UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Mechanical Engineering
School of Engineering and Applied Sciences

CCEN 101: Introduction to Engineering

Catalog Data:	**CCEN 101: Introduction to Engineering, Credits: 2** Introduces freshmen interested in engineering disciplines to basic scientific principles and engineering concepts through hands-on experiments. These experiments enable students to acquire the knowledge, skills and attitudes necessary to be successful in the pursuit of engineering disciplines. In addition, students in this course will learn how to analyze, interpret and present data. Emphasis on guided design and problem-solving methodologies. Students undertake practice-oriented group design projects. Formal written reports and oral presentations will be required.
Credits and Requirements:	2 credits, required course for all freshmen engineering students
Class Schedule	Two 150-minute lecture/lab sessions per week for one semester
Laboratory Schedule:	Lec/lab combined
Pre-requisites by Course:	None
Co-requisites Course:	None
Required Texts:	Strategies for Creative Problem Solving, Scott Fogler and Steven LeBlanc 3rd edition, Prentice Hall,
Course Coordinator:	Dr. Kate Klein
Course Objectives:	Emphasis will be placed on critical thinking and problem-solving skills. The purpose of the course is to expose the student to concepts, research, and projects across various engineering disciplines so as to enable the student to choose the engineering career-path most suitable. There will be guest lectures to give students an overview of a wide variety of engineering applications, research, and technology. The students will work on a group project that involves design constraints, fabrication, and presentation. The ability to work synergistically within small groups is a major goal of this course.
Topics Covered:	Engineering and Design cannot be neatly separated, though they both involve problem solving. Engineering is associated with an emphasis on the inter-relationship between predictions and experimentation, while design will be associated with more of an intuitive approach. In either case, the primary purpose of the course is to introduce students to a systematic method of problem solving. The methodology is applicable to both individual and group problems or projects.
Lab Experiment and Activities:	There will be a series of experimental problems encountered during this course. There will also be a robotics final project that will require each team to complete a series of challenges and then develop their own problem statement to solve for their final project. Reports and presentations will be required for all final projects.

Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO4, SO5, SO7	
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to:	
	Assessed for Student Outcomes	**SO 1-A:** Identify complex problems by examining and understanding the issues and necessity of engineering solutions. **SO 1-D:** Select and effectively utilize appropriate techniques, tools and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques. **SO 2-A:** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution. **SO 3-A:** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience. **SO 3-B:** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences. **SO 3-C:** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner. **SO 4-A:** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements. **SO 5-A:** Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members. **SO 5-C:** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance). **SO 7-B:** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by:	Dr. Kate Klein	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 225: Electrical Circuits

Catalog Data:	**ELEC-225 Electrical Circuits. Credits 3.** Description, analysis, simulation, and Design, of electric circuits. Basic concepts and laws of electrical circuits such as Ohm's and Kirchhoff's laws, Thevenin and Norton theorems and equivalents, DC and AC steady-state analysis of simple circuits, transient analysis of first and second-order circuits, frequency response and transfer functions of first and second-order circuits, and ideal op-amp circuits and diode circuits.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS-201, PHYS-205
Co-requisites Course:	ELEC-226
Required Texts:	Engineering Circuit Analysis by William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin, 8th Edition, Mc Graw Hill Publishing company.
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	This course covers Voltage and Current Laws, Handy circuit analysis techniques, The Operational Amplifier (Op-Amp), Capacitors and Inductors, RC, RL and RLC circuits, Sinusoidal Steady State analysis, AC circuit power analysis, Polyphase circuits. • Ability to design, and analysis, of purely resistive circuits • Ability to design, analysis, and evaluation of AC and DC circuits using Ohm's Law • Ability to design, analysis, and evaluation of AC and DC circuits using KVL and KCL • Ability to design, analysis, and evaluation of AC and DC circuits using Voltage and Current dividers • Ability to design, analysis, and evaluation of AC and DC circuits including Operational Amplifiers • Ability to design, analysis, and evaluation of AC circuits using frequency domain (phasor analyses) Ability to design, analysis, and evaluation of AC poly phase circuits
Topics Covered:	1. Circuit Variables: Voltage, Current, Power and Energy 2. Circuit Elements and Experimental Laws (Ohm's Law, KCL, KVL) 3. Voltage and Current Laws 4. Nodal and Mesh analysis 5. Handy circuit analysis techniques

<table>
<tr><td></td><td colspan="2">6. The Operational Amplifier (Op-Amp)
7. Capacitors and Inductors
8. RC, RL and RLC circuits
9. Sinusoidal Steady State analysis
10. AC circuit power analysis
11. Polyphase circuits
12. Magnetically coupled circuits</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-A Identify complex problems by examining and understanding the issues and necessity of engineering solutions
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Amir Shahirinia</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering curriculum committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 226: Electrical Circuits Laboratory

Catalog Data:	**ELEC-226 Electrical Circuits Laboratory. Credits 1.** A laboratory course to accompany Electrical Circuits. This course is the first in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuits.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	PHYS-201 University Physics I, PHYS-205 University Physics I laboratory
Co-requisites Course:	ELEC-225 Electrical Circuit
Required Texts:	Engineering Circuit Analysis by William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin, 8th Edition, Mc Graw Hill Publishing company.
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	This lab offers experiments on Voltage and Current Laws, Handy circuit analysis techniques, The Operational Amplifier, Capacitors and Inductors charge and discharge, RC, RL and RLC circuits, Sinusoidal Steady State analysis, and AC circuit power analysis • The students gain a broad overview of the engineering concepts associated with analysis, design, and evaluation of circuits • The students gain an in-depth emphasis which is placed on selected topics in circuits analysis • The students evaluate an "off-the-shelf" design and determine if it could meet a specification • The students demonstrate and ability to simulate, and analyze circuits using software packages such as MATLAB/Simulink, OrCAD, and PSpice and compare them with experimental results to strengthen concepts in DC and AC circuits analysis
Topics Covered:	None
Lab Experiment and Activities	1. Ohm's Law 2. Designing Series Circuits 3. Designing Series Parallel Circuits 4. Kirchhoff's Voltage and Current Laws 5. Designing Voltage and Current-Divider Circuits. 6. Maximum Power Transfer 7. Balanced Bridge Circuit 8. Superposition Theorem 9. Thevenin's Theorem

<table>
<tr><td></td><td colspan="2">10. Oscilloscope Operations
11. Peak, RMS, and Average Values of AC
12. RC Time Constant
13. Inductors and Capacitors in Series and Parallel
14. Impedance of RC, RL, and RLC Circuits
15. Power in AC Circuits
16. Transformers Characteristics
17. Selected PSpice Projects</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO2, SO3, SO5</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO5-B Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Amir Shahirinia</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 241: Assembly Language and Microprocessors

Catalog Data:	**ELEC-241 Assembly Language and Microprocessors. Credits 3.** Concepts of assembly language and the machine representation of instructions and data of a modern digital computer are presented. Students will have the opportunity to study machine addressing, stack operations, subroutines, and programmed and interrupt driven I/O. Also, basic concepts of machine organization are studied. This will include computer architecture at the register level, micro-operation components of instructions and hardware interfaces.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	APCT 231, APCT 233
Co-requisites Course:	ELEC-242
Required Texts:	1. Microcontrollers, Second Edition: From Assembly Language to C Using the PIC24 Family, 2015, Authors: Bryan A. Jones, Robert B. Reese, J.W. Bruce, Publisher: Cengage Learning PTR 20 Channel Center Street Boston, MA 02210 USA, ISBN-10: 1-305-07655-9 2. Data Sheet: PIC24 from Microchip. Each student must have a soft copy of the Data Sheet. This document may be downloaded from Microchip Technology Inc., Headquartered in Chandler, Arizona.
Course Co-coordinator:	Dr. Esther Ososanya
Course Objectives:	The objective of this course is to introduce to the electrical engineering students the concept and application of PIC 24 Microcontroller using its dedicated Assembly language, Assembly programming; Assembly-C interface; CPU and memory organization; addressing modes; arithmetic, logic and branch instructions; arrays, pointers, subroutines, stack and procedure calls.
Topics Covered:	1. Computer architecture fundamentals and an Introduction to Microcontroller 2. Number System and Digital Logic combinational and sequential blocks Review 3. Introduction to the PIC24 Microcontroller Family 4. Program and Date Memory Organizations 5. Data Transfer Instructions and Addressing Modes 6. Basic Arithmetic and Control Instructions 7. *C*-to-PIC24 Assembly Language a. MPLAB X Compatible Assembly Source Code for C Example

