

Program of Electrical Engineering:

Course Syllabi

Course Syllabus: ELEC-221 Electrical Circuits I Lec.

1. Course number and name: ELEC-221 Electrical Circuit I Lec.
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:
 - a. Electric Circuits, James W. Nilsson and Susan A. Riedel, Prentice Hall, 2011
5. Specific course information
 - a. Catalog description: This course covers Ohm's and Kirchoff's Laws, Thevenin and Norton Equivalents, analysis of RL and RC networks with and without forcing functions, the RLC circuit, computer-aided circuit simulation
 - b. Prerequisites or co-requisites: Co-requisite Phys. 1539-202 and EE 3531-223
6. Specific goals for the course
 - a. Outcomes of instruction
This course is the first course in a sequence of courses intended to develop a strong foundation in electrical circuit analysis and design.
 - b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2,a3)
 - ii. An ability to identify, formulate, and solve engineering problem (e2)
7. Topics covered
 - a. Circuit Variables: Voltage, Current, Power, and Energy
 - b. Circuit Elements and Experimental Laws (Ohm, KCL, KVL Laws)
 - c. Simple Resistive Circuits
 - d. Some Useful Techniques of Circuit Analysis
 - e. Inductance and Capacitance
 - f. Source-free RL and RC Circuits
 - g. The Application of the Unit-Step Forcing Function
 - h. Natural and Step Responses of RLC Circuits

Course Syllabus: ELEC-222 Electrical Circuits II Lec.

1. Course number and name: ELEC-222 Electrical Circuit II Lec.
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:
 - a. Electric Circuits, James W. Nilsson and Susan A. Riedel, Addison- Wesley Publishing Co., 2011
5. Specific course information
 - a. Catalog description: This course covers the sinusoidal forcing functions, sinusoidal steady-state responses using phasors, polyphase circuits, complex frequency, and frequency responses, computer-aided simulation
 - b. Prerequisites or co-requisites: Co-requisite: EE3531-224, EE 3531-221
6. Specific goals for the course
 - a. Outcomes of instruction
This course is the Second course in a sequence of courses intended to develop a strong foundation in electrical circuit analysis and design.
 - b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2,a3)
 - ii. An ability to identify, formulate, and solve engineering problem (e1, e2)
7. Topics covered
 - a. Sinusoidal Steady State Analysis
 - b. Sinusoidal Steady State Power Calculations
 - c. Balanced Three Phase Circuits
 - d. Mutual Inductance
 - e. Series, and Parallel Resonance
 - f. Introduction to the Laplace Transform
 - g. The Laplace Transform in Circuit Analysis
 - h. Two-port Circuits

Course Syllabus: ELEC-223 Electrical Circuits I Lab.

1. Course number and name: ELEC-222 Electrical Circuit I Lab
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:
 - a. Basic Electricity-Lab. Manual, Paul B. Zbar and Gordon Rockmaker, Glencoe Publishing, 2008
5. Specific course information
 - a. Catalog description: This course is the first laboratory course in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuits.
 - b. Prerequisites or co-requisites: Co-requisite: Co-requisite 3531-221 Electrical Circuit I Lec.
6. Specific goals for the course
 - a. Outcomes of instruction
This course is the first laboratory course in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuit.
 - b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
 - ii. An ability to design and conduct experiments, as well as to analyze and interpret data (b1,b2,b3)
 - iii. An ability to identify, formulate, solve engineering problems (e1,e2)
7. Topics covered
 - a. Ohm's Law
 - b. Designing Series Circuits
 - c. Voltage Divider Circuits
 - d. Designing Parallel Circuits
 - e. Designing Series Parallel Circuits
 - f. Kirchhoff's Voltage and Current Laws
 - g. Designing Voltage and Current-Divider Circuits
 - h. Maximum Power Transfer
 - i. Balanced Bridge Circuit
 - j. Superposition Theorem
 - k. Thevenin's Theorem
 - l. Selected Pspice Projects

Course Syllabus: ELEC-224 Electrical Circuits II Lab.

1. Course number and name: ELEC-222 Electrical Circuit I Lab
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:
 - a. Basic Electricity-Lab. Manual, Paul B. Zbar and Gordon Rockmaker, Glencoe Publishing, 2008
5. Specific course information
 - a. Catalog description: A Continuation of Electrical Circuits Lab I
 - b. Prerequisites or co-requisites: Co-requisite 3531-222 Electrical Circuit II Lec.
6. Specific goals for the course
 - a. Outcomes of instruction
 - i. This course is the second laboratory course in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuit.
 - b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
 - ii. An ability to design and conduct experiments, as well as to analyze and interpret data (b1,b2,b3)
 - iii. An ability to identify, formulate, solve engineering problems (e1,e2)
 - iv. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (k1)
7. Topics covered
 - a. Oscilloscope Operation
 - b. Oscilloscope Voltage Measurements
 - c. Peak,RMS,and Average Values of AC
 - d. Characteristics of Inductance
 - e. Inductances in Series and Parallel
 - f. RC Time Constants
 - g. The Capacitive Voltage Divider
 - h. Voltage Relationships in a Series RL Circuit
 - i. Power in AC Circuits
 - j. Frequency Response of a Reactive Circuit
 - k. Impedance of a Series RLC Circuit

1. Effects of Changes in Frequency in a Series RLC Circuit
 - m. Resonant frequency of a Series RLC Circuit

Course Syllabus: ELEC-301 Engineering Mathematics

1. Course number and name: ELEC- 301
2. Credits and contact hours: 3 credits, 1 hour of contact.
3. Instructor's or course coordinator's name: Dr. Sasan Haghani
4. Text book, title, author, and year: Advanced Engineering Mathematics 9th Edition by Erwin Kreyszig, Published by Wiley.

5. Specific course information

- a. brief description of the content of the course (catalog description):

This course covers Fourier Series and Integrals, Laplace Transforms, periodic functions, partial differential equations, Bessel functions and Legendre polynomials, complex analytic functions, Taylor and Laurent series. 3 Credit Hours

- b. Prerequisites or co-requisites:

Calculus II

- 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:

The objective of this course is to introduce to the electrical engineering student vigorous advanced engineering mathematics.

- b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

A-1: Apply Laplace transform to solve solutions to first and second order differential equations.

A-2: Apply complex algebra to calculate the analyticity of complex functions

E-1: Model and solve circuit problems in the Laplace domain

7. Brief list of topics to be covered:

- a. First Order Differential Equations
- b. Second Order Differential Equations
- c. The Laplace Transform
- d. Series Solutions
- e. Complex

Analysis

Course Syllabus: ELEC-307 Probability and Statistics for Engineers

1. Course number and name: ELEC-307 Probability and Statistics for Engineers
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:
 - a. Essentials of Probability and Statistics, Walpole, Myers, Myers, and Ye, Pearson Education, Inc., 2013
5. Specific course information
 - a. Catalog description: This Course covers statistics, methods of representation, sample mean, sample variance, random experiments, probability, random variable, discrete and continuous distributions, Poisson and normal distribution sampling.
 - b. Prerequisites or co-requisites: EE 3531-301 Engineering Mathematics
6. Specific goals for the course
 - a. Outcomes of instruction
 - i. The objective of this course is to introduce to the electrical engineering students the basic concepts of probability and statistics from an electrical engineering viewpoint with a good mix of rigor and vigor
 - b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
 - ii. An ability to identify, formulate, and solve engineering problems (e1,e2)
7. Topics covered
 - a. Introduction to Statistics and Probability
 - b. Random Variables, Distributions, and Expectations
 - c. Some Probability Distributions
 - d. Sampling Distributions and Data Descriptions
 - e. One-and Two- Sample Estimation Problems
 - f. One-and Two- Tests of Hypotheses
 - g. Linear Regression

Course Syllabus: ELEC-311 Computer Organization I

1. Course number and name: ELEC 311 Computer Organization I
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
Fundamentals of Digital and Computer Design with VHDL, Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698
5. Specific course information
 - a. Catalog description: This course covers foundations of digital design and digital computer systems. Boolean algebra, design of combinational and sequential circuits is introduced.
 - b. Prerequisites or co-requisites: ELEC 221 Electrical Circuits I and ELEC 313 Computer Organization I Lab
 - c. Required elective or selective elective? Required for Computer Engineering.
6. Specific goals for the course
 - a. Outcomes of instruction
 - Without a calculator, perform arithmetic functions and inter-radix conversion of numbers in various radices, and encodings. Describe the pros and cons of various coding systems.
 - Simplify a combinational logic function (given in any form) to a minimal SOP or POS Boolean equation.
 - Analyze a given combinational logic diagram to determine its function. Draw a logic diagram that implements a given function, under constraints such as a limited number and type of gates.
 - Describe the logic operation of standard combinational logic components, including encoders, decoders, multiplexers, adders, and comparators. Given a word description of a desired logic function, design and draw a minimal logic diagram using any group of standard logic components.
 - Draw logic diagrams of various latches and flip-flops using gates. Explain the operation of S-R, clocked S-R, T, J-K, and D flip-flops. Discuss the relative characteristics of various types of flip-flops. Draw a timing diagram from a sequential circuit.
 - Analyze and design simple sequential circuits and binary counters.
 - Explain the operation of a read-only memory and programmable logic devices. Determine the logic functions realized.
 - b. Student outcomes covered by the course:

Outcome a: an ability to apply knowledge of mathematics, science, and engineering.

A-1: applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

A-3: applies Scientifics and/or engineering principles toward solving engineering problems.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.

C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome E: an ability to identify, formulate, and solve engineering problems.

E-3: uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome K: ability to use the techniques, skills, and modern engineering tools necessary to electrical engineering practice.

K-3: able to use computer-aided design and analysis software tools for electrical engineering applications.

