## Master Syllabus Department of Physics and Astronomy



# PHYC 554 Electronics I

### **Course Description**

Basic concepts, theories, and applications of circuit analysis and analog electronics. Topics include DC circuits, AC circuits, frequency response of the circuits, first and second orders filter circuits, models for amplifiers and electronic devices, Op-amp circuits and applications, low and high pass and band pass amplifiers, semiconductor devices fundamentals, diode circuits, rectifier and regulated circuits, bipolar junction transistors, BJT as switches and amplifiers, small signal analysis, BJT amplifiers. (3 credit hours)

Prerequisite: PHYC 122.

#### **Course Objectives**

The Electronics I course will provide students the opportunity to obtain a deeper understanding of circuit analysis and the basis of analog electronics. Upon completion of this course the student will be able to preform analysis on DC and AC electric circuits, first and second orders filter circuits, Op-amp circuits, diode rectifier and regulated circuits, BJT amplifiers, as well as design and apply these circuits to solve problems. This course provides skills and the foundation needed for many higher level courses in physics, engineering and related fields.

#### **Course Rationale**

This Electronics I 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 a review of circuit analysis, and theory and applications of first and second orders filter circuits, Op-amp circuits, diode rectifier and regulated circuits, BJT amplifiers. 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 I course is a foundation course for physicists, chemists, engineers, high school physical science teachers and computer scientists.

#### **Course Content, Format, and Bibliography**

#### Content

DC Circuits: Circuit rules, voltage dividers, equivalent circuits, Thevenin's theorem, meters and sources interactions, Input and output Impedance, load and impedance matching.

AC Signals and Circuits: Capacitors, inductors and transformers, reactance and impedance, AC signals and circuits, Fourier analysis, frequency response of circuits, filters, first and second order filters.

Circuit Models for Amplifiers: Voltage controlled voltage amplifiers, voltage controlled current amplifiers, current controlled current amplifiers, current controlled voltage amplifiers. Input impedance, transconductance, transconductance.

OP AMP Circuits: Ideal OP AMPs, non-ideal OP AMPs, invert OP AMPs, non-invert OP AMPs, difference OP AMPs, instrument OP AMPs, Miller Integrator, differentiator, low-pass amplifiers, high-pass amplifiers, band-pass amplifiers.

Diodes and diode circuits: Semiconductors, semiconductor PN junctions, ideal and non-ideal diodes, Zener diodes, diode circuit models, diode IV characteristics, rectifier circuits, limiting and clamp circuits, AC to DC conversion, DC power suppliers.

Bipolar Junction Transistors (BJTs) and Circuits: BJT device structures and physical operations, BJT I&V characteristics, BJTs in active and saturation modes, BJT as an amplifier and switch, graphic analysis, large signal analysis, BJT biasing schemes, small signal analysis, single stage BJT amplifiers,  $\pi$  and T models, common emitter amplifiers, common-base amplifiers, common-collector amplifiers, three-stage amplifiers, coupling and isolating capacitors, frequency response of BJT amplifiers.

Circuit simulations: Circuit simulations with Mulitsim.

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