<table>
<tr><td></td><td>8. Bitwise Logical Operations
9. Introduction and Using the Status Register
10. Unsigned Conditional Tests in C and Assembly
11. Looping
12. PIC24 Indirect Addressing Modes
13. Using Subroutines
14. Stack and Call/Return, Push/Pop, Stack Overflow/Underflow
15. Implementing Subroutines in Assembly Language
16. C Pointers and Arrays
17. C Strings</td></tr>
<tr><td>Lab Experiment and Activities</td><td>None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td>Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td>Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO6-C Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory</td></tr>
<tr><td>Prepared by:</td><td>Dr. Behjat Forouzandeh, Adjunct Professor</td></tr>
<tr><td>Approved by DCC:</td><td>By Electrical and Computer Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 242: Assembly Language and Microprocessors Laboratory

Catalog Data:	**ELEC-242 Assembly Language and Microprocessors Laboratory. Credits 1.** A laboratory course to accompany the Assembly and Microprocessors lecture course. Students will have the opportunity to develop assembly language programs utilizing machine addressing, stack operations, subroutines, and programmed and interrupt driven I/O
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	APCT-231, APCT-233
Co-requisites Course:	ELEC-241
Required Texts:	Hydrology and Hydraulic Systems, by Ram S. Gupta ISBN 1-57766-455-8, Third Edition, Waveland Press, Illinois
Course Co-coordinator:	Dr. Esther Ososanya
Course Objectives:	The purpose of this LAB is to complete the aims of the related course in which students become familiar with PIC24 microcontroller and Its associated assembly language with the aid of C programming language concept as well as how to interface and use some basic peripherals inside this device. The students will also be exposed to a variety of interface techniques, both at the hardware and software levels. The course will also reinforce students' ability to program in assembly language with the role of a host simulating and hardware system.
Topics Covered:	None
Lab Experiment and Activities	1. Simulating combinational and sequential building blocks 2. Simulating Building blocks 3. An Introduction to MPLAB X IDE Microchip Tools 4. Debugging on Hardware 5. Set up a template file simulating an assembly file for mov, and add, instructions using datasheet belongs to PIC24FJ128GA010 6. Hardware Interface: 7. PIC24 assembly language programming using conditional branching, send the output to Microstick2 and see the result on a set of 4 LED's. 8. PIC24 Timer1. 9. Demonstrated LAB Projects: Interfacing LCD with PIC Microcontroller
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO5, SO6
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO5-A** Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Behjat Forouzandeh	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 301: Engineering Mathematics

Catalog Data:	**ELEC-301 Engineering Mathematics. Credits 3.** Covers Fourier series and integral, Laplace transform, periodic functions, partial differential equations, Bessel functions and Legendre polynomials, complex analytic functions, and Taylor and Laurent series.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	MATH-260
Co-requisites Course:	None
Required Texts:	Advanced Engineering Mathematics, Tenth Edition by Erwin Kreyszig, Published by Wiley
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	The purpose of this course is to get an understanding of advanced engineering mathematics topics. Upon completion of the course the students will be able to: • Solve First Order Linear Differential Equations. • Solve Second order Differential Equations with constant coefficients, both homogenous and non-homogenous • Apply Laplace Transform Techniques in the solution of differential equations. • Demonstrate ability to work with complex number • Understand complex function, differentiation of complex functions and integration of complex functions.
Topics Covered:	1. First Order Differential Equations 2. Second Order Differential Equations 3. The Laplace Transform 4. Series Solutions 5. Complex Analysis
Lab Experiment and Activities	None
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
Prepared by:	Dr. Sasan Haghani	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 307: Probability and Statistics for Engineers

Catalog Data:	**ELEC-307 Probability and Statistics for Engineers. Credits 3.** Covers purpose of statistics, methods of representation, sample mean, sample variance, random experiments, probability, random variable, discrete and continuous distributions, binomial, Poisson and normal distribution sampling.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	MATH-152, MATH-156.
Co-requisites Course:	None
Required Texts:	Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers 2nd Edition by Yates and Goodman.
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	The overall objective of this course is to introduce students to topics in probability and stochastic processes. By the end of this course the students will be able to: • Apply Bayes Theorem and Total Probability Theorem to solve probability questions. • Develop a strong foundation in using discrete and continuous random variables, and important class of discrete and continuous random variables • Learn about expectation, variance and moments of random variables. • Understand joint distributions, covariance and correlation. • Demonstrate ability to apply the central limit theorem to solve engineering problems. • Develop a strong foundation in stochastic processes, important class of stochastic processes including wide sense stationary processes.
Topics Covered:	1. Introduction to Statistics and Probability 2. Conditional Probability, Total Probability Theorem and Bayes Theorem 3. Counting Methods 4. Discrete and Continuous Random Variables, Important Distributions, and Expectations 5. Properties of CDF, PDF and PMF 6. Two or More Random Variables, Joint CDF and Joint PDF, Conditional Expectation. 7. Sum of Random Variables, Central Limit Theorem’

	8. Radom Processes, Important Classes of Random Processes, Wiener Theorem.	
Lab Experiment and Activities	None	
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
Prepared by:	Dr. Sasan Haghani	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC-315: Computer Organization

Catalog Data:	**ELEC-315 Computer Organization. Credits 3.** This course covers foundations of digital design and digital computer systems. Boolean algebra, design of combinational and sequential circuits are introduced. It also emphasizes the design, optimization and implementation of finite state machines.
Credits and Requirements:	3 Cr. and required course (BS in Electrical Engineering and BS in Electrical Engineering with Computer Engineering option)
Class Schedule	Two 80-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC 225 and ELEC 226
Co-requisites Course:	ELEC 316
Required Texts:	*Fundamentals of Digital and Computer Design with VHDL*, Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698
Course Co-coordinator:	Dr. Nian Zhang
Course Objectives:	The purpose of this course is to teach the fundamental concepts of digital logic analysis, synthesis and design, Boolean algebra, binary numbers and codes and their role in combinational circuits design. The basic analysis techniques used for sequential networks and flip-flop timing restrictions are covered. This course exposes the students to real-world implementation issues and teaches them to analyze trade-offs associated with alternate implementation technologies. • Design, analyze and implement combinational and sequential logic circuits using basic logic gates. • Perform minimization of logic expressions using Karnaugh maps and canonical standard forms. • Design and analyze logic circuits using or implementing arithmetic operations, multiplexers, encoders, simple latches and flip-flops. • Understand the design, optimization and implementation of finite state machines. Consider safety, ethical, and other societal constraints in execution of design projects
Topics Covered:	1. Digital Systems and Binary Numbers 2. Boolean Algebra and Logic Gates 3. Gate-Level Minimization 4. Combinational Logic 5. Sequential Logic Design 6. Registers and Counters 7. Memory and Programmable Logic

	8. Finite State Machine	
Lab Experiment and Activities	None	
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO6, SO7	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus, differential equations, and discrete mathematics), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by:	Dr. Nian Zhang	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC-316: Computer Organization Lab

Catalog Data:	**ELEC-316 Computer Organization Lab. Credits 1.** The course emphasizes the use of Xilinx Vivado tool in the description, modeling, simulation, verification and testing of digital systems. It includes the experimentation with logic gates, decoders and multiplexers, latches and flip-flops.
Credits and Requirements:	1 Cr. and required course (BS in Electrical Engineering and BS in Electrical Engineering with Computer Engineering option)
Class Schedule	None
Laboratory Schedule:	One 150-minutes lecture sessions per week for one semester
Pre-requisites by Course:	ELEC 225 and ELEC 226
Co-requisites Course:	ELEC 315
Required Texts:	N/A (Instructional manual provided by the instructor)
Course Co-coordinator:	Dr. Nian Zhang
Course Objectives:	• Students will demonstrate knowledge and demonstrate an ability to understand, analyze and design various combinational and sequential circuits. • Students will demonstrate an ability to design and troubleshoot finite state machines. • Students will develop skills to build and troubleshoot digital circuits. • Students will demonstrate the ability to synthesize a digital system using hardware description language on Xilinx Vivado design suite. • Students will demonstrate an ability to record the experimental data, analyze the results, and prepare a formal laboratory report. • Consider safety, ethical, and other societal constraints in execution of design projects.
Topics Covered:	1. Introduction to Logic Gates 2. Logic Circuits 3. Boolean Functions 4. Karnaugh Maps 5. Binary Math 6. Understanding Decoder 7. Multiplexers 8. Flip-Flops 9. Serial Adder 10. Sequential Counter 11. Counters with Unused States Design Using J-K Flip-Flops 12. Design of Vending Machine Using Finite State Machine
Lab Experiment and	None

