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Middle States Requirements:

1. Assessments of Student's Needs (actual forms and frequency used)
2. Data Reflecting Student Input (surveys, questionnaires, or other evaluative tools used)
3. List of Services and Programs offered and their availability
4. Evidence of Number of Students Served (ex. sign in sheet with dates)
5. Assessments of Student Support Program Effectiveness (actual forms and frequency used)
6. Assessments of Effectiveness of Student Advising (actual forms and frequency used)
7. Frequency of Assessments

Clarity and Examples

1. We only need the past 1-5 years (whatever is available will be great)
2. Copy of the Advising form used for you Majors [Appendix 1]
3. Copy of the Student Survey for Programs [Appendix 2]
4. Copy of Student Survey for ALL courses pre/post etc.
5. Special services (i. e. Honors programs, special speakers, events sponsored by department and other offerings that enhance your students experience in the program) offered specifically through the department (a past year calendar of events sponsored is great for this need)
6. Surveys following programs that ask attendee thoughts, etc.
7. Frequency: each semester, pre/post, program entry/exit, etc.
8. The course assessment forms, advising sheets and end-of-semester surveys (all fulfill question request 1)
9. I hope they yield data that hopefully provides the Program Faculty with information on student needs (fulfills 2)
10. Sign in sheets for all activities, programs
11. Student services offered by the Program (tutoring, advisement, etc.) or program supports that the department refer students to
12. How many students actually complete the course assessments and advising sheets
13. 13. finally how often are each used (7).

Introduction

The B.S. Electrical and Computer Engineering is an ABET accredited program. ABET's Engineering Accreditation Commission (EAC) accredits Electrical Engineering bachelor's degree program at the School of Engineering Applied Sciences. The assessment of the program follows the accreditation requirements by EAC.

- In June 30, 2014 the Electrical Engineering Program submitted the Self Study Report to EAC, ABET
- During the October 18-20, 2015, the EAC visited the program.
- The last accreditation visit was in 2008.

The B.S. Program fulfills the following ABET criterion:

CRITERION 1: Students
CRITERION 2: Program Educational Objectives
CRITERION 3: Student Outcomes
CRITERION 4: Continuous Improvement
CRITERION 5: Curriculum
CRITERION 6: Faculty
CRITERION 7: Facilities
CRITERION 8: Institutional Support
CRITERION 9: Program Criteria.

Program Education Objectives:

In accordance with ABET accreditation criteria and pursuant to the University's mission statement, the following program educational objectives (PEOs) have been established. Within three to six years of graduation, electrical engineering graduates are expected to exhibit the following professional characteristics:

1. Established themselves as practicing professionals in the capacity as policy makers and leaders in government and industry and/or be engaged in advanced study in electrical engineering or a related field;
2. Demonstrated their ability to successfully work both independently and as members of a professional team in the formulation and design of complex engineering systems; and function effectively as responsible professionals with effective communication skills; and
3. Shown a commitment to lifelong learning through ongoing professional training and development, leadership training, and research opportunities in order to gain a deeper understanding of the social, ethical, and environmental context of changing global conditions.

CRITERION 3. STUDENT OUTCOMES

- **Process for Establishing and Revising Program Outcomes**

The program outcomes encompass what students should be able to know, think, or do across all courses within a curriculum. Course level outcomes are more specific and describe measurable achievement expected in a particular course, identifying the unique knowledge, skills, abilities, or values expected to be gained from a given course. Course outcomes contribute to the achievement of program outcomes. ABET has defined specific program outcomes listed in Criterion of the Engineering Criteria of ABET Inc. and referred to as the 3*(a) – (k)* outcomes. The process for continuous program improvement adopted and utilized by the electrical and computer engineering program since 2004 is predicated on the use of these ABET Program Outcomes and applicable program criteria. The outcomes are revised every 4 years as in the case of the Program Educational Objectives.

- **Program Outcomes**

The program outcomes are items *(a)*-*(k)* of Criterion 3. They include:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>STUDENT OUTCOME ASSESSMENT PLAN</u>:

The outcomes assessment plan has evolved through three stages since the last accreditation visit of the program. The first stage includes the period of time immediately following the last visit of the program in 2008. The second transitional stage is between Fall 2012 and Spring 2013. And the third stage addresses the period since Fall 2013 to the present.

- **Initial stage of student outcomes assessment (Fall 2009-Fall 2012)**

This section describes the general plan that we used for the design of the assessment process for all our program outcomes in the department of Electrical and Computer Engineering. Immediately following the 2008 reaccreditation of the ECG program, the department devoted significant efforts into devising realistic, effective and sustainable implementation methods and assessment tools in line with the ABET Engineering criteria (EC) 2000, in an attempt to fix the concerns cited in the accreditation report. It was decided that faculty should revise their courses to include decisive, straightforward, and measurable classroom strategies that can be used to develop the ABET a-k outcomes in our students, and for some specific assessment forms to be developed for the purpose of data collection that can be used in the assessment process. By the end of the academic year 2010/11, all course syllabi were revised detailing the student outcomes covered and presenting evidence of the topics that contribute to an outcome. Course binders were put together at the end of the Fall and Spring semesters in the following years for peer review of the course material, the assessment of the outcome achievement in the classroom, and student performances. Samples of students work are collected and are used to contribute to both the achievement and evaluation of an outcome. The assessment method is performance-based; hence, we collected student work that required students to apply fundamental knowledge and skills that are clearly demonstrated and measurable, homework assignments, tests, final exams, lab reports, and project reports. The internal forms developed for these assessments are: (i) **Faculty Self-assessment Form,** (ii**) Peer Review Form**, (iii) **Student course evaluation Form**, and (iv**) Closing the loop: Course Improvement Form**. These forms are provided in APPENDIX EE-2 of this report.

This assessment also results in a mapping of each outcome into courses in our curriculum in which course material and student learning contributed to the achievement of that particular outcome, as shown in the following matrix. The matrix establishes links between outcome and courses. Some of the outcomes have more practical opportunities for assessment than others

Electrical Engineering Outcomes Coverage Matrix

ELECTRICAL ENGINEERING COURSES	Course Title	CR	Last offered	Criteria Covered										
				a	b	c	d	e	f	g	h	i	j	k
CCEN-105	Intro to Engineering	2	Spring 2014	X	X	X		X				X		X
ELEC-221	Electrical Circuits I Lec	3	Fall 2013	X				X						
ELEC-222	Electrical Circuits II Lec	3	Spring 2014	X				X						
ELEC-223	Electrical Circuits I LAB	1	Fall 2013	X	X			X						
ELEC-224	Electrical Circuits II LAB	1	Spring 2014	X	X			X						X
ELEC-301	Engineering Math	3	Fall 2013	X				X						
ELEC-307	Probability & Stat for Engineers	3	Spring 2014	X				X						
ELEC-311	Computer Org I Lec	3	Fall 2013	X		X		X						X
ELEC-312	Computer Org II Lec	3	Spring 2014	X		X		X						X
ELEC-313	Computer Org I Lab	1	Fall 2013	X	X	X		X		X				X
ELEC-314	Comp Org II Lab	1	Spring 2014	X	X	X		X		X				X
ELEC-351	Electronics I Lec	3	Fall 2013	X		X		X						
ELEC-352	Electronics II Lec	3	Spring 2014	X		X		X						
ELEC-353	Electronics I Lab	1	Fall 2013		X		X	X						X
ELEC-354	Electronics II Lab	3	Spring 2014		X		X	X						X
ELEC-356	Physical Electronics	3	Fall 2013	X				X		X				
ELEC-361	Electromagnetic Theory	3	Spring 2014	X				X						
ELEC-371	Signals & Systems	3	Spring 2014	X				X		X				X
ELEC-374	Signals & System Lab	1	Spring 2014	X				X		X				X
ELEC-458	Digital Signal Processing	3	Spring 2014	X				X	X			X		X
ELEC-459	Digital Computer Architecture	3	Spring 2014	X			X	X						
ELEC-467	Intro to Communications Lec	3	Fall 2013	X	X			X				X		X
ELEC-476	Intro to Communications Lab	1	Fall 2013	X	X	X		X				X		X
ELEC-469	Digital Communications Lec	3	Spring 2014	X	X			X				X		X
ELEC-473	Digital Communications Lab	1	Spring 2014	X	X	X		X				X		X
ELEC-470	Intro to Controls Sys. & Appl	3	Spring 2014	X		X		X				X		
ELEC-477	Intro to Controls Sys. & Appl Lab	1	Spring 2014	X	X	X		X				X		X
ELEC-478	Dig. Integr. Ckt Design	3	Fall 2013	X		X	X	X						X
ELEC-479	Dig. Integr. Ckt Design lab	1	Fall 2013			X	X	X		X				X
ELEC-480	Intro to Comp. Aided Digital Des	2	Fall 2013	X	X	X		X				X		
ELEC-483	Intro to Comp. Aided Digital Lab	1	Fall 2013	X	X	X		X				X		X
ELEC-495	Senior Project I	3	Fall 2013			X	X		X	X	X	X	X	
ELEC-496	Senior Project II	3	Spring 2014			X	X		X	X	X		X	

- **Transitional stage of student outcomes assessment (Fall 2012-Spring 2013)**

In the Fall of 2012, the department revised the assessment methods using outcomes vision approach i.e., establishing our own perspectives on the outcomes, setting pragmatic classroom strategies, and imbedding or blending the assessment as seamlessly as possible into the normal classroom activities. The specific approach used was to define performance indicators for each outcome, refine the indicators or outcome monitors into a set of scoring rubrics, and then incorporating the rubrics into classroom grading sheets. The grading sheets set expectations for students, and are used for both the purposes of grading and for outcomes assessment. The performance indicator is evidence that the desired outcome, or aspects of the desired outcome exist. It is what a faculty member can observe and evaluate to judge achievement of an outcome by a student. Classroom strategies or practices are then designed to achieve a specific outcome. The rubrics that are established for the outcomes are analytical scoring scales in which the observable performance indicators are divided into different levels of achievement. A level of expectation for each outcome is set by establishing a benchmark, which is a standard of aggregate student performance against which measured outcomes are compared. The measurement tools that are used in this approach serve the dual purpose not only of assessing outcomes but could also be used for grading. These tools are used to provide measurable results that could be traced back into the curriculum to identify possible weaknesses in the development of specific outcomes in our students. Weaknesses can only be identified relative to a baseline or benchmark, so the measured achievement was to be compared to the expectations set for each outcome.

Using a brainstorming approach, we sought answers to the basic questions:

- What does a particular outcome mean to us?
- What behaviors or traits will be observed in our students who have achieved this particular outcome?
- How can these outcomes be developed in our students?
- What meaningful learning experiences can contribute to the development of these outcomes in our students?
- How do we substantiate attainment of these outcomes in our graduates?
- What are some reasonable ways to assess them?
- What are their performance indicators?
- The answers to these questions coupled with faculty having initial understanding of the meaning of the entire set of eleven ABET student outcomes establish our classroom practices and strategies, the use of the assessment results in deciding upon program improvement, and define the outcomes for our program.

The following table shows an example of rubrics used in one of the core courses of the program, the course ELEC 351 Electronics I, Lec. The outcome selected for evaluation is the outcome e) from the list of student outcomes adopted for the program: ***an ability to identify, formulate, and solve engineering problems.***

The students in the course are trained to identify electronics problems and find the appropriate formulation of the problem and solve them with the tools provided in the course. The example used for identifying the ability of the students to satisfy the outcome e) is the **exam # 2** in the course. The performance indicators are:

1. Problem identified properly;
2. Uses appropriate formulation of the problem;   and
3. Ability to solve the assigned engineering problem.

The grading rubric is:

1. Not acceptable (below 40%);
2. Below expectation (40%-70%);
3. Meets minimum Expectations (70%-90%); and
4. Exceeds Expectations (90%-100%)

Each of the outcomes covered by the course is assessed using a similar assessment scheme and a final score is assigned to the outcomes. A tally of all the results obtained for all the courses is then considered to provide feedback for improving coverage of student outcomes by the courses.

Outcome Assessment Summary for Course

Course: ELEC351, Electronics I lecture **Semester: Fall 2012** **Outcomes covered by the course: (a), c) ,(e)**

Outcome selected for assessment: (e) ***an ability to identify, formulate, and solve engineering problems*** **Performance indicators selected: 1. Problem identified properly; 2. Uses appropriate formulation of the problem; 3. Ability to solve the assigned eng. problem. Grading rubric**: 1. Not acceptable (below 40%); 2. Below expectation (40%-70%); 3.Meets minimum Expectations (70%-90%); and Exceeds Expectations (90%-100%)

Rubric Criteria	1 = Not acceptable	2 = Below Expectation	3=Meets Mini Expectation	4 = Exceeds Expectations	Average Score	Std. Dev
Problem identified properly	Did not understand the problem	Shows limited understanding of engineering problem. Can identify simple with close analogies to textbook/course examples	Can identify problems and integrate prior knowledge and textbook/course concepts effectively	Can identify problems beyond the scope of the class and integrate prior knowledge and textbook/course concepts effectively. Can provide alternative definitions for the problem.	72%	16%
#Students	1	2	5	1	9	
Use of appropriate formulation of the problem	Unable to identify appropriate math.methods or scientific principles needed for correct solution. Does not recognize the connection between theory and eng. problems	Able to identify appropriate mathematical methods or scientific principles for engineering problems with close analogies to those discussed in the class text book. Has a limited understanding of the connection between theory and engineering problems	Able to identify appropriate mathematical model or scientific principle that relates to an eng. problem. Can relate theoretical concepts to engineering problems with minor errors in computations.	Able to identify appropriate mathematical model or scientific principle that relates to an engineering problem and provides alternatives solution to the problem. Can relate theoretical concepts to engineering problems without errors.	70%	16%
#Students	1	3	4	1	9	
Ability to solve the assigned engineering problem	No coherent procedure or sound strategy for problem solving. Final design does not work or does not meet specification.	Needs major guidance to formulate procedures and strategy for problem solving. Final design meets most of the specifications	Able to formulate appropriate procedures strategies for problem solving, but with minor conceptual errors. Final design meets specification	Able to Formulate effective and error free procedures and strategies for problem solving. Exceeds the specification of the design	72%	16%
#Students	1	2	5	1	9	
Overall					**71%**	
% of class sampled					**100%**	

Assignment used for assessment: EXAM # 2

Outcomes assessment procedure currently in effect since Fall 2013

- Process to Establish the Performance Criteria

For the AY 2013/ 2014, the department further refined and established the Performance Criteria for each of the Student Outcomes as listed in the table below:

#	Student Outcomes (a) through (k)	General Performance Indicators for Outcomes
1	(a) An ability to apply knowledge of mathematics, science, and engineering	A-1: Applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.
		A-2: Demonstrates knowledge of fundamental scientific and/or engineering practices.
		A-3: Applies Scientifics and/or engineering principles toward solving engineering problems.
		A-4: Applies probability and statistics in analyzing electrical engineering data.
2	(b) An ability to design and conduct experiments, as well as to analyze and interpret data	B-1: Identifies the constraints, assumptions, and models for the experiment.
		B-2: Uses appropriate equipment and techniques for data collections.
		B-3: Analyzes experimental data using appropriate tools.
		B-4: Validate experimental results with respect to assumptions, constraints and theory.
3	(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	C-1: Analyzes needs to produce problem definitions for electrical and/or electronic devices and systems including hardware and/or software components.
		C-2: Carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.
		C-3: Can work within realistic constraints, (such as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability) in realizing systems.
		C-4: Can build prototypes to meet design specifications.

#	Student Outcomes (a) through (k)	General Performance Indicators for Outcomes
4	(d) An ability to function on multidisciplinary teams	D-1: Share responsibilities and information on schedule with others on the team.
		D-2: Participates in the development and selection of ideas.
5	(e) An ability to identify, formulate, and solve engineering problems	E-1: Classifies information to identify engineering problems
		E-2: Uses analytical, computational, and/or experimental methods to obtain solution
6	(f) An understanding of professional and ethical responsibility	F-1: Evaluate ethical issues (such as safety, intellectual property, reporting data, etc.) that may occur in professional practice using professional codes of ethics.
		F-2: Interacts with industry, project sponsors, professional societies, and/or communities in a professional manner.
7	(g) An ability to communicate effectively	G-1: Produce a variety of documents, such as lab reports, using appropriate formats and grammar with discipline-specific conventions including citations.
		G-2: Delivers well-organized, logical oral presentations, including good explanations when questioned.
8	(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	H-1: Aware of the societal and global changes that engineering innovations may cause.
		H-2: Examine economic tradeoffs in engineering systems
		H-3: Evaluate engineering solutions that consider environmental factors.
9	(i) A recognition of the need for, and an ability to engage in life-long learning	I-1: Able to find, evaluate resources to learn new material not taught in class.
		I-2: Able to list sources for continuing education opportunities.
		I-3: List the advantages of continuing professional development and the disadvantages of avoiding it.
10	(j) A knowledge of contemporary issues	J-1: Describes the impact of contemporary issues on society (such as environmental, global trade, economic, health, safety trade-offs, and emerging technologies.

#	Student Outcomes (a) through (k)	General Performance Indicators for Outcomes
		J-2: Describes impact of engineering decisions on energy sources.
11	(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	K-1: Able to operate engineering equipment and instrumentations.
		K-2: Able to utilize programmable devices.
		K-3: Able to use computer-aided design and analysis software tools for electrical engineering.

- **Mapping of Outcomes to the Curriculum and Master Course Syllabi:**

After establishing the Performance Criteria for the Student Outcomes, each course in the program now develops a **Master Syllabus** that lists course specific performance criteria, i.e., specifically specifying how each course is applying the performance criteria, and identifying which Student Outcomes would be served by each course. Each master syllabus was reviewed by faculty in order to develop the **Course-to-Performance Criteria matrix.** The listing below shows the course-to-performance matrix of selected courses in the program:

ELEC 351 Electronics I

A-1: DC and AC analysis of OP-AMP circuits, diode circuits and BJT and FET amplifier circuits.
A-2: Understanding of the physical structure of semiconductor diodes, BJT and FET and MOS devices
A-3: Use appropriate small signal device models to analyze BJT and FET amplifier circuits.
C-1: Ability to design OP-AMP circuits and general BJT and FET amplifier circuits for specified voltage gain, current gain, input impedance etc…
E-2: Ability to identify the various amplifier configurations (Common Emitter, Common Base, Common Collector, Common Source etc…) for desired applications

ELEC 371 Signals and Systems

A-1: Apply Laplace, Z, and Fourier transforms to obtain the frequency domain representation of signals and systems
A-1: Apply signal analysis techniques such as convolution, Z and Fourier transforms to extract useful information.
A-2: Perform Z and inverse Z transforms using tables, partial fraction examples, and power series expansion.
E-2: Classify signals and systems based upon their properties.
E-3: Use MATLAB to create, analyze and process signals
K-1: Use MATLAB to calculate Laplace and inverse Laplace Transforms, to calculate Z-transforms and design filters.
G-1: Write assignments based on MATLAB results.

ELEC 374 Signals and Systems Lab

A-1: Apply Laplace, Z, and Fourier transforms to obtain the frequency domain representation of signals and systems
A-2: Apply signal analysis techniques such as convolution, Z and Fourier transforms to extract useful information.
A-2: Perform Z and inverse Z transforms using tables, partial fraction examples, and power series expansion.
E-2: Classify signals and systems based upon their properties.
E-3: Use MATLAB to create, analyze and process signals
K-1: Use MATLAB to calculate Laplace and inverse Laplace Transforms, to calculate Z-Transforms and design filters.
G-1: Write assignments based on MATLAB results.

ELEC 458 Digital Signal Processing
A-1: Apply Z-Transform to obtain frequency domain representation of signals.
A-2: Perform Z and inverse Z transforms using tables, partial fraction examples, and power series expansion.
E-3: Use MATLAB to analyze signals and systems
E-3: Use MATLAB to obtain structures of discrete systems.
G-1: Write assignments based on MATLAB results.
K-1: Use MATLAB to design filters.
I-2 : Able to find, evaluate resources to learn new material not taught in class.

ELEC 459 Introduction to Digital Computer Architecture and Design
A-1: Applies the CPU execution time, clock cycle per instruction, and CPU performance equation to evaluate and compare the performance of a variety of computer systems.
A-3: Applies MIPS assembly language principles toward writing the equivalent MIPS machine code for the C statements.
D-1: Students share responsibilities on ALU design using VHDL and information on schedule with others on the team of two to three students.
E-2: Develop MIPS instruction set models to formulate hardware-software solutions

ELEC 3541-467 Fundamentals of Communication Systems
A-1: Understand the properties of signals and systems in both time and frequency domain.
A-3: Determine the energy and the power of a given signal.
E-2: Determine the output of a linear time invariant system to a given input
K-1: Calculate the Fourier transform of a given signal.