7. Topics covered
 - a. Digital Systems and Binary Numbers
 - b. Boolean Algebra and Logic Gates
 - c. Gate-Level Minimization
 - d. Combinational Logic
 - e. Synchronous Sequential Logic
 - f. Registers and Counters

Course Syllabus: ELEC-312 Computer Organization II

1. Course number and name: ELEC 312 Computer Organization II

2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
Fundamentals of Digital and Computer Design with VHDL, Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698
5. Specific course information
 - a. Catalog description: The course covers sequence and control (hardwired and microprogrammed control), instruction set architecture, CPU design, and input-output interfaces for computer design. In addition, microprocessor and microprocessor based digital system is introduced.
 - b. Prerequisites or co-requisites: ELEC 311 Computer Organization I, ELEC 313 Computer Organization I Lab, and ELEC 314 Computer Organization II Lab
 - c. Required elective or selective elective? Required for Computer Engineering.
6. Specific goals for the course
 - a. Outcomes of instruction
 - Develop a strong foundation in computer and computer system design Explain the operation of a read-only memory and programmable logic devices. Determine the logic functions realized.
 - The students will be exposed to microprocessor architecture and microprocessor based design.
 - b. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering.

 - A-1: applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.
 - A-3: applies Scientifics and/or engineering principles toward solving engineering problems.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.

 - C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome E: an ability to identify, formulate, and solve engineering problems.

 - E-3: uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome K: ability to use the techniques, skills, and modern engineering tools necessary to electrical engineering practice.

 - K-3: able to use computer-aided design and analysis software tools for electrical engineering applications.
7. Topics covered

- a. Sequential Logic Design
- b. Registers and Counters
- c. Memory and Programmable Logic
- d. Finite State Machine
- e. Algorithmic State machines (ASMs)
- f. Computer Design Basics

Course Syllabus: ELEC-313 Computer Organization I Lab

1. Course number and name: ELEC 313 Computer Organization I Lab
2. Credit and contact hours: 1 credit, 15 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
Tutorials provided by the instructor.
5. Specific course information

- a. Catalog description: Experimentation with logic gates, decoders and multiplexers, latches and flip-flops.
 - b. Prerequisites or co-requisites: ELEC 311 Computer Organization I.
 - c. Required elective or selective elective? Required for Computer Engineering.
6. Specific goals for the course
- a. Outcomes of instruction
 - i. To build around a series of experiments of increasing sophistication in the design of digital circuits.
 - ii. To utilize Xilinx ISE Foundation to perform schematic entry and simulation.
 - b. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering.

A-1: applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

A-3: applies Scientifics and/or engineering principles toward solving engineering problems.

Outcome B: an ability to design and conduct experiments, as well as to analyze and interrupt date.

B-1: identifies the constraints, assumptions, and models for the experiment.

B-4: validate experimental results with respect to assumptions, constraints and theory.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.

C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome E: ability to identify, formulates, and solves problems encountered in the practice of electrical engineering.

E-1: classifies information to identify engineering problems.

E-3: uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome G: ability to communicate effectively.

G-1: produce a variety of documents, such as lab reports, using appropriate formats and grammar with discipline-specific conventions including citations.

Outcome K: ability to use the techniques, skills, and modern engineering tools necessary to electrical engineering practice.

K-3: use computer-aided design and analysis software tools for VLSI design.

7. Topics covered

- a. Introduction to Logic Gates
- b. Logic Circuits
- c. Boolean Functions
- d. Karnaugh Maps

- e. Binary Math
- f. Understanding Decoder
- g. Multiplexers
- h. Project - Calculator Design

Course Syllabus: ELEC-314 Computer Organization II Lab

1. Course number and name: ELEC 314 Computer Organization II Lab
2. Credit and contact hours: 1 credit, 15 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
Tutorials provided by the instructor.
5. Specific course information
 - a. Catalog description: This lab covers experiments/computer simulations related to the design of computers and microprocessor based digital systems.
 - b. Prerequisites or co-requisites: ELEC 311 Computer Organization I and ELEC 312 Computer Organization II.
 - c. Required elective or selective elective? Required for Computer Engineering.
6. Specific goals for the course

- a. Outcomes of instruction
 - i. To develop a strong foundation in designing and testing of digital systems.
 - ii. To utilize Xilinx ISE Foundation to perform schematic entry and simulation.
- b. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering.

A-1: applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

A-3: applies Scientifics and/or engineering principles toward solving engineering problems.

Outcome B: an ability to design and conduct experiments, as well as to analyze and interrupt date.

B-1: identifies the constraints, assumptions, and models for the experiment.

B-4: validate experimental results with respect to assumptions, constraints and theory.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.

C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome E: ability to identify, formulates, and solves problems encountered in the practice of electrical engineering.

E-1: classifies information to identify engineering problems.

E-3: uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome G: ability to communicate effectively.

G-1: produce a variety of documents, such as lab reports, using appropriate formats and grammar with discipline-specific conventions including citations.

Outcome K: ability to use the techniques, skills, and modern engineering tools necessary to electrical engineering practice.

K-3: use computer-aided design and analysis software tools for VLSI design.

7. Topics covered

- a. Flip-Flops
- b. Serial Adder
- c. Sequential Counter
- d. Counters with Unused States Design Using J-K Flip-Flops
- e. Design of Vending Machine Using Finite State Machine

Course Syllabus: ELEC-351 Electronics I Lecture

1. **Course number and name:** ELEC 351 ELECTRONICS I Lec
2. **Credit and contact hours:** 3 credits, 45 contact hours
3. **Course coordinators:** Dr. Samuel Lakeou
4. **Textbook and other Required Materials:**
Electronic Design, **Rodent & Carpenter**, Discovery Press, Schematic Capture/Cadence
PSPICE, **Hernier**

5. Specific course information

Electronics I. Lec This course covers semiconductor diodes, bipolar junction transistors (BJT) and junction field effect transistors (JFET), design of BJT and JFET amplifiers, computer-aided-design and circuit simulation. 3 Credit Hours

6. Specific course objectives and student outcomes

A. The objectives of this course are:

The objective of this course is to introduce to the electrical engineering student the state-of-the-art electronic devices and their applications. The devices to be studied include semiconductor diodes, bipolar junction transistors, and junction field effect transistors. Their fabrication and

their electrical properties will be presented thoroughly. Their basic applications as rectifiers, amplifiers etc.. will be highlighted and analyzed.

B. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering

A-1: applies mathematics to obtain an analytical or numerical solution.

A-2: demonstrates knowledge of fundamental scientific and/or engineering practices.

A-3: applies scientific and/or engineering principles toward solving engineering problems.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic constraints

C-1: analyze needs to define problems to be solved by the application of electronic devices.

Outcome E: an ability to identify, formulate, and solve engineering problems

E-2: classifies information to identify engineering problems

7. Topics covered

a. Basic concepts (Chapter 1)

- Appreciate the history of modern electronics
- Know the essential contrasts between analog and digital systems
- Appreciate the difference between analysis and design
- Know the important role played by computer simulations in design and analysis
- Appreciate the essential components in the design process

b. Ideal Operational Amplifiers (OP-AMPS) (Chapter 2)

- How to use OP-AMPS to build inverting and non-inverting amplifiers
- Circuit models used to represent OP-AMPS
- Design approaches applied to multiple-input amplifiers

c. Semiconductor diode circuit analysis (Chapter 3)

- How semiconductors work and how current flows in them
- The internal structure of the diode and the physical laws that govern its behavior
- Alternate types of diode, such as Zener, Schottky, Photo..
- General techniques for analyzing and designing circuits with diodes

d. Bipolar Junction Transistors (Chapter 4)

- The structure of bipolar junction transistors (BJT)
- Design of biasing circuits for amplifier circuits using BJTs
- Study of various amplifier configurations and their respective advantages
- Computer simulation model parameters of BJTs

e. Design of bipolar junction transistor amplifiers (Chapter 5)

- Terminal characteristics of amplifier configurations, including current and voltage gain, and input and output impedance
- Methods for coupling transistor circuits to each other
- Simulation of single and multistage amplifier configurations

f. Field Effect Transistor Amplifiers (Chapter 6)

- Understand the difference between field effect transistors (FET) and BJTs
 - Analyze and design various configurations of FET amplifiers
 - Simulation of FET amplifiers
- g. Bias Stability of Transistor Amplifiers (Chapter 7)
- Understand the mechanisms for variations in amplifier operation
 - Be able to compensate for parameter variations using diode compensation
 - Be able to design FET and BJT amplifiers to reduce the effects of temperature variations

Course Syllabus: ELEC-352 Electronics II Lecture

1. **Course number and name:** ELEC 352 ELECTRONICS II Lec
2. **Credit and contact hours:** 3 credits, 45 contact hours
3. **Course coordinators:** Dr. Samuel Lakeou
4. **Textbook and other Required Materials:**
Electronic Design, **Rodent & Carpenter**, Discovery Press, Schematic Capture/Cadence PSPICE, **Hernier**

5. Specific course information

Electronics II, Lec (3Cr). This course covers operational amplifiers, frequency response characteristics of transistor amplifiers, feedback amplifiers, oscillators, and Power amplifiers. 3 Credit Hours

6. Specific course objectives and student outcomes

A. The objectives of this course are:

- a. To introduce to the students more advanced analog integrated circuits such as operational amplifiers and their applications and their behavior with changing signal frequency;
- b. To acquaint the students with the concept of feedback in amplifier circuits and its application for stability; and
- c. To expose the student to advanced application circuits of op-amps and transistor circuits.

B. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering

A-1: applies mathematics to obtain an analytical or numerical solution.

A-2: demonstrates knowledge of fundamental scientific and/or engineering practices.

A-3: applies scientific and/or engineering principles toward solving engineering problems.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic constraints.

C-1: analyze needs to define problems to be solved by the application of electronic devices.