Activities		
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO4, SO5, SO6, SO7	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus, differential equations, and Discrete Mathematics), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO5-B** Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
Prepared by:	Dr. Nian Zhang	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 351: Electronics I

Catalog Data:	**ELEC-351 Electronics I. Credits 3.** Covers semiconductor diodes, bipolar junction transistors (BJT), and junction field effect transistors (JFET); design of BJT and JFET amplifiers, and computer-aided design and circuit simulation.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-225, ELEC-226
Co-requisites Course:	ELEC-353
Required Texts:	A. S. Sedra and K. C. Smith, "Microelectronic Circuits," 7th Edition, Oxford University Press, NY, 2014, ISBN 978-0-19-933913-6.
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	The purpose of this course is to get a fundamental understanding of microelectronic circuits and gain good working knowledge of the important phases of microelectronic circuit design as well as their applications. • Students will be able to understand the internal structure of the diodes, transistors and amplifiers and the physical laws that govern their behaviors. • Students will be able to describe various amplifier configurations and their respective advantages. • Students will understand the basic function of active elements (MOS and bipolar transistors) • Students will be able to determine circuit models of diodes and BJT and FET transistors on DC and different frequency AC signals. • Student will develop an ability to design and to analyze single-stage analog amplifier circuits (common-emitter (source), followers and differential pairs) • Students will be able to design a system, component, or process based on diodes, transistor amplifier, operational amplifier circuits to meet desired needs within realistic constraints. • Students will be able to use PSPICE to model, analyze, design, and implement diode, transistor and amplifier circuits. • Students will be developed general techniques to analyze, design and model of diode, transistor and amplifier circuits.
Topics Covered:	1. Basic concepts (Chapter 1)

<table>
<tr><td></td><td colspan="2">2. Ideal operational amplifiers (chapter 2)
3. Semiconductor diode circuit analysis (Chapter 3)
4. Bipolar Junction Transistors (Chapter 4)
5. Design of bipolar junction transistor amplifiers (Chapter 5)
6. Field Effect Transistor Amplifiers (Chapter 6)
7. Bias Stability of Transistor Amplifiers (chapter 7)</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hongmei Dang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 352: Electronics II

Catalog Data:	**ELEC-352 Electronics II. Credits 3.** Covers operational amplifiers, frequency response characteristics of transistor amplifiers, feedback amplifiers, oscillators, filters, and pulsed waveforms. Computer-aided design and circuit simulation.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-351, ELEC-353
Co-requisites Course:	ELEC-354
Required Texts:	A. S. Sedra and K. C. Smith, "Microelectronic Circuits," 7th Edition, Oxford University Press, NY, 2014, ISBN 978-0-19-933913-6.
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	This course follows ELEC351 and focuses on complex microelectronic circuit, a particular emphasis on design of integrated circuit, multistage amplifiers and their characteristics. • Students will be able to understand the internal structure of Integrated-Circuit Amplifiers, Differential and Multistage Amplifiers and the physical laws that govern their behaviors. • Students will be able to describe various amplifier operations and their respective advantages. • Students will be able to design and analyze Differential and Multistage Amplifiers. • Students will be able to simulate single and multiple stage transistor circuits to determine dc operating point and frequency response. • Students will be able to determine the frequency response of Amplifiers. • Students will understand the feedback of Amplifiers. • Students will be able to determine circuit models of integrated-circuit Amplifiers, differential and multistage amplifiers and different frequency AC signal response. • Student will develop an ability to design and to analyze differential and multistage amplifier circuits. • Students will be able to design a system, component, or process based on integrated-circuit Amplifiers, differential and multistage amplifier circuits to meet desired needs within realistic constraints. • Students will be able to use PSPICE to model, analyze, design, and implement amplifier circuits. • Students will be developed general techniques for

<table>
<tr><td></td><td colspan="2">analyze, design and model of amplifier circuit.</td></tr>
<tr><td>Topics Covered:</td><td colspan="2">1. Building Blocks of Integrated-Circuit Amplifiers (Chapter 8)
2. Differential and Multistage Amplifiers (Chapter 9)
3. Frequency Response (Chapter 10)
4. Feedback (Chapter 11)
5. Output Stages and Power Amplifiers (Chapter 12, Option)
6. Operational Amplifier Circuits (chapter 13, Option)</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO2, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hongmei Dang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 353: Electronics I Laboratory

Catalog Data:	**ELEC-353 Electronics I Laboratory. Credits 1.** A laboratory course to accompany Electronics I. Includes experiments on discrete transistor characteristics and circuits.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	ELEC-225, ELEC-226
Co-requisites Course:	ELEC-351
Required Texts:	A. S. Sedra and K. C. Smith, "Microelectronic Circuits," 7th Edition, Oxford University Press, NY. B. Lab Manual Created by Instructor
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	The purpose of this course is to gain fundamental concepts of microelectronic circuit design at the transistor level, a particular emphasis on experiments of microelectronic circuits and simulation via computer aided design. • Students will be able to conduct the diode, transistor and amplifier circuit experiments based on experimental constraints. • Students will be able to describe various amplifier configurations and their respective advantages. • Students will be able to uses analytical, computational, and/or experimental methods to obtain solutions. • Students will be able to validate experimental results with respect to assumptions, constraints and theory. • Students will be able to uses analytical, computational, and/or experimental methods to obtain solutions • Students will be able to use PSPICE to model, analyze, design, and implement diode, transistor and amplifier circuits • Students will be able to design a system, component, or process based on diodes, transistors and amplifier circuits to meet desired needs within realistic constraints. Students will demonstrate an ability to record the experimental data, interpret data, analyze the results, prepare a formal laboratory report and present laboratory results
Topics Covered:	None
Lab Experiment and Activities	1. Inverting Op-Amp Configuration 2. Non-Inverting Op-Amp Configuration 3. Difference Amplifier 4. Lossy Integrator 5. Diode I-V Transfer Curve 6. Rectifiers

<table>
<tr><td></td><td colspan="2">7. NMOS I-V Characteristics
8. NMOS at DC
9. NPN I-V Characteristics
10. NMOS Common-Source Amplifier</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO5, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO5-C Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance).
SO6-A Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols)
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hongmei Dang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 354: Electronics II Laboratory

Catalog Data:	**ELEC-354 Electronics II Laboratory. Credits 1.** Continues Electronics Lab I. Includes experiments on design of amplifiers and op-amp circuits. Lab 3 hrs., Prerequisite.
Credits and Requirements:	31Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minues Laboratory session per week for one semester
Pre-requisites by Course:	ELEC-351, ELE-353
Co-requisites Course:	ELEC-352
Required Texts:	C. S. Sedra and K. C. Smith, "Microelectronic Circuits," 7th Edition, Oxford University Press, NY. D. Lab Manual Created by Instructor
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	The purpose of this course is to gain fundamental concepts of microelectronic circuit design at the transistor level. Student should be able to: • Conduct the Integrated-Circuit Amplifiers, Differential and Multistage Amplifier circuit experiments based on experimental constraints. • Describe various amplifier configurations and their respective advantages. • Design and analyze Differential and Multistage Amplifiers. • Students will be able to simulate single and multiple stage transistor circuits to determine dc operating point and frequency response. • Design, analyze and conduct the frequency response circuits of Amplifiers. • Use analytical, computational, and/or experimental methods to obtain solutions. • Validate experimental results with respect to assumptions, constraints and theory. • Use PSPICE to model, analyze, design, and implement integrated-circuit Amplifiers, differential and multistage amplifier circuits, frequency response and feedback circuits. • Design a system, component, or process to meet desired needs within realistic constraints. • Demonstrate an ability to record the experimental data, interpret data, analyze the results, and prepare a formal laboratory report and present laboratory results.
Topics Covered:	None
Lab Experiment and Activities	1. Transistor Amplifiers (Chapter 7) 2. Building Blocks of Integrated-Circuit Amplifiers (Chapter 8)

