covered:

Week	Topic
Week 1	**WEEK 1** Brief Info on First Semester
Week 2	**WEEK 2 – 3** Period of Peace and Agreements
Week 3	
Week 4	**WEEK 4 – 5** Foundation of the new state
Week 5	
Week 6	**WEEK 6 – 7** Towards the Multi party system
Week 7	
Week 8	**WEEK 8** World War II
Week 9	**WEEK 9** End of World War II
Week 10	**WEEK 10** Cold War and aftermath
Week 11	**WEEK 11** On Ataturk's Principles and Reforms
Week 12	**WEEK 12** **General Evaluation**

Course Textbook(s)

- *NA*

Course Material(s) and Reading(s)

a. Course Reading Materials:
   i. **Bernard Lewis** – Modern Türkiye'nin Doğuşu
   ii. **Feroz Ahmad** – Demokrasi Sürecinde Türkiye (1945–1980)
   iii. **Feroz Ahmad** – Modern Türkiye'nin Oluşumu
   iv. **H.Kinder & W.Hilgemann** - Dünya Tarihi Atlası (2 Cilt) (ODTÜ Yayıncılık)
   v. **N. İlter Ertuğrul** – Cumhuriyet Tarihi El Kitabı
   vi. **Seçil Karal Akgün** – Halifeliğin Kaldırılması ve Laiklik (1924 – 1928)
   vii. **Sina Akşin** – Kısa Türkiye Tarihi
   viii. **Stanford Shaw** – Osmanlı İmparatorluğu ve Modern Türkiye/1
   ix. **Stanford Shaw, Ezel Kural Shaw** – Osmanlı İmparatorluğu ve Modern Türkiye/2
   x. **Suna Kili** – Türk Devrim Tarihi
   xi. **Şerafettin Turan** – Türk Devrim Tarihi
   xii. **Taner Timur** – Türk Devrimi ve Sonrası
   xiii. **Toktamış Ateş** – Türk Devrim Tarihi
b. PPT slides stored in LMS (ODTÜ Class).

Supplementary Readings / Resources / E-Resources

- *NA*

Assessment of Student Learning

- Will be made via
  - Informal question and answer sessions
  - Informal debates and class discussions

Course Grading

- Attendance (%50) + Final Exam Grade (%50)
- The student will get S (Satisfactory) or U (Unsatisfactory) for grading.

Course Policies

The course is aimed at;

- Providing students an efficient and physically comfortable, technically well equipped class
- Creating a self-confident atmosphere of learning
- Setting a prosperous interaction between the instructors and students
- Freeing students from stressful limitations of seeing a lecture wğithin frames of grading

Information for Students with Disabilities

To obtain disability related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the ODTÜ Disability Support Office as soon as possible. If you need any accommodation for this course because of your disabling condition, please contact me. For detailed information, please visit the websie of Disability Support Office: http://engelsiz.metu.edu.tr/

Academic Honesty

The METU Honour Code is as follows: *"Every member of METU community adopts the following honour code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."*

1. Course number and name: 2402205 – HISTORY OF TURKISH REVOLUTION I
2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): The course has no credit but equals to 2 ECTS credit. Each section has 2 (Two) hours a week.
3. Instructor's or course coordinator's name: Dr. Taner Zorbay (Course Coordinator)
4. Text book, title, author, and year:

   c. Course Reading Materials (Rest of the list is given in the web site of the course):
      i. **Altunışık, Meliha Benli and Özlem Tür.** ***Turkey: Challenges of Continuity and Change.*** London; New York: Routledge Curzon, 2005.
      ii. **Çarkoğlu, Ali and Binnaz Toprak.** *Religion, Society and Politics in a Changing Turkey.* Translated from Turkish by Çiğdem Aksoy Fromm. Istanbul: TESEV, 2007.
      iii. **Faroqhi, Suraiya.** *The* ***Ottoman Empire*** *and the World Around It.* London; New York: I. B. Tauris; New York: in the United States of America and Canada distributed by Palgrave Macmillan, 2007.
   d. PPT slides stored in ODTUCLASS.

5. Specific course information
   a. Brief description of the content of the course (catalogue description): The course is designed as a non-credited compulsory course for all undergraduate foreign students (taken by 1^{st} – 2^{nd} – 3^{rd} year students depending on dept.). It aims at teaching the history of Turkish Republic with a historical background as well as giving the details of the principles of Atatürk and events taken place throughout his life.
   b. Prerequisites or co-requisites: There are no prerequisites or co-requisites for this course.
   c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: The course is compulsory for all undergraduate foreign students (taken by 1^{st} – 2^{nd} – 3^{rd} year students depending on dept.).