Outcome e: an ability to identify, formulate, and solve engineering problems

E-2: classifies information to identify engineering problems

7. Topics covered

a. Power Amplifiers (Chapter 8)

- Design biasing circuitry for Class A, B, AB, and C operation
- Know the essential differences between various coupling techniques
- Design a complementary symmetry diode compensated power amplifier circuit
- Design a Darlington circuit
- Design regulated power supplies using both discrete components and integrated circuits

b. Practical Operational Amplifiers (Chapter 9)

- Understand the internal operation of the OP-AMP
- Be able to calculate a variety of parameters relating to circuits with OP-AMPS
- Understand the operation and utility of differential amplifiers

c. Frequency behavior of transistor amplifiers (Chapter 10)

- Understand the methods for determining the low and high cut-off frequencies for various amplifier configurations
- Understand the Miller Effect and its impact on the high frequency response

d. Feedback and stability (Chapter 11)

- Understand the different types of feedback
- Understand how amplifier stability can be controlled
- The use of unstable amplifiers as oscillators

e. Active filters (Chapter 12)

- Analyze active networks
- Design of first order active filters
- Design of Butterworth and Chebyshev Low Pass and High Pass filters

f. Assorted design topics from chapters 13, 14, 15 & 16

- Comparators and Schmitt Trigger
- Pulse Generators, 555 Timer
- Digital to analog converter
- Analog to digital converter

Course Syllabus: ELEC-353 Electronics I Lab

1. **Course number and name:** ELEC 353 ELECTRONICS I Lab

2. **Credit and contact hours:** 3 credits, 45 contact hours

3. **Course coordinators:** Dr. Samuel Lakeou

4. **Textbook and other Required Materials:**

A lab manual accompanying the textbook, Electronic Design, Rodent & Carpenter, Discovery Press will be made available to the students.

5. **Specific course information**

Electronics I, Lab (1 cr). A laboratory course to accompany Electronics I. Experiments on discrete transistor characteristics and circuits, 1 Credit Hour

6. **Specific course objectives and student outcomes**

A. The objectives of this course are:

This course is the first of a sequence of two laboratory courses intended to acquaint students with basic experimental techniques required to evaluate the performance of diode and transistor circuits.

B. Student outcomes covered by the course:

Outcome B: an ability to design and conduct experiments, as well as to analyze and interpret data

B-1: Identifies the constraints, assumptions, and models for the experiment

B-2: uses appropriate equipment and techniques for data collection

B-3: Analyzes experimental data using appropriate tools

B-4 validates experimental results with respect to assumptions, constraints and theory

Outcome D: an ability to function on multidisciplinary teams

D-1: shares responsibilities and formation on schedule with others on the team

Outcome E: an ability to identify, formulate, and solve engineering problems

D-2 : uses analytical, computational, and/or experimental methods to obtain solutions

Outcome K: Ability to use techniques, skills, and modern engineering tools necessary to electrical engineering practice

K-1: able to operate engineering equipment and instrumentation

K-3: able to use computer-aided design and analysis software tools for electrical engineering applications

7. **Topics covered**

1. The ideal operational amplifier

In this experiment we will consider the ideal op-amp since in many circuits, op-amps do behave ideally. The use of an op-amp as an inverting amplifier, a non-inverting amplifier, an integrator, a differentiator, and a follower is explained.

2. Diodes rectifiers and regulators

The purpose of this experiment is to examine the characteristics of diodes and to investigate their use in voltage regulators.

3. Bipolar junction transistors (BJT)

The purpose of this experiment is to become familiar with the operation of a bipolar junction transistor through the measurement and analysis of the transistor's characteristic parameters

4. Emitter follower amplifier

The purpose of this experiment is to learn to measure amplifier parameters (voltage and current gain, input impedance, and quiescent current) and to become familiar with transistor biasing and the emitter-follower amplifier configuration.

5. Common emitter and emitter resistor amplifiers

The purpose of this experiment is to understand the operation of a common-emitter and emitter-resistor amplifiers through both amplifier analysis and design. Due to the similarity of configuration, we refer to this as the common-emitter/emitter-resistor amplifier.

6. Common base amplifier

The objective of this experiment is to become familiar with the common-base amplifier configuration. We will learn to study amplifier parameters as functions of frequency.

7. Field effect transistors

The purpose of this experiment is to gain an understanding of field effect transistor construction and to examine the parameters that are relevant to the operation of this device.

8. Common source amplifier

The purpose of this experiment is to become familiar with the common-source FET amplifier operation and design.

9. Source follower amplifier

The purpose of this experiment is to become familiar with the source follower FET amplifier specifically the type referred to as a bootstrap source follower amplifier.

Course Syllabus: ELEC-354 Electronics II Lab

1. **Course number and name:** ELEC 354 ELECTRONICS II Lab
2. **Credit and contact hours:** 3 credits, 45 contact hours
3. **Course coordinators:** Dr. Samuel Lakeou
4. **Textbook and other Required Materials:**

A lab manual accompanying the textbook, Electronic Design, Rodent & Carpenter, Discovery Press will be made available to the students.

5. Specific course information

Electronics II, Lab (1 cr) A continuation of Electronics Lab I. Includes experiments on design of amplifiers and op-amp circuits. 1 Credit Hour

6. Specific course objectives and student outcomes

A. The objectives of this course are:

This course is the second of a sequence of two laboratory courses intended to acquaint students with basic experimental techniques required to evaluate the performance of amplifier circuit, op-amp circuits and other related circuits such as active filters etc...

B. Student outcomes covered by the course:

Outcome B: an ability to design and conduct experiments, as well as to analyze and interpret data

B-1: Identifies the constraints, assumptions, and models for the experiment

B-2: uses appropriate equipment and techniques for data collection

B-3: analyzes experimental data using appropriate tools

B-4: validates experimental results with respect to assumptions, constraints and theory

Outcome d: an ability to function on multidisciplinary teams

D-1: shares responsibilities and formation on schedule with others on the team

Outcome E: an ability to identify, formulate, and solve engineering problems

E-2 : uses analytical, computational, and/or experimental methods to obtain solutions

Outcome k: Ability to use techniques, skills, and modern engineering tools necessary to electrical engineering practice

K-1: able to operate engineering equipment and instrumentation

K-3: to use computer-aided design and analysis software tools for electrical engineering applications

7. Topics covered

1. The CE-EF amplifier

Design and analyze a common emitter –emitter follower amplifier. The purpose of this experiment is to design a system of amplifiers comprising of a source follower stage followed by a CE-EF stage and finally a complementary symmetry stage

2. Complementary Symmetry Diode Compensated (CSDC) power Amplifier (PUSH-PULL)
The purpose of this experiment is to evaluate the complementary symmetry power amplifiers.
3. Integration of Power Amplifier
The purpose of this experiment is to design a source follower stage as the input stage and integrate it with the CE-EF stage and the complementary symmetry diode compensated power amplifier previously designed. The complete amplifier will be tested and analyzed.
4. DARLINGTON Differential Amplifier
The purpose of this experiment is to study a Darlington compound differential amplifier. Emphasis will be placed on obtaining the quiescent operating conditions and the maximum possible output voltage swing for a given load.
5. Frequency response of a common-emitter amplifier
The frequency response and evaluation of the bandwidth of a CE amplifier is evaluated.
6. Feedback Amplifier
In this experiment, you will design and build a feedback amplifier and study the effect of feedback on the sensitivity and stability.
7. Signal Generators
This experiment will concentrate on the design and evaluation of different types of signal generators.
8. Active Band Pass Filter
In this experiment you will design an active band pass filter using operational amplifiers and a number of resistors and capacitors.
9. Notch Filter
To design a Wein-Bridge and a Twin-Tee 60 Hz notch filter to reject 60Hz hum from the ac power line, then compare the two filters.
10. Analog to Digital (ADC) circuits
A sample ADC circuit using an ADC0809 chip and the required control circuits will be built
11. Digital to Analog (DAC) circuits
A sample DAC0800 circuit using the DAC0800 chip and the required control circuits will be built.

Course Syllabus: ELEC-356 Physical Electronics

1. Course number and name: ELEC-356 Physical Electronics
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:
 - a. Solid State Electronics Devices, B.G. Streetman and S. Bannerjee, 6th Edn., Prentice Hall, 2006
5. Specific course information
 - a. Catalog description: Course will provide students with background on the physics and technology of semiconductor and optoelectronic devices. This will also provide an introduction to semiconductor materials, solid state physics, semiconductor devices and technology. Latest fabrication and design developments in integrated circuits and electronics will be discussed.
 - b. Prerequisites or co-requisites: Physics, 2539-202 Physics II
6. Specific goals for the course
 - a. Outcomes of instruction
 - i. Learn the physics and technology of semiconductor material and devices
 - ii. Learn the latest fabrication and design development in integrated circuits and devices
 - b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
 - ii. An ability to identify, formulate, solve engineering problems (e1,e2)
 - iii. An ability to communicate effectively (g1)
7. Topics covered
 - a. Crystal Properties and Growth of Semiconductor Materials
 - b. Atomic Structure of Semiconductor Materials
 - c. Energy Bands and Charge Carriers in Semiconductors
 - d. Excess Carriers in Semiconductors
 - e. Solid State Devices
 - f. Optoelectronic Devices
 - g. Integrated Circuits
 - h. Special Topics

Course Syllabus: ELEC-361 Electromagnetic Theory

1. Course number and name: ELEC-361 Electromagnetic Theory
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Tarak Bhar
4. Textbook, title, author, and year:

1. Engineering Electromagnetics, William H. Hayt Jr., and John A. Buck, McGraw-Hill Book Co., 2012

5. Specific course information

- a. Catalog description: Covers vector calculus, orthogonal coordinates, Coulomb and Gauss laws, scalar potentials, capacitance, and static electric and magnetic fields and their interaction with matter, as well as Laplace and Poisson Equations
- b. Prerequisites or co-requisites: EE3531-222, Physics 2539-202

6. Specific goals for the course

- a. Outcomes of instruction
 - i. Develop a strong foundation in the theory of electromagnetic field and waves and its application in electrical engineering
- b. Student outcomes addressed by the course
 - i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2,a3)
 - ii. An ability to identify, formulate, solve engineering problems (e1,e2)

7. Topics covered

- a. Vector Analysis
- b. Coulomb's Law and Electric Field Intensity
- c. Electric Flux density, Gauss's Law, and Divergence
- d. Energy and Potential
- e. Conductors and Dielectrics
- f. Capacitance

Course Syllabus: ELEC-371 Signals and Systems

1. Course number and name: ELEC- 371 Signals and Systems
2. Credits and contact hours: 3 credits, 1 hour of contact.
3. Instructor's or course coordinator's name: Dr. Sasan Haghani
4. Text book, title, author, and year: Signals and Systems using MATLAB by Luis Chaparro. ISBN: 978-0-12-374716-7
5. Specific course information
 - a. brief description of the content of the course (catalog description):
Introduces principles and techniques of continuous and discrete time linear systems. Topics include signal representation, properties of systems, convolution, Fourier series and transform, FFT, sampling theorem, filtering, Laplace and Z-transform techniques. Lec. 3 hrs. PR: ELEC 351 & ELEC 301. CR: ELEC-374.
 - b. prerequisites or co-requisites: PR: ELEC 301. CR: ELEC 374.
 - c. indicate whether a required, elective, or selected elective: Required.