<table>
<tr><td></td><td colspan="2">3. Differential and Multistage Amplifiers (Chapter 9)
4. Frequency Response (Chapter 10)
5. Feedback (Chapter 11)
6. Output Stages and Power Amplifiers (Chapter 12, Option)
7. Operational Amplifier Circuits (chapter 13, Option)</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO5, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints.
SO1-D Select and effectively utilize appropriate techniques, tools and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques.
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution.
SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience.
SO5-C Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance).
SO6-A Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols).
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods.
SO6-C Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hongmei Dang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 356: Physical Electronics

Catalog Data:	**ELEC-356 Physical Electronics. Credits 3.** Covers the growth and properties of physical and optical semiconductor materials; kinetics of charge carriers in electronic devices; design, fabrication, and operation of integrated circuits and devices, and optoelectronic devices including LEDs, lasers and, solar cells.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS-203, PHYS-207
Co-requisites Course:	None
Required Texts:	*Principles of Semiconductor Devices, Second Edition*, Sima Dimitrijev, Oxford University Press
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	The purpose of this course is to get an understanding of basic principle of semiconductor devices, with particular emphasis on physical mechanism of semiconductor devices. • Students will be able to understand physics and technology of semiconductor materials and devices. • Students will be able to use energy diagram to understand semiconductor devices including PN junction diodes, semiconductor-metal contact, bipolar junction transistors; and metal oxide semiconductor capacitors; field effect transistors; as well as carrier generation, recombination and transport in these devices. • Students will be able to describe characteristic curves of PN junction diodes, bipolar junction transistors and field effect transistors and explain the physics mechanism of these curves. • Students will be able to design semiconductor devices and improve device performance according to theory and physical mechanism. • Student will be able to learn the latest fabrication and design development in integrated circuits and devices. • To understand the engineering principles for erosion and sediment control during a construction
Topics Covered:	1. Crystal Properties and Growth of Semiconductor Materials 2. Crystal Properties and Growth of Semiconductor Materials 3. Atomic Structure of Semiconductor Materials 4. Energy Bands and Charge Carriers in Semiconductors 5. Excess Carriers in Semiconductors 6. P-N Junctions 7. Metal-Semiconductor Junctions

<table>
<tr><td></td><td colspan="2">8. Field-Effect Transistors
9. Bipolar Junction transistors</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO3, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO3-C Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner.
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hongmei Dang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 361: Electromagnetic Theory

Catalog Data:	**ELEC-361 Electromagnetic Theory. Credits 3.** Covers vector calculus, orthogonal coordinates, Coulomb and Gauss laws, scalar potentials, dielectrics, capacitance, and static electric and magnetic fields and their interaction with matter, as well as Laplace and Poisson equations.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS-201, PHYS-205, ELEC-225, ELEC-226
Co-requisites Course:	None
Required Texts:	William H. Hayt Jr., and John A. Buck, McGraw-Hill Book Co., 2012.
Course Co-coordinator:	Dr. Wagdy H. Mahmoud
Course Objectives:	The overall objective of this course is to provide students with an introduction to electromagnetic engineering and its application in electrical engineering design. Upon completion of the course the student will be able to: Develop a strong foundation in the theory of electromagnetic field and waves and its application in electrical engineering • Demonstrate ability to use various coordinate systems (Cartesian, cylindrical, and spherical) and to convert from one coordinate system to another • Understand electromagnetic fields, charge, flux, potential and currents • Apply 3-dimensional calculus and electrostatic boundary value problems • Demonstrate ability to use and apply the Divergence theorem. • Calculate the impedance of various conducting materials • Calculate the capacitance induced in engineering designs
Topics Covered:	1. Vector Analysis 2. Coulomb's Law and Electric Field Intensity 3. Electric Flux density, Gauss's Law, and Divergence 4. Energy and Potential 5. Conductors and Dielectrics 6. Capacitance
Lab Experiment and Activities	None
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO4, SO6, SO7
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-C** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (IEEE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning)
Prepared by:	Dr. Wagdy H. Mahmoud	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 371: Signals and Systems I

Catalog Data:	**ELEC-371 Signals and Systems I. Credits 3.** Introduces principles and techniques of continuous and discrete time linear systems analysis. Topics include signal representation, properties of systems, convolution, Fourier series and transform, FFT, sampling theorem, filtering, Laplace and Z-transform techniques.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-351, ELEC-353, ELEC-301
Co-requisites Course:	ELEC-374
Required Texts:	Signals and Systems using MATLAB by Luis Chaparro, 2nd edition, ISBN: 978-0-12-374716-7
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	The purpose of this course is to get a solid understanding of signals and systems. Upon completion of the class the student would be able to • Develop a strong foundation in discrete as well as continuous type signals and systems. • Able to identify system properties such as linearity, time invariance, causality, BIBO stability • Be Able to perform convolution in the time domain. • Apply Laplace and Fourier Transform Techniques to Linear Time Invariant Systems. • Apply Z-Transform techniques to discrete linear time invariance systems. • Have a solid understanding the Nyquist Theorem
Topics Covered:	1. Introduction to different signal and system types (discrete and continuous) 2. Properties and Systems Linear Time Invariant Continuous and Discrete System, Causality, Stability 3. Convolution 4. Laplace and Z-Transform 5. LTI discrete-Time systems in the transform domain
Lab Experiment and Activities	None
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO6
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Sasan Haghani	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELE 374: Signals and Systems I Laboratory

Catalog Data:	**ELEC-374 Signals and Systems I Laboratory. Credits 3.** A lab accompanying ELEC 371 to introduce students to Signals and Systems through MATLAB.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	ELEC-351, ELEC-353, ELEC-301
Co-requisites Course:	ELEC-371
Required Texts:	Signals and Systems using MATLAB by Luis Chaparro. ISBN: 978-0-12-374716-7
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	This is a Lab component of ELEC-371. By the completion of this course the student will be able to use MATLAB for the analysis of signals and systems. Specifically, the students would be able to: • Use MATLAB to plot and define functions. • Apply Inverse Laplace Transform using MALTAB • Apply Convolution using MATLAB • Perform Fourier Analysis using MATLAB • Linear and Nonlinear Filtering Using MATLAB
Topics Covered:	None
Lab Experiment and Activities	1. Introduction to different signal and system types (discrete and continuous) 2. Properties and Systems Linear Time Invariant Continuous and Discrete System, Causality, Stability 3. Convolution 4. Laplace and Z-Transform 5. LTI discrete-Time systems in the transform domain Using MATLAB to perform signal and system analysis
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO6
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Sasan Haghani	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 410: Communications and Security for Smart Grid

Catalog Data:	**ELEC-410 Comms. and Security for Smart Grid. Credits 3.** This course informs the students of the various communication technologies that are essential in the evolution of a Smart Grid and will train the students about the types of cyber-attacks on the Smart Grid, privacy and security issues and their possible solutions. Through this course the students are expected to gain an in-depth knowledge about the communication and security aspects of a Smart Grid. Students are expected to finish a course project and made presentations in class.
Credits and Requirements:	3 Cr. and elective course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-467
Co-requisites Course:	None
Required Texts:	Smart Grid Communications and Networking, Hossain, Ekram Han, Zhu Poor, H. Vincent Published: June 2012, ISBN: 9781107014138
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	The purpose of this course is to get a solid understanding of smart grid communications and privacy issues related to smart grid. By the end of this course the students will • Students will have a basic understanding of power systems including production and generation and power flow analysis. • Students will understand the elements of a smart Grid System, including the two-way communication paradigm of the smart grid. Students will also learn about the integration of renewable energy sources such as wind and solar power into a smart grid system. • Students will learn about the various communication technologies used in smart grid, including powerline communication, Wireless Mesh Networks, ZigBee protocol and application of wireless sensor networks in the smart grid. • Students will learn about the cyber security attacks that target generation, distribution and control, and the consumption sectors of the smart grid. • Student will learn about the demand response in smart grid and system stability.
Topics Covered:	1. Elements of Smart Grid 2. Integration of Renewable Energy into Smart Grid 3. Demand Response