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.): After taking this course, the students are expected to have:
      i. A sufficient knowledge of the History of Turkish Republic.
      ii. An ability to analyse issues discussed during the course.
      iii. A detailed understanding of the Principles of Kemal Atatürk via the knowledge of his life.
      iv. An awareness of the necessity of being a society with a rich historical background as well as the conscious of being a citizen in a society of different background.
      v. An ability to analyse current problems by making their connections and/or roots to historical events taken place in the past.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:
      i. An ability to apply knowledge of the course to his/her academic and personal life.
      ii. An ability to analyse and interpret knowledge given throughout the course.
      iii. An ability to function on multidisciplinary teams.
      iv. An ability to identify, to formulates, and to solve topics addressed in the course.
      v. An understanding of professional and ethical responsibility
      vi. An ability to communicate effectively (3g1 orally, 3g2 written)
      vii. The broad education necessary to understand the impact of historical knowledge in a global, economic, environmental, and societal context.
      viii. A recognition of the need for, and an ability to engage in life-long learning
      ix. A knowledge of contemporary issues
      x. An ability to use the historical knowledge and understanding necessary for life long experience.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	NA
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	NA
3	an ability to communicate effectively with a range of audiences	+
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	NA
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	+
6	an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions	NA
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	+
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
GIVEN ABOVE		

7. Brief list of topics to be covered

Week	Topic
Week 1	**WEEK 1** Introduction to the Course and the History of Anatolia
Week 2	**WEEK 2** Background Information: The World and the Ottoman Empire (13^{th} – 19^{th} Centuries)
Week 3	**WEEK 3** The Last Century of the Ottomans (20^{th} Century): The Tripoli War
Week 4	**WEEK 4** The Last Century of the Ottomans (20^{th} Century): The Balkan Wars
Week 5	**WEEK 5** World War I and the Ottomans
Week 6	**WEEK 6** End of the War and the Partition Plans of the Ottoman Empire
Week 7	**WEEK 7** The Reaction of Anatolia: The Turkish War of Independence / Part I: 1918 – 1920
Week 8	**WEEK 8** The Reaction of Anatolia: The Turkish War of Independence / Part II: 1920 – 1922
Week 9	**WEEK 9** The Post War Settlements: The Armistice of Mudros and the Peace Treaty of Lausanne
Week 10	**WEEK 10 The Formation of a Nation State / Part I: Society, Politics, the Principles and Reforms of Ataturk (1923 – 1933).**
Week 11	**WEEK 11 The Formation of a Nation State / Part II: Attempts of Multiparty System and Home Politics (1933 – 1938)**
Week 12	**WEEK 12 The Foreign Policy of Turkish Republic (1923 – 1938)**
Week 13	**WEEK 13-14 General Assessment of the semester**
Week 14	

HIST 2206 Course SyllabUS

1. Course number and name: 2402206 – HISTORY OF TURKISH REVOLUTION II

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): The course has no credit but equals to 2 ECTS credit. Each section has 2 (Two) hours a week.

3. Instructor's or course coordinator's name: Dr. Taner Zorbay (Course Coordinator)

4. Text book, title, author, and year:

   a. Course Reading Materials (Rest of the list is given in the web site of the course):
      i. **Altunışık, Meliha Benli and Özlem Tür.** ***Turkey: Challenges of Continuity and Change.*** London; New York: Routledge Curzon, 2005.
      ii. **Bağcı, Hüseyin, Jackson Janes, Ludger Kühnhardt (Eds.)** *Parameters of Partnership : the U.S., Turkey, Europe.* Baden-Baden: Nomos, 1999.
      iii. **Bağcı, Hüseyin.** *Zeitgeist: Global Politics and Turkey.* İstanbul: Orion, 2008.
   b. PPT slides stored in ODTUCLASS.

5. Specific course information
   a. Brief description of the content of the course (catalog description): The course is designed as a non-credited compulsory course for all undergraduate foreign students (taken by 1^{st} – 2^{nd} – 3^{rd} year students depending on dept.). It aims at teaching the history of Turkish Republic with a historical background as well as giving the details of the principles of Atatürk and events taken place throughout his life.
   b. Prerequisites or co-requisites: There are no prerequisites or co-requisites for this course.
   c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: The course is compulsory for all undergraduate foreign students (taken by 1^{st} – 2^{nd} – 3^{rd} year students depending on dept.).
6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.): After taking this course, the students are expected to have:
      i. A sufficient knowledge of the History of Turkish Republic.
      ii. An ability to analyse issues discussed during the course.
      iii. A detailed understanding of the Principles of Kemal Atatürk via the knowledge of his life.
      iv. An awareness of the necessity of being a society with a rich historical background as well as the conscious of being a citizen in a society of different background.
      v. An ability to analyse current problems by making their connections and/or roots to historical events taken place in the past.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:
      i. An ability to apply knowledge of the course to his/her academic and personal life.
      ii. An ability to analyse and interpret knowledge given throughout the course.
      iii. An ability to function on multidisciplinary teams.
      iv. An ability to identify, to formulates, and to solve topics addressed in the course.
      v. An understanding of professional and ethical responsibility
      vi. An ability to communicate effectively (3g1 orally, 3g2 written)
      vii. The broad education necessary to understand the impact of historical knowledge in a global, economic, environmental, and societal context.
      viii. A recognition of the need for, and an ability to engage in life-long learning
      ix. A knowledge of contemporary issues
      x. An ability to use the historical knowledge and understanding necessary for life long experience.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	NA
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	NA
3	an ability to communicate effectively with a range of audiences	+
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	NA
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	+
6	an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions	NA
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	+
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
GIVEN ABOVE		

