I. INTRODUCTION

A. A study of the fundamentals of alternating current including series and parallel AC circuits, phasors, capacitive and inductive networks, transformers, and resonance.

B. This course serves as a required or elective course on various degree plans. Curriculum plans for degrees and certificates, are listed in the current Central Texas College Catalog.

C. The delivery method of this course may be traditional lecture/lab, blended lecture/lab.

D. Prerequisite: CETT 1303 DC Circuits.

II. LEARNING OUTCOMES

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

A. Operate test equipment. (C5, C6, C7, C8, C15, C16, C18, C19, C20, F1, F2, F3, F8, F9, F10, F16)

B. Identify various sources of electricity in alternating current (AC) circuits. (C5, C6, C8, C15, C16, F1, F8)

C. Analyze AC circuits using applicable mathematical formulas. (C5, C6, C7, C8, C15, C16, C18, F1, F2, F3, F8, F9, F13)

D. Troubleshoot various AC circuits using schematic diagrams. (C1, C5, C6, C7, C8, C15, C16, C17, C18, C19, C20, F1, F2, F3, F5, F8, F9, F10, F13, F16)

III. INSTRUCTIONAL MATERIALS

A. The instructional materials identified for this course are viewable through www.ctcd.edu/books
B. Students will need an engineering calculator with trigonometric and exponents functions. Programmable calculators are not allowed on examinations.
C. A breadboard with 2200 tie-points or more. Approximate board size: 7” x 7”.

IV. COURSE REQUIREMENTS
A. Attend both lecture and lab or in the case of online delivery, be actively engaged in Blackboard and maintain constant progress.
B. Be prepared to participate in discussion, team projects/assignments and take unannounced assessments relating to the lecture materials.
C. Complete all exams/assessments.
D. Submit all assignments on time.

V. ASSESSMENTS
A. Student content mastery will be evaluated in the following areas:
   • Lab work and Homework Exercises
   • Test Equipment and Practical Exams
   • Mid Term and Final Assessment
B. Scheduled and unscheduled assessments will be given at the discretion of the instructor.
C. Exams/assessments may be composed of both subjective and objective questions plus computer output.
D. A student must take all exams/assessments. No make-up exams/assessments will be given. Both online and on campus students who know in advance that they will be absent due to school sponsored trips, military duty or orders, or any other valid reason, must arrange to take an early exam/assessment. Unexpected absences due to illness or other extenuating circumstances will require the student to see the instructor about make-up work in lieu of the missed exam/assessment.
E. Failure to pass the Lab Practical and the Final exams will result in a failing grade for the course.
F. Students with unexcused absences will be given a zero for each missed assignment.
VI. SEMESTER GRADE COMPUTATIONS

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Points</th>
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<tbody>
<tr>
<td>Lab Work &amp; Test Equipment exam</td>
<td>400</td>
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<tr>
<td>Homework</td>
<td>150</td>
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<tr>
<td>Lab Practical</td>
<td>150</td>
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<tr>
<td>Midterm and Final Assessments</td>
<td>300</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<table>
<thead>
<tr>
<th>Points</th>
<th>Grade</th>
<th>Quality Points</th>
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<tbody>
<tr>
<td>900-1000</td>
<td>A-Superior</td>
<td>4</td>
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<tr>
<td>800-899</td>
<td>B-Above Average</td>
<td>3</td>
</tr>
<tr>
<td>700-799</td>
<td>C-Average</td>
<td>2</td>
</tr>
<tr>
<td>600 - 699</td>
<td>D – Passing but Unsatisfactory</td>
<td>1</td>
</tr>
<tr>
<td>0 - 599</td>
<td>F-Failure</td>
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</table>

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM THE INSTRUCTOR

A. **Course Withdrawal:** It is the student’s responsibility to officially withdraw from a course if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file a Central Texas College Application for Withdrawal (CTC Form 59). The student must sign the withdrawal form.

CTC Form 59 will be accepted at any time prior to Friday of the 12th week of classes during the 16-week fall and spring semesters. The deadline for sessions of other lengths is:

- 10-week session Friday of the 8th week
- 8-week session Friday of the 6th week
- 5-week session Friday of the 4th week

The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.

For non-GoArmyEd active military students, the effective date of withdrawal is the filing date with the Education Center. For all other students, the effective date of withdrawal is the date that the withdrawal application is received by the Central Texas College representative.

Students who used financial aid, military tuition assistance, VA benefits, or other non-personal funds may be required to repay tuition and fees to the funding agency. For specific repayment requirements, contact the Office of Student Financial Aid or Veterans Services Office before withdrawing. Military tuition assistance students should visit their military Education Center or Navy College Office.

A student who officially withdraws will be awarded the grade of “W” provided the student’s attendance and academic performance are satisfactory at the time of
official withdrawal. Students must file a withdrawal application with the College before they may be considered for withdrawal.

A student may not withdraw from a class for which the instructor has previously issued a grade of “F,” “FI,” “FN,” “IP,” or “XN.”

