Course Number and Title: ELC 225 Electrical Circuits II

Campus Location:
Georgetown, Dover, Stanton, Wilmington

Effective Date:
2022-52

Prerequisite:
ELC 125, (MAT 193 or concurrent)

Co-Requisites:
none

Course Credits and Hours:
4.00 credits
3.00 lecture hours/week
3.00 lab hours/week

Course Description:
This course covers advanced treatment of direct current (DC) /alternating current (AC) circuit analysis with emphasis on applied use of fundamental theorems including Kirchoff's laws; source conversions; Thevenin and Norton's theorems; maximum power transfer; branch, mesh, and nodal analysis techniques; transient circuit effects; phasor analysis; apparent, reactive, and real power; and series/parallel resonant conditions.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
Electronics Parts Kit, Digital Multimeter, TI-84+ or TI-89 Calculator

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Apply basic laws of electricity to series, parallel, and series-parallel circuits, including Ohm's law, Kirchhoff's laws, voltage and current divider theorems, and Watt's law. (CCC 2, 6; PGC 1, 2, 3, 4)
2. Assess complex and multiple source direct current circuits using theoretical analysis. (CCC 2, 6; PGC 1, 2, 3, 4)
3. Describe the construction, characteristics, and transient responses of capacitors and inductors in direct current circuits. (CCC 2, 6; PGC 1, 2, 3, 4)
4. Analyze, through algebraic and trigonometric methods, the characteristics of a sine wave including amplitude, frequency, and phase. (CCC 1, 2, 6; PGC 1, 2, 3, 4)
5. Analyze and compute alternating current circuit parameters in series, parallel, and series-parallel networks using phasor and impedance diagrams. (CCC 2, 6; PGC 1, 2, 3, 4)
6. Assess complex and multiple source alternating current circuits using theoretical analysis. (CCC 2, 6; PGC 1, 2, 3, 4)
7. Analyze the frequency response of a series or parallel resonant circuit. (CCC 2, 6; PGC 1, 2, 3, 4)
8. Analyze the principles of power with circuits containing alternating current sources. (CCC 2, 6; PGC 1, 2, 3, 4)
9. Analyze the principles and characteristics of transformers and polyphase systems. (CCC 1, 2, 6; PGC 1, 2, 3, 4)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Apply basic laws of electricity to series, parallel, and series-parallel circuits, including Ohm's law, Kirchhoff's laws, voltage and current divider theorems, and Watt's law.
    1. Predict the currents and voltages for single source series, parallel, and series-parallel direct current circuits.
    2. Compute the power consumed by each component of a single source series, parallel, and series-parallel direct current circuits.
    3. Apply voltage and current divider laws to determine the parameters of single source series-parallel direct current circuits.
    4. Apply Kirchhoff's current and voltage laws to determine the parameters of series-parallel direct current circuits.
2. Assess complex and multiple source direct current circuits using theoretical analysis.
    1. Use source conversion to solve voltage and currents in complex multi-source direct current circuits.
    2. Use mesh analysis to solve voltages and currents in complex multisource direct current circuits.
    3. Use branch analysis to solve voltages and currents in complex multisource direct current circuits.
    4. Use nodal analysis to solve voltages and currents in complex multisource direct current circuits.
    5. Solve simultaneous equations to determine the value of currents and voltages in complex multisource direct current circuits.
    6. Use the superposition theorem to analyze a multisource direct current circuit.
    7. Apply Thevenin’s theorem to simplify a direct current circuit for analysis.