7. Brief list of topics to be covered

Week	Topic
Week 1	**WEEK 1** Introduction to the Course and the History of Anatolia
Week 2	**WEEK 2** Background Information: Turkey under Ataturk's Presidency (1923 – 1938).
Week 3	**WEEK 3** Ismet Inonu, the National Chief (1938 – 1945).
Week 4	**WEEK 4** World War II and Turkey: Between East and West.
Week 5	**WEEK 5** Reshaping Turkish Democracy: From Single Party System to Multi-Party System (1946 – 1950).
Week 6	**WEEK 6** Democratic Party: Adnan Menderes and a New Way in Politics (1950 – 1960).
Week 7	**WEEK 7** Turkey in World Politics: The Cold War Period Experience
Week 8	**WEEK 8** The Military Interventions in Turkey: A Step Back or Forward? (1960, 1971, 1980).
Week 9	**WEEK 9** The Civil Politics and Turkish Society
Week 10	**WEEK 10** Turkey after 1980s / Part I: Civil Politics Reactivated.
Week 11	**WEEK 11** Turkey after 1980s / Part II: End of Cold War.
Week 12	**WEEK 12** General Assessment of the semester
Week 13	
Week 14	

Course Syllabus - 6420105

1. Course number and name: 6420105 Turkish I

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other). 0 METU Credit, 4 ECTS Credits, 4 Lesson Hours.

3. Instructor's or course coordinator's name: Esra Darıcı

4. Text book, title, author, and year
   a. other supplemental materials
      İstanbul Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı A1 (2015)
      Aydan Eryiğit Umunç , Türkçe Konuşalım Ders Kitabı, Çalışma Kitabı 1, Hacettepe Üniversitesi Yayınları (2011)
      Yeni Hitit Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı – 1 Temel (2012)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Introduction to Turkish speaking and writing skills at the beginner and elementary level.
   b. prerequisites or co-requisites: there is no prerequisite
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Must Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      The characteristics, rules and basic grammar is given in this course. Practical work is carried to improve the students comprehension, writing and speaking skills in Turkish.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered

WEEKS	SUBJECT	DETAILS
1	Alfabe, tanışma selamlaşma diyalogları.	Çoğul eki, soru eki, Ünlü uyumu, temel nesneler
2	Kendini tanıtma	Sayıları söyleme, form doldurma. Bu/şu/o

3	Nerede?, Kimde?	Bulunma durumu eki, var / yok
4	Günlük hayatı anlatma	Şimdiki zaman, temel fiiller
5	Nereye, kime, nereden, kimden	Yönelme ve çıkma durumu ekleri, sık kullanılan kelimeler
6	İstekleri ifade etme	-mek istemek kalıbı, lokanta – alışveriş diyalogları
7	Ara sınav - Sahiplik belirtme	İyelik ekleri, akrabalık kelimeleri
8	Saat söyleme	-dan önce, -dan sonra
9	Günlük plan yapma	-madan önce, –dıktan sonra
10	Yol tarif etme	Adres sorma, yer-yön ifadelerini kullanma
11	Karşılaştırma yapma	-den daha, en, isim tamlamaları
12	Hastalığını söyleme	Doktor-hasta diyalogları
13	Emir ve istek bildirme ve anlayabilme	Kurallar, sohbet diyalogları, yapım ekleri
14	Geçmişi anlatma	Belirli geçmiş zaman

Course Syllabus - 6420106

1. Course number and name: 6420106 Turkish II

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other). 0 METU Credit, 4 ECTS Credits, 4 Lesson Hours.

3. Instructor's or course coordinator's name: Esra Darıcı

4. Text book, title, author, and year
   a. other supplemental materials
      İstanbul Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı A2 (2015)
      Aydan Eryiğit Umunç , Türkçe Konuşalım Ders Kitabı, Çalışma Kitabı 2, Hacettepe Üniversitesi Yayınları (2011)
      Yeni Hitit Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı – 1 Temel (2012)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Introduction to Turkish speaking and writing skills at the beginner and elementary level.
   b. prerequisites or co-requisites: Having passed the course of 6420105
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Must Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      The characteristics, rules and basic grammar is given in this course. Practical work is carried to improve the students comprehension, writing and speaking skills in Turkish.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered

WEEKS	SUBJECT	DETAILS
1	Yemek siparişi, yol tarifi	Emir kipi
2	Tarif etme, plan yapma	İstek kipi, yapım ekleri (-lı, -sız, -lık)

3	Geçmişi anlatma	Belirli geçmiş zaman
4	Geçmişi anlatma	Bağlaçlar (çünkü, bu nedenle, bu sebeple, bunun için)
5	Gelecek planları yapma	Gelecek zaman
6	Gelecek planları yapma	İsim cümlelerinde gelecek zaman, karşılaştırma (gibi, kadar)
7	Ara sınav - Geçmişten bahsetme	Belirsiz geçmiş zaman (-miş) masallar, efsaneler
8	Geçmişten bahsetme	İsim cümlelerinde belirsiz geçmiş zaman
9	Bir diyaloğu anlama ve aktarma	Doğrudan anlatım (diye), Bağlaçlar (hem…hem, ne…ne, ya…ya)
10	Hobileri ve alışkanlıkları anlatma	Geniş zaman
11	Kendinden bahsetme	-dır eki
12	Yetenekleri söyleme	Yeterlilik fiili
13	Teklif etme	Yeterlilik fiilinin fonksiyonları
14	Tahmin etme	Zarf fiiller (-ıp, -madan)

Course Syllabus - 6420201

1. Course number and name: 6420201 Elementary Turkish

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other). 0 METU Credit, 2 ECTS Credits, 2 Lesson Hours.