6. Specific goals for the course

- i. specific outcomes of instruction:

The objective of this course is to introduce to the Electrical Engineering students the basic concepts of discrete time signal and systems in both the time-domain and in the transform-domain. Specific outcomes are to analyze analog and digital signals and systems, determine BIBO stability, use Laplace and Z-transforms for system analysis, Nyquist Theorem, Digital to Analog and Analog to Digital Conversion.

- ii. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

A-1: Apply Laplace, Z, and Fourier transforms to obtain the frequency domain representation of signals and systems

A-1: Apply signal analysis techniques such as convolution, Z and Fourier to extract useful information.

A-2: Perform Z and inverse Z transforms using tables, partial fraction examples, and power series expansion.

E-2: Classify signals and systems based upon their properties.

E-3: Use MATLAB to create, analyze and process signals

G-1: Write assignments based on MATLAB results.

K-1: Use MATLAB to calculate Laplace and inverse Laplace Transforms, to calculate Z-Transforms and design filters.

7. Brief list of topics to be covered:

- a. Discrete-time and Continuous-time signals and systems in the time-domain
- b. Discrete-time signals in the transform-domain
- c. LTI discrete-Time systems in the transform domain
- d. Digital processing of continuous-time signals

Course Syllabus: ELEC-374 Signals and Systems Lab

1. Course number and name: ELEC- 374
2. Credits and contact hours: 1 credits, 1 hour of contact.
3. Instructor's or course coordinator's name: Dr. Sasan Haghani
4. Text book, title, author, and year: Signals and Systems using MATLAB by Luis Chaparro. ISBN: 978-0-12-374716-7
5. Specific course information
 - a. brief description of the content of the course (catalog description):
A lab accompanying ELEC 371 to introduce students to Signal and Systems through MATLAB.
 - b. Prerequisite or corequisite: CR: ELEC-371
 - c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:

required
6. Specific goal of the course
 - a. Outcomes of instruction
 - i. Use Matlab to analyze signals and systems in the discrete domain
 - ii. Use Matlab to obtain response of LTI systems
 - b. Student outcomes addressed by the course
 - A-1: Apply Laplace, Z, and Fourier transforms to obtain the frequency domain representation of signals and systems
 - A-1: Apply signal analysis techniques such as convolution, Z and Fourier transforms to extract useful information.
 - A-2: Perform Z and inverse Z transforms using tables, partial fraction examples, and power series expansion.
 - E-2: Classify signals and systems based upon their properties.
 - E-3: Use MATLAB to create, analyze and process signals
 - G-1: Write assignments based on MATLAB results.
 - K-1: Use MATLAB to calculate Laplace and inverse Laplace Transforms, to calculate Z-Tranforms and design filters.
7. Brief list of topics to be covered:
 - a. Discrete-time and continuous-time signals and systems in the time-domain

- b. Discrete-time and continuous-time signals in the transform-domain
- c. LTI discrete-Time systems in the transform domain
- d. Digital processing of continuous-time signals

Course Syllabus: ELEC-458 Digital Signal Processing

1. Course number and name: ELEC- 458 Digital Signal Processing
2. Credits and contact hours: 3 credits, 1 hour of contact.
3. Instructor's or course coordinator's name: Dr. Sasan Haghani
4. Text book, title, author, and year: Advanced Digital Signal Processing, Theory and Practice, by Manolakis, Cambridge University Press.
5. Specific course information
 - a. Brief description of the content of the course (catalog description):
 - b. Prerequisites or co-requisites: PR:

ELEC 371.
 - c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

Elective
6. Specific goals for the course
 - a. specific outcomes of instruction:

The objective of this course is to introduce to the Electrical Engineering students the basic of discrete time signal and systems in both the time-domain and in the transform-domain.
 - b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

A-1: Apply Z-Transform to obtain frequency domain representation of signals.
A-2: Perform Z and inverse Z transforms using tables, partial fraction examples, and power series expansion.
E-3: Use MATLAB to analyze signals and systems
E-3: Use MATLAB to obtain structures of discrete systems.
G-1: Write assignments based on MATLAB results.
K-1: Use Matlab to design filters.
I-2: Able to find, evaluate resources to learn new material not taught in class.
7. Brief list of topics to be covered:

- a. Discrete time signals and systems
- b. The Z-Transform
- c. Fourier Representation of Signals
- d. Transform analysis of LTI systems
- e. Sampling of continuous time systems
- f. The discrete Fourier transform
- g. Structures for discrete time systems.
- h. Design of FIR and IIR filters.
- i. Finite word length effects.

Course Syllabus: ELEC-459 Introduction to Digital Computer Architecture and Design

1. Course number and name: ELEC 459 Introduction to Digital Computer Architecture and Design
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
 - a. David A. Patterson and John L. Hennessy, Computer Organization & Design, The Hardware/Software Interface, Morgan Kaufmann, Fourth Edition, 2008. ISBN-10: 0123744938, ISBN-13: 978-0123744937
 - b. MIPS assembly Language Programming, Robert L. Briton, Pearson Prentice Hall, 2003. ISBN-10: 0131420445, ISBN-13: 978-0131420441
5. Specific course information
 - a. Catalog description: This course provides an understanding of the structure and operation of contemporary computer systems from the instruction set architecture level through the register transfer implementation level. The course also explores theory and application of computation, levels of abstraction, instruction set design, assembly language programming, processor data paths, data path control, pipeline design, design of memory hierarchies, memory management, and input/output. A contemporary behavioral/functional/logical simulator will be used for projects.
 - b. Prerequisites or co-requisites: ELEC 312 Computer Organization II, ELEC 480 Intro to Computer Aided Digital Design, ELEC 251 Assembler and Systems, and ELEC 253 Assembler and Systems Lab.
 - c. Required elective or selective elective? Required for Computer Engineering.
6. Specific goals for the course
 - a. Outcomes of instruction
 - i. To gain the knowledge needed to design and analyze high-performance computer architecture
 - ii. To utilize the MIPS instruction set to write simple assembly language program
 - iii. To compare and contrast the performance and complexity of the various hardware methods for executing assembly language programs
 - iv. To evaluate and design instruction set architecture in terms of memory efficiency, performance, and capabilities.
 - v. To gain the knowledge needed to design pipelined datapath for maximum throughput, and evaluate its performance.
 - b. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering.

- A-1: applies mathematics (integral calculus, differential equations, linear , complex variables, and discrete mathematics) to obtain an analytical or numerical solution.
- A-3: applies Scientifics and/or engineering principles toward solving engineering problems.

Outcome D: ability to function on multidisciplinary team.

- D-1: share responsibilities and information on schedule with others on the team.

Outcome E: an ability to identify, formulate, and solve engineering problems.

- E-2: develop instruction set models to formulate hardware-software solutions.

7. Topics covered

- a. Computer Abstractions and Technology (Chapter 1)
- b. Instructions: Language of the Machine (Chapter 2)
- c. Arithmetic for Computers (Chapter 3)
- d. The Processor (Chapter 4)
- e. Large and Fast: Exploiting Memory Hierarchy (Chapter 5)
- f. Assemblers, Linkers, and the SPIM Simulator (Appendix B)
- g. The Basics of Logic Design (Appendix C)
- h. Mapping Control to Hardware (Chapter D)

Course Syllabus: ELEC-467 Fundamentals of Communication Systems

1. Course number and name: 3531- 467 Fundamentals of Communication Systems
2. Credits and contact hours: 3 credits 45 contact hours
3. Instructor's or course coordinator's name: Dr. Paul Cotae
4. Text book, title, author, and year: Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)

5. Specific course information

- a. brief description of the content of the course (catalog description):

Introduces the concepts underlying analog and digital communication systems. Topics include amplitude modulation, phase and frequency modulation, sampling and quantization theory, and pulse modulation. Effect of noise on the performance of these modulation techniques is covered.

- b. prerequisites or co-requisites:

3531- 371 Signals & Systems, Co-requisite: 3531- 476 Fundamentals Communication Systems Lab, Matlab software

- c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

elective

6. Specific goals for the course

- a. specific outcomes of instruction:

This is the first course in a sequence of courses intended to develop the fundamental of communication systems with emphasis on analog modulation techniques. The student will be able to compute the important parameters of a communication system, including signal power, signal bandwidth, spectra, and probability of error.

- b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Satisfies the following Program Outcomes:

Outcome A: Knowledge of mathematics, science, and engineering and the ability to apply this knowledge in solving problems

A-1: Applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

Outcome B: An ability to design and conduct experiments, as well as to analyze and interrupt data.

B-1: appropriate equipment and techniques for data collections.

Outcome E: Ability to identify, formulate, and solve engineering problems

E-2: Uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome I: Recognition of the need for, and an ability to engage in life-long learning

I-2: Able to find, evaluate resources to learn new material not taught in class.

Outcome K: Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

K-1: Able to operate engineering equipment and instrumentations.

7. Brief list of topics to be covered:

- a. Elements of an Electrical Communication System
- b. Signals and Linear Systems (Basic concepts, Fourier series, Fourier transform, Filter design, Power and Energy, Hilbert transform and its properties, Lowpass and Bandpass signals)
- c. Amplitude Modulation (Intro to Modulation, Amplitude Modulation, Implementation of AM Modulators and Demodulators, Signal Multiplexing and AM-Radio Broadcasting)
- d. Angle Modulation (Representation of FM and PM signals, Spectral Characteristics of Angle-Modulated Signals, Implementation of Angle Modulators and Demodulators, FM-Radio and Television Broadcasting, and Mobile Wireless Telephone Systems)
- e. Probability and Random Process (Review of Probability and Random Variables, Random Process, Gaussian and White Processes)
- f. Effect of Noise on Analog Communication Systems (Effect of Noise on AM Systems, Angle Modulation, Comparison of AM Systems)
- g. Digital Cellular Communication Systems.

