

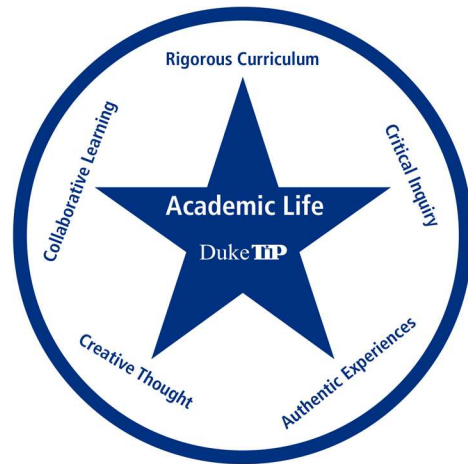
**Duke Talent Identification Program
Summer Studies Program 2019
Electrical Engineering**

Site: Duke University West

Term: Term 1

Instructor: Michael D'Argenio

TA: Denis Dineen



Course Description:

Electrical engineers are key creators behind many high-tech innovations such as global positioning systems that can pinpoint a car's location, giant generators that can power entire cities, and new designs for an airplane's electrical system. Explore the physical basis and mathematical models of electrical components and circuits. Work in teams to design and build electronic circuits and investigate voltage, resistance, amperes, watts, and circuit theorems. Analyze linear circuits, semiconductors, frequency representation, and sequential logic. Understand the elements of electrical engineering that are used as the fundamental building blocks of modern computing. Determine applications for electrical engineering concepts in other scientific fields and everyday life. Employ concepts in a creative way to solve a problem in an integrated design project.

Required Texts:

None. All course materials will be provided to the students.

Course Objectives:

Upon completion of this course, students should be able to:

- Outline NAE's 14 Grand Challenges for Engineering, their relationships to the different engineering disciplines, and how engineering principles can be used to overcome them.
- Explain the motivation for the creation of the field of electrical engineering.
- Compare the different fields and applications of electrical engineering such as power, RF, communications, bioelectronics, micro/nanoelectronics, controls, signal processing, computer architecture, networking, system-level design.
- Apply the engineering design process and examine the role of creativity and communication in effectively solving a problem.
- Motivate the use of models and show their limitations.
- Explain the role of ethics within the field of engineering and how it should be used to select and prioritize the problems which should be addressed.
- Express the importance of safe, well-documented lab procedures and recall the functions of electrical lab equipment.
- Define useful methods in efficiently debugging issues in hardware and software.
- Outline the stages of power delivery from generation, to transmission, to distribution.
- Understand the purposes of the fundamental circuit elements and make use of them.
- Implement low-level digital logic and illustrate its role as the foundation of modern computing.
- Demonstrate the use of basic control flow in constructing software programs.
- Develop software on a microcontroller to interface with and control hardware.
- Construct a project using both the technical skills and design behaviors outlined above to effectively solve a problem.

Assignments and Evaluation:

This course is presented in a modular format. Each module consists of a specific electrical engineering concept. The students will complete practice problems for each module to demonstrate understanding of and competency with the concepts. The students will work collaboratively on lab demonstrations and generate lab reports to illustrate their understanding of the application of the topics. Every day will start with a brief quiz to see if there were any unclear points from the previous day's lesson. This quiz is not meant to penalize students but to ensure that the material is being effectively conveyed to meet the course objectives. After the quiz, we will review any unclear concepts before moving on to that day's lesson.

The students will be expected to actively participate and engage with the instructors, their classmates, and the material. The students will research and present one research area related to the NAE's Grand Challenges for Engineers to show the importance and need for engineers in the 21st century. There will be a final design project that will require students to utilize critical and creative thinking skills to combine multiple concepts to produce an end result. Students will be expected to collaborate and effectively communicate their design process and results.

Course Schedule

Week One: Electrical Engineering

Circuit Analysis - voltage, current, resistance, capacitance, inductance

Circuit Components - resistors, capacitors, inductors, semiconductors, diodes, transistors, ICs

Power generation and transmission

Week Two: Computer Engineering

Low-Level Computing - transistor logic, boolean logic design, assembly language

High-Level Computing - C programming, microcontrollers, embedded systems design

Week Three: Integrated Design Project

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