3. Instructor's or course coordinator's name: Esra Darıcı

4. Text book, title, author, and year
   a. other supplemental materials
      İstanbul Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı B1 (2015)
      Yeni Hitit Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı – 2 Orta (2012)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Characteristics of Turkish, speaking and writing skills of Turkish at intermediate level, idioms, proverbs and phrases in Turkish vocabulary.
   b. prerequisites or co-requisites: No prerequisites
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Must Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      Raising the awareness of students about the basic features of Turkish. Developing students' oral and written communication skills. Expanding their knowledge of idioms, proverbs and phrases
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered

WEEKS	SUBJECT	DETAILS
1	Türkçenin temel özellikleri	Ünlü uyumları, ünsüz uyumları, ses düşmeleri
2	Hobiler hakkında konuşma	Durum ekleri (-e, -de, -den)

3	Başımızdan geçen bir olayı anlatma	Belirtme eki
4	Meslekler, iş ilanları	Gereklilik kipi (-meli, -malı)
5	Hayalimizdeki meslek	Gereklilik kullanımları (zorunda, lazım, gerek, mecbur)
6	Hayatımızdaki keşkeler	Dilek kipi
7	Ara Sınav	
8	Deneyimleri anlatma	Zarf fiil (-ken)
9	Kişisel görüşlerden bahsetme	Şart kipi
10	Özgün fikir ve görüşlerin anlatıldığı metinleri anlama	Ettirgen çatı
11	Duygu ve ifadeleri anlama	Edilgen çatı
12	Bir tartışmada düşünceleri savunma	Tarafından, -ce öbeği
13	Bilgi alışverişinde bulunma	Zarf fiiller (-dıkça, -dığı sürece)
14	Türkçede sık kulanılan deyim ve atasözleri	

Course Syllabus - 6420202

1. Course number and name: 6420202 Intermediate Turkish

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other). 0 METU Credit, 2 ECTS Credits, 2 Lesson Hours.

3. Instructor's or course coordinator's name: Esra Darıcı

4. Text book, title, author, and year
   a. other supplemental materials
      İstanbul Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı B2 (2015)
      Yeni Hitit Yabancılar İçin Türkçe Ders Kitabı, Çalışma Kitabı – 2 Orta (2012)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Characteristics of Turkish, speaking and writing skills of Turkish at intermediate level, idioms, proverbs and phrases in Turkish vocabulary.
   b. prerequisites or co-requisites: Having passed the course of 6420201
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Must Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      Raising the awareness of students about the basic features of Turkish. Developing students' oral and written communication skills. Expanding their knowledge of idioms, proverbs and phrases
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered

WEEKS	SUBJECT	DETAILS
1	Dilin temel özellikleri	Dil-kültür ilişkisi, Türkçenin lehçe ve ağızları
2	Dille ilgili diğer kavramlar	Anadil, ikidillilik, argo

3	Haber, ropörtaj gibi metinleri anlama	Sıfat fiiller
4	Konuşma ve tartışmalara katılma	Sıfat fiiller
5	Sunum yapma teknikleri	Dolaylı anlatım
6	Bildirici metinler	Soru cümlelerinde dolaylı anlatım
7	Ara Sınav	
8	Kültürünü anlatma	İsim cümlelerinde dolaylı anlatım
9	Ayrıntılı açıklamalar yapabilme	Bağlaçlar (oysaki, halbuki, meğerse)
10	Tartışma yapabilme	Bağlaçlar (üstelik, hatta, bununla birlikte)
11	Yazılı anlatımları tanıma	Nedenleştirme (dolayı, nedeniyle, yüzünden)
12	Yazılı anlatımları tanıma	Adlaştırma
13	Paragrafta düşünceyi geliştirme yollarını öğrenme	Karşıtlık kurma
14	Türkçede sık kulanılan deyim ve atasözleri	

Course Syllabi

8. Course number and name: 6420303 - Turkish I

9. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): Course Credit: 0; Course ECTS: 2.0

10. Instructor's or course coordinator's name: Güllüzar Uysal (Coordinator)

11. Text book, title, author, and year: AKSAN, Doğan (2000). Her Yönüyle Dil (Ana Çizgileriyle Dilbilim). Ankara: TDK Yayınları; ÇOTUKSÖKEN,Yusuf (2001). Üniversite Öğrencileri İçin Uygulamalı Türk Dili I, II. İstanbul: Papatya Yayıncılık.

    a. other supplemental materials: AKSAN, Doğan (2008). Türkçenin Gücü. Ankara: Bilgi Yayınevi; AKSOY, Ömer Asım (1990). Dil Yanlışları. Ankara: Emel Matbaacılık; DİL DERNEĞİ (2002). Türkçenin Kullanımında Karşılaşılan Sorunlar ve Çözümleri. Ankara.

12. Specific course information
    a. brief description of the content of the course (catalog description): Language; the elements of language, the use of language in oral communication; the use of language in written communication; native language; the elements of Turkish language, the present state of Turkish language; official communication.
    b. prerequisites or co-requisites: No prerequisites
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

13. Specific goals for the course
    a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
        - The student will be able to define what the language is.
        - The student will be able to explain the linguistic features of the language.
        - The student will be able to explain the relation between the language and the thinking.
        - The student will be able to discuss the relations between the language and the culture and the society
        - The student will be able to explain the types of the language: mother language, standard language, dialect, accent, idiolect, sociolect, pidgin, creole, artificial language etc.
        - The student will be able to sort the languages in the world by grammatical features. The student will be able to sort the languages in the world by language families.
        - The student will be able to know the history of Turkish language.
        - The student will be able to explain the reasons and the results of the Language Revolution of Turkish.
        - The student will be able to explain the grammatical rules of the Turkish language.
        - The student will be able to know the rules of preparing an effective presentation.
        - The student will be able to know the rules of using body language in public speeches.
        - The student will be able to learn the rules of text planning even oral or written.

