

## **ELC 131 CIRCUIT ANALYSIS I**

### **COURSE DESCRIPTION:**

Prerequisites: None

Corequisites: MAT 121

This course introduces DC and AC electricity with emphasis on circuit analysis, measurements, and operation of test equipment. Topics include DC and AC principles, circuit analysis laws and theorems, components, test equipment operation, circuit simulation software, and other related topics. Upon completion, students should be able to interpret circuit schematics; design, construct, verify, and analyze DC/AC circuits; and properly use test equipment. Course Hours Per Week: Class, 3. Lab, 3. Semester Hours Credit, 4.

### **COURSE OBJECTIVES**

Upon completion of this course, the student will be able to:

- a. Inspect electrical connections.
- b. Conduct ohmmeter tests on circuit components.
- c. Isolate faults to module, circuit, and component level.
- d. Isolate faults by signal tracing and injection.
- e. Analyze voltage and current measure to isolate fault.
- f. Conduct in-circuit tests of components.
- g. Check components by patching.
- h. Setup test circuits.
- i. Test inductors and capacitors.
- j. Locate parts from a schematic.
- k. Identify and select wire resistors.
- l. Identify and select wire and cables.
- m. Identify and select inductors and transformers.
- n. Identify, select, and handle fuses and other protective devices.
- o. Identify, select, and handle mechanical switches.
- p. Identify, select, handle, and store batteries.
- q. Identify, select, and handle relays.
- r. Identify, select, handle, and store meter movements.
- s. Identify, select, handle, and store capacitors.
- t. Analyze active and passive DC/AC circuits.
- u. Perform transient analysis of RCL circuits.
- v. Analyze coupling and decoupling circuits.
- w. Analyze function generator circuits
- x. Measure physical quantities.
- y. Select and apply volt-ohms and current meters.
- z. Select and apply power supplies
- aa. Select and apply oscilloscopes.
- bb. Select and apply signal generators.
- cc. Select and apply sweep generators.
- dd. Select and apply function generators.

- ee. Maintain a clean and organized work environment.
- ff. Interpret and apply safety codes and procedures.
- gg. Recognize and handle hazardous equipment and systems.
- hh. Apply first aid.
- ii. Plan and execute projects.
- jj. Maintain and organize data.
- kk. Interpret and follow installation specifications.
- ll. Interpret manuals to determine maintenance procedures.
- mm. Interpret schematics to determine principle circuit functions.
- nn. Maintain technical logbook.
- oo. Prepare documentation for experiment and test procedures.
- pp. Solve simple equations.
- qq. Solve linear simultaneous equations for circuit analysis.
- rr. Calculate using log exponential and trigonometric functions.
- ss. Analyze vector diagram in rectangular and polar coordinates.
- tt. Solve phasor problems using complex numbers.
- uu. Calculate using calculators.
- vv. Express absolute and relative power and voltage levels in decibels.
- ww. Interpret and convert units of measurements.
- xx. Interpret and determine accuracy of measurements.
- yy. Determine cumulative error of measurements and calculations.
- zz. Align equipment using recommended procedures.
- aaa. Conduct frequency measurements.
- bbb. Conduct phase measurements.
- ccc. Analyze and interpret waveforms.
- ddd. Maintain standards for calibration.
- eee. Follow detailed test procedures.
- fff. Conduct power output measurements.
- ggg. Layout electronic components.

## **OUTLINE OF INSTRUCTION:**

- I. Introduction to electricity
  - A. Electron theory
    - 1.) Atomic structure
    - 2.) Electrostatic fields
    - 3.) Bonding mechanisms
    - 4.) Insulators/conductors
  - B. Elementary circuits
    - 1.) Basic elements - source, load, switch
    - 2.) Pictorial diagrams
    - 3.) Schematic symbols
  - C. SI units
    - 1.) Scientific notation
    - 2.) SI unit prefixes
    - 3.) Calculator operation