<table>
<tr><td></td><td>4. Role of two-way communication in Smart Grid
5. Smart Grid Communication Standards
6. Cyber Security Challenges in Smart Grid
7. Load altering attacks
8. Privacy concerns in Smart Grid</td></tr>
<tr><td>Lab Experiment and Activities</td><td>None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td>Meets Program Educations Objectives through Student Outcomes: SO3, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance</td><td>SO3-B Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences

SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).</td></tr>
<tr><td>Prepared by:</td><td>Dr. Sasan Haghani</td></tr>
<tr><td>Approved by DCC:</td><td>By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 420: Power Electronics

Catalog Data:	**ELEC-420 Power Electronics. Credits 3.** This power electronics course Introduces basic topologies of power switching circuits, switching characteristics of semiconductor devices including IGBT transistors, modeling, design, analysis, and control of DC/DC converters, AC/DC rectifiers, DC/AC inverters, AC/AC cycle converter, and switch- mode power supplies and power electronics applications in motor drives, uninterrupted power supplies, power systems, high frequency energy conversion, and renewable energy systems. Software and hardware are used in the lab to design and analyze power electronics circuits in real time
Credits and Requirements:	3 Cr. and elective course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-352, ELEC-354
Co-requisites Course:	None
Required Texts:	Power Electronics: Converters, Applications and Design, Media Enhanced, 3rd Edition, by Ned Mohan, ISBN: 0471226939
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	Fundamentals and applications of devices, circuits and controllers used in systems for electronic power processing and conversion • Ability to design, and analysis of AC-DC rectifier circuits, and recognize the characteristic current and voltage harmonics generated • Ability to design, and analysis of DC-DC converter circuits for power supply applications, and identify the application of appropriate topologies • Ability to design, and analysis of DC-AC inverter circuits, and state and apply the fundamentals of Pulse-Width Modulation (PWM) control
Topics Covered:	1. Introduction and principles of electronic power processing 2. Power semiconductors - usage, driving, protection, applications, design aspects 3. Analysis and design of rectifier circuits 4. Analysis and design of DC-DC converters and off-line power supplies 5. Analysis and design of inverter circuits
Lab Experiment and Activities	None
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering)
Prepared by:	Dr. Amir Shahirinia	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 458: Digital Signal Processing I

Catalog Data:	**ELEC-458 Digital Signal Processing I. Credits 3.** Time and frequency analysis of discrete- time signals and systems, sampling theorem, Z-transform, FFT techniques. Fast implementations of the DFT and its relatives. IIR and FIR digital filter design, implementation, and quantization error analysis. Decimation, interpolation and introduction to multirate digital signal processing.
Credits and Requirements:	3 Cr. and elective course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-371, ELEC-374
Co-requisites Course:	None
Required Texts:	Advanced Digital Signal Processing, Theory and Practice, by Manolakis, Cambridge University Press.
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	The purpose of this course is to provide a solid understanding of digital signal processing techniques to the students. By the end of the class the students would be able to: • Have a solid understanding of sampling, quantization error, and discrete time processing of continuous time signals. • Perform Discrete Time Fourier Transform and Discrete Fourier Transform Analysis. • Apply Z-Transform techniques to digital system analysis. • Design Digital Filters using various techniques. • Have a solid understanding of minimum phase and all pass systems. • Be able to use MATLAB effectively in the design and analysis of discrete systems.
Topics Covered:	1. Discrete-time and Continuous-time signals and systems in the time-domain 2. DTFT and DFT 3. Minimum phase and all pass systems 4. FIR and IIR Filter Design and implementation 5. Sampling, Quantizing, and discrete time processing of continuous time signals 6. Use of MATLAB in the design and processing of discrete and continuous signals and filter design
Lab Experiment and Activities	None

Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO5, SO6	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering) **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO5-B** Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Sasan Haghani	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC-459: Digital Computer Architecture and Design

Catalog Data:	**ELEC-459 Digital Computer Architecture and Design. Credits 3.** 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.
Credits and Requirements:	3 Cr. and required course (BS in Electrical Engineering with Computer Engineering option), Selective elective (BS in Electrical Engineering)
Class Schedule	Two 80-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC 241, ELEC 242, ELEC 315, and ELEC 316
Co-requisites Course:	None
Required Texts:	*Computer Organization & Design*, David A. Patterson and John L. Hennessy, The Hardware/Software Interface, Morgan Kaufmann, Fourth Edition, 2008. *MIPS assembly Language Programming*, Robert L. Briton, Pearson Prentice Hall, 2003. ISBN-13: 978-0131420441
Course Co-coordinator:	Dr. Nian Zhang
Course Objectives:	• Students will be able to gain the knowledge needed to design and analyze high-performance computer architecture • Students will be able to utilize the MIPS instruction set to write simple assembly language program • Students will be able to compare and contrast the performance and complexity of the various hardware methods for executing assembly language programs • Students will be able to evaluate, and design instruction set architecture in terms of memory efficiency, performance, and capabilities. • Students will be able to gain the knowledge needed to design pipelined Datapath for maximum throughput and evaluate its performance. • Consider safety, ethical, and other societal constraints in execution of design projects.
Topics Covered:	1. Computer Abstractions and Technology 2. Instructions: Language of the Machine 3. Arithmetic for Computers 4. The Processor

<table>
<tr><td></td><td colspan="2">5. Large and Fast: Exploiting Memory Hierarchy
6. Assemblers, Linkers, and the SPIM Simulator
7. The Basics of Logic Design
8. Mapping Control to Hardware</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO6, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO2-C Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering)
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
SO6-C Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Nian Zhang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 461: Electrical Energy Conversion

Catalog Data:	**ELEC-461 Electrical Energy Conversion. Credits 3.** Covers theory of electromechanical energy conversion, DC motors and generators, power electronics, AC rotating machine theory.
Credits and Requirements:	3 Cr. and elective ELEC 352, ELEC 354 course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-352, ELEC-354
Co-requisites Course:	ELEC-462
Required Texts:	Electric Machinery Fundamentals, 5th Edition, by Stephen J. Chapman, ISBN: 987-0-07-352954-7.
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	The purpose of this course is to get an understanding of electromechanical energy conversion. • Ability to apply fundamental laws of electromagnetism (Faraday's and Ampere's Laws) to analyze and design of simple energy conversion devices and transformers • Ability to analyze three-phase circuit • Ability to apply fundamentals of magnetic circuits to machines (DC and AC) design • Learn the fundamentals of electromechanical energy conversion • Ability to apply the fundamentals of direct-current to design generators and motors for specific needs • Learn the fundamentals of alternating-current generators and motors • Ability to apply the fundamentals of alternating-current to design synchronous and asynchronous generators and motors for specific needs • Learn the importance of energy conversion to society • Ability to use MATLAB to solve DC and AC machine problems
Topics Covered:	1. Introduction to Machinery Principals 2. Transformers 3. AC Machine Fundamentals 4. Synchronous Generators and Motors 5. Induction Motors 6. DC Machine Fundamentals 7. DC Generators and Motors
Lab Experiment and Activities	None

Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO4	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities
Prepared by:	Dr. Amir Shahirinia	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 462: Electrical Energy Conversion Laboratory

Catalog Data:	**ELEC-462 Electrical Energy Conversion Laboratory. Credits 1.** Includes experiments on DC and AC motors and generators.
Credits and Requirements:	1 Cr. and elective course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	ELEC-352, ELEC-354
Co-requisites Course:	ELEC-461
Required Texts:	Electric Machinery Fundamentals, 5th Edition, by Stephen J. Chapman, ISBN: 987-0-07-352954-7.
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	This lab offers experiments on single-phase and three-phase transformers, AC induction machines, DC machines • The students gain a broad overview of the engineering concepts associated with analysis, design, and evaluation of energy conversion devises • The students gain an in-depth emphasis which is placed on selected topics in electric machinery (single-phase and three-phase transformers, AC induction machines, DC machines) • The students demonstrate ability to collect data from the experiments on electric machinery set ups (transformers, AC and DC machines), test, and analyze it • The students evaluate an "off-the-shelf" design of electric machinery and determine if it could meet a specification and the problem needs
Topics Covered:	None
Lab Experiment and Activities	1. Machinery Principals 2. Transformers 3. AC Machines (Induction Motors) 4. DC Machines (Series, Shunt, Compound)
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO2, SO3, SO5
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO5-B** Ability to plan collaborative tasks, share responsibilities and engage in the success of team goals including experimental data collection, analyses and writing the reports for each experiment
Prepared by:	Dr. Amir Shahirinia	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 467: Fundamentals of Communication Systems