ELEC 476 Fundamentals of Communication System Laboratory
B-2: To be able to adjust the frequency and the amplitude of the various signals generated by the Dual Function Generator. To be able demonstrate the use of the True RMS Voltmeter/Power Meter as a Voltmeter. To be able show the relationship between rms and peak-to peak voltage.
E-2: To understand an AM communication system using AM/DSB/ SSB generator and AM/DSB Receiver functionality and to be familiar with the AM/DSB/SSB generator and the AM/DSB Receiver as well as terminology used in amplitude modulation.

K-1: Use a Spectrum analyzer to analyze frequency modulation and identify narrow band modulation. Find frequencies of the components making up a frequency modulated signal and to study the signals in both the time and frequency domain.

ELEC 470 Introduction to Control Systems & Applications

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

ELEC 477 Introduction to Control Systems & Applications Lab

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

ELEC 478 Digital Integrated Circuits Design

A-1: Calculate the capacitances including oxide-related capacitances and junction capacitances.
A-3: Applies CMOS inverter principles toward investigating current-voltage relationship, with or without consideration of Channel length modulation.
C-2: Determine the type and amount of channel implant required to satisfy the threshold voltage change for the design of resistive-load inverter.
D-1: Students share responsibilities on semiconductor physics issues in the VLSI design and information on schedule with others on the team of two to three students.
E-3: Determine the necessary channel width for the nMOS transistor with a specific drain current.
K-3: Able to use Tanner Tools for VLSI design, simulation, and verification on electrical engineering applications.

ELEC 479 Digital Integrated Circuits Design Lab

C-1: Analyzes needs to produce problem definitions for electrical and/or electronic devices and systems including hardware and/or software components.
C-4: Can build prototypes on CMOS inverter design to meet design specifications.

D-1: Students share responsibilities on CMOS inverter layout and simulation and information on schedule with others on the team of two to three students.
E-1: Selection of appropriate tools of Tanner Tools EDA needed to run an experiment, i.e. S-Edit, L-Edit.
E-3: Use transient analysis to obtain the input-output relationship of a VLSI circuit.
G-1: Produce a variety of documents, such as lab reports, using appropriate formats and grammar with discipline-specific conventions including citations.
K-3: Proficiency in using the Tanner Tools to perform VLSI design analysis, simulation, modeling, design and verification.

ELEC 480 Digital Design and Synthesis
A-3: Apply engineering principle toward solving engineering problem such as development of digital systems.
B-1: Identify problem constraints and verify models for digital systems.
C-2: Carry out design process (including HDL code development, and design verification) to satisfy problem requirements.
E2: Use analytical and computational methods to obtain solution.
I-1: Use resources such as computer-aided design tutorials and FPGA board manuals to learn new materials not taught in class.

ELEC 483 Digital Design and Synthesis Lab
A-3: Apply engineering principle toward solving engineering problem such as development of digital systems.
B-1: Identify problem constraints and verify models for digital systems.
C-1: Analyze needs to produce problem definition for digital design problems including implementation on FPGA board using integrated design tools.
C-2: Carry out design process (including HDL code development, and design verification using test benches) to satisfy problem requirements including implementation on FPGA board using integrated design tools.
E-2: Use analytical and experimental methods to formulate and solve a digital design problem.
I-1: Use resources such as computer-aided design tutorials and FPGA board manuals to learn new materials not taught in class.
K-2: Ability to utilize Field Programmable Gate Array (FPGA) boards for prototyping, testing, and evaluation.
K-3: Ability to use computer-aided design tools for digital system design on FPGA boards.

ELEC 495 Senior Project I
C-2: Carry out design process (such as concept generation, modeling, simulation, synthesis, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components, and within realistic constraints.
D-1: Share responsibilities and information on schedule with others on the project team.
D-2: Participate in the development and selection of ideas for the projects.
F-1: Evaluate ethical issues (such as safety, intellectual property, reporting data, etc.) that may occur in professional practice using professional codes of ethics.

F-2: Interact with industry, project sponsors, professional societies, and/or community in a professional manner.
G-1: Produce a variety of documents, such as project reports, using appropriate formats and grammar with discipline-specific conventions including citations.
H-2: Examine economic tradeoffs in engineering systems.
H-3: Evaluate engineering solutions that consider environmental factors.
I-1: Use resources to learn new material not taught in class
J-1: Describe the impact of contemporary issues (such as environmental, global trade, economic, health, safety trade-offs, and emerging technologies).
J-2: Describe impact of engineering decisions on energy resources.

ELEC 495 Senior Project II

C-3: Work within realistic constraints, (such as economical, environmental, societal, manufacturability, health and safety, ethical, and sustainability) in realizing systems.
C-4: Build prototypes that meet design specifications.
C-2: Carry out design process (such as concept generation, modeling, simulation, synthesis, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components, and within realistic constraints.
D-1: Share responsibilities and information on schedule with others on the project team.
D-2: Participate in the development and selection of ideas for the projects.
E-3: Use analytical, computational, and/or experimental methods to obtain solutions.
F-1: Evaluate ethical issues (such as safety, intellectual property, reporting data, etc.) that may occur in professional practice using professional codes of ethics.
F-2: Interact with industry, project sponsors, professional societies, and/or community in a professional manner.
G-1: Produce a variety of documents, such as project reports, using appropriate formats and grammar with discipline-specific conventions including citations.
G-2: Deliver well-organized, logical oral presentations, including good explanations when questioned on the projects.
H-2: Examine economic tradeoffs in engineering systems.
H-3: Evaluate engineering solutions that consider environmental factors.
J-1: Describe the impact of contemporary issues (such as environmental, global trade, economic, health, safety trade-offs, and emerging technologies).
J-2: Describe impact of engineering decisions on energy resources.

MECH 478 Mechatronics

A-1: Understands the use of modeling, analysis, and control dynamics of physical systems. Determine the solutions of the differential equation of a Mass-Spring-damper system and validate solutions with simulation output.
B-1: Identifies the constraints, assumptions, and models for the experiment Identify constraints, assumptions and models appropriate for a physical system operation.
B-2: Uses appropriate equipment and techniques for data collections. Use appropriate data acquisition instrument and control software to acquire real-time data, monitor, and control a physical system

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

C-3: Can work within realistic constraints, (such as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability) in realizing systems Carry out a real life mechatronics project with realistic constraints such as operability, economic, and safety factor. Carry out experiments on actual systems involving monitoring and control.(One example involves the application of electronic damping for Mass-spring-damper system)

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

A. Relationship of Student Outcomes to Program Educational Objectives

As discussed in section of Criterion 2, the Program Educational Objectives for the Electrical and Computer Engineering program are listed below:

- ***Our graduates would acquire the necessary technical, scientific and problem solving skills to provide solutions to real world challenges;***
- ***Our graduates will have a strong background to immediately pursue advanced engineering studies and be employable in a variety of electrical and computer engineering jobs; and***
- ***Our graduates will be able to function in multidisciplinary teams, demonstrate understanding of ethical responsibilities in engineering and pursue life-long learning and professional development.***

The program graduates will need certain knowledge, skills, and behaviors in order to prepare them to attain these PEOs. Thus, the outcome statements and the program curriculum were developed with all these desirable attributes in mind, and to produce graduates with these attributes.

Program outcomes *(a)*-*(e), (k)* are used to design a curriculum that will prepare students to attain the first educational objective. The outcomes support the first program objective in that these outcomes are essential elements of "***...necessary technical, scientific and problem solving skills...***". Program outcomes *(a), (b), (g), (i)* support the second program objective inasmuch as these outcomes are necessary to "***...a strong background to immediately pursue advanced engineering studies and be employable*.**"

Program outcomes *(d), (g),* and *(k)* relate to the **written and oral communication** aspect of the third program objective; outcomes *(f), (h),* and *(j)* support the need for "***...function in multidisciplinary teams, demonstrate understanding of ethical responsibilities in engineering*** and pursue life-long learning; and outcome (i) supports the life-long learning aspect."

The following table summarizes the relationship between the Program Outcomes and the Program Educational Objectives:

Program Educational Objectives	ABET 2014-15 Criteria										
	(a) Fundamentals of Math/Science eng.	(b) Design, Experiment, Analysis	(c) Engineering Design	(d) Multi-disciplinary Teams	(e) Engineering problems	(f) Professional and Ethics	(g) Effective Communication	(h) Global , Economic and Environmental	(i) Life-long Learning	(j) Contemporary Issues	(k) Modern Engineering Tools
Skills and Knowledge for Employment	●	●	●	●	●	○		○		○	●
Preparedness for Graduate Study	●	●	●		●	●					●
Function in multidisciplinary teams, demonstrate understanding of ethical responsibilities in engineering						●	○	○	●	●	●

● Explicit relation ○ **Implicit relation**

B. Relationship of Courses in the Curriculum to the Program Outcomes

The relationship between course and program outcomes is described in the **Electrical Engineering Outcomes Coverage Matrix,** presented earlier under the outcomes Assessment Plan. The curriculum map describes the contribution of courses to program learning outcomes.

The Outcomes Coverage Matrix shows the expected coverage of the program outcomes by the courses offered by the program. The matrix reflects the outcomes coverage outlined in the course syllabi listed in **APPENDIX A**.

Throughout the semester, the course instructor uses specific questions on homework, quiz, labs, or exams directly related to the course outcomes. Course activities performed by each student relative to the performance indicators (PI) such as "**A-1, A-2, B-1,…, K-3**" associated with each outcome, are reviewed and evaluated individually. The assessment for each outcome (from A to K) is the result of the evaluation of the compiled evaluation of the PIs pertaining to the particular outcome.

- **Documentation**

Every course taught in the academic year FY11/12 had a corresponding binder in which a Self-Assessment Form is included. This form presented in **APPENDIX EE-2** outlines the degree of coverage of the Course Objectives and the Program Outcomes covered by the course as well as the components of the course which cover these Program Outcomes. Every course taught in the academic year AY13/14, has a corresponding binder in which the new Student Outcome Assessment Plan and the Grading Rubrics Metrics are included.

- **Achievement of Program Outcomes**

The achievement of the program outcomes is measured by the score obtained by the coverage of each outcome by the spring and fall semester courses of each year.

Starting in AY13-14, the assessment of the outcomes coverage will be done selectively. The following table shows the assessment of the outcomes coverage for selected F13 courses and their respective scores.

<u>Outcomes coverage of ECG courses , selected for assessment</u>

ELECTRICAL ENGINEERING COURSES	Course Title	CR	Criteria Covered										
			a	b	c	d	e	f	g	h	i	J	k
ELEC-351	Electronics I Lec	3	X		X		X						
ELEC-353	Electronics I Lab	1		X		X	X						X
ELEC-356	Physical Electronics	3	X				X						X
ELEC-371	Signals & Systems	3	X				X						X
ELEC-459	Intro to Digital Computer Architecture and Design	3	X			X	X						
ELEC-467	Fundamental of Communication Systems Lec	3		X			X						X
ELEC-470	Intro to Controls Sys. & Appl	3	X		X						X		
ELEC-477	Intro to Controls Sys. & Appl Lab	1		X	X						X		
ELEC-478	Dig. Integr. Ckt Design	3	X		X	X	X						X
ELEC-479	Dig. Integr. Ckt Design Lab	1			X	X	X		X				X
ELEC-480	Intro to Comp. Aided Digital Des	2		X	X		X				X		
ELEC-483	Intro to Comp. Aided Digital Lab	1		X	X		X				X		
ELEC-495	Senior Project I	3						X	X	X		X	
ELEC-496	Senior Project II	3						X	X	X		X	
MECH-478	Mechatronics	3			X	X			X				
Score by individual outcome by criterion			83 %	78.5 %	83 %	86.7 %	81.77 %	78.5 %	79.9 %	71.45 %	83.1 %	75.6 %	82 %
OVERALL SCORE		Meets Minimum Expectation (70% to 90%)											

CRITERION 4. CONTINUOUS IMPROVEMENT

A. Student Outcomes

In 2012, the department agrees that the outcomes vision approach is an effective assessment strategy and so this method was used for the assessment of all of our program outcomes. This assessment method allows us to evaluate the learned skills, disciplinary-knowledge, and behaviors that motivated a specific outcome, and therefore provides guidance for improvement efforts. Outcomes-based assessment focuses on what students have learned, or what they actually can do, at the time of graduation. The performance indicators that we defined for each outcome provide the answers to the question: How could we assess a specific outcome in our students? The performance indicators that represent a relatively broad interpretation of the outward appearance of each outcome in our students, and that are used in the assessment.

Frequency of course assessment for student learning outcomes

A set of outcomes (one third of the total number of outcomes) is evaluated every three years. At the end of the third year, an overall assessment of the outcomes will be conducted and improvements suggested and corrective actions taken. However, interim changes may take place if deemed appropriate before the end of the 3-year cycle.

Expectations of level of attainment of each outcome

It is expected that each outcome will attain a minimum level of 3 on a scale from **1 to 4**.

Course forms/tables used for assessment

Each course is assigned a set of tables for recording the following:

- Course assessment criteria
- Course specific performance indicators; and
- Student assessment score for the course

As an example, the forms pertaining to the course ELEC-351 are presented below:

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

Electrical Engineering

Course Assessment Criteria

COURSE	**Course No:**	ELEC-351
	Course Name:	Electronics I Lec
	Instructor:	Dr. Samuel Lakeou
	Term:	Fall 2013
	Student Outcomes:	A, C, E
	Performance Indicators:	A-1,A-2,A-3,C-1,E-2

ASSESSMENT CRITERIA	**DIRECT ASSESSMENT: Project/Report/Presentation**	
	1	**Homework Assignments 1-13**
	2	**Exam # 1**
	3	**Exam # 2**
	4	**Exam # 3**
	5	**Final Exam**
	6	
	INDIRECT ASSESSMENT: (Please list Please list such as KSA Survey/Personal Mastery/Class Observation/Course Follow up)	
	1	**Knowledge, Skill or Ability (KSA) Survey**
	2	**Student Perception of Mastery Subject**
	3	
	4	

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School of Engineering and Applied Sciences

Electrical Engineering

Course Specific Performance Indicators

Course Number	ELEC-351
Course Name	**Electronics I**

Performance Indicators	General Performance Indicators (From Master Syllabus)	Course-Specific Performance Indicators (Faculty decides and provides the representation)	Assessment Example
A-1	Applies mathematics to obtain an analytical or numerical solution	DC and AC analysis of OP-AMP circuits, diode circuits and BJT and FET amplifier circuits	HW/Exams
A-2	Demonstrates knowledge of fundamental scientific and/or engineering practices	Understanding of the physical structure of semiconductor diodes, BJT, FET and MOS devices	HW/Exams
A-3	Applies scientific and/or engineering principles toward solving engineering problems	Use appropriate small signal device models to analyze BJT and FET amplifier circuits	HW/Exams
C-1	Analyze needs to define problems to be solved by the application of electronic devices	Ability to design OP=AMP circuits and general BJT and FET amplifier circuits for specified voltage gain, current gain, input impedance etc…	HW/Exams
E-2	Classifies information to identify engineering problems	Ability to identify various amplifier configurations (Common Emitter, Common Collector, Common Sopurce etc…) for desired applications	HW/Exams

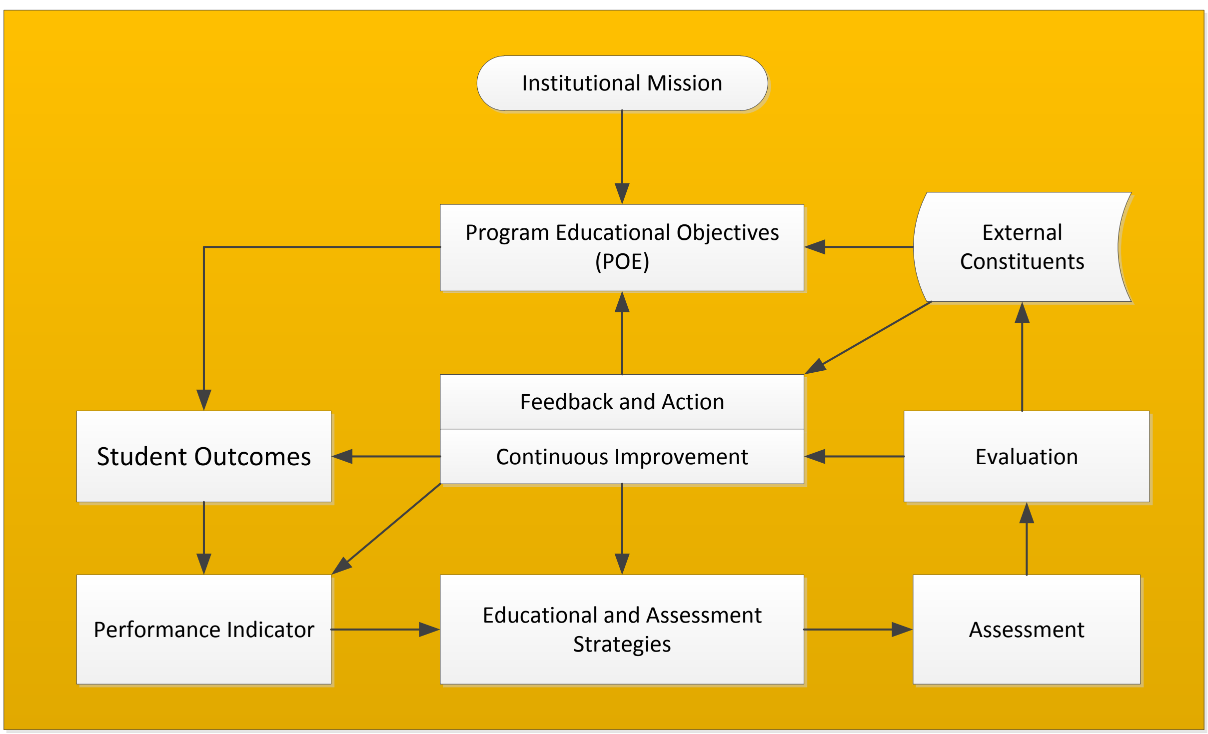
University of the District of Columbia
School of Engineering and Applied Sciences

Electrical Engineering

Student Assessment Score For the Course					
Course No:			**ELEC 351**		
Course Name:			**Electronics I Lec**		
Type of Outcome PIs measured	**A-1**	**A-2**	**A-3**	**C-2**	**E-2**
Student	**Each row represents a student, RATE each student on a scale of 1 to 4 (4 being the best) as how well they met each outcome/PI. Use whole numbers only**				
Student 1	2	3	3	2	4
Student 2	3	3	3	3	3
Student 3	4	2	4	4	3
Student 4	3	3	3	2	4
Student 5	4	3	3	3	4
Student 6	3	4	3	3	4
Student 7	3	3	4	3	4
Student 8	4	3	3	3	4
Student 9	3	4	3	4	4
Mean for the course	**3.23**	**3.12**	**3.23**	**3**	**3.78**

B. Continuous Improvement

In order to meet the ABET criteria, the School of engineering has established and adopted a manageable Continuous Improvement system for their educational processes. The first step in this was establishing a college mission that is consistent with the University mission. The second step was for each department to establish suitable educational objectives and outcomes for each degree program. This went through a number of iterations. While the ABET definitions of objectives as “broad statements that describe the career and professional accomplishments” and outcomes as “narrower statements that describe what students are expected to know and be able to do” are simple, the department and its constituencies (that is the faculty, Advisory Board, Alumni, and employers) found that frequent revision and rephrasing was necessary to ensure clarity. A major element of these criteria is the continuous improvement process via objectives and outcomes assessment and evaluation procedures. At the core of this continuous improvement process are the tools that have been used to assess the achievement of program educational objectives which include program alumni and employers questionnaires surveys, while senior exit interviews, indirect course assessments, and rigorous direct student outcomes assessment plan similarly assess program’s outcomes. Subsequent improvements, such as revising the curriculum, teaching methods, or lab facilities, are undertaken as necessary. Documenting these improvements and the evaluation process that led to them has been an essential part of the continuous improvement system. A graphical depiction of this process is presented in the figure below:



The following procedure is used for collecting information for making Program Improvement:

1. Evaluation by students of every course taught in each semester. The form used for this purpose is the **Student Course Questionnaire** and is presented in **APPENDIX EE-2**;
2. Evaluation by a peer of every course taught using the **Course Evaluation Form** presented in **APPENDIX EE-2**;
3. Every faculty who submits a course material package for peer review fills out a **Self-Assessment Form** presented in **APPENDIX EE-2**;
4. An **Individual Course Evaluation Summary Form** presented in **APPENDIX EE-2** is filled out by the faculty at the end of the peer review of spring and fall semester courses. In this form the faculty recommends changes to be made before the next offering of the course evaluated;
5. A **Senior Project Presentation Evaluation Sheet** presented in **APPENDIX EE-2** is filled out by all attendees of the Senior Project Presentation Day held every year
6. **An Exit Interview Form of Graduating Seniors,** presented in **APPENDIX EE-2** is collected from all graduating seniors
7. **Alumni Information Form,** presented in **APPENDIX EE-2** is sent out to the alumni of the program every two years
8. **An Employer Evaluation Form,** presented in **APPENDIX EE-2** is sent to known employers of the program alumni every four years.
9. **An Advisory Board Evaluation Form,** presented in **APPENDIX EE-2** completed by the Electrical engineering Advisory Board every two years
10. **A Program Evaluation Summary Form** presented in **APPENDIX EE-2** which summarizes the proposed program improvement.