    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
        - An ability to recognize importance of the language and communication in individual and social life.
        - An ability to realize relations between the language and the thought, the culture, and the society.
        - An ability to explain the place and importance of Turkish in world languages.
        - An ability to discuss the actual problems of Turkish language.
        - An ability to evaluate a speech according to different context and points of view.

- An ability to express the opinions and feelings clearly in speaking and writing
- An ability to use correct language vocabulary, structures in oral and written communication.
- An ability to speak Turkish language keeping the rules of stress and intonation.
- An ability to use the body language in accordance with the speech.
- An ability to comprehend a composition that he/she listen, read, and watch.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	+
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

14. Brief list of topics to be covered

The emergence, definition, and features of language. The relation between the language and the thinking. The relations between the language and the culture and the society. The types of language: mother language, standard language, dialect, accent, idiolect, sociolect, pidgin, creole, artificial language etc. Classification of languages according to their structures in the world. Classification of languages according to their families in the world. The brief history of Turkic Languages. the Language Revolution in Turkey. The grammatical rules of the Turkish language: Phonetics, Syntax, Morphology and Semantics. The rules of preparing an effective presentation. The rules of using body language in public speeches. The rules of text planning even oral or written. Punctuation. The foreign words in Turkish.

Course Syllabi

1. Course number and name: **6420304 - Turkish II**

2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).
   Course Credit: 0; **Contact Hours:** 2 hours a week; **Course ECTS:** 2.0

3. Instructor's or course coordinator's name:
   Güllüzar Uysal (Coordinator)

4. Text book, title, author, and year
   Ateş, Kemal (2007) *Türk Dili*, Ankara: İmge Yayınları.
   Çotuksöken, Yusuf. (2008), *Üniversite Öğrencileri İçin Uygulamalı Türk Dili*. İstanbul: Papatya Yayıncılık.
   Özdemir, Emin (1999) *Yazınsal Türler*, Ankara: Bilgi Yayınevi.
   Özdemir, Emin. (2004) *Sözlü-Yazılı Anlatım Sanatı, Kompozisyon*. İstanbul: Remzi Kitabevi.
   a. other supplemental materials:
      Selected books, stories, poems, essays and articles.
      Selected movies, music and documentary.

5. Specific course information
   a. brief description of the content of the course (catalog description): Oral and written expression; types of oral and written expression; general rules of official communication; writing research papers; classroom exercises and discussions.
   b. prerequisites or co-requisites: **6420303 - Turkish I**
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: **Required course.**

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      - The student will be able to know the written expression and the types of written expression.
      - The student will be able to know the oral expression and the types of oral expression.
      - The student will be able to develop the comprehension and expression ability.
      - The student will be able to learn and practice critical thinking.
      - The student will be able to apply rules of academic writing.
      - The student will be able to reflect on ideas and facts in oral and written expressions.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

- An ability to explain the ways to be successful in oral and written expression,
- An ability to prepare and participate oral expression genres,
- An ability to communicate and works in teams,
- An ability to improve reading and research skills,
- An ability to explain the rules to be successful in written expression,
- An ability to researches a scientific topic and increases the ability to present.

	ABET Student Outcomes	Check if this student

		outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

7. Brief list of topics to be covered:
   Expression, written expression, basic rules of expression.
   Outline and the arrangement of thoughts.
   Paragraph and creating paragraph.
   Types of expression styles: expository, narrative, descriptive and argumentative.
   Improving writing skills and creativity.
   Critical thinking and critical analysis.
   Fictional Genres: novel, story, poem, drama.
   Non-Fictional Genres: essay, article, critique, column
   Scientific Genres: scientific article, research report.
   Oral Expression Genres: panel, forum, debate, symposium, briefing, discussion, conferences, congress, interviews.
   Functional Genres: letter, statement of purpose, curriculum vitae.

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF AEROSPACE ENGINEERING

15. Course number and name
    AEE 231 Thermodynamics

16. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other).
    (4-0) 4 credits, all categorized as engineering topics. The course has four lecture hours a week and no laboratory sessions. The duration of each lecture hour is 50 minutes.

17. Instructor's or course coordinator's name
    Asst. Prof. Dr. Özge BAŞKAN PERÇİN

18. Text book, title, author, and year
    "Fundamentals of Thermodynamics", C. Borgnakke and R.E. Sonntag, (7th edition), Wiley, 2009.
    a. other supplemental materials
    "Fundamentals of Engineering Thermodynamics", M.J. Moran and H.N. Shapiro, (5th edition), Wiley 2006.