Course Syllabus: ELEC-469 Digital Communication Systems

1. Course number and name: 3531- 469 Digital Communication Systems
2. Credits and contact hours: 3 credits 45 contact hours
3. Instructor's or course coordinator's name: Dr. Paul Cotae
4. Text book, title, author, and year: Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
5. Specific course information
 - a. brief description of the content of the course (catalog description):

The course covers the most widely used digital modulation techniques, including amplitude, frequency, and phase-shift keying. The effect of noise on digital communication systems is studied, including bit-error-rate and bandwidth. The course concludes with an overview of both wire and wireless communication systems: land-based and cellular telephone systems, satellite systems, and fiber optic systems. Laboratory demonstrations and learning modules will be used to supplement the concepts covered in the course.

- b. prerequisites or co-requisites:

3531-307 Probability and Statistics
3531- 371 Signals & Systems,
Co-requisite: 3531- 473 Digital Communications Laboratory

- c. 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
 - a. specific outcomes of instruction:

This is the second course in a sequence of courses intended to develop the fundamental concepts of digital communication systems with emphasis on digital modulation techniques. The student will be able to compute the important parameters of a digital communication systems, signal bandwidth, spectra, and probability of error.

- b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Satisfies the following Program Outcomes:

A.1 Knowledge of mathematics, science, and engineering and the ability to apply this knowledge in solving problems

1. Applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

B.2 An ability to design and conduct experiments, as well as to analyze and interpret data.

2. Uses appropriate equipment and techniques for data collections.

E.2 Ability to identify, formulate, and solve engineering problems

2. Uses analytical, computational, and/or experimental methods to obtain solutions.

I.2 Recognition of the need for, and an ability to engage in life-long learning

2. Able to find, evaluate resources to learn new material not taught in class.

K.1 Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

1. Able to operate engineering equipment and instrumentations.

7. Brief list of topics to be covered:

a. Analog to digital conversion:

- i. The sampling theorem, quantization, and encoding.
- ii. Pulse Code Modulation (PCM),
- iii. Differential Pulse Code Modulation (DPCM),
- iv. Delta Modulation (DM).

b. Digital modulation in an additive White Gaussian noise baseband channel.

- i. Geometric representation of signal waveforms.
- ii. Digital Modulation Bandpass Systems : Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM).
- iii. Optimum receiver for binary modulated signals (correlation demodulator and matched filter).
- iv. M-ary pulse modulation and Probability of error for M-ary pulse modulation

c. Digital transmission through bandlimited AWGN channels:

- i. Signal design for bandlimited channels (the Nyquist Criterion, Partial Response Signals)
- ii. Symbol by symbol Detection of Data with controlled ISI
- iii. System Design in the presence of channel distortions.

d. Transmission of digital information via carrier modulation.

- i. Demodulation and Detection of Amplitude Modulated Signals
- ii. Demodulation and Detection of Phase Modulated Signals
- iii. Demodulation and Detection of Frequency Modulated Signals
- iv. Comparison of Modulation Methods

e. Selected topics in digital communications:

Spread spectrum systems (generation and properties of pseudorandom sequences, Gold codes, direct-sequence spread-spectrum, frequency hop spread spectrum, processing gain, code division multiple access).

1. Course number and name: ELEC 470, Introduction to Control Systems & Applications
2. Credits and contact hours: 3 credits, 45 contact hours
3. Course Instructor: Wagdy H. Mahmoud
4. Text book, title, author, and year: *Control Systems Engineering, Sixth Edition*, Norman S. Nise, John Wiley & Sons, Inc. Hoboken, NJ, 2011
5. Specific course information
 - a. Catalog Description: This course examines some of the techniques available for analysis and design of continuous time and discrete time feedback control systems. Topics include modeling, performance measures, transfer functions, generalized error coefficient, introduction to state-space methods, stability, controllability and observability, root locus and frequency domain analysis, compensation methods, state feedback and pole placements control system design.
 - b. Prerequisites or co-requisites: Prerequisites: ELEC 371. Co-requisites: ELEC 477
 - c. Required, elective, or selective elective: Required (BS in Electrical Engineering), Selective elective (BS in Electrical Engineering with Computer Engineering option)
6. Specific goals of the course
 - a. Outcomes of instructions
 - i. Students will be able to describe basic features and configuration of a control system
 - ii. Students will be able to describe control systems analysis, design objectives, and design process
 - iii. Students will be introduced to the basic techniques of time and frequency domain analysis.
 - iv. Students will be able to find the transfer function representation of linear time-invariant (LTI) electrical networks and transitional mechanical systems using Laplace transform, and to produce analogous electrical and mechanical systems
 - v. Student should be able to find the state-space representation for a LTI electrical and mechanical systems, and to describe their relation to frequency domain methods
 - vi. Student should be able to understand the fundamental characteristics and properties of feedback control systems.
 - vii. Students will be able to determine time response from state-space models and use pole-placement methods to improve system response
 - viii. Students should be able to use Routh-Hurwitz table to determine the stability of a system represented in state space

- ix. Students should be able to use the root locus method to design a parameter value to meet a transient response specification for a system of order two or higher
 - x. Student should be able to find the z-transform of a digital system
- xi. Students will be able to MATLAB and SIMULINK to analyze, design, and implement control systems and compensators.
 - xii. Student will understand how the methodology of feedback control can be broadly applied in society to such areas as economics, biology, manufacturing, aeronautics, etc.

b. Student outcomes addressed by this course:

- A-1: Solve linear ordinary differential equation models for both free and forced responses using Laplace transform.
- A-2: Describe the structure of common feedback control systems using block diagram and transfer functions.
- C-3: Ability to design control systems to meet desired needs and realistic constraints such as stability and performance (settling time, overshoot, and damping ratio).
- E-2: Develop state space models for electrical and mechanical systems.
- I-1: Use resources such as published literature and MathWorks (MATLAB, Simulink, tool boxes) manuals and tutorials to learn new materials not taught in class.

7. Topics covered

- a. Introduction (Chapter 1)
- b. Modeling in the frequency domain (chapter 2)
- c. Modeling in the time domain (Chapter 3)
- d. Time response (Chapter 4)
- e. Reduction of multiple subsystems (Chapter 5)
- f. Stability (Chapter 6)
- g. Steady-State errors (chapter 7)
- h. Root Locus Techniques (Chapter 8)
- i. Digital Control Systems (Chapter 13)

Course Syllabus: ELEC-473 Digital Communication Lab

1. Course number and name: 3531- 473 Digital Communication Lab
2. Credits and contact hours: 1 credit 45 contact hours
3. Instructor's or course coordinator's name: Dr. Paul Cotae
4. Text book, title, author, and year: Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
5. Specific course information
 - a. brief description of the content of the course (catalog description):
The lab covers the most widely used digital modulation techniques, including amplitude, frequency, and phase-shift keying. The effect of noise on digital communication systems is studied, including bit-error-rate and bandwidth.
 - b. prerequisites or co-requisites:
3531-307 Probability and Statistics
3531- 371 Signals & Systems,
Co-requisite: 3531- 473 Digital Communications Laboratory
 - c. indicate whether a required, elective, or selected elective course in the program
selected elective.
6. Specific goals for the course
 - a. specific outcomes of instruction:
The student will become familiar with the most widely used types of digital modulation employed in land-based, wireless, and optical fiber communication systems. The student will be able to analyze and design basic digital communication systems.
 - b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Satisfies the following Program Outcomes:

Outcome A: Knowledge of mathematics, science, and engineering and the ability to apply this knowledge in solving problems

A-3: Applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

Outcome B: An ability to design and conduct experiments, as well as to analyze and interrupt data.

B-3: Uses appropriate equipment and techniques for data collections.

Outcome C: Ability to design and realize electrical and electronics components, systems, or processes to meet desired needs and realistic constraints such as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

C-1: Analyzes needs to produce problem definitions for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome E-2: Ability to identify, formulate, and solve engineering problems

C-2: Uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome I: Recognition of the need for, and an ability to engage in life-long learning

I-2: Able to find, evaluate resources to learn new material not taught in class.

Outcome K: Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

K-1: Able to operate engineering equipment and instrumentations.

7. Brief list of topics to be covered:

a. Analog to digital conversion:

- i. The sampling theorem, quantization, and encoding.
- ii. Pulse Code Modulation (PCM),
- iii. Differential Pulse Code Modulation (DPCM),
- iv. Delta Modulation (DM).

b. Digital modulation in an additive White Gaussian noise baseband channel.

- i. Geometric representation of signal waveforms.
- ii. Digital Modulation Bandpass Systems : Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM).
- iii. Optimum receiver for binary modulated signals (correlation demodulator and matched filter).
- iv. M-ary pulse modulation and Probability of error for M-ary pulse modulation

c. Digital transmission through bandlimited AWGN channels:

- i. Signal design for bandlimited channels (The Nyquist Criterion, Partial Response Signals)
- ii. Symbol by symbol Detection of Data with controlled ISI
- iii. System Design in the presence of channel distortion.
- iv. System Design in the presence of channel distortion.

d. Transmission of digital information via carrier modulation.

- i. Demodulation and Detection of Amplitude Modulated Signals
- ii. Demodulation and Detection of Phase Modulated Signals
- iii. Demodulation and Detection of Frequency Modulated Signals
- iv. Comparison of Modulation Methods

e. Selected topics in digital communications:

Spread spectrum systems (generation and properties of pseudorandom sequences, Gold codes, direct-sequence spread-spectrum, frequency hop spread spectrum, processing gain, code division multiple access).