- II. Current and voltage
  - A. Electric current (electron and conventional)
    - 1.) Coulomb unit
    - 2.) Ampere unit
  - B. Potential difference
    - 1.) Definition of potential difference and voltage gradient
    - 2.) Unit - volt
    - 3.) Difference between voltage, PD, EMF, 'E', "V"
    - 4.) Sources of potential difference
      - (a) Batteries
      - (b) Generators
      - (c) Thermocouples
      - (d) Others
- III. Resistance
  - A. Definition of resistance
  - B. Ohm's law
  - C. Resistors
    - 1.) Types
      - (a) Function
      - (b) Construction
    - 2.) Color code
- IV. Electrical power and energy
  - A. Power and energy
  - B. Joule's law
  - C. Conversion and efficiency
- V. Resistive networks
  - A. Resistors in series
    - 1.) Current flow
    - 2.) Voltage drops
    - 3.) Power
    - 4.) Kirchoff's voltage law
  - B. Resistors in parallel
    - 1.) Current flow
    - 2.) Voltage drops
    - 3.) Kirchoff's current law
    - 4.) Power
  - C. Resistors in series/parallel
  - D. Voltage dividers
  - E. Current dividers
- VI. DC circuit network analysis
  - A. Kirchoff's laws
  - B. Voltage
    - 1.) Superposition
    - 2.) Thevenin's

- VII. Static electricity
  - A. Static charge
  - B. Electrostatic induction
  - C. Capacitance
    - 1.) Capacitors in series
    - 2.) Capacitors in parallel
  - D. Charging a capacitor
  - E. Discharging a capacitor
- VIII. Electromagnetism
  - A. Magnetism
  - B. Electromagnetism induction
  - C. Inductance
    - 1.) Inductors in series
    - 2.) Inductors in parallel
  - D. Instantaneous current in an inductor
- IX. Introduction to alternating current
  - A. AC sine wave
  - B. Transformers
    - 1.) Mutual induction
    - 2.) Transformer action
    - 3.) Transformer ratio
    - 4.) Open-circuit and short-circuit testing
- X. Electronic aspects of AC circuits
  - A. Reactance
    - 1.) Capacitive
    - 2.) Inductive
    - 3.) Reactance of RCL circuits
    - 4.) Resonance
      - (a) Effects of frequency
      - (b) Series resonance
      - (c) Parallel resonance
      - (d) Q of resonance circuits
      - (e) Selectivity
      - (f) Basic filter networks
  - B. Impedance
    - 1.) Vectors/phasors in AC
    - 2.) RC series/parallel circuits
    - 3.) RL series/parallel circuits
    - 4.) RCL series/parallel circuits
  - C. Power in RCL circuits
- XI. Circuit testing and evaluation
  - A. fundamentals of circuit performance
    - 1.) Acceptable performance
      - (a) Determine primary circuit function from schematic
      - (b) Determine primary circuit function from manufacturer's specifications
      - (c) Determine primary circuit function from normal operation -previously observed

- 2.) Fault prediction
  - (a) Possible faults
  - (b) Effects on circuit performance
- B. Analysis symptoms to isolate performance
  - 1.) system or module level
  - 2.) Circuit level
  - 3.) Component level
- C. Troubleshooting techniques
  - 1.) Without test equipment
    - (a) Maintenance check
      - (1) General maintenance considerations
      - (2) Consult maintenance manuals if available
    - (b) Calibration check
    - (c) Patching, etc.
  - 2.) With test equipment
    - (a) Test circuit setups
      - (1) Typical setups - temporary
      - (2) Special setups and test jigs
      - (3) In-circuit vs. out-of-circuit-testing
      - (4) Power-on vs. power-off testing
    - (b) VOM tests
  - 3.) Signal generator and oscilloscope
    - (a) Signal injection
    - (b) Signal tracing
  - 4.) Other equipment - curve tracers, etc.

## **REQUIRED TEXTBOOKS AND MATERIALS:**

Floyd, Thomas L. Principles of Electric Circuits (Electron Flow Version). 2<sup>nd</sup> ed. Charles Merrill.  
Buchla, David. Experiments in Basic Circuits. Charles Merrill.

## **STATEMENT FOR STUDENTS WITH DISABILITIES:**

Students who require academic accommodations due to any physical, psychological, or learning disability are encouraged to request assistance from a disability services counselor within the first two weeks of class. Likewise, students who potentially require emergency medical attention due to any chronic health condition are encouraged to disclose this information to a disability services counselor within the first two weeks of class. Counselors can be contacted by calling 919-536-7207, ext. 1413 or by visiting the Student Development Office in the Phail Wynn Jr. Student Services Center, room 1209.