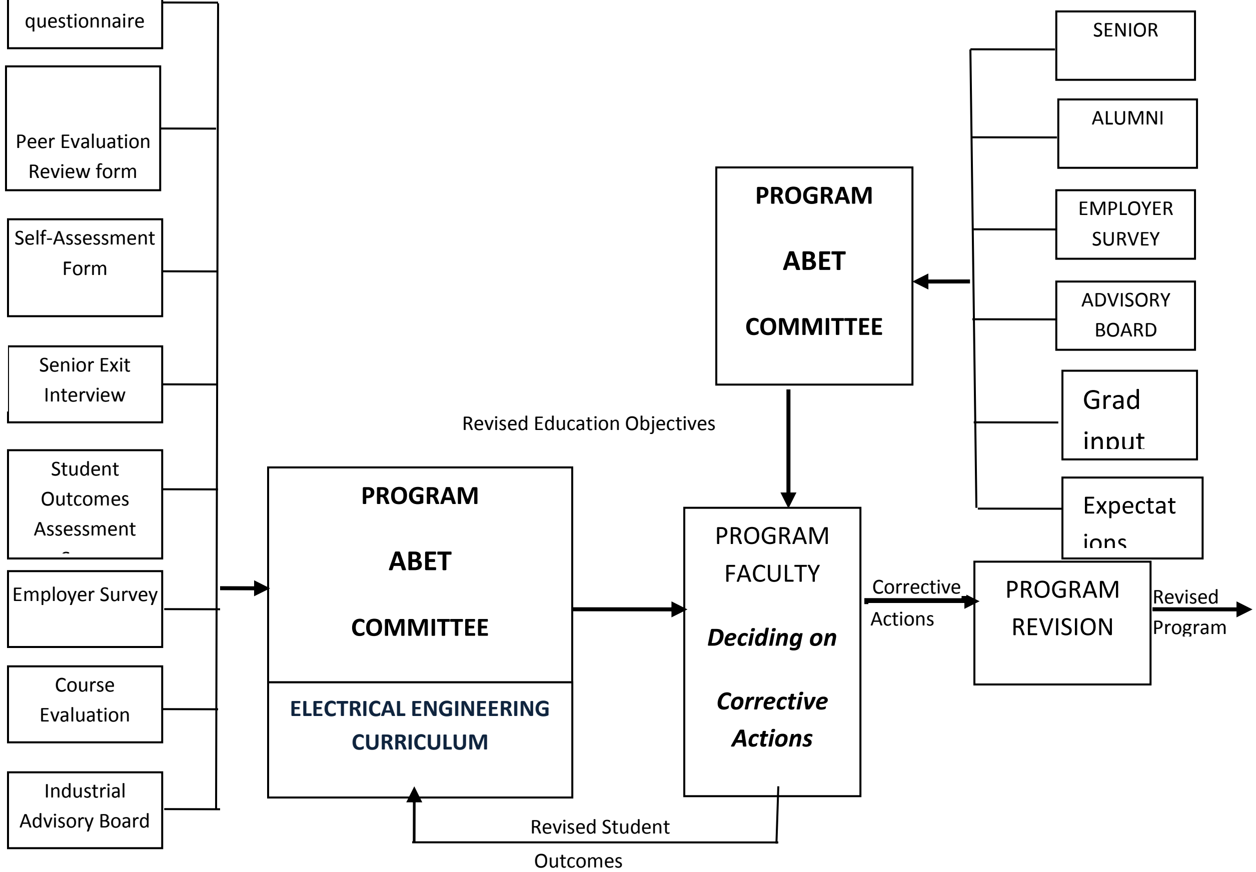
The following table contains the data collection and information gathering which has taken place in the last few years until present:

Forms	Semesters
Student Course questionnaire	Every semester **since** Fall 2011
Course Evaluation Form	Every semester **since** Fall 2011
Self-Assessment Form	Every Semester **since** Fall 2011
Individual Course Evaluation Summary	Every semester **since** Fall 2011
Senior Project Evaluation Sheet	Every spring semester **since** spring 2011
Exit Interview	Every spring semester **since** spring 20*09*
Alumni Information Form	Summer 08 and spring 14
Employer Evaluation Form	Summer 08 and spring 14
Student Outcome Assessment Form	Fall 2012, 2013 Spring 2012, 2013, 2014
Program Evaluation Summary Form	Spring 2011, and Spring 2014

The forms listed in the above Table will be made available for review during the visit.

The outcomes vision process has been a valuable approach that provided our faculty with a critical review of our curriculum. Real changes have been affected in our courses as a result of the program improvement process.
The overall program improvement process of the program of electrical engineering is summarized in the table below:

PROGRAM EDUCATIONAL OBJECTIVES ASSESSMENT



STUDENT OUTCOME ASSESSMENT

- **Actions to Improve the Program (Fall 2009 to Fall 2013)**

The following programmatic changes were made as part of the Continuous Improvement Process based on the review of the achievement of the student learning outcomes during the period Fall 2009 to Fall 2012.

1. More technical electives were introduced for Electrical Engineering without Computer Engineering Option and Electrical Engineering with Computer Engineering Option curricula . These electives include: digital signal processing, mechatronics, microcontrollers, digital communications etc...
2. Modifications of the curriculum by removing the following course, which allowed the program to concentrate on more topics of current interest:
   - _Electromagnetic Theory II

3. A new laboratory, ELEC-374, Signals and Systems Lab (1 Credit) was introduced
4. At least 2 Teaching Assistants (TA) were hired routinely every semester
5. Engineering Economics, MECH406 was made a required course
6. More SPICE assignments (Cadence package) to be made in most basic circuits and electronics courses
7. Wider MATLAB utilization in all engineering and mathematics courses was promoted
8. Mandatory oral presentations in several courses.
9. Mandatory term papers in several courses
10. Renaming of the courses on digital system design ELEC480 and communications courses ELEC467/476 to better reflect their respective course contents.

- **Actions to Improve the Program (Fall 2013 onward)**

Starting fall 2013, all assessment of student outcomes follows a similar process as outlined earlier in steps 1 to 12. However, the outcomes are evaluated based on the outcome coverage evaluated for each course after gathering the following:

- Course assessment criteria
- Course specific performance indicators; and
- Student assessment score for the course

In following academic years, a selected number of outcomes (a through k) will be assessed based on the evaluation of individual performance indicators assigned to each outcome (i.e. a1, a2; …b1,b3,…k1,k2).

A thorough curriculum revision is also envisaged to ascertain that the program remain on par with comparable programs in order to attract more transfer students.

All curriculum changes initiated by the program have to be approved by the School's curriculum committee, the Dean and by the Faculty Senate and the Provost before their implementation.

C. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A. and 4.B must be available for review at the time of the visit. Other information such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made could also be included.

- **Information Used for Program Improvement**

CRITERION 5. CURRICULUM

A. Program Curriculum

Table 5-1 Curriculum - **Electrical Engineering (Option: Computer Engineering)**

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)* Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other	Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
First Semester							
IGED 110 Foundation Writing I	R			3		F13,S14	20
CHEM 111 General Chemistry I Lec	R	3				F13,S14	22
CHEM 113 General Chemistry I Lab	R	1				F13,S14	22
MATH 151 Calculus I	R	3				F13,S14	15
MATH 155 Calculus I Lab	R	1				F13,S14	15
CCEN 101 Intro. to Engineering	R		2			F13,S14	22
IGED140 Foundation Oral Communications	R			3		F13,S14	22
Second Semester							
IGED 111 Foundation Writing II	R			3		F13,S14	22
MATH 152 Calculus II	R	3				F13,S14	15
MATH 156 Calculus II Lab	R	1				F13,S14	15
PHYS 201 University Physics I Lec	R	3				F13,S14	16
PHYS 205 University Physics I Lab	R	1				F13,S14	16
ACCT 231 Intro. to Comp. Sci. I Lec	R				3	F13,S14	22
ACCT 233 Intro. To Comp. Sci. I Lab	R				1	F13,S14	22
Third Semester							
IGED 210 Discovery Writing	R			3		F13,S14	22
MATH 213 Discrete Mathematics	R	3				S13,S14	15
PHYS 202 University Physics II Lec	R	3				F13,S14	15
PHYS 206 University Physics II Lab	R	1				F13,S14	15

CVEN 201	Engineering Mechanics I	R		3			F12,F13	14
ELEC 221	Electrical Circuits I	R		3			F12,F13	15
ELEC 223	Electrical Circuits I Lab	R		1			F12,F13	15
Fourth Semester								
IGED 140	Foundation Ethics	R			3		F13,S14	22
MATH 260	Differential Eq. with Linear Alg.	R	4				S13,S14	15
ACCT 232	Intro. to Comp. Sci. II Lec	R				3	F13,S14	22
ACCT 234	Intro. to Comp. Sci. II Lab	R				1	F13,S14	22
ELEC 301	Engineering Math	R	3				F12,F13	18
ELEC 222	Electrical Circuits II	R		3			S13,S14	9
ELEC 224	Electrical Circuits II Lab	R		1			S13,S14	9
Fifth Semester								
ELEC 311	Comp. Organization I	R		3			F12,F13	7
ELEC 313	Comp. Organization I Lab	R		1			F12,S14	9
ELEC 351	Electronics I	R		3			F12,F13	17
ELEC 353	Electronics I Lab	R		1			F12,F13	16
CSCI 251	Assemblers and Sys. Lec	R				3	F12,F13	12
CSCI 253	Assemblers and Sys. Lab	R				1	F12,F13	12
IGED 270	Cultural Diversity	R			3		F13,S14	22
Sixth Semester								
ELEC 312	Comp. Organization II	R		3 (√)			S13,S14	14
ELEC 314	Comp. Organization II Lab	R		1 (√)			S13,S14	14
ELEC 352	Electronics II	R		3 (√)			S13,S14	13
ELEC 354	Electronics II Lab	R		1 (√)			S13,S14	13
ELEC 307	Prob. and Stat. for Engineers	R	3				S13,S14	15
ELEC 371	Signals and Systems	R		3			F13,F14	16
ELEC 374	Signals and Systems Lab	R		1			F13,F14	17
IGED 280	Discovery Civics	R			3		F13,S14	22

Seventh Semester							
ELEC 467 Fundamental of Comm. Lec	R		3			F12,F13	15
ELEC 476 Fundamental of Comm.. Lab	R		1 (√)			F12,F13	15
ELEC 478 Dig. Int. Cir. Des. Lec	R		3 (√)			F12,F13	19
ELEC 479 Dig. Int. Cir. Des. Lab	R		1 (√)			F12,F13	19
ELEC 480 Dig. Design and Synthesis Lec	R		2 (√)			F12,F13	18
ELEC 483 Dig. Design and Synthesis Lab	R		1 (√)			F12,F13	18
ELEC 495 Senior Project I	R		3 (√)			F12,F13	8
Eighth Semester							
ELEC 459 Digital Computer Arch. & Design	R		3 (√)			S13,S14	11
ELEC 496 Senior Project II	R		3 (√)			S13,S14	9
ELEC xxx Electrical Engineering Electives**	SE		3			F13/ S14	10
CSCI xxx CS Elective***	SE				3	F13/ S14	15
MECH-406 Engineering Economics	R		3			F12,F13	20
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		33 Hours	59 Hours	21 Hours	15 Hours		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		25.78%	46.10%	16.40%	11.72%		
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours				
	Minimum Percentage	25%	37.5 %				

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be required during the campus visit.

Table 5-2 Curriculum - **Electrical Engineering**

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)* Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other	Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
First Semester							
IGED 110 Foundation Writing I	R			3		F13,S14	22
CHEM 111 General Chemistry I Lec	R	3				F13,S14	22
CHEM 113 General Chemistry I Lab	R	1				F13,S14	22
MATH 151 Calculus I	R	3				F13,S14	15
MATH 155 Calculus I Lab	R	1				F13,S14	15
CCEN 101 Intro. to Elec. & Comp Eng	R		2			F13,S14	20
IGED140 Foundation Oral Communications	R			3		F13,S14	22
Second Semester							
IGED 111 Foundation Writing II	R			3		F13,S14	22
MATH 152 Calculus II	R	3				F13,S14	15
MATH 156 Calculus II Lab	R	1				F13,S14	15
PHYS 201 University Physics I Lec	R	3				F13,S14	16
PHYS 205 University Physics I Lab	R	1				F13,S14	16
ACCT 231 Intro. to Comp. Sci. I Lec	R				3	F13,S14	22
ACCT 233 Intro. To Comp. Sci. I Lab	R				1	F13,S14	22
Third Semester							
IGED 210 Discovery Writing	R			3		F13,S14	22
PHYS 202 University Physics II Lec	R	3				F13,S14	15
PHYS 206 University Physics II Lab	R	1				F13,S14	15
CVEN 201 Engineering Mechanics I	R		3			S13,S14	14

ELEC 221 Electrical Circuits I	R		3			F12,F13	15
ELEC 223 Electrical Circuits I Lab	R		1			F12,F13	15
Fourth Semester							
IGED 140 Foundation Ethics	R			3		F13,S14	22
MATH 260 Differential Eq. with Linear Alg.	R	4				S13,S14	15
PHYS 203 University Physics III Lec	R	3				F12,F13	4
PHYS 207 University Physics III Lab	R	1				F12,F13	4
ELEC 222 Electrical Circuits II	R		3			S13,S14	9
ELEC 224 Electrical Circuits II Lab	R		1			S13,S14	9
Fifth Semester							
ELEC 307 Engineering Mathematics	R	3				F12,F13	18
ELEC 311 Comp. Organization I	R		3			F12,F13	11
ELEC 313 Comp. Organization I Lab	R		1			F12,S14	11
ELEC 351 Electronics I	R		3			F12,F13	17
ELEC 353 Electronics I Lab	R		1			F12,F13	16
ELEC 356 Physical Electronics	R		3			F12,F13	7
ELEC 361 Electromagnetic Theory	R		3			F12,F13	15
Sixth Semester							
ELEC 312 Comp. Organization II	R		3 (√)			S13,S14	14
ELEC 314 Comp. Organization II Lab	R		1 (√)			S13,S14	14
ELEC 352 Electronics II	R		3 (√)			S13,S14	13
ELEC 354 Electronics II Lab	R		1 (√)			S13,S14	13
ELEC 307 Prob. and Stat. for Engineers	R	3				S13,S14	15
ELEC 371 Signals and Systems	R		3			S13,S14	16
ELEC 374 Signals and Systems Lab	R		1			S13,S14	17
IGED 280 Discovery Civics	R			3		F13,S14	22

Seventh Semester							
ELEC 467 Fundamental of Comm. Lec	R		3			F12,F13	15
ELEC 476 Fundamental of Comm.. Lab	R		1 (√)			F12,F13	15
ELEC 470 Control Sys. & Appl. Lec	R		3 (√)			S13,S14	12
ELEC 477 Control Sys. & Appl. Lab	R		1 (√)			S13,S14	10
ELEC 495 Senior Project I	R		3 (√)			F12,F13	8
ELEC XXX Electrical Engineering Elective	R		7			F13/ S14	12
Eighth Semester							
IGED 270 Discovery Diversity	R			3		F13/ S14	22
ELEC 496 Senior Project II	R		3 (√)			S13,S14	9
ELEC xxx Electrical Engineering Electives**	SE		6			F13/ S14	12
MECH-406 Engineering Economics	R		3			F12,F13	20
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		34 Hours	69 Hours	21 Hours	4 Hours		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		26.6%	53.90%	16.40%	3.1%		
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours				
	Minimum Percentage	25%	37.5 %				

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

- **Program Curriculum**

The overall curriculum of the electrical engineering program with or without the computer engineering option satisfies the curriculum component (Criterion 5) of new 2014-2015 ABET Criteria for Accrediting Engineering Programs. The specific coverage in the individual area is as follows:

The total coverage of **mathematics and basic sciences with experimental experience** spans over 34 credits or 33 credits (equivalent to little more than one year of study) for the electrical engineering without or with computer engineering option respectively.

The mathematics content of the curriculum includes calculus I, II, linear algebra and differential equations, engineering mathematics (Fourier and Laplace transforms, etc…) and probability and statistics for engineers. Discrete mathematics is required in the Electrical Engineering with Computer Engineering Option. A broad spectrum of mathematical concepts well above the trigonometry level is covered in these courses.

The basic science requirements of the program cover more than one half year of study and are in compliance with the curriculum component, Criterion 5. The basic sciences content of the program includes two semesters of university physics and one semester of general chemistry, including a laboratory component in each course. An additional university physics course is required in the electrical engineering without computer engineering option.

The year-long combination of college level mathematics and basic sciences provides a solid foundation to the students enabling them to pursue advanced engineering courses both at the undergraduate and graduate levels. A solid foundation in these subjects will also allow them to pursue a wide range of engineering careers.

The **engineering topics** covered in the curriculum consist of courses with substantial engineering science and engineering design components. The engineering science coverage of the program is equivalent to more than one year of study and ranges from the core electrical engineering courses (e.g., electrical circuits, electronics, computer organization, etc…) to Engineering Mechanics I. The engineering science coverage of the program is broad enough to provide students with a good background for future engineering practice as well as graduate studies. Students acquire their design experience at the upper-level electrical engineering courses and are required to take capstone design courses. Most of the design assignments are open-ended in nature and the design assignments are evaluated based on the students' creativity and the soundness of the engineering details involved. Testing, literature search, and evaluation of the prototype are part of the design assignments. Simple and advanced design projects using Computer Aided Engineering tools such as Xilinx's ISE and EDK, Mentor Graphics' Nanometer Design Tools, Matlab's Simulink, have been achieved by the students with very good results.

The engineering topics covered are in tune with the state of the art in areas such as embedded systems design, FPGA based design integrated circuit layout design etc. In fact, students submit their integrated circuit design to the MOSIS service for prototyping. The students are well prepared to tackle the challenges in their graduate studies or their first engineering job.

The capstone design course draws from the student's accumulated knowledge in their four years of study.

The general education component complements the technical content of the curriculum and is consistent with the program and institution objectives. From 2008 through the Spring of 2012, the general education component encompasses studies in English, humanities, and social science courses. Students are required to take four English courses. Coverage of humanities and social sciences extends over one half year of study. It includes philosophy, history, psychology, economics, political science, geography, fine arts and literature courses. Whenever appropriate, students are advised to take both courses of a given social studies or humanity sequence to enable them to acquire breadth and depth in the selected area.

"The UDC's general education program is rooted in the classical ideals of undergraduate liberal education and UDC's unique history, mission, and student population. It gives students a solid foundation in the liberal arts and sciences, helping them develop the intellectual tools they need to excel in any endeavor they pursue. It exposes students to the wisdom and perspective of a variety of disciplines, and it builds fundamental skills that they will be able to use no matter what their ultimate major or career. In a rapidly-changing, increasingly complex world in which our graduates may change careers multiple times, a strong general education is needed more than ever." Recently, the general education courses are upgraded to include several IGED courses with emphasis on ethics, public speaking, writing proficiency etc…

Course material related to the courses taught in the last academic year will be made available for review during Fall 2014 ABET visit.