Course Syllabus: ELEC-476 Fundamentals of Communication Systems Lab

1. Course number and name: 3531- 476 Fundamentals of Communication Systems Lab
2. Credits and contact hours: 1 credit 45 contact hours
3. Instructor's or course coordinator's name: Dr. Paul Cotae
4. Text book, title, author, and year:
 - a. Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
 - b. Analog Communications: Vol. 1 (Instrumentation), Vol. 2 (AM/DSB/SSB), and Vol. 3 (FM/PM), Lab-Volt Ltd.
5. Specific course information
 - a. brief description of the content of the course (catalog description):

This laboratory course demonstrates many of the topics covered in the companion lecture course. Learning modules and experiments include signal analysis, band limiting of signals, and types of pulse modulation; particular emphasis is placed on pulse-code modulation (PCM) and digital multiplexing (TDM). The course uses a self-paced computer-learning module system to simulate and perform troubleshooting and measurements on communication circuits and systems.
 - b. prerequisites or co-requisites:

3531-307 Probability and Statistics
3531- 371 Signals & Systems,
Co-requisite: 3531- 473 Digital Communications Labor
 - c. indicate whether a required, elective, or selected elective course in the program selected elective.
6. Specific goals for the course
 - a. specific outcomes of instruction:

The student will become familiar with the most widely used types of digital modulation employed in land-based, wireless, and optical fiber communication systems. The student will be able to analyze and design basic digital communication systems.
 - b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Satisfies the following Program Outcomes:

Outcome A: Knowledge of mathematics, science, and engineering and the ability to apply this knowledge in solving problems

A-1: Applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.

Outcome B: An ability to design and conduct experiments, as well as to analyze and interpret data.

B-1: Uses appropriate equipment and techniques for data collections.

Outcome C: Ability to design and realize electrical and electronics components, systems, or processes to meet desired needs and realistic constraints such

as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

C-1: Analyzes needs to produce problem definitions for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome E: Ability to identify, formulate, and solve engineering problems

E-2: Uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome I: Recognition of the need for, and an ability to engage in life-long learning

I-2: Able to find, evaluate resources to learn new material not taught in class.

Outcome K: Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

K-1: Able to operate engineering equipment and instrumentations.

7. Brief list of topics to be covered:

a. Analog to digital conversion:

- i. The sampling theorem, quantization, and encoding.
- ii. Pulse Code Modulation (PCM),
- iii. Differential Pulse Code Modulation (DPCM),
- iv. Delta Modulation (DM).

b. Digital modulation in an additive White Gaussian noise baseband channel.

- i. Geometric representation of signal waveforms.
- ii. Digital Modulation Bandpass Systems : Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM).
- iii. Optimum receiver for binary modulated signals (correlation demodulator and matched filter).
- iv. M-ary pulse modulation and Probability of error for M-ary pulse modulation

c. Digital transmission through bandlimited AWGN channels:

- i. Signal design for bandlimited channels (The Nyquist Criterium, Partial Response Signals)
- ii. Response Signals)
- iii. Symbol by symbol Detection of Data with controlled ISI
- iv. System Design in the presence of channel distorsion.

d. Transmission of digital information via carrier modulation.

- i. Demodulation and Detection of Amplitude Modulated Signals
- ii. Demodulation and Detection of Phase Modulated Signals
- iii. Demodulation and Detection of Frequency Modulated Signals
- iv. Comparison of Modulation Methods

Course Syllabus: ELEC-477 Introduction to Control Systems & Applications

1. Course number and name: ELEC 477, Introduction to Control Systems & Applications Laboratory
2. Credits and contact hours: 1 credits, 45 contact hours
3. Course Instructor: Wagdy H. Mahmoud
4. Text book, title, author, and year: *Control Systems Engineering, Sixth Edition*, Norman S. Nise, John Wiley & Sons, Inc. Hoboken, NJ, 2011
5. Specific course information
 - a. Catalog Description: Experiments include simulation of continuous time and discrete time feedback control systems, such as modeling, performance measures, transfer functions, generalized error coefficient, introduction to state-space methods, stability, controllability and observability, root locus and frequency domain analysis, compensation methods, state feedback and pole placements, and control system design.
 - b. Prerequisites or co-requisites: Prerequisites: ELEC 371. Co-requisites: ELEC 470
 - c. Required, elective, or selective elective: Required (BS in Electrical Engineering), Selective elective (BS in Electrical Engineering with Computer Engineering option)
6. Specific goals of the course
 - a. Outcomes of instructions
 - i. Student should be able to use MATLAB and the Symbolic Math Toolbox to (1) verify the behavior of closed-loop systems, (2) generate and manipulate polynomials and transfer function, (3) perform partial-fraction expansions, (4) find Laplace transforms for time functions, (5) find time functions from Laplace transforms, (6) create LTI transfer functions from symbolic transfer functions, (7) perform solutions of symbolic simultaneous equations, (8) generate an LTI state-space representation of a system, (9) convert an LTI state-space representation of a system to an LTI transfer function, and (10) design the gain of a controller via root locus
 - ii. Students should be able to use Simulink to: (1) evaluate the effects of pole location upon the time response systems (percent overshoot, settling time, peak time, rise time) for both first- and second-order, (2) evaluate the effect of additional poles and zeros upon the time response of second-order systems, (3) evaluate the effect of the gain of a closed-loop system upon transient response and steady-state errors, (4) verify the equivalency of the basic forms, including cascade, parallel, and feedback forms, (5) verify the equivalency of the basic moves, including moving blocks past summing junctions, and moving blocks past pickoff points, (6) evaluate the effect of pole location and loop gain in a negative feedback system upon stability, (7) verify and evaluate the effect of input waveform, loop gain, and system type upon steady- state errors, (8) verify and evaluate the effect of open-loop poles and zeros upon the shape of the root

locus, and (9) use root locus as a tool for estimating the effect of open-loop gain upon the transient response of closed-loop systems

b. Student outcomes addressed by this course:

- A-1: Solve linear ordinary differential equation models for both free and forced responses using Laplace transform
- A-2: Describe the structure of common feedback control systems using block diagram and transfer functions.
- B-3: Able to design experiments and analyze results using appropriate (graphical) tools.
- C-3: Able to design control systems to meet desired needs and realistic constraints such as stability and performance (settling time, overshoot, and damping ratio)
- E-2: Develop state space models for electrical and mechanical systems.
- I-1: Use resources such as published literature and/or MathWorks (MATLAB, Simulink, tool boxes) manuals and tutorials to learn new materials not taught in class.
- K-4: Use MATLAB, Simulink and control toolbox to simulate control system response.

7. Topics covered

- a. Introduction (Chapter 1)
- b. Modeling in the frequency domain (chapter 2)
- c. Modeling in the time domain (Chapter 3)
- d. Time response (Chapter 4)
- e. Reduction of multiple subsystems (Chapter 5)
- f. Stability (Chapter 6)
- g. Steady-State errors (chapter 7)
- h. Root Locus Techniques (Chapter 8)
- i. Digital Control Systems (Chapter 13)

Course Syllabus: ELEC-478 Digital Integrated Circuits Design

1. Course number and name: ELEC 478 Digital Integrated Circuits Design
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
CMOS Digital Integrated Circuits: Analysis and Design, S. Kang, and Y. Leblebici, Third Edition, McGraw Hill, 2003.
5. Specific course information
 - a. Catalog description: Analysis, design and layout of complex digital integrated circuits in MOS Technology. The course emphasizes design through projects, and requires extensive use of simulation and layout CAD tools.
 - b. Prerequisites or co-requisites: ELEC 312 Computer Organization II and ELEC 479, Digital Integrated Circuits Design Lab.
 - c. Required elective or selective elective? Required for Computer Engineering.
6. Specific goals for the course
 - a. Outcomes of instruction
 - i. To provide the students with concepts and techniques of analysis, design, and layout of CMOS digital integrated circuits.
 1. Students learn the trends in semiconductor technology, and how it impacts scaling and performance.
 2. Students understand the concept of design rules.
 3. Students have an understanding of the characteristics of CMOS circuit construction.
 - ii. To apply the techniques on more complex designs such as arithmetic building blocks.
 1. Students can use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
 2. Be able to create models of moderately sized CMOS circuits that realize specified digital functions.
 - iii. To analyze the impacts of various timing methodologies on the performance and functionality of sequential digital circuits.
 1. Students examine the time-domain behavior of bistable elements and sequential MOS logic circuits.
 - iv. To utilize CAD tools to explore design alternatives.
 1. Students can apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
 2. Students can design static CMOS combinational and sequential logic at the transistor level, including mask layout.

b. Student outcomes covered by the course:

Outcome A: an ability to apply knowledge of mathematics, science, and engineering.

- A-1: applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.
- A-3: applies Scientifics and/or engineering principles toward solving engineering problems.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.

- C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

Outcome D: ability to function on multidisciplinary team.

- D-1: share responsibilities and information on schedule with others on the team.

Outcome E: ability to identify, formulates, and solves problems encountered in the practice of electrical engineering.

- E-3: uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome k: ability to use the techniques, skills, and modern engineering tools necessary to electrical engineering practice.

- k-3: able to use computer-aided design and analysis software tools for engineering applications.

7. Topics covered

- a. Introduction of digital integrated circuit design.
- b. Overview of the MOS devices.
- c. Static and dynamic behavior of the diode.
- d. Static and dynamic behavior of the MOS transistor.
- e. Layout design rules.
- f. Mentor Graphics tools.
- g. The inverter.
- h. Designing combinational logic gates in CMOS.

Course Syllabus: ELEC-479 Digital Integrated Circuit Design Lab

1. Course number and name: ELEC 479 Digital Integrated Circuit Design Lab
2. Credit and contact hours: 1 credit, 15 contact hours
3. Course coordinators: Dr. Nian Zhang
4. Textbook, title, author, and year:
Tutorials provided by the instructor.
5. Specific course information
 - a. Catalog description: Provides VLSI design experience that includes design of basic VLSI CMOS functional blocks, verification of the design, testing, and debugging. Several complex VLSI projects will be submitted for fabrication.
 - b. Prerequisites or co-requisites: ELEC 478 Digital Integrated Circuit Design.
 - c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
 - a. Outcomes of instruction
 - i. To provide the students with CMOS digital integrated circuits design and simulation method.
 - ii. To utilize Tanner Tools to explore design alternatives, design, simulate, and make layout of the IC circuits.
 - iii. To fabricate the IC chip through the MOSIS, and test the chip.
 - b. Student outcomes covered by the course:

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.