B. **Instructor Initiated Withdrawals:** Faculty are authorized to withdraw students who are not making satisfactory course progress to include failure to meet College attendance requirements as outlined in the section of the Catalog entitled “Satisfactory Progress Standards.” The instructor will assign the appropriate grade on CTC Form 59 for submission to the registrar.

Students enrolled in distance learning courses are expected to maintain constant progress throughout the course. Failure to do so may result in the student being administratively withdrawn by the instructor.

Students who have not attended class by the 12th class day of a 16-week course or the 6th class day of an 8-week term may be administratively withdrawn by the instructor with a grade of "W." Students may be administratively withdrawn from any class when their absences reach a total equal to 12.5% of the class hours for the course; and in the opinion of the instructor, the student cannot satisfactorily complete the course. An example: Students attending a 48-hour class during an 8-week period normally meet 180 minutes each session for 16 sessions. Those students accumulating two (2) unexcused absences are subject to Administrative Withdrawal since the total unexcused absences equal 12.5% of class hours for the course. Those students attending a 48 hour class during a 16-week period normally meet 90 minutes each session for 32 sessions. Those students accumulating four (4) unexcused absences are subject to Administrative Withdrawal since the total unexcused absences equals 12.5% of class hours for the course. In a distance learning course the last date of attendance is the last activity by the student in the course.

C. **Administrative Withdrawal:** A student may be administratively withdrawn by a designated member of the administrative staff of the College when the student has been placed on Academic Suspension or Disciplinary Suspension; the student has an outstanding financial obligation owed to the college; or the student registered for a course without the required prerequisite or departmental permission.

The College is under no obligation to refund tuition and fees, or other costs associated with an administrative or instructor initiated withdrawal.

D. **Incomplete Grade:** The College catalog states, “An incomplete grade may be given in those cases where the student has completed the majority of the coursework but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course...” Prior approval from the instructor is required before the grade of “IP” for Incomplete is recorded.
E. **Cell Phones and Pagers:** Students will silence cell phones and mobile devices while in the classroom or lab.

F. **Americans with Disabilities Act (ADA):** Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Review the website at [www.ctcd.edu/disability-support](http://www.ctcd.edu/disability-support) for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

G. **Instructor Discretion:** The instructor reserves the right of final decision in course requirements and may make changes to the course outline and/or assignments as needed.

H. ** Civility:** Individuals are expected to be aware of what a constructive educational experience is and be respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

I. **Degree Progression:** Students who receive a grade of “D” are advised not to enroll in the next course for which this course was a prerequisite.

J. **Failing Grade:** The grade of “F” or “FN” will be given for academic failure, non-attendance or scholastic dishonesty.

K. **Scholastic Honesty:** All students are expected to maintain the highest standards of scholastic honesty in the preparation of all course work and during examinations. The college policy on scholastic honesty, including definitions on plagiarism, collusion, and cheating can be found at the following URL: [http://online.ctcd.edu/plagiarism.cfm](http://online.ctcd.edu/plagiarism.cfm)
VIII. COURSE OUTLINE

A. Lesson One: Alternating Voltage and Current

1. Lesson Objectives: Upon successful completion of this Lesson the student will be able to:
   a. Understand how a sine wave of alternating voltage is generated.
   b. Calculate the instantaneous value of a sine wave.
   c. Define the following values for a sine wave, peak, peak-to-peak, root-mean-square, and average.
   d. Calculate the rms, average, and peak-to-peak values of a sine wave when the peak value is known.
   e. Define the terms frequency and period and list the units of each.
   f. Calculate the wavelength when the frequency is known.
   g. Understand the concept of phase angles.
   h. Define the term harmonics.
   i. Understand the 60-Hz AC power line and the basics of residential wiring.
   j. Outline the basics of residential house wiring.

2. Learning activities:
   a. Reading assignments Chapter 15 in the text book. (F1)
   b. Work problems as assigned (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
   c. Perform respective assigned lab. (C5, C6, C15, C16, C17, C18, C19, C20)

3. Lesson Outline
   a. Alternating current applications.
   b. The sine-wave
   c. Alternating current
   d. Voltage and current values in a sine wave
   e. Frequency
   f. Period
   g. Wavelength
   h. Phase angle
   i. Harmonics
   j. Non-sinusoidal AC waveforms

B. Lesson Two: Capacitance

1. Lesson Objectives: Upon successful completion of this Lesson the student will be able to:
   a. Understand how charge is stored in the dielectric of a capacitor.
   b. Understand how a capacitor charges and discharges.
   c. Define the farad unit of capacitance.
   d. List the physical factors affecting the capacitance of a capacitor.
e. List several types of capacitors and the characteristics of each.
f. Understand how an electrolytic capacitor is constructed.
g. Understand how capacitors are coded.
h. Calculate the total capacitance of parallel connected capacitors.
i. Calculate the energy stored in a capacitor.
j. Understand how an ohmmeter can be used to test a capacitor.
k. Calculate the equivalent capacitance of series-connected capacitors.
l. Define the terms leakage, dielectric absorption, and equivalent series resistance as they relate to capacitors.