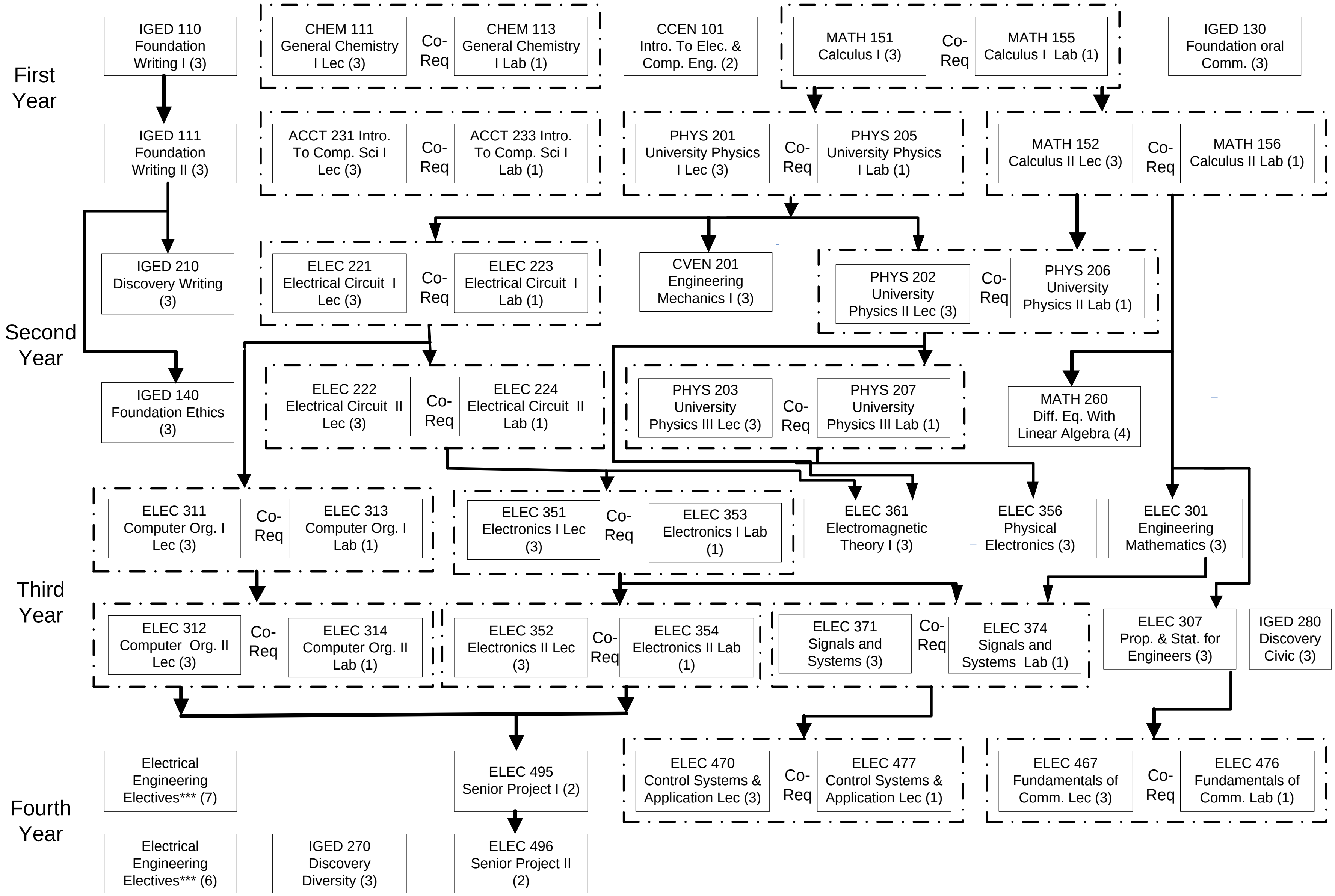
- **Materials available during visit**

The following materials will be available for review: course syllabi, course folders, sample of student assignment portfolios; students' transcripts, prerequisite flowchart, table of curriculum.

- **Prerequisite Flow Chart**

The Prerequisite Flow Charts of the Electrical Engineering program without and with the Computer Engineering Option are presented below.

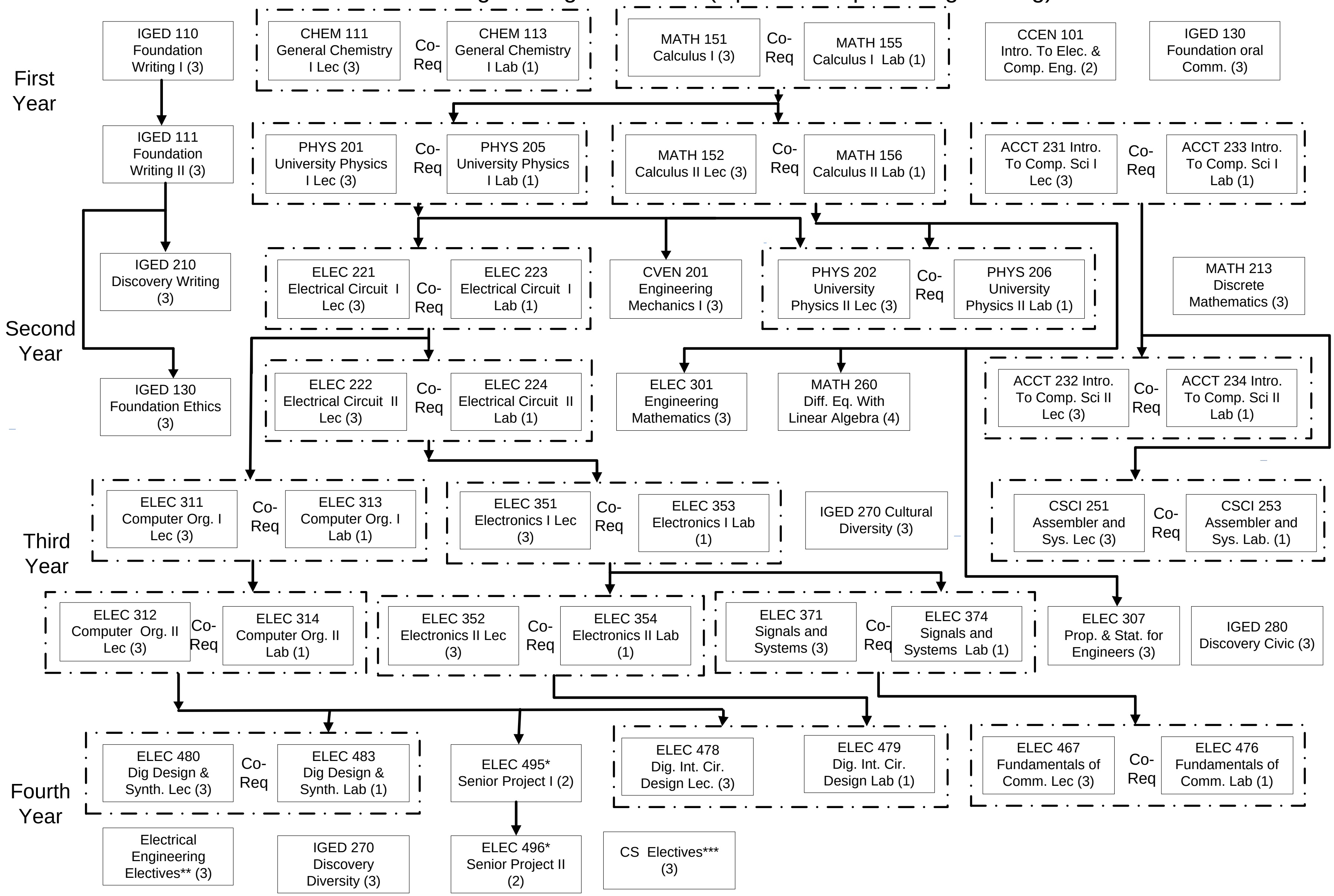
Electrical Engineering Curriculum



** Electrical Engineering Electives (most current): ELEC 458, ELEC 469/473, ELEC 471, ELEC 474, ELEC 479/479, ELEC 480/483, ELEC 461/462, ELEC 463, MECH 473 (MEMS), or MECH 481 (Mechatronics) or equivalent. Consult the UDC course catalog for the prerequisite for elective courses

Note: The EE Electives must have at least one lab course

Electrical Engineering Curriculum (Option: Computer Engineering)



***Contains intensive writing component**

** **Electrical Engineering Electives (most current)**: ELEC 458, ELEC 469/473, ELEC 470/477, ELEC 471, ELEC 471, ELEC 474, ELEC 463, ELEC 461/462, MECH 3511-473 (MEMS), MECH 3511-478 (MECHATRONICS), or equivalent.

*****Computer Science Electives**: To be selected from Operating Systems, Digital Image Processing, Networking, and other courses approved by advisor.

B. Course Syllabi

The course syllabi for the Electrical and Computer engineering program is presented in Appendix A (Part I)

CRITERION 6. FACULTY

- Faculty Qualifications

The faculty qualifications are shown in Table 6-1 and their respective resumes are in APPENDIX-B

Table 6-1. Faculty Qualifications

Name	Rank	Type of Academic Appointment TT, T, NTT	FT or PT	Highest Degree and Field	Institution from	Years of Experience			Professional Registration/ Certification	Level of Activity (high, med, low, none) in:		
						Govt./Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting /Summer Work in Industry
Tarak Bhar	P	T	FT	Ph.D. EE	Te4as A & M University, 1973	5	36	31		IEEE	Med	High
Paul Cotae	P	T	FT	Ph.D. EE	Polytechnica University of Romenia, 1997	2	32	6		IEEE (Senior)	High	High
Sasan Haghani	AST	TT	FT	Ph.D. EE	University of Alberta, Canada, 2007	1	7	5		IEEE	High	Med
Samuel Lakeou	P	T	FT	Ph.D. EE	Nat. Polytech Institute of Grenoble, 1978, France	8	33	30		IEEE (Senior)	Med	High
Esther Ososanya	P	T	FT	Ph.D. EE	University of Bradford (UK), 1985	10	27	13		IEEE	High	Med
Wagdy Mahmoud	ASC	T	FT	Ph.D. EE	University of Alabama, Tuscalusa, 1997	2	18	10	PE (MD)	IEEE, (Senior)	High	Med.
Nian Zhang	AST	TT	FT	Ph.D. EE	University of Science & Technology, Missouri, 2007	1	10	5		IEEE	High	Med

A. Faculty Workload

The faculty workload is presented in Table 6.2. The faculty workload is based on the provisions included in the master. The teaching load can reach up to 32 professional units (PU) per semester. A typical 3 Credit undergraduate course carries 8.5 PUs. A 3 credit graduate course carries 11 PUs 11. Additional 1.5 PUs are assigned to first time teaching of a course. Each faculty may carry up to a maximum of 128 PUs over a two academic year.

B. Faculty Size

The faculty size is adequate. The number of student advisee assigned to each faculty is about **25**. Since 2008, **three** new faculty were recruited to strengthen the communications (analog and digital), and computer engineering courses of the curriculum.

The faculty of the program of Electrical Engineering comprises the following:

- Dr. Tarak Bhar
- Dr. Samuel Lakeou (Chairman)
- Dr. Esther Ososanya
- Dr. Wagdy Mahmoud
- Dr. Paul Cotae
- Dr. Sasan Haghani
- Dr. Nian Zhang

C. Faculty Competencies

The majority of faculty hold (see faculty CV's in **APPENDIX B**) advanced degrees in electrical engineering and have the basic background to teach most of the courses offered in the program. The following shows the currently practiced curricular area coverage:

Basic Circuits and (micro) Electronics (analog/digital)

Dr. Tarak Bhar
Dr. Samuel Lakeou

Signals and Communications

Dr. Paul Cotae
Dr. Sasan Haghani

Controls and Power

Dr. Samuel Lakeou
Dr. Wagdy Mahmoud
Prof Edward Fowlkes

Advanced Digital Circuits and Systems

Dr. Esther Ososanya
Dr. Wagdy Mahmoud
Dr. Nian Zhang

D. Professional Development

Faculty are encouraged to attend various short courses and professional conferences in order to keep abreast with the state-of-the-art in their respective areas of expertise. The Department budgets provides from $1,500 to $2000 to each faculty member for such activities each year. Also, faculty often use travel funds from their research grants in order to complement their travel fund allocation. The faculty have been active in publishing papers for presentation at conferences such as the ASEE Annual Conferences, IEEE conferences, and in refereed research journals.

Professional development of faculty is generally expressed in form of their participation in professional conferences; grant supported research; summer research; industrial consultancy; and National Research Labs summer research fellowships.

In the last five years every faculty member has attended at least one professional conference per year. The following are the most representative professional development activities performed by the faculty in the last few years:

Dr. Tarak Bhar

- Summer Research Fellow (2008 – 2014), Naval Research Laboratory, Washington, DC.

Dr. Samuel Lakeou

- Summer Research Fellow (2008- 2009), Naval Research Laboratory, Washington, DC.
- Attended two conferences per year
- Submitted several grant proposals as PI, most of which were successfully funded
- Fulbright Scholar 2009-1010
- Published several scientific publications during the last 5 years

Dr. Esther Ososanya

- Published several scientific publications during the last 5 years
- Reviewed several NSF Graduate Fellowship Programs and technical Research papers
- Submitted several grant proposals as PI and Co-PI, most of which were successfully funded
- Attended several short courses and workshops (Xilinx, ABET Fundamentals, etc…)

Dr. Wagdy Mahmoud

- Attended several short courses (Xilinx, Mentor Graphics etc…)
- Submitted several research proposals as a Co-PI, most of which were successfully funded.
- Attended two conferences per year
- Attended 3 ABET workshops
- Published several scientific and educational publications in the past 5 years

Dr. Paul Cotae

- Summer Research Fellow (2009 – 2013) Naval Research Laboratory, Washington, DC.
- Submitted several research grant proposals as PI and Co-PI, most of which were successfully funded.
- Attended at least four professional conferences per year
- Published several scientific publications during the last 5 years
- Attended several short courses in MATLAB.
- Associate Editor for the IEEE Communication Letters journal (2008-2012); ELSEVIER *International Journal of Computers & Electrical Engineering* (2007-present) *International Journal of Computers & Electrical Engineering;* guest co-editor of special issue on Wireless Systems: Modeling, Monitoring, Transmission, Performance Evaluation and Optimization, Vol.39, Issue 6, August 2013.
- NSF panelist:
- Presidential Awards for Excellence in Mathematics and Science (PAEMST NSC), August 2009.
- Innovative Technology Experiences for Student and Teachers (ITEST) April 2010.
- Air Force Summer Faculty Fellowship Program Review Panel, Friday, January 8, 2010 and, Jan. 2012.
- Nominated as an Expert on Electronics and Telecommunication for the Romanian National Research Council, September 2010 and September 2011.

Dr. Sasan Haghani:

- Judge at the BKX/NIS National Conferences 2012- present.
- Judge at the Emerging Researchers National Conference 2012-present.
- Reviewer for National Science Foundation Proposals.
- Reviewer for several IEEE Conference and Journal Publications in the fields of communications theory and wireless communications.
- Myrtilla Miner Faculty Fellow, University of the District of Columbia 2012-2013.

Dr. Nian Zhang:

- Co-Chair, 2014 Discover Innovation Day
- Co-Chair, 2012 and 2013 Engineering Week
- Associate Editor, IEEE Transactions on Neural Networks, 2010-present
- Guest Editor, Computational Intelligence and Neuroscience Journal
- Guest Editor, International Journal of Systems, Control and Communications (IJSCC)
- Publications Chair, 2014 Fifth International Conference on Intelligent Control and Information Processing (ICICIP), Dalian, China, August 18-24, 2014
- Publications Chair, 2013 Sixth International Conference on Advanced Computational Intelligence (ICACI 2013), Hangzhou, China, October 19-21, 2013
- Publications Chair, The International Conference on Information Science and Technology (ICIST 2013), Yangzhou, China, March 23-25, 2013
- Myrtilla Miner Faculty Fellow, University of the District of Columbia, 2013
- IEEE CIS Neural Networks (NN) Technical Committee Member
- IEEE Senior Member
- IEEE Computational Intelligence Society Member
- Summer Faculty Fellow, Naval Research Laboratory, Summer 2013

Table 6-2. Faculty Workload Summary

Faculty Member (name)	FT or PT[4]	Classes Taught (Course No./Credit Hrs.) Term and Year[1]	Total Activity Distribution[2]		
			Teaching	Research/Scholarly Activity	Other[3]
Dr. T. Bhar	FT	ELEC-221, 3 Credits, F13	60%	25%	University/Community
		ELEC-223, 1 Credit, F13			
		ELEC-356 3 Credits, F13			
		ELEC-222, 3 Credits, S14			
		ELEC-224, 1 Credit, S14			
Dr. P. Cotae	FT	ELEC 467, 3 Credits, F13	50%	40%	University/Community
		ELEC 476, 1 Credit			
		ELEC 574, 3 Credits, F13			
		ELEC 699 (Thesis), 1 Credit, F13			
		ELEC 669, (Project), 1 Credit, F13			
		ELEC 699(Thesis)			
		ELEC 469/569			
		ELEC 473, 3 Credits,S14			
		ELEC 574, 3 Credits, S14			
Dr. S. Haghani		ELEC-301, 3 Credits, F13	50%	40%	University/Community
		ELEC-507, 3 Credits, F13			
		ELEC-586, 3 Credits, F13			
		CCEN-101, 2 Credits, F13			
		ELEC-371, 3 Credits, S14			
		ELEC-374, 1 Credits, S14			
		ELEC-458, 3 Credits, S14			
Dr. S. Lakeou	FT	ELEC-351, 3 Credits, F13	40%	25%	Chairman/University
		ELEC-353, 3 Credits, F13			

Faculty Member (name)	FT or PT[4]	Classes Taught (Course No./Credit Hrs.) Term and Year[1]	Total Activity Distribution[2]		
			Teaching	Research/Scholarly Activity	Other[3]
		ELEC-352, 3 Credits, S14			
		ELEC-354, 1 Credit, S14			
Dr. E. Ososanya	FT	ELEC-495, 3 Credits, F13	55%	25%	Program Director
		MECH-381, 3 Credits, F13			
		ELEC-496, 3 Credits, S14			
		MECH-478, 3 Credits, S14			
		ELEC586, 3 Credits, S14			
Dr. W. Mahmoud	FT	ELEC-480, 2 Credits, F13	50%	30%	MS Program Director
		ELEC-483, 1 Credit, F13			
		ELEC-495, 2Credits, F13			
		ELEC-470, 3 Credits, S14			
		ELEC-571, 3 Credits, F13			
		ELEC-477, 1 Credit , S14			
		ELEC-496, 2 Credits, S14			
		ELEC-578, 3 Credit, S14			
Dr. N. Zhang	FT	ELEC-311, 3 Credits, F13	60%	30%	University/Community
		ELEC-313, 1 Credit, F13			
		ELEC-478, 3 Credits, F13			
		ELEC-479, 1 Credits, F13			
		ELEC-312, 3 Credits, S14			
		ELEC-314, 1 Credit, S14			
		ELEC-699, 1 Credit, S14			

1 Indicate Term and Year for which data apply (the academic year preceding the visit).
2 Activity distribution should be in percent of effort. Members' activities should total 100%.
3 Indicate sabbatical leave, etc., under "Other."
4 FT = Full Time Faculty PT = Part Time Faculty

E. Authority and Responsibility of Faculty

In addition to teaching responsibilities, faculty have a major role with respect to course creation, modification, and evaluation, definition and revision of program educational objectives and student outcomes, and their role in the attainment of the student outcomes. All curriculum revisions are reviewed and approved by the Dean, the Faculty Senate and the Provost before implementation. The faculty also have some of the following responsibilities:

a) Student advising

Every faculty has the responsibility to advise students during registration and during the course of every regular semester. Assistance to students during their selection of appropriate courses, evaluation of transfer credits, mentoring of students, etc,, are the main areas of faculty interaction with students. Every faculty is expected to devote at least 5 office-hours a week for student counseling

b) University service

University service is a major component of faculty responsibility. It is generally provided in departmental, school or university level committee memberships and other special assignments directed at helping the university.

The most recent faculty involvements in University Service are as follows:

Dr. Tarak Bhar:
Member, Departmental Evaluation and Promotions Committee

Dr. Samuel Lakeou:
Departmental Chairmanship

Dr. Esther Ososanya:
Member, Departmental Curriculum Committee
Member, Departmental Evaluation and Promotions Committee**,**
Executive Member of the University Faculty Association,
BSEE Program Director

Dr. Wagdy Mahmoud:
Member, Departmental Curriculum Committee
Member, Departmental Evaluation and Promotions Committee,
MSEE Program Director,
Member of the University Faculty Senate
Member of UDC general education committee
Member of UDC graduate council
Chair of MSEE program committee

Dr. Paul Cotae:

- Member, Departmental Curriculum Committee (2009-2013)
- Chair – Engineers Week at UDC, February 2009 – February 2012.
- Research Group Coordinator SEAS AY 2009- AY 2012.
- Member – Graduate Committee MSEE, Fall 2010, AY 2011 – AY 2013.
- Member – MSEE graduate program curriculum (since 2009).

Dr. Sasan Haghani:

- Member, Departmental Curriculum Committee (2010-present)
- Member, Department Graduate Committee (2010-present)
- Chair of the Committee to Select the Director of Admission at the University
- Member of the Committee for Online Learning (2009-2011)

Dr. Nian Zhang:

- Chair of ECE Department Curriculum Committee
- Member, ECE Department Graduate Committee
- Co-Chair, 2014 Discover Innovation Day
- Co-Chair, 2012 and 2013 Engineering Week

APPENDICES

Appendix A – Course Syllabi

Course Syllabus: ELEC-221 Electrical Circuits I Lec.

