PHYC 556 Electronics II

Course Description

Basic concepts, theories, and applications of digital electronics, electric instrumentation and controls. Topics include MOSFETs, MOSFECT amplifiers and circuits, MOSFET logic circuits, logic gates, boolean algebra, combinational logic and circuits, sequential logic and circuits, Flip-Flops and applications, memories, digital to analog conversion, analog to digital conversion, data acquisition, electrical instrumentation, and computer controlled instrumentation. (3 credit hours)

Prerequisite: PHYC 122.

Course Objectives

The Electronics II course will provide students the opportunity to learn the basis of digital electronics and devices, as well as automated data acquisitions, control and computer controlled instrumentation. Upon completion of this course the student will be able to perform analysis various sorts of digital circuits, as well as design and apply these circuits to solve problems. Students will also learn the basis of control and automated data acquisitions, computer controlled instrumentation. This course provides skills and the foundation needed for many higher level courses in physics, engineering and related fields.

Course Rationale

This Electronics II course is offered for the physics and majors and minors as well as graduate students. It is a part of the one-year electronics course sequence, and it is a four credit hour course with labs. It provides an overview of digital circuits and all building blocks of digital devices, as well as control and automated dada acquisitions. The knowledge and skills gained in this course are particularly beneficial to students who wish to do experimental work in a science or engineering field.

This Electronics II course is a foundation course for physicists, chemists, engineers, high school physical science teachers and computer scientists.

Course Content, Format, and Bibliography

Content

MOSFET: MOSFET device structures and physical operations, I&V characteristics, MOSFETs in active and saturation modes, MOSFET as an amplifier and switch, graphic analysis, large signal analysis, MOSFET biasing schemes, small signal analysis, single stage MOSFET amplifiers, CMOSFECT pairs as switches, MOSFECT logic circuits.

Logic Gates: Realization of logic gates using CMOSFETS. Invertor logic gates, NOR logic gates, NAND logic gates, OR logic gates and AND logic gates, pull-down and pull-up MOSFET circuits.

Boolean Algebra: Number systems and conversion, basic logic gates and circuits, deMogan theorem, logic gate circuits simplification and conversion.

Combinational Logic: Combinational logic circuits and applications, signal gating, signal combinations and fixing, Multiplexing, Demultiplexing, coding and decoding, adders and other arithmetic operations.

Sequential Logic: Sequential logic circuits and applications, data latches, level sensitive data latches, edge trigged data latches, flip-flops, T flip-flops, JK flip-flops, synchronous counters, asynchronous counters, registers, shift registers.

Memories, Types of memories, physical structures of memories, static RAM memories, memory circuits, memory structure and blocks, extension of memories. Basic structure of computers and microprocessors.

D/A and A/D: Digital to analog and analog to digital conversion circuits and applications.

Data Acquisitions: D to A and A to D controls using data acquisition boards. Digital input and output. Automated data acquisition and control with LabView programming and A to D, D to A, and digital input and output.

Computer Controlled Instrumentation: Basis of electric instrumentation, IEEE-488.2 interface protocol, general purpose interface board (GPIBs), control and programming of electric instruments with LabView programming and GPIBs.

Format

Homework, labs, lab reports, and examinations

This course is taught as a dual undergraduate/graduate course. Students will be required to complete activities appropriate for the level of the course in which they are enrolled. Student performance on homework, exams and/or labs will be evaluated using different standards for undergraduate and graduate students.

Bibliography

Microelectronic Circuits by A. S. Sedra and K. C. Smith; Handouts