Catalog Data:	**ELEC-467 Fundamentals of Communication Systems. Credits 3.** 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 are covered.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-307, ELEC-371, ELEC-374
Co-requisites Course:	ELEC-476
Required Texts:	Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
Course Co-coordinator:	Dr. Paul Cotae
Course Objectives:	The purpose of this course is to get an understanding of fundamental concepts of an electrical communication system. • To understand the basic concepts of signals and systems such as Fourier series, Fourier transform, filter design, power and energy, Hilbert transform and its properties, lowpass and bandpass signals. • To familiarize with the Amplitude Modulation process focusing on the implementation of AM Modulators and Demodulators, Signal Multiplexing and AM-Radio Broadcasting. • To understand the Angle Modulation process including 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. • Ability to work and to apply the Probability and Random Processes, Gaussian and White Processes to evaluate the performance of the Amplitude modulation and Angle modulation systems in the presence of additive white Gaussian noise. • Ability to plan and design a computer program to evaluate the Fourier coefficients of a periodic signal.
Topics Covered:	1. Elements of an Electrical Communication System 2. Signals and Linear Systems 3. Amplitude Modulation 4. Angle Modulation 5. Probability and Random Process 6. Effect of Noise on Analog Communication Systems

	7. Digital Cellular Communication Systems	
Lab Experiment and Activities	None	
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
Prepared by:	Dr. Paul Cotae	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 468: Wireless Communications

Catalog Data:	**ELEC-468 Wireless Communications. Credits 3.** Cellular radio concepts: frequency reuse and handoff strategies. Large scale path loss models; fading and multipath: flat fading versus frequency selective fading; modulation schemes for mobile communication: narrowband versus spread spectrum; equalization; RAKE receiver; multiple access techniques; FDMA, CDMA; and co-channel interference and channel capacity. Common wireless standards.
Credits and Requirements:	3 Cr. and elective course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-467 and ELEC-476
Co-requisites Course:	None
Required Texts:	1. Wireless Communications, Principles and Practice, 2nd Edition, T. S. Rappaport, Prentice Hall. ISBN: 0-13-042232-0 2. Mobile Wireless Communications, Mischa Schwartz, Cambridge University Press
Course Co-coordinator:	Dr. Sasan Haghani
Course Objectives:	The purpose of this course is to get a solid understanding of wireless communications. By the end of this course the students will have a solid understanding of the following: • The cellular concept, frequency reuse concept, channel assignment strategies. • Interference and system capacity, trunking and grade of service, ways to improve capacity of wireless systems • Mobile Radio Propagation, basic propagation mechanisms, Two- ray model, diffraction, scattering. Practical link budget using path loss models, log-normal shadowing. Outdoor and indoor propagation models • large scale and small-scale fading, multipath. Impulse response for a multipath channel. Various types of fading, fast fading, slow fading, frequency selective fading, frequency non-selective fading. • A brief introduction to practical modulation techniques for wireless communications • Diversity Techniques used to combat the effects of fading, maximal ration combining, equal gain combining and selection combining.
Topics Covered:	1. Cellular Concept, Frequency Reuse and Channel Assignment Strategies

<table>
<tr><td></td><td colspan="2">2. Channel Capacity and co-channel interference
3. Indoor and Outdoor propagation models
4. Small- and Large-Scale Fading
5. Modulation Techniques for Wireless Communications
6. Diversity Techniques
7. TDMA, DCMA and FDMA
8. Wireless Standards</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design
Solution
SO3-B Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Sasan Haghani</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 469: Digital Communications I

Catalog Data:	**ELEC-469 Digital Communications I. Credits 3.** Basis functions, orthogonalization of signals, vector representation of signals, optimal detection in noise, matched filters, pulse shaping, inter-symbol interference, maximum likelihood detection, channel cutoff rates, error probabilities, bandwidth, and power-limited signaling. Basics modulations schemes: ASK, FSK, PSK, QAM.
Credits and Requirements:	3 Cr. and elective course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-467, ELEC-476
Co-requisites Course:	None
Required Texts:	Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
Course Co-coordinator:	Dr. Paul Cotae
Course Objectives:	The purpose of this course is to get an understanding of the basic elements of a digital communication systems. • To familiarize students with analog to digital conversion focusing on the sampling theorem, quantization, and encoding. • To understand modulation processes as Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM). • To familiarize with Digital Modulation Bandpass Systems: Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK) and Quadrature Amplitude Modulation (QAM). • Ability to plan and design an optimum receiver for binary modulated signals (correlation demodulator and matched filter). • Ability to plan and design a M-ary pulse modulation and calculate the probability of error for M-ary pulse modulation • Ability to plan and design a digital communication system via carrier modulation including: Demodulation and Detection of Amplitude Modulated Signals, Demodulation and Detection of Phase Modulated Signals, Demodulation and Detection of Frequency Modulated Signals. • To understand and to make a comparison of the Digital Modulation Methods.
Topics Covered:	1. Analog to digital conversion: 2. Digital modulation in an additive White Gaussian noise baseband channel. 3. Digital transmission through bandlimited AWGN channels.

<table>
<tr><td></td><td colspan="2">4. Selected topics in digital communications: Code Division Multiple Access.</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2,</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Paul Cotae</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 470: Introduction to Control Systems and Applications

Catalog Data:	**ELEC-470 Introduction to Control Systems and Applications. Credits 3.** 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.
Credits and Requirements:	3 Cr. and required course for the Electrical Engineering program
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC-371, ELEC-374
Co-requisites Course:	ELEC-477
Required Texts:	Feedback Control of Dynamic Systems, 7th Edition, Author: Gene F. Franklin, J. Powell, Abbas Emami-Naeini, ISBN: 0133496597
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	The purpose of this course is to get an understanding of feedback control, Dynamic models, and Dynamic response, Analysis of feedback, Root-locus design method, and Frequency-response, and state space design. • The students gain a broad overview of the engineering concepts associated with design, analysis, open-loop and closed-loop control of dynamic systems • The students gain an in-depth emphasis which is placed on selected topics including block diagrams for control platforms, state space model, stability analysis, time response, frequency response, and design classic controllers such as P, PI, PD, and PID • The students gain skills and understanding in the areas of modeling and analysis of first order, second order and multi order systems • The students demonstrate and ability to work with MATLAB/Simulink software packages to reinforce concepts in feedback control of dynamic systems.
Topics Covered:	1. Math and linear algebra review 2. Partial fraction 3. Laplace transform 4. Block diagrams 5. Dynamic time response of the first order systems

<table>
<tr><td></td><td colspan="2">6. Dynamic time response of the second order systems
7. Routh's stability criterion
8. Analysis of feedback
9. Design of proportional controller
10. Design of PI, PD, and PID controller
11. Root-locus design method
12. Frequency-response design method (Bode diagram)
13. State space design</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-A Identify complex problems by examining and understanding the issues and necessity of engineering solutions
SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Amir Shahirinia</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 473: Digital Communication Systems laboratory