1. Course number and name: ELEC-221 Electrical Circuit I Lec.

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:
   a. Electric Circuits, James W. Nilsson and Susan A. Riedel, Prentice Hall, 2011

5. Specific course information
   a. Catalog description: This course covers Ohm's and Kirchoff's Laws, Thevenin and Norton Equivalents, analysis of RL and RC networks with and without forcing functions, the RLC circuit, computer-aided circuit simulation

   b. Prerequisites or co-requisites: Co-requisite Phys. 1539-202 and EE 3531-223

6. Specific goals for the course
   a. Outcomes of instruction
      This course is the first course in a sequence of courses intended to develop a strong foundation in electrical circuit analysis and design.

   b. Student outcomes addressed by the course
      i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2,a3)
      ii. An ability to identify, formulate, and solve engineering problem (e2)

7. Topics covered
   a. Circuit Variables: Voltage, Current, Power, and Energy
   b. Circuit Elements and Experimental Laws (Ohm, KCL, KVL Laws)
   c. Simple Resistive Circuits
   d. Some Useful Techniques of Circuit Analysis
   e. Inductance and Capacitance
   f. Source-free RL and RC Circuits
   g. The Application of the Unit-Step Forcing Function
   h. Natural and Step Responses of RLC Circuits

Course Syllabus: ELEC-222 Electrical Circuits II Lec.

1. Course number and name: ELEC-222 Electrical Circuit II Lec.

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:

a. Electric Circuits, James W. Nilsson and Susan A. Riedel, Addison- Wesley Publishing Co., 2011

5. Specific course information

a. Catalog description: This course covers the sinusoidal forcing functions, sinusoidal steady-state responses using phasors, polyphase circuits, complex frequency, and frequency responses, computer-aided simulation
b. Prerequisites or co-requisites: Co-requisite: EE3531-224, EE 3531-221

6. Specific goals for the course

a. Outcomes of instruction

This course is the Second course in a sequence of courses intended to develop a strong foundation in electrical circuit analysis and design.

b. Student outcomes addressed by the course

i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2,a3)
ii. An ability to identify, formulate, and solve engineering problem (e1, e2)

7. Topics covered

a. Sinusoidal Steady State Analysis
b. Sinusoidal Steady State Power Calculations
c. Balanced Three Phase Circuits
d. Mutual Inductance
e. Series, and Parallel Resonance
f. Introduction to the Laplace Transform
g. The Laplace Transform in Circuit Analysis
h. Two-port Circuits

Course Syllabus: ELEC-223 Electrical Circuits I Lab.

1. Course number and name: ELEC-222 Electrical Circuit I Lab

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:
   a. Basic Electricity-Lab. Manual, Paul B. Zbar and Gordon Rockmaker, Glencoe Publishing, 2008

5. Specific course information
   a. Catalog description: This course is the first laboratory course in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuits.

   b. Prerequisites or co-requisites: Co-requisite: Co-requisite 3531-221 Electrical Circuit I Lec.

6. Specific goals for the course
   a. Outcomes of instruction
      This course is the first laboratory course in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuit.

   .

   b. Student outcomes addressed by the course
      i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
      ii. An ability to design and conduct experiments, as well as to analyze and interpret data (b1,b2,b3)
      iii. An ability to identify, formulate, solve engineering problems (e1,e2)

7. Topics covered
   a. Ohm's Law
   b. Designing Series Circuits
   c. Voltage Divider Circuits
   d. Designing Parallel Circuits
   e. Designing Series Parallel Circuits
   f. Kirchhoff's Voltage and Current Laws
   g. Designing Voltage and Current-Divider Circuits
   h. Maximum Power Transfer
   i. Balanced Bridge Circuit
   j. Superposition Theorem
   k. Thevenin's Theorem
   l. Selected Pspice Projects

Course Syllabus: ELEC-224 Electrical Circuits II Lab.

1. Course number and name: ELEC-222 Electrical Circuit I Lab

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:
   a. Basic Electricity-Lab. Manual, Paul B. Zbar and Gordon Rockmaker, Glencoe Publishing, 2008

5. Specific course information
   a. Catalog description: A Continuation of Electrical Circuits Lab I

   b. Prerequisites or co-requisites: Co-requisite 3531-222 Electrical Circuit II Lec.

6. Specific goals for the course
   a. Outcomes of instruction
      i. This course is the second laboratory course in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuit.

   b. Student outcomes addressed by the course
      i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
      ii. An ability to design and conduct experiments, as well as to analyze and interpret data (b1,b2,b3)
      iii. An ability to identify, formulate, solve engineering problems (e1,e2)
      iv. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (k1)

7. Topics covered
   a. Oscilloscope Operation
   b. Oscilloscope Voltage Measurements
   c. Peak,RMS,and Average Values of AC
   d. Characteristics of Inductance
   e. Inductances in Series and Parallel
   f. RC Time Constants
   g. The Capacitive Voltage Divider
   h. Voltage Relationships in a Series RL Circuit
   i. Power in AC Circuits
   j. Frequency Response of a Reactive Circuit
   k. Impedance of a Series RLC Circuit

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

Course Syllabus: ELEC-301 Engineering Mathematics

1. Course number and name: ELEC- 301

2. Credits and contact hours: 3 credits, 1 hour of contact.

3. Instructor's or course coordinator's name: Dr. Sasan Haghani
4. Text book, title, author, and year: Advanced Engineering Mathematics 9^{th} Edition by Erwin Kreyszig, Published by Wiley.

5. Specific course information
   a. brief description of the content of the course (catalog description):

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

   b. Prerequisites or co-requisites:

      Calculus II

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

      Required

6. Specific goals for the course

   a. specific outcomes of instruction:

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

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

      A-1: Apply Laplace transform to solve solutions to first and second order differential equations.
      A-2: Apply complex algebra to calculate the analycity of complex functions
      E-1: Model and solve circuit problems in the Laplace domain

7. Brief list of topics to be covered:
   a. First Order Differential Equations
   b. Second Order Differential Equations
   c. The Laplace Transform
   d. Series Solutions
   e. Complex Analysis

Course Syllabus: ELEC-307 Probability and Statistics for Engineers

1. Course number and name: ELEC-307 Probability and Statistics for Engineers

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:
    a. Essentials of Probability and Statistics, Walpole, Myers, Myers, and Ye, Pearson Education, Inc., 2013

5. Specific course information
    a. Catalog description: This Course covers statistics, methods of representation, sample mean, sample variance, random experiments, probability, random variable, discrete and continuous distributions, Poisson and normal distribution sampling.

    b. Prerequisites or co-requisites: EE 3531-301 Engineering Mathematics

6. Specific goals for the course
    a. Outcomes of instruction
        i. The objective of this course is to introduce to the electrical engineering students the basic concepts of probability and statistics from an electrical engineering viewpoint with a good mix of rigor and vigor

    b. Student outcomes addressed by the course
        i. An ability to apply knowledge of mathematics, science, and engineering (a1.a2)
        ii. An ability to identify, formulate, and solve engineering problems (e1,e2)

7. Topics covered
    a. Introduction to Statistics and Probability
    b. Random Variables, Distributions, and Expectations
    c. Some Probability Distributions
    d. Sampling Distributions and Data Descriptions
    e. One-and Two- Sample Estimation Problems
    f. One-and Two- Tests of Hypotheses
    g. Linear Regression

Course Syllabus: ELEC-311 Computer Organization I

1. Course number and name: ELEC 311 Computer Organization I

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

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
   Fundamentals of Digital and Computer Design with VHDL, Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698

5. Specific course information
   a. Catalog description: This course covers foundations of digital design and digital computer systems. Boolean algebra, design of combinational and sequential circuits is introduced.

   b. Prerequisites or co-requisites: ELEC 221 Electrical Circuits I and ELEC 313 Computer Organization I Lab

   c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
   a. Outcomes of instruction
   - Without a calculator, perform arithmetic functions and inter-radix conversion of numbers in various radices, and encodings. Describe the pros and cons of various coding systems.
   - Simplify a combinational logic function (given in any form) to a minimal SOP or POS Boolean equation.
   - Analyze a given combinational logic diagram to determine its function. Draw a logic diagram that implements a given function, under constraints such as a limited number and type of gates.
   - Describe the logic operation of standard combinational logic components, including encoders, decoders, multiplexers, adders, and comparators. Given a word description of a desired logic function, design and draw a minimal logic diagram using any group of standard logic components.
   - Draw logic diagrams of various latches and flip-flops using gates. Explain the operation of S-R, clocked S-R, T, J-K, and D flip-flops. Discuss the relative characteristics of various types of flip-flops. Draw a timing diagram from a sequential circuit.
   - Analyze and design simple sequential circuits and binary counters.
   - Explain the operation of a read-only memory and programmable logic devices. Determine the logic functions realized.

   b. Student outcomes covered by the course:

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

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

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

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

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

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

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

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

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

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

Course Syllabus: ELEC-312 Computer Organization II

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

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

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
   Fundamentals of Digital and Computer Design with VHDL, Richard Sandige and Michael Sandige, McGraw-Hill, 2012. ISBN-13: 978-0073380698

5. Specific course information
   a. Catalog description: The course covers sequence and control (hardwired and microprogrammed control), instruction set architecture, CPU design, and input-output interfaces for computer design. In addition, microprocessor and microprocessor based digital system is introduced.

   b. Prerequisites or co-requisites: ELEC 311 Computer Organization I, ELEC 313 Computer Organization I Lab, and ELEC 314 Computer Organization II Lab

   c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
   a. Outcomes of instruction
   - Develop a strong foundation in computer and computer system design Explain the operation of a read-only memory and programmable logic devices. Determine the logic functions realized.
   - The students will be exposed to microprocessor architecture and microprocessor based design.

   b. Student outcomes covered by the course:

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

   Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.
   - C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or

electronic devices and systems including hardware and/or software components.

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

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

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

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

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

Course Syllabus: ELEC-313 Computer Organization I Lab

1. Course number and name: ELEC 313 Computer Organization I Lab

2. Credit and contact hours: 1 credit, 15 contact hours

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
   Tutorials provided by the instructor.

5. Specific course information
   a. Catalog description: Experimentation with logic gates, decoders and multiplexers, latches and flip-flops.

   b. Prerequisites or co-requisites: ELEC 311 Computer Organization I.

   c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
   a. Outcomes of instruction
   i. To build around a series of experiments of increasing sophistication in the design of digital circuits.
   ii. To utilize Xilinx ISE Foundation to perform schematic entry and simulation.

   b. Student outcomes covered by the course:

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

   Outcome B: an ability to design and conduct experiments, as well as to analyze and interrupt date.
   - B-1: identifies the constraints, assumptions, and models for the experiment.
   - B-4: validate experimental results with respect to assumptions, constraints and theory.

   Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.
   - C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

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

E-1: classifies information to identify engineering problems.

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

Outcome G: ability to communicate effectively.

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

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

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

7. Topics covered
   a. Introduction to Logic Gates
   b. Logic Circuits
   c. Boolean Functions
   d. Karnaugh Maps
   e. Binary Math
   f. Understanding Decoder
   g. Multiplexers
   h. Project - Calculator Design

Course Syllabus: ELEC-314 Computer Organization II Lab

1. Course number and name: ELEC 314 Computer Organization II Lab

2. Credit and contact hours: 1 credit, 15 contact hours

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
   Tutorials provided by the instructor.

5. Specific course information
   a. Catalog description: This lab covers experiments/computer simulations related to the design of computers and microprocessor based digital systems.

   b. Prerequisites or co-requisites: ELEC 311 Computer Organization I and ELEC 312 Computer Organization II.

   c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
   a. Outcomes of instruction
      i. To develop a strong foundation in designing and testing of digital systems.
      ii. To utilize Xilinx ISE Foundation to perform schematic entry and simulation.

   b. Student outcomes covered by the course:

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

   Outcome B: an ability to design and conduct experiments, as well as to analyze and interrupt date.
   - B-1: identifies the constraints, assumptions, and models for the experiment.
   - B-4: validate experimental results with respect to assumptions, constraints and theory.

   Outcome C: an ability to design a system, component, or process to meet desired needs within realistic.
   - C-2: carries and design process (such as concept generation, modeling, evaluation, iteration) to satisfy project requirements for electrical and/or electronic devices and systems including hardware and/or software components.

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

E-1: classifies information to identify engineering problems.

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

Outcome G: ability to communicate effectively.

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

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

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

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

Course Syllabus: ELEC-351 Electronics I Lecture

1. **Course number and name**: ELEC 351 ELECTRONICS I Lec

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

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

4. **Textbook and other Required Materials**:
   Electronic Design, **Rodent & Carpenter**, Discovery Press, Schematic Capture/Cadence PSPICE, **Hernier**

5. **Specific course information**

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

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

   A. The objectives of this course are:

   The objective of this course is to introduce to the electrical engineering student the state-of-the-art electronic devices and their applications. The devices to be studied include semiconductor diodes, bipolar junction transistors, and junction field effect transistors. Their fabrication and their electrical properties will be presented thoroughly. Their basic applications as rectifiers, amplifiers etc.. will be highlighted and analyzed.

   B. Student outcomes covered by the course:

   Outcome A: an ability to apply knowledge of mathematics, science, and engineering
   - A-1: applies mathematics to obtain an analytical or numerical solution.
   - A-2: demonstrates knowledge of fundamental scientific and/or engineering practices.
   - A-3: applies scientific and/or engineering principles toward solving engineering problems.

   Outcome C: an ability to design a system, component, or process to meet desired needs within realistic constraints
   - C-1: analyze needs to define problems to be solved by the application of electronic devices.

   Outcome E: an ability to identify, formulate, and solve engineering problems
   - E-2: classifies information to identify engineering problems

7. **Topics covered**
   a. Basic concepts (Chapter 1)
      - Appreciate the history of modern electronics
      - Know the essential contrasts between analog and digital systems

- Appreciate the difference between analysis and design
- Know the important role played by computer simulations in design and analysis
- Appreciate the essential components in the design process

b. Ideal Operational Amplifiers (OP-AMPS) (Chapter 2)
   - How to use OP-AMPS to build inverting and non-inverting amplifiers
   - Circuit models used to represent OP-AMPS
   - Design approaches applied to multiple-input amplifiers

c. Semiconductor diode circuit analysis (Chapter 3)
   - How semiconductors work and how current flows in them
   - The internal structure of the diode and the physical laws that govern its behavior
   - Alternate types of diode, such as Zerer, ,Schottky, Photo..
   - General techniques for analyzing and designing circuits with diodes

d. Bipolar Junction Transistors (Chapter 4)
   - The structure of bipolar junction transistors (BJT)
   - Design of biasing circuits for amplifier circuits using BJTs
   - Study of various amplifier configurations and their respective advantages
   - Computer simulation model parameters of BJTs

e. Design of bipolar junction transistor amplifiers (Chapter 5)
   - Terminal characteristics of amplifier configurations, including current and voltage gain, and input and output impedance
   - Methods for coupling transistor circuits to each other
   - Simulation of single and multistage amplifier configurations

f. Field Effect Transistor Amplifiers (Chapter 6)
   - Understand the difference between field effect transistors (FET) and BJTs
   - Analyze and design various configurations of FET amplifiers
   - Simulation of FET amplifiers

g. Bias Stability of Transistor Amplifiers (Chapter 7)
   - Understand the mechanisms for variations in amplifier operation
   - Be able to compensate for parameter variations using diode compensation
   - Be able to design FET and BJT amplifiers to reduce the effects of temperature variations

Course Syllabus: ELEC-352 Electronics II Lecture

1. **Course number and name**: ELEC 352 ELECTRONICS II Lec

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

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

4. **Textbook and other Required Materials**:
   Electronic Design, **Rodent & Carpenter**, Discovery Press, Schematic Capture/Cadence PSPICE, **Hernier**

5. **Specific course information**

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

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

A. The objectives of this course are:

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

B. Student outcomes covered by the course:

<u>Outcome A</u>: an ability to apply knowledge of mathematics, science, and engineering

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

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

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

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

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

<u>Outcome e</u>: an ability to identify, formulate, and solve engineering problems

E-2: classifies information to identify engineering problems

7. **Topics covered**
   a. Power Amplifiers (Chapter 8)
      - Design biasing circuitry for Class A, B, AB, and C operation
      - Know the essential differences between various coupling techniques
      - Design a complementary symmetry diode compensated power amplifier circuit
      - Design a Darlington circuit
      - Design regulated power supplies using both discrete components and integrated circuits
   b. Practical Operational Amplifiers (Chapter 9)
      - Understand the internal operation of the OP-AMP
      - Be able to calculate a variety of parameters relating to circuits with OP-AMPS
      - Understand the operation and utility of differential amplifiers
   c. Frequency behavior of transistor amplifiers (Chapter 10)
      - Understand the methods for determining the low and high cut-off frequencies for various amplifier configurations
      - Understand the Miller Effect and its impact on the high frequency response
   d. Feedback and stability (Chapter 11)
      - Understand the different types of feedback
      - Understand how amplifier stability can be controlled
      - The use of unstable amplifiers as oscillators
   e. Active filters (Chapter 12)
      - Analyze active networks
      - Design of first order active filters
      - Design of Butterworth and Chebyshev Low Pass and High Pass filters
   f. Assorted design topics from chapters 13, 14, 15 & 16
      - Comparators and Schmitt Trigger
      - Pulse Generators, 555 Timer
      - Digital to analog converter
      - Analog to digital converter

Course Syllabus: ELEC-353 Electronics I Lab

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

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

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

4. **Textbook and other Required Materials**:
A lab manual accompanying the textbook, Electronic Design, Rodent & Carpenter, Discovery Press will be made available to the students.

5. Specific course information

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

6. Specific course objectives and student outcomes

A. The objectives of this course are:

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

B. Student outcomes covered by the course:

   <u>Outcome B</u>: an ability to design and conduct experiments, as well as to analyze and interpret data
   B-1: Identifies the constraints, assumptions, and models for the experiment
   B-2: uses appropriate equipment and techniques for data collection
   B-3: Analyzes experimental data using appropriate tools
   B-4 validates experimental results with respect to assumptions, constraints and theory

   <u>Outcome D</u>: an ability to function on multidisciplinary teams
   D-1: shares responsibilities and formation on schedule with others on the team

   <u>Outcome E:</u> an ability to identify, formulate, and solve engineering problems
   D-2 : uses analytical, computational, and/or experimental methods to obtain solutions

   <u>Outcome K:</u> Ability to use techniques, skills, and modern engineering tools necessary to electrical engineering practice
   K-1: able to operate engineering equipment and instrumentation
   K-3: able to use computer-aided design and analysis software tools for electrical engineering applications

7. Topics covered

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

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

3. Bipolar junction transistors (BJT)
   The purpose of this experiment is to become familiar with the operation of a bipolar junction transistor through the measurement and analysis of the transistor's characteristic parameters

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

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

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

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

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

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

Course Syllabus: ELEC-354 Electronics II Lab

1. **Course number and name**: ELEC 354 ELECTRONICS II Lab

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

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

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

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

5. **Specific course information**

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

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

   A. The objectives of this course are:

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

   B. Student outcomes covered by the course:

      <u>Outcome B</u>: an ability to design and conduct experiments, as well as to analyze and interpret data
      B-1: Identifies the constraints, assumptions, and models for the experiment
      B-2: uses appropriate equipment and techniques for data collection
      B-3: analyzes experimental data using appropriate tools
      B-4: validates experimental results with respect to assumptions, constraints and theory

      <u>Outcome d</u>: an ability to function on multidisciplinary teams
      D-1: shares responsibilities and formation on schedule with others on the team

      <u>Outcome E:</u> an ability to identify, formulate, and solve engineering problems
      E-2 : uses analytical, computational, and/or experimental methods to obtain solutions

      <u>Outcome k:</u> Ability to use techniques, skills, and modern engineering tools necessary to electrical engineering practice
      K-1: able to operate engineering equipment and instrumentation
      K-3: to use computer-aided design and analysis software tools for electrical engineering applications

7. Topics covered

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

2. Complementary Symmetry Diode Compensated (CSDC) power Amplifier (PUSH-PULL)
   The purpose of this experiment is to evaluate the complementary symmetry power amplifiers.

3. Integration of Power Amplifier
   The purpose of this experiment is to design a source follower stage as the input stage and integrate it with the CE-EF stage and the complementary symmetry diode compensated power amplifier previously designed. The complete amplifier will be tested and analyzed.

4. DARLINGTON Differential Amplifier
   The purpose of this experiment is to study a Darlington compound differential amplifier. Emphasis will be placed on obtaining the quiescent operating conditions and the maximum possible output voltage swing for a given load.

5. Frequency response of a common-emitter amplifier
   The frequency response and evaluation of the bandwidth of a CE amplifier is evaluated.

6. Feedback Amplifier
   In this experiment, you will design and build a feedback amplifier and study the effect of feedback on the sensitivity and stability.

7. Signal Generators
   This experiment will concentrate on the design and evaluation of different types of signal generators.

8. Active Band Pass Filter
   In this experiment you will design an active band pass filter using operational amplifiers and a number of resistors and capacitors.

9. Notch Filter
   To design a Wein-Bridge and a Twin-Tee 60 Hz notch filter to reject 60Hz hum from the ac power line, then compare the two filters.

