GROSSMONT COLLEGE

Official Course Outline

PHYSICAL SCIENCE 210 – FUNDAMENTALS OF ELECTRIC CIRCUITS

1. Course Number Course Title Semester Units Semester Hours

PSC 210 Fundamentals of 4 3 hours lecture*:* 48-54 hours

Electric Circuits 3 hours lab*:* 48-54 hours

96-108 outside-of-class hours for lecture

192-261 total hours

2. Prerequisites

“A “C” grade or higher or Pass or concurrent enrollment in MATH 280 or PHYC 240 or equivalent

Corequisite

None

Recommended Preparation

None

3. Catalog Description

Physical Science 210 provides an introduction to DC and AC circuit construction and analysis for students majoring in the physical sciences. Applies Kirchoff's Laws, nodal and mesh analysis, Norton and Thevenin's theorems to real and theoretical circuits. Also covers steady-state and transient responses of networks, RLC circuits, complex impedance, and power transfer. Students will use laboratory tools (e.g. breadboards, oscilloscopes, and signal generators) to construct, and analyze circuits.

4. Course Objectives

The student will:

a. Calculate basic circuit parameters using Kirchoff's Laws

b. Design DC circuits using node-voltage and mesh-current methods

c. Perform superposition, Thevenin Equivalent and Norton’s Equivalent operations to simplify linear circuits

d. Employ phasor diagrams to understand sinusoidal response to linear circuits

e. Perform frequency analysis to analyze AC circuits and their transient and steady-state responses

f. Calculate AC power characteristics

g. Analyze circuits containing operational amplifiers

i. Perform electrical measurements safely in a laboratory setting, using standard lab equipment

j. Document results from electrical laboratory experiments, and compare those results to theoretical predictions.

5. Instructional Facilities

a. Standard classroom

b. Standard laboratory with 4 power outlets per student, networked for internet access

c. Electrical circuits equipment with one lab station (oscilloscope, power supply, signal generator etc.) per two students

d. Computers or laptops for internet access and simulation software

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6. Special Materials Required of Student

a. Breadboard kits for building circuits

b. Optional Multisim student-edition software for home use

7. Course Content

a. Fundamental concepts: current, voltage, power, dependent and independent sources, resistance.

b. Simple circuits: conventions, Ohm’s Law, Kirchoff’s Law, circuit reduction, voltage and current dividers

c. Independent sources: ideal voltage source, ideal current source

d. Voltmeters and ammeters: ideal and non‐ideal (i.e., with internal resistance)

e. Network analysis: nodal analysis, mesh analysis, source transformations, superposition,

f. Thevenin’s and Norton’s theorems

g. Capacitors and Inductors: current/voltage relationships, series and parallel configurations, energy storage, DC behavior.

h. Ideal and real operational amplifiers

i. Natural and step response of first and second order RLC circuits: resonance and damped responses

j. Sinusoidal concepts: phasor concepts and complex algebra, complex impedance and admittance, phasor diagrams

k. Alternating current network analysis: nodal analysis, mesh analysis, source transformations

l. Energy and power: instantaneous and average power, root-mean-square and average voltage and current, complex power, reactive power, maximum power transfer

8. Method of Instruction

1. Lecture
2. Laboratory
3. Homework – written and online

9. Methods of Evaluating Student Performance

1. Exams - mid-terms and final
2. Homework – online and written.

Example #1. Solve the given resistor network for all currents and voltages. Example #2. Calculate the resonant frequency and bandwidth of the RLC circuit shown.

1. Laboratory projects – weekly and semester-long.

Example #1. Construct a Schmitt trigger circuit with the voltage bounds specified.

Example #2. Construct, and test an AM radio receiver and amplifier circuit capable of tuning to 760 kHz, with output to a speaker of 4 ohms impedance.

10. Outside Class Assignments

a. Weekly homework including reading and writing assignments.

Example: Describe the construction of the AM radio receiver as if you were writing a manual for a kit to be sold to schools.

b. Laboratory reports.

11. Texts

1. Required Text(s):

Any one of these (at instructor's option):

1. Alexander, Charles K., and Matthew N. O. Sadiku. *Fundamentals of Electric Circuits*. New York, NY: McGraw-Hill, 2013.
2. Nilsson, James William, and Susan A. Riedel. *Electric Circuits*. New York, NY: Pearson Education Limited, 2015.
3. Irwin, J. David, and R. M. Nelms. *Basic Engineering Circuit Analysis*. Hoboken, NJ: Wiley, 2015.

4) Ulaby, Fawwaz T., et al. *Circuits*. Austin, TX: National Technology & Science Press, 2016.

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11. Texts (continued)

b. Supplementary texts and workbooks:

1) Hayes, Thomas, and Paul Horowitz. *Learning the Art of Electronics: a Hands-on Lab Course*. Cambridge, UK: Cambridge University Press, 2019

2) Horowitz, Paul, and Winfield Hill. *The Art of Electronics*. Cambridge, UK: Cambridge University Press, 2018.

Addendum: Student Learning Outcomes

Upon completion of this course, our students will be able to do the following:

1. Analyze and predict the behavior of DC circuits containing resistors, capacitors, inductors, operational amplifiers, and power supplies - separately and in combination.
2. Analyze and predict the behavior of AC circuits containing resistors, capacitors, inductors, operational amplifiers, and power supplies - separately and in combination.
3. Safely construct electric circuits, test their operation, and perform measurements on them in a laboratory setting
4. Document laboratory results in a coherent, reproducible manner for comparison with theoretical predictions

Date approved by the Governing Board: May 19, 2020