C-1: analyzes needs to produce problem definitions for electrical and/or electronic devices and systems including hardware and/or software components.

C-4: Can build prototypes to meet design specifications.

Outcome D: ability to function on multidisciplinary team.

D-1: share responsibilities and information on schedule with others on the team.

Outcome E: ability to identify, formulates, and solves problems encountered in the practice of electrical engineering.

E-1: classifies information to identify engineering problems.

E-2: uses analytical, computational, and/or experimental methods to obtain solutions.

Outcome G: ability to communicate effectively.

G-1: produce a variety of documents, such as lab reports, using appropriate formats and grammar with discipline-specific conventions including citations.

Outcome k: ability to use the techniques, skills, and modern engineering tools necessary to electrical engineering practice.

K-3: use computer-aided design and analysis software tools for VLSI design.

7. Topics covered

- a. Creating Gate Level Schematics and Simulation Design Architect and Eldo.
- b. Creating Transistor Level Schematics and Simulation Design Architect and Eldo.
- c. VHDL/Verilog Simulation with ModelSim.
- d. Transistor Level Inverter Simulation with Eldo (DC Analysis, Transient Analysis, and AC Analysis).
- e. Layout in IC Station.
- f. Fabricate the IC chip through MOSIS.

Course Syllabus: ELEC-480 Digital Design and Synthesis

1. Course number and name: ELEC 480, Digital Design and Synthesis
2. Credits and contact hours: 2 credits, 30 contact hours
3. Course Instructor: Wagdy H. Mahmoud
4. Text book, title, author, and year: *VHDL for Engineering*, Kenneth L. Short , Prentice Hall, 2009
5. Specific course information
 - a. Catalog Description: Introduces the techniques of modeling digital systems at various levels of abstraction and computer-aided design algorithms applied to these models to support design and analysis tasks. Covers modeling through the use of a modern hardware description language (VHDL/Verilog), test generation, event-driven simulation algorithms, and physical design used to map the synthesized logic design onto physical IC area. This is not a how-to course on using CAD tools; it is a study of the algorithms used by CAD tools.
 - b. Prerequisites or co-requisites: Prerequisites: ELEC 312. Co-requisites: ELEC 483
 - c. Required, elective, or selective elective: Required (BS in Electrical Engineering with Computer Engineering option) , Selective elective (BS in Electrical Engineering)
6. Specific goals of the course
 - a. Outcomes of instructions
 - i. The student will demonstrate knowledge in number systems and application of Boolean algebra in the areas of digital circuits and systems.
 - ii. The student will demonstrate knowledge and an ability to analyze simple combinational (decoders, encoders, multiplexers, demultiplexers, etc.), sequential circuits (registers and counters), main storage devices (flip flops and latches), and state machines
 - iii. Demonstrate the ability to create combinational and sequential designs utilizing three basic VHDL modelling styles: data flow, structural, and behavioural.
 - iv. The student will demonstrate an ability for hardware design utilizing the three basic VHDL modelling styles: data flow, structural, and behavioural
 - v. The student will demonstrate an ability to design optimized synchronous and asynchronous circuits
 - vi. The student will demonstrate an ability to design a VHDL test bench for validation of a component design.
 - vii. The student will demonstrate an understanding of the design options to implement digital systems in hardware and their cost benefit tradeoffs
 - viii. The student will demonstrate an ability to discuss major trends in industry and current research activities within the continually changing field of computer architecture design.

- b. Student outcomes addressed by this course:
 - i. Student outcomes:
 - A-3: Apply engineering principle toward solving engineering problem such as development of digital systems.
 - B-1: Identify problem constraints and verify models for digital systems.
 - C-2: Carry out design process (including HDL code development, and design verification) to satisfy problem requirements.
 - E2: Use analytical and computational methods to obtain solution.
 - I-1: Use resources such as computer-aided design tutorials and FPGA board manuals to learn new materials not taught in class.

7. Topics covered

- a. Introduction to VHDL
- b. Digital Design Using VHDL
- c. VHDL Entities, Architectures, and Coding Styles
- d. Signals and Data Types
- e. Dataflow Style Combinational Design
- f. Behavioral Style Combinational Design
- g. Event-Driven Simulation
- h. Testbenches for Combinational Designs
- i. Latches and Flip-Flops
- j. Multi-bit latches, Registers, Counters and Memory
- k. Finite-State Machines
- l. Subprograms and packages
- m. Testbenches for Sequential Systems
- n. Modular Design Hierarchy

Course Syllabus: ELEC-483 Digital Design and Synthesis Laboratory

1. Course number and name: ELEC 483, Digital Design and Synthesis laboratory
2. Credits and contact hours: 1 credits, 45 contact hours
3. Course Instructor: Wagdy H. Mahmoud
4. Text book, title, author, and year: *VHDL for Engineering*, Kenneth L. Short , Prentice Hall, 2009
5. Specific course information
 - a. Catalog Description: The course emphasizes the use of computer-aided design (CAD) tools in the description, modeling, simulation, verification and testing of digital systems. Alternative coding styles and methodology used for combinational and sequential digital logic designs are evaluated. The use of Field Programmable gate arrays is integrated into the course as the target physical domain.
 - b. Prerequisites or co-requisites: Prerequisites: ELEC 312. Co-requisites: ELEC 483
 - c. Required, elective, or selective elective: Required (BS in Electrical Engineering with Computer Engineering option) , Selective elective (BS in Electrical Engineering)
6. Specific goals of the course
 - a. Outcomes of instructions
 - i. Students will be able to describe the architecture and basic building blocks of a standard Field Programmable Gate Array (FPGA) logic device.
 - ii. Students will be able to describe the advantages and disadvantages the cost benefit and tradeoffs associated with the use programmable logic devices such as of FPGAs.
 - iii. Students will demonstrate knowledge and an ability to design simple combinational (decoders, encoders, multiplexers, demultiplexers, etc.), sequential circuits (registers and counters), main storage devices (flip flops and latches), and complex state machines.
 - iv. Students will demonstrate an ability for developing combinational and sequential designs on programmable logic devices utilizing the three basic VHDL modelling styles: data flow, structural, and behavioural
 - v. Students will demonstrate an ability to design, synthesize and implement optimized synchronous and asynchronous circuits
 - vi. Students will be able to demonstrate the ability to optimize the performance of serial designs through the use of Intellectual Product (IP) components, and the implementation of parallel and pipelined design techniques.
 - vii. Students will be able to analyze the performance of hardware systems using simulation tools.
 - viii. Students will demonstrate an ability to design a VHDL test bench for validation of a component design.
 - ix. Students will demonstrate the ability to design implement and verify the operations of a functioning simple microprocessor with CPU, memory, and I/O ports in a FPGA device.

- x. Students will demonstrate the ability to synthesize a digital system using hardware description language and proprietary design tools (such as Xilinx Integrated Design Environment (ISE) software).
- xi. Students will demonstrate an ability to discuss major trends in industry and current research activities within the continually changing field of computer architecture design and the need for continuing education.

b. Student outcomes addressed by this course:

i. Student outcomes:

- A-3: Apply engineering principle toward solving engineering problem such as development of digital systems.
- B-1: Identify problem constraints and verify models for digital systems.
- C1: Analyze needs to produce problem definition for digital design problems including implementation on FPGA board using integrated design tools.
- C-2: Carry out design process (including HDL code development, and design verification using test benches) to satisfy problem requirements including implementation on FPGA board using integrated design tools.
- E2: Use analytical and experimental methods to formulate and solve a digital design problem.
- I-1: Use resources such as computer-aided design tutorials and FPGA board manuals to learn new materials not taught in class.
- K2: Ability to utilize Field Programmable Gate Array (FPGA) boards for prototyping, testing, and evaluation.
- K3: Ability to use computer-aided design tools for digital system design on FPGA boards.

7. Topics covered

- a. Introduction to integrated design environment
- b. Overview of programmable logic devices
- c. Combinational logic building blocks (adders, muxes, decoders, encoders, counters, etc.)
- d. Sequential logic building blocks (latches, flip-flops, registers)
- e. Serial, parallel, pipelined designs
- f. Synchronous and asynchronous designs
- g. Intellectual product components
- h. Behavioral and timing simulation
- i. Synthesis
- j. High Level Design Flow
- k. Top Level System Design

Course Syllabus: ELEC-495 SENIOR PROJECT I

1. Course number and name: ELEC 495 SENIOR PROJECT I
2. Credit and contact hours: 3 credits, 60 contact hours
3. Course coordinators: Dr. Esther T. Ososanya and Dr. Wagdy Mahmoud
4. Textbook and other Required Materials, title, author, and year:
 - a. Material dependent upon project: course materials pertinent to the individual projects are provided either electronically or through hand-outs as needed.
 - b. Manufacturer's data manuals as available on product websites
 - c. The IEEE digital library: available on-line through the UDC library web site, for literature search.
5. Specific course information
 - a. Catalog description: Conceptualization, design, building, testing and promulgation of an electrical engineering project by the student under the supervision of a faculty member.
 - b. Prerequisites or co-requisites: Prerequisites: ELEC 351 and ELEC 313
 - c. Required elective or selective elective: Required for both Electrical Engineering and Electrical Engineering with Computer Engineering option.
6. Specific goals for the course:
 - a. Outcomes of instructions: At the end of this course students should be able to:
 - i. Explain the steps involved in an engineering design process
 - ii. Articulate the benefits of mathematics, natural sciences, computer science, and applied sciences in the field of engineering.
 - iii. Demonstrate the ability to analyze new and unfamiliar engineering problems, reference it against known and familiar information, and to adapt known knowledge in solving new engineering problems.
 - iv. Demonstrate the ability to identify and develop research ideas that responds to a specific need.
 - v. Design a system, component, or program to solve appropriate engineering problem or address a desired need.
 - vi. Use professional hardware/software design and computer-aided design tools in the implementation and validation of the design
 - vii. Design a system within a set of realistic constraints including most of the following considerations: economic; environmental; sustainability; ethical; manufacturability; health and safety; and social.
 - viii. Function effectively on a multidisciplinary team.
 - ix. Exhibit knowledge of professional ethical codes.
 - x. Use external resources to obtain technical information necessary to complete the design of a system, component, or program.
 - xi. Demonstrate the ability to cite sources used in research.
 - xii. Write a final design report describing the design and validation test using the IEEE writing format.