10. Analog to Digital (ADC) circuits
    A sample ADC circuit using and ADC0809 chip and the required control circuits will be built

11. Digital to Analog (DAC) circuits
    A sample DAC0800 circuit using the DAC0800 chip and the required control circuits will be built.

Course Syllabus: ELEC-356 Physical Electronics

1. Course number and name: ELEC-356 Physical Electronics

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:
   a. Solid State Electronics Devices, B.G. Streetman and S. Bannerjee, 6th Edn., Prentice Hall, 2006

5. Specific course information
   a. Catalog description: Course will provide students with background on the physics and technology of semiconductor and optoelectronic devices. This will also provide an introduction to semiconductor materials, solid state physics, semiconductor devices and technology. Latest fabrication and design developments in integrated circuits and electronics will be discussed.

   b. Prerequisites or co-requisites: Physics, 2539-202 Physics II

6. Specific goals for the course
   a. Outcomes of instruction
      i. Learn the physics and technology of semiconductor material and devices
      ii. Learn the latest fabrication and design development in integrated circuits and devices

   b. Student outcomes addressed by the course
      i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2)
      ii. An ability to identify, formulate, solve engineering problems (e1,e2)
      iii. An ability to communicate effectively (g1)

7. Topics covered
   a. Crystal Properties and Growth of Semiconductor Materials
   b. Atomic Structure of Semiconductor Materials
   c. Energy Bands and Charge Carriers in Semiconductors
   d. Excess Carriers in Semiconductors
   e. Solid State Devices
   f. Optoelectronic Devices
   g. Integrated Circuits
   h. Special Topics

Course Syllabus: ELEC-361 Electromagnetic Theory

1. Course number and name: ELEC-361 Electromagnetic Theory

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

3. Course coordinators: Dr. Tarak Bhar

4. Textbook, title, author, and year:

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

5. Specific course information

    a. Catalog description: Covers vector calculus, orthogonal coordinates, Coulomb and Gauss laws, scalar potentials, capacitance, and static electric and magnetic fields and their interaction with matter, as well as Laplace and Poisson Equations

    b. Prerequisites or co-requisites: EE3531-222, Physics 2539-202

6. Specific goals for the course

    a. Outcomes of instruction
        i. Develop a strong foundation in the theory of electromagnetic field and waves and its application in electrical engineering

    b. Student outcomes addressed by the course
        i. An ability to apply knowledge of mathematics, science, and engineering (a1,a2,a3)
        ii. An ability to identify, formulate, solve engineering problems (e1,e2)

7. Topics covered

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

Course Syllabus: ELEC-371 Signals and Systems

1. Course number and name: ELEC- 371 Signals and Systems

2. Credits and contact hours: 3 credits, 1 hour of contact.

3. Instructor's or course coordinator's name: Dr. Sasan Haghani

4. Text book, title, author, and year: Signals and Systems using MATLAB by Luis Chaparro. ISBN: 978-0-12-374716-7

5. Specific course information
   a. brief description of the content of the course (catalog description): Introduces principles and techniques of continuous and discrete time linear systems. Topics include signal representation, properties of systems, convolution, Fourier series and transform, FFT, sampling theorem, filtering, Laplace and Z-transform techniques. Lec. 3 hrs. PR: ELEC 351 & ELEC 301. CR: ELEC-374.
   b. prerequisites or co-requisites: PR: ELEC 301. CR: ELEC 374.
   c. indicate whether a required, elective, or selected elective: Required.

6. Specific goals for the course

   i. specific outcomes of instruction:

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

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

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

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

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

   E-2: Classify signals and systems based upon their properties.
   E-3: Use MATLAB to create, analyze and process signals

G-1: Write assignments based on MATLAB results.

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

7. Brief list of topics to be covered:

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

Course Syllabus: ELEC-374 Signals and Systems Lab

1. Course number and name: ELEC- 374

2. Credits and contact hours: 1 credits, 1 hour of contact.

3. Instructor's or course coordinator's name: Dr. Sasan Haghani

4. Text book, title, author, and year: Signals and Systems using MATLAB by Luis Chaparro. ISBN: 978-0-12-374716-7

5. Specific course information
   a. brief description of the content of the course (catalog description):
      A lab accompanying ELEC 371 to introduce students to Signal and Systems through MATLAB.

   b. Prerequisite or corequisite: CR: ELEC-371

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

      required

6. Specific goal of the course
   a. Outcomes of instruction
      i. Use Matlab to analyze signals and systems in the discrete domain
      ii. Use Matlab to obtain response of LTI systems

   b. Student outcomes addressed by the course

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

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

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

      E-2: Classify signals and systems based upon their properties.
      E-3: Use MATLAB to create, analyze and process signals

      G-1: Write assignments based on MATLAB results.

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

7. Brief list of topics to be covered:

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

Course Syllabus: ELEC-458 Digital Signal Processing

1. Course number and name: ELEC- 458 Digital Signal Processing

2. Credits and contact hours: 3 credits, 1 hour of contact.

3. Instructor's or course coordinator's name: Dr. Sasan Haghani

4. Text book, title, author, and year: Advanced Digital Signal Processing, Theory and Practice, by Manolakis, Cambridge University Press.

5. Specific course information
   a. Brief description of the content of the course (catalog description):

   b. Prerequisites or co-requisites: PR:

      ELEC 371.

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

      Elective

6. Specific goals for the course

   a. specific outcomes of instruction:

   The objective of this course is to introduce to the Electrical Engineering students the basic of discrete time signal and systems in both the time-domain and in the transform-domain.

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

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

7. Brief list of topics to be covered:

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

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

1. Course number and name: ELEC 459 Introduction to Digital Computer Architecture and Design

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

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
    a. David A. Patterson and John L. Hennessy, Computer Organization & Design, The Hardware/Software Interface, Morgan Kaufmann, Fourth Edition, 2008. ISBN-10: 0123744938, ISBN-13: 978-0123744937
    b. MIPS assembly Language Programming, Robert L. Briton, Pearson Prentice Hall, 2003. ISBN-10: 0131420445, ISBN-13: 978-0131420441

5. Specific course information
    a. Catalog description: This course provides an understanding of the structure and operation of contemporary computer systems from the instruction set architecture level through the register transfer implementation level. The course also explores theory and application of computation, levels of abstraction, instruction set design, assembly language programming, processor data paths, data path control, pipeline design, design of memory hierarchies, memory management, and input/output. A contemporary behavioral/functional/logical simulator will be used for projects.

    b. Prerequisites or co-requisites: ELEC 312 Computer Organization II, ELEC 480 Intro to Computer Aided Digital Design, ELEC 251 Assembler and Systems, and ELEC 253 Assembler and Systems Lab.

    c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
    a. Outcomes of instruction
        i. To gain the knowledge needed to design and analyze high-performance computer architecture
        ii. To utilize the MIPS instruction set to write simple assembly language program
        iii. To compare and contrast the performance and complexity of the various hardware methods for executing assembly language programs
        iv. To evaluate and design instruction set architecture in terms of memory efficiency, performance, and capabilities.
        v. To gain the knowledge needed to design pipelined datapath for maximum throughput, and evaluate its performance.

    b. Student outcomes covered by the course:

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

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

Outcome D: ability to function on multidisciplinary team.

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

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

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

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

Course Syllabus: ELEC-467 Fundamentals of Communication Systems

1. Course number and name: 3531- 467 Fundamentals of Communication Systems

2. Credits and contact hours: 3 credits 45 contact hours

3. Instructor's or course coordinator's name: Dr. Paul Cotae

4. Text book, title, author, and year: Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)

5. Specific course information
   a. brief description of the content of the course (catalog description):

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

   b. prerequisites or co-requisites:

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

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

      elective

6. Specific goals for the course

   a. specific outcomes of instruction:

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

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

      Satisfies the following Program Outcomes:

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

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

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

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

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

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

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

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

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

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

7. Brief list of topics to be covered:

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

Course Syllabus: ELEC-469 Digital Communication Systems

1. Course number and name: 3531- 469 Digital Communication Systems

2. Credits and contact hours: 3 credits 45 contact hours

3. Instructor's or course coordinator's name: Dr. Paul Cotae

4. Text book, title, author, and year: Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)

5. Specific course information
   a. brief description of the content of the course (catalog description):

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

   b. prerequisites or co-requisites:

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

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

      Selected elective

6. Specific goals for the course

   a. specific outcomes of instruction:

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

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

Satisfies the following Program Outcomes:

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

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

B.2 An ability to design and conduct experiments, as well as to analyze and interrupt date.

2. Uses appropriate equipment and techniques for data collections.

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

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

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

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

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

1. Able to operate engineering equipment and instrumentations.

7. Brief list of topics to be covered:

   a. Analog to digital conversion:
      i. The sampling theorem, quantization, and encoding.
      ii. Pulse Code Modulation (PCM),
      iii. Differential Pulse Code Modulation (DPCM),
      iv. Delta Modulation (DM).
   b. Digital modulation in an additive White Gaussian noise baseband channel.
      i. Geometric representation of signal waveforms.
      ii. Digital Modulation Bandpass Systems : Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM).
      iii. Optimum receiver for binary modulated signals (correlation demodulator and matched filter).
      iv. M-ary pulse modulation and Probability of error for M-ary pulse modulation
   c. Digital transmission through bandlimited AWGN channels:
      i. Signal design for bandlimited channels (the Nyquist Criterion, Partial
      ii. Response Signals)
      iii. Symbol by symbol Detection of Data with controlled ISI
      iv. System Design in the presence of channel distortions.

   d. Transmission of digital information via carrier modulation.
      i. Demodulation and Detection of Amplitude Modulated Signals
      ii. Demodulation and Detection of Phase Modulated Signals
      iii. Demodulation and Detection of Frequency Modulated Signals
      iv. Comparison of Modulation Methods

   e. Selected topics in digital communications:
      Spread spectrum systems (generation and properties of pseudorandom sequences, Gold codes, direct-sequence spread-spectrum, frequency hop spread spectrum, processing gain, code division multiple access).

Course Syllabus: ELEC-470 Introduction to Control Systems & Applications

1. Course number and name: ELEC 470, Introduction to Control Systems & Applications

2. Credits and contact hours: 3 credits, 45 contact hours

3. Course Instructor: Wagdy H. Mahmoud

4. Text book, title, author, and year: *Control Systems Engineering*, *Sixth Edition*, Norman S. Nise, John Wiley & Sons, Inc. Hoboken, NJ, 2011

5. Specific course information
   a. Catalog Description: This course examines some of the techniques available for analysis and design of continuous time and discrete time feedback control systems. Topics include modeling, performance measures, transfer functions, generalized error coefficient, introduction to state-space methods, stability, controllability and observability, root locus and frequency domain analysis, compensation methods, state feedback and pole placements control system design.
   b. Prerequisites or co-requisites: Prerequisites: ELEC 371. Co-requisites: ELEC 477
   c. Required, elective, or selective elective: Required (BS in Electrical Engineering), Selective elective (BS in Electrical Engineering with Computer Engineering option)

6. Specific goals of the course
   a. Outcomes of instructions
      i. Students will be able to describe basic features and configuration of a control system
      ii. Students will be able to describe control systems analysis, design objectives, and design process
      iii. Students will be introduced to the basic techniques of time and frequency domain analysis.
      iv. Students will be able to find the transfer function representation of linear time-invariant (LTI) electrical networks and transitional mechanical systems using Laplace transform, and to produce analogous electrical and mechanical systems
      v. Student should be able to find the state-space representation for a LTI electrical and mechanical systems, and to describe their relation to frequency domain methods
      vi. Student should be able to understand the fundamental characteristics and properties of feedback control systems.
      vii. Students will be able to determine time response from state-space models and use pole-placement methods to improve system response
      viii. Students should be able to use Routh-Hurwitz table to determine the stability of a system represented in state space

ix. Students should be able to use the root locus method to design a parameter value to meet a transient response specification for a system of order two or higher

x. Student should be able to find the z-transform of a digital system

xi. Students will be able to MATLAB and SIMULINK to analyze, design, and implement control systems and compensators.

xii. Student will understand how the methodology of feedback control can be broadly applied in society to such areas as economics, biology, manufacturing, aeronautics, etc.

b. Student outcomes addressed by this course:

A-1: Solve linear ordinary differential equation models for both free and forced responses using Laplace transform.

A-2: Describe the structure of common feedback control systems using block diagram and transfer functions.

C-3: Ability to design control systems to meet desired needs and realistic constraints such as stability and performance (settling time, overshoot, and damping ratio).

E-2: Develop state space models for electrical and mechanical systems.

I-1: Use resources such as published literature and MathWorks (MATLAB, Simulink, tool boxes) manuals and tutorials to learn new materials not taught in class.

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

Course Syllabus: ELEC-473 Digital Communication Lab

1. Course number and name: 3531- 473 Digital Communication Lab

2. Credits and contact hours: 1 credit 45 contact hours

3. Instructor's or course coordinator's name: Dr. Paul Cotae

4. Text book, title, author, and year: Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)

5. Specific course information
   a. brief description of the content of the course (catalog description):
      The lab covers the most widely used digital modulation techniques, including amplitude, frequency, and phase-shift keying. The effect of noise on digital communication systems is studied, including bit-error-rate and bandwidth.
   b. prerequisites or co-requisites:
      3531-307 Probability and Statistics
      3531- 371 Signals & Systems,
      Co-requisite: 3531- 473 Digital Communications Laboratory
   c. indicate whether a required, elective, or selected elective course in the program
      selected elective.

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

Satisfies the following Program Outcomes:

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

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

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

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

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

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

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

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

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

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

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

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

7. Brief list of topics to be covered:
   a. Analog to digital conversion:
      i. The sampling theorem, quantization, and encoding.
      ii. Pulse Code Modulation (PCM),
      iii. Differential Pulse Code Modulation (DPCM),
      iv. Delta Modulation (DM).

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

   c. Digital transmission through bandlimited AWGN channels:
      i. Signal design for bandlimited channels (The Nyquist Criterium, Partial
      ii. Response Signals)
      iii. Symbol by symbol Detection of Data with controlled ISI
      iv. System Design in the presence of channel distorsion.
   d. Transmission of digital information via carrier modulation.
      i. Demodulation and Detection of Amplitude Modulated Signals
      ii. Demodulation and Detection of Phase Modulated Signals

iii. Demodulation and Detection of Frequency Modulated Signals
iv. Comparison of Modulation Methods

e. Selected topics in digital communications:
Spread spectrum systems (generation and properties of pseudorandom sequences, Gold codes, direct-sequence spread-spectrum, frequency hop spread spectrum, processing gain, code division multiple access).

Course Syllabus: ELEC-476 Fundamentals of Communication Systems Lab

1. Course number and name: 3531- 476 Fundamentals of Communication Systems Lab

2. Credits and contact hours: 1 credit 45 contact hours

3. Instructor's or course coordinator's name: Dr. Paul Cotae

4. Text book, title, author, and year:
   a. Fundamentals of Communication Systems, John G. Proakis and M. Salehi, Prentice Hall 2005 (ISBN 0-13-147135-X)
   b. Analog Communications: Vol. 1 (Instrumentation), Vol. 2 (AM/DSB/SSB), and Vol. 3 (FM/PM), Lab-Volt Ltd.
5. Specific course information
   a. brief description of the content of the course (catalog description):
      This laboratory course demonstrates many of the topics covered in the companion lecture course. Learning modules and experiments include signal analysis, band limiting of signals, and types of pulse modulation; particular emphasis is placed on pulse-code modulation (PCM) and digital multiplexing (TDM). The course uses a self-paced computer-learning module system to simulate and perform troubleshooting and measurements on communication circuits and systems.
   b. prerequisites or co-requisites:
      3531-307 Probability and Statistics
      3531- 371 Signals & Systems,
      Co-requisite: 3531- 473 Digital Communications Labor
   c. indicate whether a required, elective, or selected elective course in the program
      selected elective.

6. Specific goals for the course
   a. specific outcomes of instruction:
      The student will become familiar with the most widely used types of digital modulation employed in land-based, wireless, and optical fiber communication systems. The student will be able to analyze and design basic digital communication systems.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      Satisfies the following Program Outcomes:
      Outcome A: Knowledge of mathematics, science, and engineering and the ability to apply this knowledge in solving problems
      A-1: Applies mathematics (integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics) to obtain an analytical or numerical solution.
      Outcome B: An ability to design and conduct experiments, as well as to analyze and interrupt date.
      B-1: Uses appropriate equipment and techniques for data collections.
      Outcome C: Ability to design and realize electrical and electronics components, systems, or processes to meet desired needs and realistic constraints such

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

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

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

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

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

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

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

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

7. Brief list of topics to be covered:
   a. Analog to digital conversion:
      i. The sampling theorem, quantization, and encoding.
      ii. Pulse Code Modulation (PCM),
      iii. Differential Pulse Code Modulation (DPCM),
      iv. Delta Modulation (DM).

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

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

   d. Transmission of digital information via carrier modulation.
      i. Demodulation and Detection of Amplitude Modulated Signals
      ii. Demodulation and Detection of Phase Modulated Signals
      iii. Demodulation and Detection of Frequency Modulated Signals
      iv. Comparison of Modulation Methods

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

1. Course number and name: ELEC 477, Introduction to Control Systems & Applications Laboratory

2. Credits and contact hours: 1 credits, 45 contact hours

3. Course Instructor: Wagdy H. Mahmoud

4. Text book, title, author, and year: *Control Systems Engineering*, *Sixth Edition*, Norman S. Nise, John Wiley & Sons, Inc. Hoboken, NJ, 2011

5. Specific course information
   a. Catalog Description: Experiments include simulation of continuous time and discrete time feedback control systems, such as modeling, performance measures, transfer functions, generalized error coefficient, introduction to state-space methods, stability, controllability and observability, root locus and frequency domain analysis, compensation methods, state feedback and pole placements, and control system design.
   b. Prerequisites or co-requisites: Prerequisites: ELEC 371. Co-requisites: ELEC 470
   c. Required, elective, or selective elective: Required (BS in Electrical Engineering), Selective elective (BS in Electrical Engineering with Computer Engineering option)

6. Specific goals of the course
   a. Outcomes of instructions
      i. Student should be able to use MATLAB and the Symbolic Math Toolbox to (1) verify the behavior of closed-loop systems, (2) generate and manipulate polynomials and transfer function, (3) perform partial-fraction expansions, (4) find Laplace transforms for time functions, (5) find time functions from Laplace transforms, (6) create LTI transfer functions from symbolic transfer functions, (7) perform solutions of symbolic simultaneous equations, (8) generate an LTI state-space representation of a system, (9) convert an LTI state-space representation of a system to an LTI transfer function, and (10) design the gain of a controller via root locus
      ii. Students should be able to use Simulink to: (1) evaluate the effects of pole location upon the time response systems (percent overshoot, settling time, peak time, rise time) for both first- and second-order, (2) evaluate the effect of additional poles and zeros upon the time response of second-order systems, (3) evaluate the effect of the gain of a closed-loop system upon transient response and steady-state errors, (4) verify the equivalency of the basic forms, including cascade, parallel, and feedback forms, (5) verify the equivalency of the basic moves, including moving blocks past summing junctions, and moving blocks past pickoff points, (6) evaluate the effect of pole location and loop gain in a negative feedback system upon stability, (7) verify and evaluate the effect of input waveform, loop gain, and system type upon steady- state errors, (8) verify

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

b. Student outcomes addressed by this course:

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

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

Course Syllabus: ELEC-478 Digital Integrated Circuits Design

1. Course number and name: ELEC 478 Digital Integrated Circuits Design

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

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
   CMOS Digital Integrated Circuits: Analysis and Design, S. Kang, and Y. Leblebigi, Third Edition, McGraw Hill, 2003.

5. Specific course information
   a. Catalog description: Analysis, design and layout of complex digital integrated circuits in MOS Technology. The course emphasizes design through projects, and requires extensive use of simulation and layout CAD tools.

   b. Prerequisites or co-requisites: ELEC 312 Computer Organization II and ELEC 479, Digital Integrated Circuits Design Lab.

   c. Required elective or selective elective? Required for Computer Engineering.

6. Specific goals for the course
   a. Outcomes of instruction
      i. To provide the students with concepts and techniques of analysis, design, and layout of CMOS digital integrated circuits.
         1. Students learn the trends in semiconductor technology, and how it impacts scaling and performance.
         2. Students understand the concept of design rules.
         3. Students have an understanding of the characteristics of CMOS circuit construction.
      ii. To apply the techniques on more complex designs such as arithmetic building blocks.
         1. Students can use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
         2. Be able to create models of moderately sized CMOS circuits that realize specified digital functions.
      iii. To analyze the impacts of various timing methodologies on the performance and functionality of sequential digital circuits.
         1. Students examine the time-domain behavior of bistable elements and sequential MOS logic circuits.
      iv. To utilize CAD tools to explore design alternatives.
         1. Students can apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.