    8. Apply Norton's theorem to simplify a direct current circuit for analysis.
    9. Apply the maximum power transfer theorem to determine when maximum power is transferred from a given direct current circuit.
    10. Convert between delta-type and wye-type network arrangements to simplify a direct current circuit for analysis.
    11. Assemble and collect voltage and current data in complex and multiple source direct current circuits using acceptable industry standards and the tools and equipment required in your work environment.
    12. Assemble and collect data in complex and multiple source direct current circuits using circuit analysis software simulation tools.
3. Describe the construction, characteristics, and transient responses of capacitors and inductors in direct current circuits.
    1. Compute total capacitance of capacitors in a series, parallel, or series-parallel configuration.
    2. Compute total inductance of inductors in a series, parallel, or series-parallel configuration.
    3. Sketch the charge and discharge transient curves for a direct current resistor-capacitor (RC) charging and discharging network.
    4. Solve for the Thevenin equivalent circuit for a complex network external to the capacitive element of a direct current circuit.
    5. Sketch the storage and release transient curves for a direct current resistor-inductor (RL) energizing and de-energizing network.
    6. Solve for the Thevenin equivalent circuit for a complex network external to the inductive element of a direct current circuit.
    7. Assemble and collect voltage and current data for direct current circuits containing capacitors and inductors using acceptable industry standards and the tools and equipment required in your work environment.
    8. Assemble and collect data in direct current circuits containing capacitors and inductors using circuit analysis software simulation tools.
4. Analyze, through algebraic and trigonometric methods, the characteristics of a sine wave including amplitude, frequency, and phase.
    1. Calculate alternating current voltages and currents in all forms: peak-to-peak, peak, average, and effective values.
    2. Analyze voltages and currents graphically with phasor diagrams and sine wave graphs.
    3. Calculate phasor results in polar and rectangular form, converting readily from one form to the other.
    4. Solve for the instantaneous value of a given sine wave at a particular angular displacement.
    5. Solve for the phase variation between two sine waves given the trigonometric representation for each.
5. Analyze and compute alternating current circuit parameters in series, parallel, and series-parallel networks using phasor and impedance diagrams.
    1. Compute capacitive and inductive reactance.
    2. Compute capacitive and inductive susceptance.
    3. Compute impedance of a series circuit mathematically as a vector and graphically as an impedance diagram.
    4. Compute admittance of a parallel circuit mathematically as a vector and graphically as an admittance diagram.
    5. Solve for voltages and currents in series and parallel circuits mathematically as phasors and sine waves and graphically as phasor diagrams and sine wave diagrams.
    6. Solve for voltages and currents in a variety of series-parallel circuits.
6. Assess complex and multiple source alternating current circuits using theoretical analysis.
    1. Use source conversion to solve voltages and currents in complex multisource alternating current circuits.
    2. Use mesh analysis to solve voltages and currents in complex multisource alternating current circuits.
    3. Use branch analysis to solve voltages and currents in complex multisource alternating current circuits.
    4. Use nodal analysis to solve voltages and currents in complex multisource alternating current circuits.
    5. Solve simultaneous equations to determine the value of currents and voltages in complex multisource alternating current circuits.
    6. Apply the superposition theorem to solve alternating current networks with independent and dependent sources.
    7. Apply Thevenin's theorem to solve alternating current networks with independent and dependent sources.
    8. Apply Norton's theorem to solve alternating current networks with independent and dependent sources.
    9. Apply the maximum power transfer theorem to determine when maximum power is transferred from a given alternating current circuit.
    10. Convert between delta-type and wye-type network arrangements to simplify an alternating current circuit for analysis.
    11. Assemble and collect data for complex and multiple source alternating current circuits using acceptable industry standards and the tools and equipment required in your work environment.
    12. Assemble and collect data for complex and multiple source alternating current circuits using circuit analysis software simulation tools.
7. Analyze the frequency of a series or parallel resonant circuit.
    1. Calculate the frequency response of series or parallel combination of elements.
    2. Predict the frequency response of a series or parallel resonant circuit.
    3. Explain the impact of the quality factor on the frequency response of a series or parallel resonant network.
    4. Calculate a tuned network's quality factor, bandwidth, and power levels at specific frequency levels.
    5. Calculate and sketch the frequency response of low pass, high pass, band pass, and band stop filters.
    6. Interpret the Bode response of a filter.
8. Analyze the principles of power with circuits containing alternating current sources.
    1. Analyze and compare the differences among real, reactive, and apparent power in circuits containing resistive and reactive components.
    2. Illustrate power graphically with the power triangle.
    3. Calculate power factor and power factor correction.
9. Analyze the principles and characteristics of transformers and polyphase systems.
    1. Explain the operation of an iron-core and air-core transformer.
    2. Describe how voltages are established across the primary and secondary coils of a transformer.
    3. Describe transformer circuits, including the concepts of mutual inductance, equivalent circuits, load characteristics, regulation, and efficiency.
    4. Solve for voltages, currents, and power in polyphase circuits with balanced and unbalanced wye and delta connections.

Evaluation Criteria/Policies:
The grade will be determined using the Delaware Tech grading system:

90	–	100	=	A
80	–	89	=	B
70	–	79	=	C
0	–	69	=	F

Students should refer to the [Student Handbook - https://www.dtcc.edu/handbook](https://www.dtcc.edu/handbook) for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
Summative: 3-4 Exams (equally weighted)	50%
Summative: 5-8 Laboratory Experiments (equally weighted)	20%
Formative: Homework/Pop Quizzes (equally weighted)	20%
Formative: Quizzes (equally weighted)	10%
TOTAL	100%

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):

1. Perform the duties of an entry-level technician using the skills, modern tools, theory, and techniques of the electronics engineering technology.
2. Apply a knowledge of mathematics, science, engineering, and technology to electronics engineering technology problems that require limited application of principles but extensive practical knowledge.
3. Conduct, analyze, and interpret experiments using analysis tools and troubleshooting methods.
4. Identify, analyze and solve narrowly defined electronics engineering technology problems.
5. Explain the importance of engaging in self-directed continuing professional development.
6. Demonstrate basic management, organizational, and leadership skills which commit to quality, timeliness and continuous improvement.

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the [disabilities services - https://www.dtcc.edu/disabilitysupport](https://www.dtcc.edu/disabilitysupport) web page or visit the campus Advising Center.