Student outcomes addressed by this course:

Assessed for Program Outcomes:

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

- C- 2: Carry out design process (such as concept generation, modeling, simulation, synthesis, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components, and within realistic constraints.

Outcome F: An understanding of professional and ethical responsibilities

- F-1. Evaluate ethical issues (such as safety, intellectual property, reporting data, etc.) that may occur in professional practice using professional codes of ethics.

- F-2. Interact with industry, project sponsors, professional societies, and/or community in a professional manner.

Outcome I: A recognition of the need for, and an ability to engage in life-long learning

- I-1. Use resources to learn new material not taught in class

Others:

- D-1. Share responsibilities and information on schedule with others on the project team.
- D-2. Participate in the development and selection of ideas for the projects.
- G-1. Produce a variety of documents, such as project reports, using appropriate formats and grammar with discipline-specific conventions including citations.
- H-2. Examine economic tradeoffs in engineering systems.
- H-3. Evaluate engineering solutions that consider environmental factors.
- J-1. Describe the impact of contemporary issues (such as environmental, global trade, economic, health, safety trade-offs, and emerging technologies).
- J-2. Describe impact of engineering decisions on energy resources.

7. Topics covered

- a. Course organization and team formation.
- b. Review of basic design tools, methodologies and relevant literature.
- c. Technical writing using the IEEE format.
- d. Top-down and bottom-up engineering design methodologies.
- e. Modern system level software and hardware design and simulation tools.
- f. Design documentation and review.
- g. Design validations
- h. Engineering ethics and societal impact of Engineering.

Course Syllabus: ELEC-496 SENIOR PROJECT II

1. Course number and name: ELEC 496 SENIOR PROJECT II
2. Credit and contact hours: 3 credits, 60 contact hours
3. Course coordinators: Dr. Esther T. Ososanya and Dr. Wagdy Mahmoud
4. Textbook and other Required Materials, title, author, and year:
 - a. Material dependent upon project: course materials pertinent to the individual projects are provided either electronically or through hand-outs as needed.
 - b. Manufacturer's data manuals as available on product websites
 - c. The IEEE digital library: available on-line through the UDC library web site, for literature search.
 - d. Matlab, Simulink, and Matlab toolbox available at <http://www.mathworks.com/access/helpdesk/help/helpdesk.html>
 - e. xilinx ISE, xilinx System generator, xilinx EDK documentations and tutorials available at http://www.xilinx.com/publications/prod_mktg/index.htm
5. Specific course information
 - a. Catalog description: Continuation of design project SENIOR PROJECT I. Students will consider feasibility of a design project, the effect of economic factors on the design and make presentations in oral and written form for evaluation.
 - b. Prerequisites or co-requisites: Prerequisites: ELEC 495 SENIOR PROJECT I
 - c. Required elective or selective elective: Required for both Electrical Engineering and Electrical Engineering with Computer Engineering option.
 - d. This is the second of a sequence of two project courses in the program of Electrical Engineering. The design content of the course is 2 credits.
6. Specific goals for the course
 - a. the specific goals for the course are:
 - i. to consolidate the student ability in utilizing the scientific methods to collect, analyze, and discuss information across a wide variety of subjects.
 - ii. assign specific open-ended type engineering projects to students to implement.
 - iii. expose students to state-of-the-art design techniques including advanced computer-aided- engineering tools. Discuss reliability, design constraints and design optimization, and safety issues. The student is expected to demonstrate creativity and good judgment in the design activity, both in the selection of design tools and the materials for the design. Emphasis will be placed on cost effectiveness and the use of top-down design methodology.
 - iv. to encourage students to conduct thorough investigation about the assigned project by using appropriate literature search. Initially, the students will be encouraged to develop proposals for the design of an *open-ended* design project, which will be reviewed by the instructor. The instructor will either approve the proposed design project or will assign another project.
 - v. improve the overall technical competency of students in conducting research thorough investigation about the assigned project by using appropriate literature search.
 - vi. improve the written and oral communication of students.
 - b. Student outcomes addressed by this course:

Outcome C: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

- C-3: Work within realistic constraints, (such as economical, environmental, societal, manufacturability, health and safety, ethical, and sustainability) in realizing systems.
- C-4: Build prototypes that meet design specifications.

Outcome D: An ability to function on multidisciplinary team

- D-1: Share responsibilities and information on schedule with others on the project team.
- D-2: Participate in the development and selection of ideas for the projects.

Outcome G: An ability to communicate effectively

- G-1: Produce a variety of documents, such as project reports, using appropriate formats and grammar with discipline-specific conventions including citations.
- G-2: Deliver well-organized, logical oral presentations, including good explanations when questioned on the projects.

Outcome H: The broad education necessary to understand the impact of engineering solution in global, economic, environmental and social context

- H-2: Examine economic tradeoffs in engineering systems.
- H-3: Evaluate engineering solutions that consider environmental factors.

Others:

- C-2: Carry out design process (such as concept generation, modeling, simulation, synthesis, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components, and within realistic constraints.
- E-3: Use analytical, computational, and/or experimental methods to obtain solutions.
- F-1: Evaluate ethical issues (such as safety, intellectual property, reporting data, etc.) that may occur in professional practice using professional codes of ethics.
- F-2: Interact with industry, project sponsors, professional societies, and/or community in a professional manner.
- J-1: Describe the impact of contemporary issues (such as environmental, global trade, economic, health, safety trade-offs, and emerging technologies).
- J-2: Describe impact of engineering decisions on energy resources.

7. Topical Coverage

- a. Project selection & group discussions
- b. First draft and Further Discussion
- c. Prototype building & testing
- d. Final oral presentations

Course Syllabus: MECH-478 Mechatronics

1. Course number and name: MECH-478 Mechatronics
2. Credit and contact hours: 3 credits, 45 contact hours
3. Course coordinators: Dr. Esther T. Ososanya and Dr. Devdas Shetty
4. Textbook, title, author, and year:
 - a. Mechatronics System Design, Devdas Shetty and Richard A. Kolk, 2011, second edition, Cengage Learning
 - b. Software and Hardware Engineering, Fredrick M Cady and James M. Sibigtroth, 2000, Oxford University Press
5. Specific course information
 - a. Catalog description: Fundamental concepts in mechatronics including instrumentation, integration of mechanical, electronics, and control engineering. Operating principles of electromechanical actuators, motors, sensors, drives, and analog motion control. Modeling, simulation, analysis, virtual prototyping and visualization of mechanical systems, and Applications of microprocessors, and microprocessor interfacing to eletromechanical systems.
 - b. Prerequisites or co-requisites: ME 3511-381, Senior EE or ME Standing
 - c. Required elective or selective elective? Required for ME, selective elective for EE.
6. Specific goals for the course
 - a. Outcomes of instruction
 - i. Learn assembly language programming
 - ii. Student can program a microcontroller, wrote assembly language codes, develop, debug, and implement real-time software for a specific application
 - iii. Learn microcontroller architecture
 - iv. Student can complete the real-time interface design to a microcontroller for the control of a specific peripheral device, perform data acquisition, and control the system.
 - v. Be able to identify the appropriate sensors and actuators for a specific application
 - vi. Students learn the basics of sensor and actuator theory, design, and application.
 - vii. Students can understand the selection and use of appropriate transducers and actuators for a specific application
 - viii. Learn Modeling and Simulation of Physical Systems
 - ix. Students understand mechatronics design process and learn the basics of digital electronics and mechatronic system elements.
 - x. Students understand modeling and simulation of physical systems, using the notion of Transfer Functions, Direct and Analog Block Diagram Modeling
 - xi. Students understand the connection between the mathematical model and physical system

- xii. Gain experience designing and controlling basic mechatronic systems
- xiii. perform model based control system design and implementation using visual programming (Vissim),
- xiv. Perform real time control of mechanical system using NI Compact- DAQ devices with Labview or the Quarc Control software, and microcontrollers.
- xv. Learn the capabilities and limitations of other disciplines.

b. Student outcomes addressed by the course

Outcome A: An ability to apply knowledge of mathematics, science, and engineering

A-1: Understands the use of modeling, analysis, and control dynamics of physical systems. Determine the solutions of the differential equation of a Mass-Spring-damper system and validate solutions with simulation output.

Outcome B: An ability to design and conduct experiment, analyze and interpret data.

B-1: Identifies the constraints, assumptions, and models for the experiment
Identify constraints, assumptions and models appropriate for a physical system operation.

B-2: Uses appropriate equipment and techniques for data collections.
Use appropriate data acquisition instrument and control software to acquire real time data, monitor, and control a physical system

B-3: Analyzes experimental data using appropriate tools.
Use appropriate engineering data processing tools and simulation package to analyze data, interrupt the data and draw conclusions based on the results, and generate plots.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic constraints.

C-3: Can work within realistic constraints, (such as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability) in realizing systems

Carry out a real life mechatronics project with realistic constraints such as operability, economic, and safety factor.

Carry out experiments on actual systems involving monitoring and control.(One example involves the application of electronic damping for Mass-spring-damper system)

Outcome D: An ability to function on multidisciplinary team

D-1 Shares responsibilities and information on schedule with others on the team
Knowledge of other disciplines and contribution to ideas

7. Topics covered

- a. Microcontroller architecture
- b. Assembly Language Programming: M68HC12 Instruction Set
M68HC12 Parallel I/O, Timer, A/D converters, Interrupts
- c. Mechatronics System Design Process, Mechatronics Key Elements, and Applications
- d. Modeling and Simulation of Physical Systems
Block Diagrams, Manipulations, and Simulation
Block Diagram Modeling, Direct Method and Analogy Approach
Electrical Systems, Mechanical Translational and Rotational systems

- e. Sensors and Actuators and Signal Conditioning and Real Time Interface
- f. Case Studies