2. Students can design static CMOS combinational and sequential logic at the transistor level, including mask layout.

b. Student outcomes covered by the course:

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

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

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

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

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

Outcome D: ability to function on multidisciplinary team.

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

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

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

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

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

7. Topics covered

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

Course Syllabus: ELEC-479 Digital Integrated Circuit Design Lab

1. Course number and name: ELEC 479 Digital Integrated Circuit Design Lab

2. Credit and contact hours: 1 credit, 15 contact hours

3. Course coordinators: Dr. Nian Zhang

4. Textbook, title, author, and year:
   Tutorials provided by the instructor.

5. Specific course information
   a. Catalog description: Provides VLSI design experience that includes design of basic VLSI CMOS functional blocks, verification of the design, testing, and debugging. Several complex VLSI projects will be submitted for fabrication.

   b. Prerequisites or co-requisites: ELEC 478 Digital Integrated Circuit Design.

   c. Required elective or selective elective? Required for Computer Engineering.

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

   b. Student outcomes covered by the course:

   <u>Outcome C</u>: an ability to design a system, component, or process to meet desired needs within realistic.
   - C-1: analyzes needs to produce problem definitions for electrical and/or electronic devices and systems including hardware and/or software components.
   - C-4: Can build prototypes to meet design specifications.

   <u>Outcome D</u>: ability to function on multidisciplinary team.
   - D-1: share responsibilities and information on schedule with others on the team.

   <u>Outcome E</u>: ability to identify, formulates, and solves problems encountered in the practice of electrical engineering.
   - E-1: classifies information to identify engineering problems.
   - E-2: uses analytical, computational, and/or experimental methods to obtain solutions.

   <u>Outcome G</u>: ability to communicate effectively.

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

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

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

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

Course Syllabus: ELEC**-480 Digital Design and Synthesis**

1. Course number and name: ELEC 480, Digital Design and Synthesis

2. Credits and contact hours: 2 credits, 30 contact hours

3. Course Instructor: Wagdy H. Mahmoud

4. Text book, title, author, and year: *VHDL for Engineering*, Kenneth L. Short , Prentice Hall, 2009

5. Specific course information
   a. Catalog Description: Introduces the techniques of modeling digital systems at various levels of abstraction and computer-aided design algorithms applied to these models to support design and analysis tasks. Covers modeling through the use of a modern hardware description language (VHDL/Verilog), test generation, event-driven simulation algorithms, and physical design used to map the synthesized logic design onto physical IC area. This is not a how-to course on using CAD tools; it is a study of the algorithms used by CAD tools.
   b. Prerequisites or co-requisites: Prerequisites: ELEC 312. Co-requisites: ELEC 483
   c. Required, elective, or selective elective: Required (BS in Electrical Engineering with Computer Engineering option) , Selective elective (BS in Electrical Engineering)

6. Specific goals of the course
   a. Outcomes of instructions
   i. The student will demonstrate knowledge in number systems and application of Boolean algebra in the areas of digital circuits and systems.
   ii. The student will demonstrate knowledge and an ability to analyze simple combinational (decoders, encoders, multiplexers, demultiplexers, etc.), sequential circuits (registers and counters), main storage devices (flip flops and latches), and state machines
   iii. Demonstrate the ability to create combinational and sequential designs utilizing three basic VHDL modelling styles: data flow, structural, and behavioural.
   iv. The student will demonstrate an ability for hardware design utilizing the three basic VHDL modelling styles: data flow, structural, and behavioural
   v. The student will demonstrate an ability to design optimized synchronous and asynchronous circuits
   vi. The student will demonstrate an ability to design a VHDL test bench for validation of a component design.
   vii. The student will demonstrate an understanding of the design options to implement digital systems in hardware and their cost benefit tradeoffs
   viii. The student will demonstrate an ability to discuss major trends in industry and current research activities within the continually changing field of computer architecture design.

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

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

Course Syllabus: ELEC-483 Digital Design and Synthesis Laboratory

1. Course number and name: ELEC 483, Digital Design and Synthesis laboratory

2. Credits and contact hours: 1 credits, 45 contact hours

3. Course Instructor: Wagdy H. Mahmoud

4. Text book, title, author, and year: *VHDL for Engineering,* Kenneth L. Short , Prentice Hall, 2009

5. Specific course information
   a. Catalog Description: The course emphasizes the use of computer-aided design (CAD) tools in the description, modeling, simulation, verification and testing of digital systems. Alternative coding styles and methodology used for combinational and sequential digital logic designs are evaluated. The use of Field Programmable gate arrays is integrated into the course as the target physical domain.
   b. Prerequisites or co-requisites: Prerequisites: ELEC 312. Co-requisites: ELEC 483
   c. Required, elective, or selective elective: Required (BS in Electrical Engineering with Computer Engineering option) , Selective elective (BS in Electrical Engineering)

6. Specific goals of the course
   a. Outcomes of instructions
   i. Students will be able to describe the architecture and basic building blocks of a standard Field Programmable Gate Array (FPGA) logic device.
   ii. Students will be able to describe the advantages and disadvantages the cost benefit and tradeoffs associated with the use programmable logic devices such as of FPGAs.
   iii. Students will demonstrate knowledge and an ability to design simple combinational (decoders, encoders, multiplexers, demultiplexers, etc.), sequential circuits (registers and counters), main storage devices (flip flops and latches), and complex state machines.
   iv. Students will demonstrate an ability for developing combinational and sequential designs on programmable logic devices utilizing the three basic VHDL modelling styles: data flow, structural, and behavioural
   v. Students will demonstrate an ability to design, synthesize and implement optimized synchronous and asynchronous circuits
   vi. Students will be able to demonstrate the ability to optimize the performance of serial designs through the use of Intellectual Product (IP) components, and the implementation of parallel and pipelined design techniques.
   vii. Students will be able to analyze the performance of hardware systems using simulation tools.
   viii. Students will demonstrate an ability to design a VHDL test bench for validation of a component design.
   ix. Students will demonstrate the ability to design implement and verify the operations of a

functioning simple microprocessor with CPU, memory, and I/O ports in a FPGA device.

x. Students will demonstrate the ability to synthesize a digital system using hardware description language and proprietary design tools (such as Xilinx Integrated Design Environment (ISE) software).

xi. Students will demonstrate an ability to discuss major trends in industry and current research activities within the continually changing field of computer architecture design and the need for continuing education.

b. Student outcomes addressed by this course:

i. Student outcomes:

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

7. Topics covered

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

Course Syllabus: ELEC-495 SENIOR PROJECT I

1. Course number and name: ELEC 495 SENIOR PROJECT I

2. Credit and contact hours: 3 credits, 60 contact hours

3. Course coordinators: Dr. Esther T. Ososanya and Dr. Wagdy Mahmoud

4. Textbook and other Required Materials, title, author, and year:
    a. Material dependent upon project: course materials pertinent to the individual projects are provided either electronically or through hand-outs as needed.
    b. Manufacturer's data manuals as available on product websites
    c. The IEEE digital library: available on-line through the UDC library web site, for literature search.

5. Specific course information
    a. Catalog description: Conceptualization, design, building, testing and promulgation of an electrical engineering project by the student under the supervision of a faculty member.
    b. Prerequisites or co-requisites: Prerequisites: ELEC 351 and ELEC 313
    c. Required elective or selective elective: Required for both Electrical Engineering and Electrical Engineering with Computer Engineering option.

6. Specific goals for the course:

a. Outcomes of instructions: At the end of this course students should be able to:

- i. Explain the steps involved in an engineering design process
- ii. Articulate the benefits of mathematics, natural sciences, computer science, and applied sciences in the field of engineering.
- iii. Demonstrate the ability to analyze new and unfamiliar engineering problems, reference it against known and familiar information, and to adapt known knowledge in solving new engineering problems.
- iv. Demonstrate the ability to identify and develop research ideas that responds to a specific need.
- v. Design a system, component, or program to solve appropriate engineering problem or address a desired need.
- vi. Use professional hardware/software design and computer-aided design tools in the implementation and validation of the design
- vii. Design a system within a set of realistic constraints including most of the following considerations: economic; environmental; sustainability; ethical; manufacturability; health and safety; and social.
- viii. Function effectively on a multidisciplinary team.
- ix. Exhibit knowledge of professional ethical codes.
- x. Use external resources to obtain technical information necessary to complete the design of a system, component, or program.
- xi. Demonstrate the ability to cite sources used in research.
- xii. Write a final design report describing the design and validation test using the IEEE writing format.

Student outcomes addressed by this course:

Assessed for Program Outcomes:

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

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

Outcome F: An understanding of professional and ethical responsibilities

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

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

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

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

Others:

D-1. Share responsibilities and information on schedule with others on the project team.

D-2. Participate in the development and selection of ideas for the projects.

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

H-2. Examine economic tradeoffs in engineering systems.

H-3. Evaluate engineering solutions that consider environmental factors.

J-1. Describe the impact of contemporary issues (such as environmental, global trade, economic, health, safety trade-offs, and emerging technologies).

J-2. Describe impact of engineering decisions on energy resources.

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

Course Syllabus: ELEC-496 SENIOR PROJECT II

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

b. Student outcomes addressed by this course:

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

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

<u>Outcome D</u>: An ability to function on multidisciplinary team

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

Outcome G: An ability to communicate effectively

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

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

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

Others:

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

7. Topical Coverage

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

Course Syllabus: MECH-478 Mechatronics

1. Course number and name: MECH-478 Mechatronics

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

3. Course coordinators: Dr. Esther T. Ososanya and Dr. Devdas Shetty

4. Textbook, title, author, and year:
   a. Mechatronics System Design, Devdas Shetty and Richard A. Kolk, 2011, second edition, Cengage Learning
   b. Software and Hardware Engineering, Fredrick M Cady and James M. Sibigtroth, 2000, Oxford University Press

5. Specific course information
   a. Catalog description: Fundamental concepts in mechatronics including instrumentation, integration of mechanical, electronics, and control engineering. Operating principles of electromechanical actuators, motors, sensors, drives, and analog motion control. Modeling, simulation, analysis, virtual prototyping and visualization of mechanical systems, and Applications of microprocessors, and microprocessor interfacing to eletromechanical systems.
   b. Prerequisites or co-requisites: ME 3511-381, Senior EE or ME Standing
   c. Required elective or selective elective? Required for ME, selective elective for EE.

6. Specific goals for the course
   a. Outcomes of instruction
      i. Learn assembly language programming
      ii. Student can program a microcontroller, wrote assembly language codes, develop, debug, and implement real-time software for a specific application
      iii. Learn microcontroller architecture
      iv. Student can complete the real-time interface design to a microcontroller for the control of a specific peripheral device, perform data acquisition, and control the system.
      v. Be able to identify the appropriate sensors and actuators for a specific application
      vi. Students learn the basics of sensor and actuator theory, design, and application.
      vii. Students can understand the selection and use of appropriate transducers and actuators for a specific application
      viii. Learn Modeling and Simulation of Physical Systems
      ix. Students understand mechatronics design process and learn the basics of digital electronics and mechatronic system elements.
      x. Students understand modeling and simulation of physical systems, using the notion of Transfer Functions, Direct and Analog Block Diagram Modeling
      xi. Students understand the connection between the mathematical model and physical system

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

b. Student outcomes addressed by the course

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

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

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

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

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

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

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

C-3: Can work within realistic constraints, (such as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability) in realizing systems
Carry out a real life mechatronics project with realistic constraints such as operability, economic, and safety factor.
Carry out experiments on actual systems involving monitoring and control.(One example involves the application of electronic damping for Mass-spring-damper system)

Outcome D: An ability to function on multidisciplinary team

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

7. Topics covered

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

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

Appendix B – Faculty Vitae

FACULTY VITAE

1. Name: Tarak Bhar

2. Education

B.S. Electrical Engineering	Calcutta University	1964
M.S. Electrical Engineering	Calcutta University	1965
M.S. Physics	Baylor University	1970
Ph.D. Electrical Engineering	Texas A&M University	1973

3. Academic experience:

University of the district of Columbia	Professor	Aug 1973- present
Howard University	Asst. Professor	Aug. 1973- May 1979

4. Non academic experience:

Naval research Laboratory	Summer Consultant	1995-2012

5. Certification or professional registrations: None

6. Membership in professional organizations; IEEE., ASEE

7. Honors and Awards:
   a. Listed **in Who's Who in America, 2011**
   b. Listed in Directory of World Researchers, 1981
   c. Listed in Who's Who in the East, 1980

8. Service activities
   a. Member, dept. curriculum committee 2009-present
   b. Member, dept. evaluation and promotion committee

9. Publications and presentations from past five years:
   a. Ultrafast Carrier Relaxation in Si, NRL, Washington DC. 2010
   b. SerDes Transreceiver for High Speed Serial Communication, NRL, 2011

10. Recent professional development activities
   a. BAE Systems DTRA Quarterly Review Workshop June 2010 at Manassas, Virginia
   b. 2010 Ieee NSREC at Denver, Colorado.
   c. Short course on Custom IC & Memories July 2010
   d. Radiation Effects Data Workshop July 2010
   e. High Performance Computing Modernization Program at Army Research Lab. 2010
   f. 2011 IEEE NSREC at Las Vegas, Nevada, July 2011
   g. NASA Electronic Parts and Packaging (NEPP) Program's Workshop 2011
   h. NSF MRI Workshop, 2012

FACULTY VITAE

1. **Name**: Dr. Paul Cotae

2. **Education**:

Technical University of Iasi, Romania	Electrical Engineering	B. S.	1980
Technical University of Iasi, Romania	Electrical Engineering	M S.	1980
"Polytechnica" University, Bucharest, Romania	Telecommunications	Ph.D.	1992
University of Colorado at Boulder	Applied Mathematics	M.S.	1998

3. **Academic experience**:

University of the District of Columbia	Professor	2013 – FT
University of the District of Columbia	Associate Professor	2008 – 2013, FT
University of Texas at San Antonio	Assistant Professor	2002 – 2008, FT
Technical University of Iasi, Romania	Professor	1998 – 2004, FT
Technical University of Iasi, Romania	Associate Professor	1992 – 1998, FT
Technical University of Iasi, Romania	Lecturer	1990 – 1992, FT
Technical University of Iasi, Romania	Assistant Professor	1984 – 1990, FT

4. **Non-academic experience:**
   2009 - 2013: ONR Faculty Fellow for the ONR-ASEE Summer Faculty Research Program, Naval Research Laboratories, Washington DC, PT
   1997 – 1999: Consultant, Global Positioning Systems, Navsys Corp., Colorado Springs, Colorado, PT
5. **Certifications or professional registrations:** None.
6. **Current membership in professional organizations:** IEEE, ASEE
7. **Honors and awards**

Academic (selected)

- 2013: Selected in Top 25 Professors at Affordable Historically Black Colleges by Affordable College Online.
- 2013: Faculty Recognition Award for "Outstanding Research and Professional Service" in the School of Engineering and Applied Sciences at the University of the District of Columbia, May 1st , 2013.
- 2013: Chair of the ASEE Mid-Atlantic Conference at UDC, October 11-12, 2013.
- 2010: UDC School of Engineering and Applied Sciences: Award for Outstanding Contributions to Research and Professional Service, April 20, 2010.

IEEE Honors and Awards (selected)

- Associate Editor for the IEEE Communication Letters journal (2003-2012).
- 2013 IEEE Distinguished Service Award in recognition of "Outstanding Leadership of the Communication Society and receiving the GLOBECOM 2016 Executive Chair Leadership" from the IEEE Washington Section, May 25, 2013.
- 2013 IEEE Washington Section Chair Award in recognition and appreciation for "Distinguished service and outstanding leadership as IEEE Washington Section Chair in 2012" from IEEE Washington Section, May 25, 2013.
- 2011 IEEE Communication Society: North America Region Chapter Achievement Award (CAA ComSoc), Citation "For achieving excellence in chapter activities and for contributions in furthering the objectives of the society".

- 2011 IEEE Communication Society: Chapter of the Year Award (CoY ComSoc), Citation "For achieving the highest excellence in chapter activities and for outstanding contributions furthering the objectives of the society".
- IEEE Washington D.C. Section: *Chair* 2012, *Vice Chair* 2011.

8. **Service activities** **Within of the institution (selected)**

Chair - Engineers Week at UDC, February 2009 – February 2012, Research Group Coordinator SEAS AY 2009- AY 2012, Member – Graduate Committee MSEE, Fall 2010, AY 2011 - AY 2012, Member – MSEE graduate program curriculum (since 2009),Member – UDC Electrical Engineering Department Curricular Committee (since 2008).

Outside the institution (selected)

- NSF Reviewer: August 2009, Innovative Technology Experiences for Student and Teachers (ITEST) April 2010,The Transforming Undergraduate Education in Science Technology (TUES) July 2010, July 2011 and July 2012.
- Conference Session Chair (8), Conference Organizer (4), Associate editor (3 journals), IEEE Reviewer.

9. **Briefly list the most important publications and presentations from the past five years: 5 (out of 3 journal papers, 16 conference papers, 5 invited talks and 35 paper presentations)**

[1] M. Shadaram, **Paul Cotae**, C. Lacatus,"Introduction to the Special Issue on "Wireless systems: Modeling, monitoring, transmission, performance evaluation and optimization", (Guest Editorial), *International Journal on Computers and Electrical Engineering*, Vol.39, issue 6, pp.1585-1586, Aug. 2013.

[2] Ira S. Moskowitz**, Paul Cotae,** Myong H. Kang, Pedro N. Safier, "Capacity Approximations for a Deterministic MIMO Channel", *Advances in Electrical and Computer Engineering*, Vol. 11, no. 1, pp. 3-10. Sept. 2011, *(5 citations).*

[3]Ira S. Moskowitz, Pedro N. Safier **Paul Cotae**, "Algebraic Information Theory and Kosko's Forbidden Interval Theorem", *Proceedings of the IASTED International Conference Advances in Computer Science (ACS)*, April 10-12, 2013 Phuket Thailand, *DOI: 10.2316/P.2013.801-053,* pp.337-343, April 2013.

[4] Hadis Dashtestani, **Paul Cotae** and Ira S. Moskowitz, "On the Optimal Placement of Underwater Sensors in a Tree Shaped Multi-hop Hierarchical Network" *Proceedings of the IEEE 47th Annual Conference on Information Sciences and Systems* - CISS 2013, John Hopkins University, March 21-22, pp.1-6, March 2013.

[5] **Paul Cotae** and Ira S. Moskowitz, "On the Partial Ordering of the Discrete Memoryless Channels Arising in Cooperative Sensor Networks", *Proceedings of 4th International Conference on New Technologies, Mobility and Security*, NTMS'2011, Paris, France, February 7-10, pp.1-6, 2011, *(1 citation).*

10. **Briefly list the most recent professional development activities**

NSF MRI Workshop 2013, ABET Workshop 2013, NSF Advanced Writing Grant Workshop 2012, UDC STEM Workshop 2012, PKAL Workshop 2011, NSF HBCU Workshop 2011, NI Workshop 2010, etc.

FACULTY VITEA

1. **Name: Dr. Sasan Haghani**

2. **Education**:

Isfahan University of Technology, Iran	Electrical Engineering	B.S	2000
University of Alberta, Canada	Electrical Engineering	MS.	2002
University of Alberta, Canada	Electrical Engineering	Ph.D.	2007

3. **Academic experience**:

University of the District of Columbia	Assistant Professor	2013-present FT
University of South Alabama	Assistant Professor	2007-2009 FT

4. **Non-academic experience: None**

5. **Certifications or professional registrations:** None.

6. **Current membership in professional organizations:** IEEE

7. **Honors and awards**

- Faculty Recognition Award for Excellence in Teaching and Mentoring, School of Engineering
- and Applied Sciences, University of the District of Columbia, 2012.
- Alberta Ingenuity Fund Scholarship, 2002-2007.
- Alberta Informatics Circle of Research Excellence (iCORE) Scholarship, 2003-2007.
- J. Gordin Kaplan Graduate Student Award, 2003.
- University of Alberta International Student Di erential Fee Tuition Waiver, 2000-2001.
- First Rank award in the B.Sc., Isfahan University of Technology, Isfahan, IRAN, 2000.

8. **Service activities**

- Reviewer for the National Science Foundation for the TUES and HBCU-UP Proposals.
- Reviewer for several IEEE journals including IEEE Transactions on Communications, IEEE Transactions on Wireless Communications, IEEE Transactions on Vehicular Technology and IEEE Communications Letters.
- Reviewer for several IEEE conferences including IEEE International Conference on Communications, IEEE Global Communications Conference, IEEE Wireless Communications & Networking Conference and IEEE Vehicular Technology Conference.
- Session Chair for IEEE Wireless Communications and Networking Conference, Las Vegas, NV, USA, April 2008.
- Session Chair for the 68th Annual Joint Meeting of the BKX/NIS.
- Judge at the 2012 Emerging Researchers National Conference.
- Judge at the 2012 and 2013 Annual Biomedical Research Conference for Minority Students.