Catalog Data:	**ELEC-473 Digital Communication Systems laboratory. Credits 1.** This is a laboratory course in digital communication. Experiments include sampling, frequency division, multiplexing and pulse code modulation. It also includes simulation techniques of digital communication systems. The course is intended to supplement the course ELEC 469.
Credits and Requirements:	3 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	ELEC-467, ELEC-476, ELEC-307
Co-requisites Course:	ELEC-469
Required Texts:	Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
Course Co-coordinator:	Dr. Paul Cotae
Course Objectives:	The purpose of this course is to get an understanding of the most widely used digital modulation techniques, including amplitude, frequency, and phase-shift keying. • To familiarize students with the Emona DATEx board to sample a message using natural sampling then a sample-and-hold scheme. • To understand the sampled message in the frequency domain using the NI ELVIS Dynamic Signal Analyzer and examine the effect of a problem called aliasing. • To familiarize with water resources engineering problems, legal aspects, regulatory requirements, watershed-based planning concepts • To understand the PCM Encoder module on the Emona DATEx to convert the following to PCM: a fixed DC voltage, a variable DC voltage and a continuously changing signal. • To understand the urban drainage problems, storm sewer and combined sewer system problems and their evolution, urban storm water management strategies • Ability plan and design PCM communications system. • To familiarize with FSK and PSK digital modulations systems and techniques.
Topics Covered:	None
Lab Experiment and Activities	1. Analog to digital conversion: 2. Digital modulation in an additive White Gaussian noise baseband channel. 3. Digital transmission through bandlimited AWGN channels:

<table>
<tr><td></td><td colspan="2">4. Transmission of digital information via carrier modulation.
5. Selected topics in digital communications</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO6-C Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Paul Cotae</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC474: Special Topic in Electrical Engineering - Nanotechnology Process

Catalog Data:	**ELEC-474 Nanotechnology Process. Credits 3.** Overview of the broad spectrum of processing approaches involved in "top down", "bottom up", and hybrid nanofabrication. Covers nucleation and growth, photolithography, physical vapor deposition, etching, and metallization, and hands-on projects of these basic nanofabrication techniques.
Credits and Requirements:	3 Cr. and required course
Class Schedule	One 150-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS-203, PHYS-207, CHEM 111, CHEM113
Co-requisites Course:	None
Required Texts:	The Science and Engineering of Microelectronic Fabrication by Campbell Stephen, *Second Edition,* Oxford University Press, New York
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	The purpose of this course is to get an understanding of nanofabrication techniques, a particular emphasis on photolithography, physical vapor deposition and hands-on projects of these basic nanofabrication techniques. • Students will have a basic understanding of nano-scale assembly materials, devices and systems. • Students will understand, analyze photolithography and various physical vapor deposition. • Students will understand, analyze wet etching, ion milling and reactive ion etching. • Students will understand lab project and complete lab project such as photolithography, PVD and etching lab according to laboratory procedure and safety protocols under supervising. • Students will develop a constructive team to conduct collaborative tasks and engage in the success of team goals. • Students will analyze and interpret experimental results, draw conclusions and produce lab reports using appropriate formats and grammar and citations. • Students will be cultivated for interest in the research and development of nanotechnology for future advancement of the career in Electronics, Semiconductor, Photovoltaics and Healthcare industry.
Topics Covered:	1. Mechanism of Thin Film Growth 2. Photolithography

<table>
<tr><td></td><td colspan="2">3. Vacuum and Plasma
4. Physical Vapor Deposition
5. Wet and dry etching
6. Fabrication processes of Nanoscale Field-Effect Transistors, Solar Cells and Medical Devices.</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">Hands-on lab projects of Solar Cell fabrication such as Photolithography, Thin film Deposition, Etching and Metallization.</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO5, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply scientific, engineering and mathematical principles toward solving problems in nanotechnology area.
SO1-C Develop procedures and methods to solve complex engineering problems involving in nanotechnology.
SO1-D Effectively utilize fabrication tools for a specific engineering task and assignment.
SO2-A Analyze the design problem and develop design solution for nanoscale devices.
SO2-B Integrate prior knowledge to develop solutions for nano-devices.
SO2-C Develop nano-devices and explain impact of the nano-devices on social or economic aspects.
SO3-A Produce lab reports and design reports using appropriate formats and grammar and citations.
SO3-C Produce lab reports with appropriate graphics and clearly explain and analyze figures and tables in lab report.
SO5-B Plan collaborative tasks understand individual responsibility and engage in the success of team goals.
SO5-C Develop a constructive team environment such as diversity and assistance.
SO6-A Conduct fabrication experimentation according procedure and safety protocols.
SO6-B Analyze and interpret data and verify experimental results.
SO6-C Draw conclusions that are supported by the analysis and interpretation of data.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hongmei Dang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 476: Fundamentals of Communication Systems Laboratory

Catalog Data:	**ELEC-476 Fundamentals of Communication Systems Laboratory. Credits 1.** This is a laboratory course in RF and digital communication. Experiments include operation of phase-locked loop, AM and FM modulation, frequency division multiplexing, and pulse-code modulation.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	ELEC 307, ELEC 371, ELEC 374
Co-requisites Course:	ELEC 467
Required Texts:	Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
Course Co-coordinator:	Dr. Paul Cotae
Course Objectives:	The purpose of this course is to get an understanding of communication circuits and systems through experimental set ups. Emphasis will be placed on Amplitude Modulation and its different facets in both transmission and reception, using AM, DSB, and SSB. Experiments on Phase Modulation (PM), and Frequency Modulation (FM) will be included. • To familiarize students with the fundamental aspects of the Amplitude Modulation process. • To familiarize with the Generation of AM Signals and the Reception of AM Signals. • To understand the concepts of Double-Sideband Modulation (DSB) and Single-Sideband Modulation (SSB). • To familiarize with Frequency Modulation Concepts • To understand Fundamentals of Frequency Modulation • To familiarize with the Generation of the FM Signals
Topics Covered:	None
Lab Experiment and Activities	1. Amplitude Modulation Fundamentals 2. The Generation of AM Signals 3. Reception of AM Signals 4. Double-Sideband Modulation (DSB) 5. Single-Sideband Modulation (SSB) 6. Frequency Modulation Concepts 7. Fundamentals of Frequency Modulation 8. Generation of FM Signals
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO6
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Paul Cotae	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC-478: Digital Integrated Circuits Design

Catalog Data:	**ELEC-478 Digital Integrated Circuits Design. Credits 3.** This course covers 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.
Credits and Requirements:	3 Cr. and required course (BS in Electrical Engineering with Computer Engineering option), Selective elective (BS in Electrical Engineering)
Class Schedule	Two 80-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC 315, ELEC 316, ELEC 352, and ELEC 354
Co-requisites Course:	ELEC 479
Required Texts:	*CMOS Digital Integrated Circuits: Analysis and Design*, S. Kang, and Y. Labeling, Third Edition, McGraw Hill, 2003. ISBN-13: 978-0072460537
Course Co-coordinator:	Dr. Nian Zhang
Course Objectives:	• To provide the students with concepts and techniques of analysis, design, and layout • of CMOS digital integrated circuits. • To apply the techniques on more complex designs such as arithmetic building blocks. • To analyze the impacts of various timing methodologies on the performance and • functionality of sequential digital circuits. • To utilize CAD tools to explore design alternatives
Topics Covered:	1. Introduction of digital integrated circuit design. 2. Overview of the MOS devices. 3. Static and dynamic behavior of the diode. 4. Static and dynamic behavior of the MOS transistor. 5. Layout design rules. 6. Mentor Graphics tools. 7. The inverter. 8. Designing combinational logic gates in CMOS.
Lab Experiment and Activities	None
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO6, SO7
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning)
Prepared by:	Dr. Nian Zhang	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC-479: Digital Integrated Circuit Design Lab

Catalog Data:	**ELEC-479 Digital Integrated Circuit Design Lab. Credits 1.** The course provides VLSI design experience that includes design of basic VLSI CMOS functional blocks, verification of the design, testing, and debugging.
Credits and Requirements:	1 Cr. and required course (BS in Electrical Engineering with Computer Engineering option), Selective elective (BS in Electrical Engineering)
Class Schedule	None
Laboratory Schedule:	One 150-minutes lecture sessions per week for one semester
Pre-requisites by Course:	ELEC 315, ELEC 316, ELEC 352, and ELEC 354
Co-requisites Course:	ELEC 478
Required Texts:	N/A (Instructional manual provided by the instructor)
Course Co-coordinator:	Dr. Nian Zhang
Course Objectives:	• Students will demonstrate an ability to implement integrated circuit (IC) design by using the Mentor Graphics IC Nanometer Design (previously called Tanner Tools). • Students will demonstrate the capability to design full custom cells and mixed standard cell and block hierarchical layouts. • Students will demonstrate knowledge and demonstrate an ability to understand, analyze and design the whole process of full custom and semi-custom IC designs. • Students will become familiar with the IC design method, design concept, and MOSIS fabrication. • Students will demonstrate an ability to record the experimental data, analyze the results, and prepare a formal laboratory report. • Consider safety, ethical, and other societal constraints in execution of design projects.
Topics Covered:	1. Creating Gate Level Schematics and Simulation Design 2. Creating Transistor Level Schematics and Simulation Design 3. VHDL/Verilog Simulation 4. Transistor Level Inverter Simulation (DC Analysis, Transient Analysis, and AC Analysis) 5. Layout in IC Station 6. Adding Pads
Lab Experiment and Activities	None

Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO3, SO5, SO6	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO5-A** Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-C** Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Nian Zhang	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 480: Digital System Design and Synthesis

Catalog Data:	**ELEC-480 Digital System Design and Synthesis. Credits 3.** This introductory level VHDL course covers coding styles and methodology used for testing hardware component and FPGA, or system. The course emphasizes the use of computer-aided design (CAD) tools in the description, modeling, and design of digital systems. The use of Field Programmable gate arrays is integrated into the course as the target physical domain. The main characteristics of the Verilog Language will also be discussed.
Credits and Requirements:	3 Cr. and required course for the Computer Engineering option
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC 315, ELEC 316
Co-requisites Course:	ELEC-483
Required Texts:	*Fundamentals of Digital and Computer Design with VHDL,* Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698
Course Co-coordinator:	Dr. Wagdy H. Mahmoud
Course Objectives:	The overall objective of this course is to provide students with advanced knowledge of hardware description languages and their use in digital system designs. Upon completion of the course the student will be able to: • Write synthesizable VHDL code for arbitrary functions • Write synthesizable VHDL code for combinational logic designs • Write synthesizable VHDL code for sequential logic designs. • Write testbenches for VHDL code designs • Write synthesizable VHDL code for Finite State machines applications • Develop VHDL functions, procedures, and libraries. • Understand Verilog hardware description language and how to convert one HDL code to another.
Topics Covered:	1. Introduction to VHDL 2. Digital Design Using VHDL 3. VHDL Entities, Architectures, and Coding Styles 4. Signals and Data Types 5. Dataflow Style Combinational Design 6. Behavioral Style Combinational Design 7. Event-Driven Simulation 8. Testbenches for Combinational Designs 9. Latches and Flip-Flops

<table>
<tr><td></td><td colspan="2">10. Multi-bit latches, Registers, Counters and Memory
11. Finite-State Machines
12. Subprograms and packages
13. Testbenches for Sequential Systems
14. Modular Design Hierarchy</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO2, SO6, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO2-C Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering)
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning)
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Wagdy H. Mahmoud</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
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Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 483: Digital System Design and Synthesis Laboratory

Catalog Data:	**ELEC-483 Digital System Design and Synthesis Laboratory. Credits 1.** 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.
Credits and Requirements:	1 Cr. and required course for the Computer Engineering option.
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	ELEC-315, ELEC-316
Co-requisites Course:	ELEC-480
Required Texts:	*Fundamentals of Digital and Computer Design with VHDL,* Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698
Course Co-coordinator:	Dr. Wagdy H. Mahmoud
Course Objectives:	The overall objective of this course is to provide students with advanced knowledge of hardware description languages and their use in digital system designs. Upon completion of the course the student will be able to: • Write synthesizable VHDL code for combinational and sequential logic designs • Write testbenches for VHDL code designs • Write synthesizable VHDL code for Finite State machines applications • Use computer-aided tools (Vivado Software package) to implement VHDL designs • Ability to implement their design using FPGA boards • Ability to demonstrate implemented design and orally explain their designs • Ability to write reports explain their digital designs and the lessons learned implementing the laboratory assignment.
Topics Covered:	None
Lab Experiment and Activities	1. Introduction to integrated design environment 2. Overview of programmable logic devices 3. Combinational logic building blocks (adders, muxes, decoders, encoders, counters, etc.) 4. Sequential logic building blocks (latches, flip-flops, registers) 5. Serial, parallel, pipelined designs 6. Synchronous and asynchronous designs

<table>
<tr><td></td><td colspan="2">7. Intellectual product components
8. Behavioral and timing simulation
9. Synthesis
10. High Level Design Flow
11. Top Level System Design</td></tr>
<tr><td>Relationship of course to ECE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO2, SO3, SO5, SO6, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO2-C Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering)
SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO5-A Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members
SO6-A Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols)
SO6-C Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Wagdy H. Mahmoud</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 495: Senior Project I

Catalog Data:	**ELEC-495 Senior Project I. Credits 3.** Conceptualization, design, building, testing and promulgation of an electrical engineering project by the student under the supervision of a faculty member.
Credits and Requirements:	3 Cr. and required course
Class Schedule	M/W 2:00-3:50 pm.
Laboratory Schedule:	Two 110-minutes laboratory sessions per week for one semester
Pre-requisites by Course:	ELEC-315, ELEC -316, ELEC-352, ELEC 354, ELEC-371, ELEC-374
Co-requisites Course:	None
Required Texts:	1. Material dependent upon project. Other course materials pertinent to the individual projects will be provided either electronically or through hand-outs as needed. 2. Manufacturer's data manuals and/or Instruction Manual
Course Co-coordinator:	Dr. Esther Ososanya
Course Goals and Objectives:	The goal of this course is to demonstrate competency in the application of technical knowledge gained from all core and elective courses of the program courses. It satisfies both the professional components as defined by ABET Inc. and the general education writing requirements. It also satisfies all Electrical Engineering program objectives. **Course objectives:** • To initiate the student in the utilization of scientific methods to collect, analyze, and discuss information across a wide variety of subjects. • Initiate students in the conceptualization and design of specific open-ended type engineering projects. • Expose students to state-of-the-art design techniques including advanced computer-aided-engineering tools. • Improve the overall technical competency of students in conducting research through investigation about the assigned project by using appropriate literature search. • Improve the written and oral communication of students.
Topics Covered:	None
Lab Experiment and Activities	1. Use modern engineering design, test and verification tools in the implementation of engineering projects. 2. Ability to produce quality written reports for technical and non-technical readers using the IEEE format. 3. Demonstrate the ability to cite sources used in research.
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO2, SO3, SO4, SO7

Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering) **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (IEEE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by:	Dr. Esther Ososanya	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Electrical and Computer Engineering
School of Engineering and Applied Sciences

ELEC 496: Senior Project II

Catalog Data:	**ELEC-4496 Senior Project II. Credits 3.** Continues the design project, Senior Project I. Students will consider feasibility of design project, the effect of economic factors on the design, and make presentations in oral and written form for evaluation.
Credits and Requirements:	3 Cr. and required course
Class Schedule	M/W 2:00-3:50 pm
Laboratory Schedule:	Two 110-minutes laboratory sessions per week for one semester
Pre-requisites by Course:	ELEC-495
Co-requisites Course:	None
Required Texts:	Manufacturer's data manuals and/or Instruction Manual.
Course Co-coordinator:	Dr. Esther Ososanya
Course Goals and Objectives:	The goal of this course is to demonstrate professional competency in the application of technical knowledge gained from all core and elective courses of the program courses. It satisfies both the professional components as defined by ABET and the general education writing requirements. It also satisfies all Electrical Engineering program objectives. **Course objective:** • The students will design and implement a specific open-ended type engineering project. • 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. • Improve the overall technical competency of students in conducting thorough investigation about the assigned project. • Improve the written and oral communication of students.
Topics Covered:	None
Lab Experiment and Activities	1. Review of design specifications 2. Phase I Project report 3. Implementation of the project, debugging, testing, and design verification. 4. Oral presentation and submission of the project final report
Relationship of course to ECE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO2, SO3, SO4, SO5
Course Outcomes	Students will be able to:

	Assessed for Student Outcomes Performance Indicators	**SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Electrical Engineering) **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (EEE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO5-A** Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members **SO5-B** Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals **SO5-C** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance)
Prepared by:	Dr. Esther Ososanya	
Approved by DCC:	By Electrical and Computer Engineering Department Curriculum Committee.	