19. Specific course information
    a. brief description of the content of the course (catalog description)
       Basic concepts, properties of pure substances, first law of thermodynamics for closed systems and control volumes, entropy, second law of thermodynamics, second law analysis, introductory cycle analysis.
    b. prerequisites or co-requisites
       (None)
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
       Required

20. Specific goals for the course
    a. specific outcomes of instruction
       - A firm understanding of basic concepts and laws of thermodynamics.
       - Ability to analyze thermodynamic systems encountered in practice.
       - Ability to make proper assumptions to simplify complicated thermodynamics problems in engineering applications.
    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

	ABET Student Outcomes	Check if this student outcome is addressed by this course

1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		

21. Brief list of topics to be covered

Week	Topic
Week 1	Basic concepts of thermodynamics
Week 2	Properties of pure substances and ideal mixtures
Week 3	First law, closed systems
Week 4	
Week 5	First law, control volume
Week 6	
Week 7	Second law
Week 8	
Week 9	Entropy
Week 10	
Week 11	Exergy analysis and applications
Week 12	
Week 13	Closed and open cycle analysis
Week 14	

METU
DEPARTMENT OF CHEMICAL ENGINEERING

ChE 204 Thermodynamics I

Credits and Contact Hours: (4-0) 4 credits (**ES**). Four classes a week, 50 minutes each class.

Course Coordinator: Dr. Harun Koku

Textbook: S.I. Sandler, "Chemical, Biochemical and Engineering Thermodynamics", 5th Ed., Wiley, 2018.

Catalog Description:

Concepts of equilibrium, temperature and reversibility. First law and concepts of heat and work; second law and entropy. Equations of state and thermodynamic properties of pure substances. Engineering applications of these principles in the analysis and design of closed and open systems. Thermodynamic analysis of cyclic processes including power generation and refrigeration.

Prerequisites: PHYS 105

Course Status: Required

Course Learning Outcomes:

At the end of this course, the student will be able to:

- Differentiate reversible and irreversible processes
- Calculate heat and work interactions
- Apply first law to solve problems in closed and open systems
- Apply second law to solve problems in closed and open systems
- Apply first and second laws to analyse power and refrigeration cycles
- Estimate properties of real substances

Specific ABET Student Outcomes Addressed by the Course:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Brief List of Topics

- Introduction. Basic definitions. Forms of Energy, Heat, and reversible and irreversible work. Equilibrium state, intensive and extensive variables.
- Thermodynamic properties.
- Conservation of mass and energy: The general balance equations.
- First Law of Thermodynamics.
- Applications: Open and closed systems, operating under transient conditions and at steady state.
- Second law of thermodynamics.
- Applications: Open and closed systems, operating under transient conditions and at steady state.
- Power cycles. Refrigeration and air conditioning. Liquefaction of gases.
- Estimation of properties of real substances: Maxwell relations.
- Generalized correlations, principle of corresponding states. Departure functions.

- Estimation and correlation of thermodynamic properties of real substances: Applications in mass, energy and entropy balances.

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

1. Course number and name: 5690203, Thermodynamics I
2. Credits, contact hours and categorization of credits: 3 (3-0), 3, Engineering Topic
3. Instructor's or course coordinator's name: Dr. Abdullah Ulaş, Dr. Almıla Güvenç Yazıcıoğlu, Dr. Özgür Bayer, Dr. Feyza Kazanç
4. Textbook: M.J. Moran, H.N. Shapiro, D.D. Boettner, M.B.Bailey, Principles of Engineering Thermodynamics, SI version, 8th ed., Wiley, 2015.
   a. other supplemental materials: C. Borgnakke and R.E. Sonntag, Fundamentals of Thermodynamics, 8th Edition, John Wiley, 2014.
5. Specific course information
   a. brief description of the content of the course: Basic concepts and definitions. Properties of a pure substance. Equations of state. Work and heat. First law of thermodynamics. Internal energy and enthalpy. Second law of thermodynamics. Carnot cycle. Entropy.
   b. prerequisites or co-requisites: None
   c. indicate whether a required, elective, or selected elective course in the program: Required course
6. Specific goals of the course
   a. specific outcomes of instruction: 1. Ability to identify thermodynamic equilibrium state and understand the basic differences between thermodynamics and heat transfer, fluid mechanics courses. 2. Habit of correct use of units. 3. Ability to differentiate system and control volume processes. 4. Understanding of usage of thermodynamic tables. 5. Ability to identify the limits of the ideal gas assumption. 6. Ability to differentiate qualitatively heat and work. 7. Ability to calculate work. 8. Ability to appreciate the energy conversion. 9. Ability to differentiate unsteady and steady flow applications. 10. Ability to analyze different steady flow devices. 11. Ability to analyze the heat engines and calculate thermal efficiency. 12. Ability to analyze the refrigerators, heat pumps and calculate coefficient of performance. 13. Ability to construct ideal cycles applying reversible processes. 14. Ability to spot the source of irreversibility. 15. Ability to differentiate ideal engine and actual one. 16. Ability to appreciate a new property, entropy, not a directly measurable one but indicating the direction of the process. 17. Ability to find isentropic efficiency. 18. Ability to derive some thermodynamical relations using entropy concept.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	√

2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	√
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	√
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
The Mechanical Engineering Program Criterion for Curriculum: The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes		√

7. Brief list of topics to be covered

Week	Topic
1	Introduction
2	Energy and the 1st Law of Thermodynamics
3	Energy and the 1st Law of Thermodynamics
4	Energy and the 1st Law of Thermodynamics
5	Evaluating Properties
6	Evaluating Properties
7	Evaluating Properties
8	Control Volume Analysis Using Energy
9	Control Volume Analysis Using Energy
10	Control Volume Analysis Using Energy
11	The 2nd Law of Thermodynamics
12	Using Entropy
13	Using Entropy
14	Using Entropy