9. **Briefly list the most important publications and presentations from the past five years:**

S. Haghani, and H. Dashtestani, "BER of Noncoherent MFSK with Postdetection Switch-and-Stay Combining in TWDP Fading," *Proc. of IEEE Vehicular Technology Conference*, Quebec City, QC, Canada, Sept. 3-6, 2012.

S. Haghani, "Bit Error Rate of Noncoherent MFSK with S + N Selection Combining in Two Wave with Diffuse Power Fading," *Proc. of IEEE Global Communications Conference,* Houston, TX, Dec. 5-9, 2011.

S. Haghani, "Average BER of BFSK with Postdetection Switch-and-Stay Combining in TWDP Fading," *Proc. of IEEE Vehicular Technology Conference,* San Francisco, CA, Sept. 5-8, 2011.

S. Haghani and N. C. Beaulieu, "On Decorrelation in Dual-Branch Diversity Systems," *IEEE Transactions on Communications*, vol. 57, pp. 2138-2147, July, 2009.

S. Haghani and N. C. Beaulieu, "Performance Analysis of S+N Selection Diversity Receivers in Correlated Rayleigh and Rician Fading," IEEE Transactions on Wireless Communications, vol 7, pp. 146-154, Jan. 2008.

S. Haghani and N. C. Beaulieu, "Predetection Switched Combining in Correlated Rician Fading," IEEE Transactions on Wireless Communications, vol. 6, pp. 2788-2792, Aug. 2007.

S. Haghani, N. C. Beaulieu and M. Z. Win, "Penalty of Hybrid Diversity with Uncoded Modulation in Slow Rayleigh Fading," IEEE Transactions on Wireless Communications, vol. 5, Issue 9, pp. 2363-2368, Sept. 2006.

S. Haghani and N. C. Beaulieu, "Accurate Analyses of Postdetection Switch-and-Stay Diversity in Rician Fading," IEEE Transactions on Communications, vol. 54, pp. 1175-1178, July 2006.

10. Briefly list the most recent professional development activities

NSF Workshop 2012
ABET Workshop 2012
NSF Advanced Writing Grant Workshop 2012
UDC STEM Workshop 2011.

FACULTY VITAE

1. **Name**: Wagdy H. Mahmoud

2. **Education**

Degree	Discipline	Institution	Year
B.S.	Electrical Engineering	Ain Shams University, Cairo, Egypt	1975
M.S.	Computer Science	The University of Alabama, Tuscaloosa, AL	1989
M.S.	Electrical Engineering	The University of Alabama, Tuscaloosa, AL	1991
Ph.D.	Electrical Engineering	The University of Alabama, Tuscaloosa, AL	1997

3. **Academic Experience**

Institution	Rank/Title	Dates Hold	FT/PT
University of DC	Associate Professor	Aug 2004 – present	FT
Tennessee Technological University	Assistant Professor	Aug 1998 – Aug 2004	FT
Vanderbilt University, Summer Internship Research Program	Visiting Assistant Professor	Summer 2003 Summer 2004	PT
University of South Alabama	Visiting Assistant Professor	Jan 1998 – Aug 1998	FT
Shelton Community College, AL	Instructor	Jan 1994 – Aug 1995	PT

4. **Non-academic experience**

Organization	Title	Duties	Dates	FT/PT
Arab Republic of Egypt Telecommunication	Telecommunication Engineer – Manager	Manager of operation and maintenance	1997 – 1987	FT

5. **Certifications or professional registration**: PE Maryland

6. **Membership in professional organizations:** Senior Member: IEEE Computer Society, Member: IEEE Signal processing Society, Member: American Society for Engineering Education (ASEE)

7. **Honors and awards**
   a. UDC Faculty recognition award for outstanding services to programs in SEAS (2013)
   b. Eta Kappa Nu
   c. Tau Beta Pi

8. **Service activities**

a. Member of the Faculty Senate of the University.
b. Member of the Academic Senate Policy and Procedure subcommittee (ASPPC) of the FS.
c. Member of the UDC Graduate Council
d. Director of graduate program at the ECG department.
e. Chair of the DEPC committee in the ECG department.
f. Member of the On-Line learning university-wide committee representing SEAS.
g. Member of the university-wide General Education committee representing SEAS.

h. Faculty advisor for IEEE and HKN Student Chapter.

9. Publications and presentations from past five years

a. **Wagdy H Mahmoud**, "Incorporating System-Level Design Tools into Upper-Level Electrical Engineering Courses," International Journal of Modern Engineering, IJME Spring/ Summer 2009 issue (Volume 9, Number 2), pp. 35-42.
b. **Wagdy H. Mahmoud**, Nian Zhang,"Software/Hardware Implementation of an Adaptive Noise Cancellation System," Proceedings of the 2013 ASEE Annual Conference and Exposition, Atlanta, GA, June 23 - 26, 2013.
c. Esther Ososanya, **Wagdy H. Mahmoud**, Sasan Haghani, et al, "The Design of a Wi-Fi Enabled Cloud Monitoring Device**, "**Proceedings of the 2013 ASEE Annual Conference and Exposition, Atlanta, GA, June 23 - 26, 2013.
d. **Wagdy H. Mahmoud**, Esther Ososanya, "ANAEROBIC DIGESTOR OF ORGANIC WASTE PROCESSING:A BIOMASS ENERGY PRODUCTION PROJECT," Proceedings of the 2012 ASEE Annual Conference and Exposition, San Antonio, TX, June 23 - 26, 2012
e. **Wagdy H Mahmoud**, "Incorporating Soft Core and hard Core in Capstone Design Courses, "Proceedings of The 2009 ASEE Annual Conference and Exposition, Austin TX, June 14 - 17, 2009.

10. Recent professional development activities

a. Xilinx workshop "Introduction to Embedded System Design and High Level Synthesis using Vivado," University of Illinois, Urbana Champaign, IL, November 2013
b. The The American Society of Engineering Education 2012 Annual Conference, Atlanta, GA, June 23-26, 2013
c. The American Society of Engineering Education 2012 Annual Conference, San Antonio, TX, June 10-13, 2012
d. ABET, "Advanced Assessment Workshop", Baltimore, MD, October 2013
e. ABET "Fundamentals of Program Assessment Workshop," Seattle, WA, September 2013
f. The JEOM Workshop at the Army Research Laboratory (ARL) APG, Maryland, June 2010
g. The ONR-NSF sponsored Faculty Workshop on Power Systems, the University of Minnesota in Minneapolis, Minnesota, June 2010
h. The University of the District of Columbia workshop, "Proposal Writing Mini Workshop," October, 2010.

FACULTY VITAE

1. **Name**: Dr. Samuel Lakeou

2. **Education**:

Ph.D. Electrical Engineering, 1978 (with Highest Honors, "Mention Tres Bien et Felicitations du Jury"), Ecole Nationale d'Electronique et de Radioelectricte de Grenoble (ENSERG) of the National Polytechnic Institute of Grenoble (France)
M.Sc. Electrical Engineering, 1976, University of Grenoble I (Joseph Fourier)
B.Sc. Electrical Engineering, 1974, University of Grenoble I (Joseph Fourier)

3. **Academic experience**:

Advancement in rank:
1988-present: **Professor** of Electrical Engineering, Department of Electrical and Computer Engineering, University of the District of Columbia (UDC). FT
1986-1988: **Associate professor**, Department of Electrical Engineering, UDC, FT
1979-1981: **Assistant Professor**, Department of Electrical Engineering, UDC, FT
1978-1979: **Assistant Professor**, Technical College of Trappes, France, PT

4. **Non-academic experience**:

2000-2006: SFA, Inc. , **Engineering Consultant** for the Naval Research Lab.
Major responsibilities: Design of a CNC controller apparatus for a rapid prototyping laser system of direct-write electronic circuit
1984-1986: **Member Engineering Staff, RCA, New Products Laboratory**, Consumer Electronics Division, and Indianapolis IN

5. **Certifications or professional registrations:** None

6. **Current membership in professional organizations: Senior member** IEEE, member ASEE

7. **Honors and awards**

   2009-2010: Fulbright Research Fellow, Bahir Dar University, Ethiopia; Eta Kappa Nu Engineering Honor Society; Academic excellence scholarship from the French government from 1970 until 1978

8. **Service activities (within the institution)**

2013-present: Chairman, Department of Electrical and Computer Engineering and **Acting Assistant Dean**, School of Engineering and Applied Sciences, UDC
2010-2013: **Chairman,** Department of Electrical and Computer Engineering**, Acting Chairman**, Department of Civil and Mechanical Engineering and **Acting Assistant Dean**, School of Engineering and Applied Sciences, UDC
2009-2010: **Chairman**, Department of Electrical and Computer Engineering and **Acting Assistant Dean**, School of Engineering and Applied Sciences, UDC
2003-2009: **Chairman,** Department of Electrical and Computer Engineering, UDC
2006-Present: **Director**, Center of Excellence for Renewable Energy (www.udc.edu/cere), UDC

2001-2003: **Chairman,** Department of Electrical Engineering & Computer Science
1997-2001: Engineering Program Director, Electrical, Mechanical and Civil Engineering
1988-1993: Chairman, Department of Electrical Engineering, UDC
1986-1987: Program Coordinator, Program of Electrical Engineering**, UDC**

9. Publications (in last 5 years):

- *Mobile Solar Power Delivery System for Rural Applications*, **S. Lakeou et al**. first AfricaPVSEC2014 conference, Durban, South Africa conference proceedings, **March 2014**
- *UDC-BDU Partnership: Renewable Energy Project at Bahir Dar University*, **S. Lakeou, et. al.,** 28th European Photovoltaic Solar Energy Conference & Exhibition, Paris, France, **2013**
- *Survey of Renewable Energy Installations in Rural Ethiopia and Design of a Low Cost Inverter for Rural Applications*, **S. Lakeou**, M. Mengesha, G. Gelalcha, 27th European Photovoltaic Solar Energy Conference & Exhibition, Frankfurt Germany, **2012**
- *Completion of a Model, Low Cost, Novel PV Powered Water Delivery Project in Rural Ethiopia*, **S. Lakeou**, M. Mengesha, G. Gelalcha, 27th European Photovoltaic Solar Energy Conference & Exhibition, Frankfurt Germany, **2012**
- *Successful Hybrid Solar and Wind Based Renewable Energy Project In Rural Ethiopia* , **S. Lakeou**, B. Latigo, 25th European Photovoltaic Solar Energy Conference & Exhibition, Valencia, Spain, **2010**
- *Design And Implementation of A Virtual Web Based Power Measurement Module For A Hybrid Renewable Power System,* E. Ososanya, **S. Lakeou**, W. Mahmoud, P. KC, L. Kemathe , A. Ukaegbu , R. Kamdem, **ASEE10** Annual Conference Proceedings
- *Undergraduate Research in New Concept in Solar Energy Capture: Theory, Modeling, and Simulation*, **S. Lakeou,** E. Ososanya, W. Mahmoud, F. Mbengue, A. Sirag, B. Latigo, B. Coboyo, American Association for Engineering Education Annual Conference, Pittsburg, PA, **2008**

FACULTY VITAE

1. Name: Esther T. Ososanya

2. Education

B.S Physics, University of Aston, Birmingham, UK, 1976
M.S Electrical Engineering, University of Southampton, Southampton, UK, 1978
Ph.D. Electrical Engineering, University of Bradford, Bradford, UK, 1985

3. Academic Experience:

University of the District of Columbia, Professor, BSEE Program Director, 2001–Present, FT
Tennessee Technological University, Associate Professor, 1993-2000, FT
Michigan Technological University, Visiting Professor, 1989-1993, FT
University of Birmingham, Birmingham, UK, Post-doctoral Research Fellow, 1985-1988, FT

4. Non-academic experience

Dextralog Scantex, Blackpool, UK, Software Development Engineer, 1988-1989, FT
Mullards Southampton, Southampton, UK, Assistant Engineer, Integrated Circuit Design, 1978-1980, FT

5. Certifications or professional registrations: None

6. Current membership in professional organizations: Member IEEE, ASEE

7. Honors and awards:

School of Engineering Outstanding Contribution in Undergraduate Research, 2010

8. Service activities (within and outside of the institution):

•
   a. ECG Department ABET Self-study report coordinator, 2013-present.
   b. Chair, University Student Appeal Committee, 2008-present
   c. Member and Standing Committee Chair for University Senate, 2005 – 2009
   d. Secretary, NEA Faculty Association, 2010-present
   e. Project Coordinator, Luis Stoke Armstrong for Minority Participation, LSAMP, 2006-2010

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

- Ososanya, E., Haghani, S., Mahmoud, W., Lalindra Jayatilleke, Abayomi, Dairo, and Sewnet Temesgen, “The Design of a Wi-Fi Enabled Cloud Monitoring Device”, Proceedings of the ASEE Annual Conference and Exposition, Paper ID #7655, Atlanta, Georgia, June 23-26, 2013..
- W. Mahmoud, E. Ososanya, P. Behera, A. Adebayo, and X. Song, “Anaerobic Digestor of Organic Waste Processing: A Biomass Energy Production Project”, AC 2012-3784, American Society for Engineering Education, 2012 Conference Proceedings, June 2012.

- Ososanya, E., Mahmoud, W., Lakeou, S., Ukaegbu A., Kamdem, R., (2010). Design and Implementation of a Virtual Web-based Power Measurement Module for a Hybrid Renewable Energy Power System", Proceedings of the ASEE Annual Conference and Exposition, AC 2010-1992, Louisville, Kentucky, June 22-23, 2010
- Zhang, Nian; Kamdem, Roland; Ososanya, Esther; Mahmoud, Wagdy; Liu, Wenxin; (2010). VHDL implementation of the hybrid fuzzy logic controllers with FPGA. IEEE Xplore, Intelligent Control and Information Processing (ICICIP), 2010 International Conference on Digital Object; Identifier:10.1109/ICICIP.2010.5564277, 2010, Page(s): 5 – 10.
- Cotae, P., Ososanya, E., Mahmoud, W., "Design and Applications of Distributed and Scalable Under Water Wireless Sensor Acoustic Networks:, ASEE Global Colloquium on Engineering Education, ASEE Global Colloquium on Engineering Education, Budapest, Hungary, October 2009.

10. Briefly list the most recent professional development activities

    a. QEM workshop on Proposal Writing, Baltimore, November 2012, 2013
    b. ABET Program Assessment workshop, October 2012, 2013
    c. Advanced Purdue STEM Women of Color professional development workshop, 2012
    d. Xilinx Foundation workshop, December 2011
    e. National Education Association (NEA) Minority Leadership Training, 2011, 2012
    f. Nanotechnology Education Train the Trainer Workshops, Penn State University, 2009, 2010, 2011 (18 credit hours).

FACULTY VITAE

1. Name: Nian Zhang
2. Education

B.S.	Electrical Engineering	Wuhan University of Technology	1996
M.S.	Electrical Engineering	Huazhong University of Science & Technology	1999
Ph.D.	Computer Engineering	Missouri University of Science & Technology	2004

3. Academic experience:
University of the District of Columbia Assistant Professor Aug. 2009-present, FT
South Dakota School of Mines & Technology Assistant Professor Aug. 2004-May 2009, FT
4. Non academic experience:
Naval research Laboratory Summer Fellow 2013
5. Certification or professional registrations: None
6 Membership in professional organizations: IEEE Member, IEEE CIS Neural Networks (NN) Technical Committee Member, IEEE Computational Intelligence Society Member
7. Honors and Awards:
   a. Myrtilla Miner Faculty Fellow, University of the District of Columbia, 2013.
   b. Best Paper Award recipient for the paper entitled "A Fuzzy Attributed Graph Approach to Subcircuit Extraction Problem," IEEE International Conference on Fuzzy Systems (FUZZ-IEEE), St. Louis, MO, May 25-28, 2003.

8. Service activities (Selected)
   a. Vice Chair of Engineering Week, University of the District of Columbia, 2011, 2012.
   b. Member, dept. curriculum committee 2009-present
   c. Member, dept. graduate committee 2009-present
   d. C4OL-Committee for online Learning Committee 2009-2011
   e. Commencement Convocation Committee 2009-2010
   f. Grant Review Panel, National Robotics Initiative (NRI) HCI/Social Robotics review panel at the National Science Foundation, 2012.
   g. Associate Editor, IEEE Transactions on Neural Networks, 2010-present.
   h. Guest Editor, 1. Computational Intelligence and Neuroscience Journal. 2. International Journal of Systems, Control and Communications (IJSCC).
   i. Organization Committee Member (Selected from 14 organization committees)
   1) Publications Chair, 2014 Fifth International Conference on Intelligent Control and Information Processing (ICICIP), Dalian, China, August 18-24, 2014.
   j. Technical Program Committee Member (Selected from 12 technical program committees)
   1) The 2011 IEEE Symposium on Foundations of Computational Intelligence (FOCI'2011), Halle aux Farines, Paris, France, April 11-15, 2011.
   k. Session Chair. 1) 2008 IEEE World Congress on Computational Intelligence (WCCI), Hong Kong, China, June 1-6, 2008.
9. Publications and presentations from past five years: **5 (out of 1 book, 10 journal papers, 39 conference papers, and 2 technical reports)**
   1. Nian Zhang, Pradeep K. Behera, and Charles Williams, "Solar Radiation Prediction Based on Particle Swarm Optimization and Evolutionary Algorithm Using Recurrent Neural

Networks," 2013 IEEE International Systems Conference (IEEE SysCon 2013), Orlando, Florida, April 15-18, 2013.
2. Lalindra Jayatilleke and Nian Zhang, "Landmark-Based Localization for Unmanned Aerial Vehicles," 2013 IEEE International Systems Conference (IEEE SysCon 2013) - Special Session "Cyber-Physical Systems and Autonomic Management", Orlando, Florida, April 15-18, 2013.
3. Wen Yu, Haibo He, Nian Zhang, Editors, "Advances in Neural Networks - ISNN 2009," Berlin: Springer, 2009. (ISBN: 9783642015069)
4. Kiwon Park and Nian Zhang, "Duel Fuzzy Logic Controllers Design for Autonomous Robot Navigation," International Journal of Systems, Control and Communications (IJSCC), vol. 3, no. 3, pp. 322-329, 2011.
5. Xindi Cai, Nian Zhang, Ganesh Kumar Venayagamoorthy, and Donald C. Wunsch II, "Time Series Prediction with Recurrent Neural Networks Trained by a Hybrid PSO-EA Algorithm," Neurocomputing, vol. 70, no. 13-15, pp. 2342-2353, August 2007.

10. Recent professional development activities: (Selected)

a. UDC STEM Center Summer Research Day, 2012.
b Judge, the 70th Joint Annual BKX/NIS Meeting on March 13-17, 2013 at the Hyatt Regency Reston, Reston, VA.
c. UDC representative, 2nd USA Science & Engineering Festival, 2012.
d. UDC representative, Grad school fair at the Washington Convention Center, Washington, DC, 2011, 2010.
e. Recruitment table of SEAS at the 2011 Emerging Researchers National (ERN) Conference in Science, Technology, Engineering and Mathematics (STEM), February 24-26, 2011, Washington Hilton Hotel, Washington, DC.
f. CUR Dialogues, Hamilton Crowne Plaza, Washington, DC, February 25-27, 2010.
g. Army Research Lab JEOMS Faculty Workshop, Aberdeen Proving Ground, Maryland, 2010.
i. Career Pathways Workshop for Future Homeland Security S&T Professionals, Washington, DC, 2010.

Appendix C – Equipment

APPENDIX C – LABORATORY EQUIPMENT

List of Major Equipment in Electrical Engineering

List of Equipment	Condition	List of Major Application Software Used
Tektronix, TDS 200 Series, Digital Real-Time Oscilloscopes, **Quantity**: 30	S	Electronics Workbench Cadence PSPICE MatLab, Simulink LogicWorks MS Office Suite LabView Tanner Tools LeditPro (VLSI) Xilinx ISE, EDK
Wavetek Model 25, Precision 5Mhz Function Generators, **Quantity**: 30	S	
Eghty (80) Mhz Agilent 33250A, Function Generators, **Quantity**: 2	S	
Tektronix CDM250, Digital Multimeters **Quantity**: 30	S	
Dual Output, 30V Power Supplies, **Quantity**: 30	S	
LabVolt Digital Com.Training Kit **Quantity**: 10	S	
Dell Optiplex Laboratory Computers **Quantity**: 70	N (17) S (53)	
Sun Workstation **Quantity**: 6	S	
Laboratory HP5200 Laser	N(4)	
Printers **Quantity**: 5	S(1)	
Set of Labvolt Communications Lab Trainer **Quantity**: 2	S	

Tektronix Spectrum Analyzer **Quantity**: 2 64 Channel Logic Analyzer **Quantity**: 4 Assortment of Controls Systems Equipment from QUANSER	S S S	