1. Course number and name: 5690205, Statics
2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): 3 (3-0), 3, Engineering Topic
3. Instructor's or course coordinator's name: Assoc.Prof.Dr. Kıvanç Azgın,Assoc.Prof.Dr. Hüsnü Dal, Prof.Dr. Haluk Darendeliler, Assoc.Prof.Dr. Yiğit Yazıcıoğlu
4. Texbook: Hibbeler, R.C., "Engineering Mechanics: Statics", 14th (SI) Edition, Pearson Education, 2017.
   a. other supplemental materials: Beer, F. P., Johnston, E. R., "Vector Mechanics for Engineering: Statics", McGraw-Hill; Meriam, J. L., Kraige, L.G.,"Engineering Mechanics: Statics and Dynamics", J.Wiley; Shames, I. H., "Engineering Mechanics: Statics", Prentice Hall.
5. Specific course information
   a. brief description of the content of the course:
      Idealizations and principles of mechanics. Important vector quantities, classification and equivalence of force systems. State of equilibrium. Elements of structures; trusses and beams. Friction. Center of gravity and Centroid. Moments of Inertia. Elements of statics of fluids.
   b. prerequisites or co-requisites:
      2300105 General Physics I, 2360120 Calculus of Functions of Several Variables
   c. indicate whether a required, elective, or selected elective course (as per Table 5-1) in the program: Required course
6. Specific goals of the course
   a. specific outcomes of instruction:

      1. Understanding of how to represent force, moment of force and couple as vectors. 2. Ability of using vector algebra in the analysis of forces, moments and couples. 3. Ability to move a force acting on a rigid body to a parallel position in space. 4. Ability to identify the type of a special force system (e.g. concurrent, coplanar, distributed, parallel, general 3D). 5. Ability to calculate the simplest resultant of a general force system. 6. Ability to adequately represent the effect of a support on a rigid body. 7. Ability to isolate a rigid body from all of its contacts and draw the free body diagram. 8. Ability to handle a group of rigid bodies by using Newton's third law. 9. Ability to calculate unknown forces or other related unknowns through the use of equilibrium equations for a rigid body that is in equilibrium. 10. Ability to identify a two force member. 11. Understanding of the static indeterminacy. 12. Ability to calculate the internal forces for simple trusses using the method of joints or method of sections. 13. Ability to plot the shear force, bending moment and axial force distribution in beams using the method of sections. 14. Ability to plot the shear force, bending moment, axial force distribution in beams using the differential equations of equilibrium. (Summation method). 15. Ability to carry out static force analysis of rigid bodies and simple machines like wedges in dry frictional contact. 16. Ability to perform force analysis of flexible belts in frictional contact. 17. Ability to locate the centroid, center of mass, and center of gravity of a rigid body. 18. Ability to calculate first, second and polar moments of area for various beam cross sections or for any other generic shape. 19. Ability to handle composite surfaces.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	√
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
The Mechanical Engineering Program Criterion for Curriculum: The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes		√

7. Brief list of topics to be covered

Week	Topic
1	Introduction, General Concepts, Units, Significant Figures
2	Scalars and Vectors, Vector Operations, Coordinate Systems, Position Vectors, Unit Vectors, Force Vectors, Dot Product
3	Particle Equilibrium Equations, Connecting Elements, Planar Equilibrium, Spatial Equilibrium
4	Cross Product, Moment of a Force about a Point, Principle of Transmissibility, Resultant Moment of a System of Forces, Moment of a Resultant Force, Moment of a Force about an Axis, Moment of a Couple, Resultant of Couples
5	Equivalent Force Systems, Simplest Resultant, Concurrent Systems, Coplanar Systems, Parallel Systems, Wrench
6	Centroid of Curves, Areas, Volumes, Center of Mass and Gravity, Centroid of Composite Bodies
7	General Distributed Loading, Fluid Pressure, Simple Distributed Loading
8	General Rigid Body Equilibrium Equations, Planar Equilibrium, Free Body Diagrams, Planar Equilibrium Equations
9	Spatial Equilibrium, Free Body Diagrams in Space, Redundant and Improper Constraints, Two and Three Force Members
10	Trusses, Method of Joints, Zero Force Members, Method of Sections
11	Internal Forces, Planar and Spatial Cases, Sign Conventions, Method of Sections, Differential-Integral Relations
12	Drawing Shear Force and Bending Moment Diagrams using equations and areas/slopes
13	Basic Theory of Dry Friction, Equilibrium Problems, Impending Motion Problems, Wedges, Belts
14	Moment of Inertia, Parallel Axis Theorem, Radius of Gyration, Finding Moment of Inertia by Integration and by Composite Areas

1. Course number and name: 5690351, Thermodynamics of Heat Power
2. Credits, contact hours, and categorization of credits in Table 5-1 (math and basic science, engineering topic, and/or other): 3 (3-0), 3, Engineering Topic
3. Instructor's or course coordinator's name: Prof. Dr. Hüseyin Vural, Prof. Dr. Abdullah Ulaş, Assoc. Prof. Dr. Cemil Yamalı, Assoc. Prof. Dr. Ahmet Yozgatligil, Prof. Dr. Almıla Güvenç Yazıcıoğlu, Assist. Prof. Dr. Özgür Bayer, Assist Prof. Dr. Altuğ Özçelikkale, Assist Prof. Dr. Ali Karakuş.
4. Textbook, title, author, and year: Principles of Engineering Thermodynamics, Michael J. Moran, Howard N. Shapiro, Daise D. Boettner, Margaret B. Bailey, 2017.
   a. other supplemental materials: None.
5. Specific course information
   a. brief description of the content of the course (catalog description): Conservation of energy. Conservation of mass. Work and heat. First law of thermodynamics. Properties and processes of ideal gases. Second law of thermodynamics. Compressors, internal combustion engines. Properties of s.team. Heat exchangers. Steam power plants, nuclear energy power plants. Pumps and fans. Refrigeration. (Offered to non-ME students only).
   b. prerequisites or co-requisites: none
   c. indicate whether a required, elective, or selected elective course (as per Table 5-1) in the program: required course
6. Specific goals of the course
   a. specific outcomes of instruction:

      Ability to identify thermodynamic equilibrium state and understand the basic differences between thermodynamics and heat transfer, fluid mechanics courses. Habit of correct use of units. Ability to differentiate system and control volume processes. Understanding of usage of thermodynamic tables. Ability to identify the limits of the ideal gas assumption. Ability to differentiate qualitatively heat and work. Ability to calculate work. Ability to appreciate the energy conversion. Ability to differentiate unsteady and steady flow applications. Ability to analyze different steady flow devices. Ability to analyze the heat engines and calculate thermal efficiency. Ability to analyze the refrigerators, heat pumps and calculate coefficient of performance. Ability to construct ideal cycles applying reversible processes. Ability to spot the source of irreversibility. Ability to differentiate ideal engine and actual one. Ability to appreciate a new property, entropy, not a directly measurable one but indicating the direction of the process. Ability to find isentropic efficiency. Ability to derive some thermodynamical relations using entropy concept.

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	√
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	√
3	an ability to communicate effectively with a range of audiences	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	
Specific outcomes of instruction: *(please add additional student outcomes specific to the course)*		
-		

7. Brief list of topics to be covered

Week	Topic
1	Introduction
2	Evaluating Properties of Pure Substance
3	Evaluating Properties of Pure Substance
4	Evaluating Properties of Pure Substance
5	Energy and 1st Law of Thermodynamics
6	Energy and 1st Law of Thermodynamics
7	Control Volume Analysis Using Energy
8	Control Volume Analysis Using Energy
9	The 2nd Law of Thermodynamics
10	The 2nd Law of Thermodynamics
11	Using Entropy
12	Using Entropy
13	Cycle Analysis of Gas Power Systems: Reciprocating Internal Combustion Engines
14	Cycle Analysis of Gas Power Systems: Gas Turbine Engines and Jet Propulsion

Course Syllabi

1. METE 230, Fundamentals of Materials Science and Engineering

2. Credits: 3, contact hours:3, Engineering Topics, (3-0) 3, no design component

3. Prof.Dr. Hüsnü Emrah Ünalan (Coordinator)

4. William D. Callister, David G. Retwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, John Wiley and Sons, 3rd edition (2008), 4th edition (2012), 5th edition (2016)

5. Specific course information
   a. Introduction and classification of materials; structure of metals, ceramics and polymers, imperfections; diffusion; phase diagrams and microstructure; materials properties: mechanical, electrical, magnetic, optical and chemical; composite materials.
   b. No prerequisites
   c. Course type is decided by the related department.
6. Specific goals for the course
   a. Explain the fundamentals of materials science and engineering concepts. Comprehend the conceptual framework for the internal structure of engineering materials.
   Establish important relationships between internal structure, properties and performance of materials.)
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. Please see table below:

	ABET Student Outcomes	Check if this student outcome is addressed by this course
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X
Departmental SOs: 8. a knowledge of the scientific and engineering principles underlying the four major elements of the field; structure, properties, processing and performance related to material systems 9. an ability to apply and integrate knowledge from each of the four major elements of the field to solve materials and/or process selection and design problems		

7. Brief list of topics to be covered:

   Introduction (Classification of materials, advanced materials, nanomaterials);

Structure of Metals, Ceramics and Polymers (Unit cells, metallic crystal structures, ceramic crystal structures, polymorphism and allotropy, crystal systems, Crystallographic directions, crystallographic planes, crystalline and noncrystalline materials, Polymer structures, thermoplastic and thermosetting polymers);

Imperfections (Point defects in metals, ceramics and polymers, impurities in solids, miscellaneous imperfections);

Phase Diagrams / Microstructure (Phases, microstructure and phase equilibrium, Binary isomorphous systems, binary eutectic systems, equilibrium phase diagrams with intermediate phases, ceramic phase diagrams, Development of microstructure in iron-carbon alloys);

Materials Properties (Mechanical properties: elastic deformation, mechanical behavior of metals, polymers and ceramics, Electrical properties: electrical conduction, semiconductivity, conductivity in ceramics and polymers, dielectric behavior, Magnetic properties: basic concepts, soft and hard magnetic materials, magnetic storage, superconductivity, Optical properties: optical properties of metals and nonmetals, Chemical properties: corrosion of metals and ceramics materials, degradation in polymers);

Composite Materials (Particle and fiber reinforced composites, structural composites).