2. **Learning Activities:**
a. Reading assignments Chapter 16 in the textbook. (F1)
b. Work problems as assigned (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
c. Perform respective labs. (C5, C6, C15, C16, C17, C18, C19, C20)

3. **Lesson Outline**
a. How charge is stored in a cap
b. Charging and discharging a cap.
c. The Farad
d. Typical caps
e. Electrolytic capacitors
f. Parallel capacitances
g. Series Capacitances
h. Stray Capacitance
i. Energy in electrostatic fields

C. **Lesson Three: Capacitance Reactance and Capacitive Circuits**

1. **Lesson Objectives:** Upon successful completion of this Lesson the student will be able to:
   a. Explain how alternating current can flow in a capacitive circuit.
   b. Calculate the reactance of a capacitor when the frequency and capacitance are known.
   c. Calculate the total capacitive reactance of series connected capacitors.
   d. Calculate the equivalent capacitive reactance of parallel connected capacitors.
   e. Explain how Ohm’s law can be applied to capacitive reactance.
   f. Calculate the capacitive current when the capacitance and rate of voltage change are known.
   g. Explain why the current leads the voltage by 90 degrees for a capacitor.
   h. Define the term impedance.
   i. Calculate the total impedance and phase angle of a series RC circuit.
   j. Describe the operation and application of an RC phase-shifter circuit.
k. Calculate the total current, equivalent impedance, and phase angle of a parallel RC circuit.
l. Understand how a capacitor can couple some AC frequencies, but not others.
m. Calculate the individual capacitor voltage drops for capacitors in series.
n. Calculate the capacitive current that flows with non-sinusoidal waveforms.

2. **Learning Activities:**
a. Read Chapters 17 and 18 in the text book. (F1)
b. Work problems as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
c. Perform assigned labs.

3. **Lesson Outline**
a. Phase angles in an RC circuit
b. Xc and R in series
c. Xc and R in parallel
d. Capacitive voltage dividers
e. The general case of capacitive current

D. **Lesson Four: Inductance**

1. **Lesson Objectives:** Upon successful completion of this Lesson the student will be able to:
a. Explain the concept of self-inductance.
b. Define the Henry unit of Inductance and define mutual inductance.
c. Calculate the inductance when the induced voltage and rate of current change are known.
d. List the physical factors affecting the inductance of an inductor.
e. Calculate the induced voltage across an inductor given the inductance and rate of current change.
f. Explain how induced voltage opposes a change in current.
g. Describe how a transformer works and list important transformer ratings.
h. Calculate the currents, voltages, and impedances of a transformer circuit.
i. Identify the different types of transformer cores.
j. Calculate the total inductance of series connected inductors.
k. List some common troubles with inductors.
l. Calculate the equivalent inductance of parallel-connected inductors.

2. **Learning Activities:**
a. Reading assignments: Chapter 19 in the text. (F1)
b. Work problems as assigned (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
c. Perform labs. (C5, C6, C15, C16, C17, C18, C19, C20)
Lesson Objectives: Upon successful completion of this Lesson the student will be able to:

a. Explain how inductive reactance reduces the amount of alternating current.

b. Calculate the reactance of an inductor when the frequency and inductance are known.

c. Calculate the total reactance of series connected inductors.

d. Calculate the equivalent reactance of parallel connected inductors.

e. Understand how Ohm’s law can be applied to inductive reactance.

f. Understand the wave shape of induced voltage produced by sine-wave alternating current.

g. Explain why the voltage leads the current by 90 degrees for an inductor.

h. Calculate the total impedance and phase angle of a series RL.

i. Calculate the total current, equivalent impedance, and phase angle of a parallel RL circuit.

j. Define what is meant by the Q of a coil.

k. Understand how an inductor can be used to pass some AC frequencies, but block others.

l. Calculate the induced voltage that is produced by a non-sinusoidal current.

Learning Activities:

a. Reading assignments: Chapters 20 and 21 in the text. (F1)

b. Work problems as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)

c. Perform respective lab. (C5, C6, C15, C16, C17, C18, C19, C20)

Lesson Outline

a. How XL reduces I

b. Series and parallel reactance

c. Ohms law applied to XL

d. Sine wave IL lags VL

e. Applications of XL

f. Impedance
g. Q of a coil
h. AF and RF chokes

F. Lesson Six: RC and L/R Time Constants

1. Lesson Objectives: Upon successful completion of this Lesson the student will be able to:
   a. Define the term transient response.
   b. Define the term time constant.
   c. Calculate the time constant of a circuit containing resistance and inductance.
   d. Explain the effect of producing a high voltage when opening an RL circuit.
   e. Calculate the time constant of a circuit containing resistance and capacitance.
   f. Explain how capacitance opposes a change in voltage.
   g. List the criteria for proper differentiation and integration.
   h. Explain why a long time constant is required for an RC coupling circuit.
   i. Use the universal time constant graph to solve for voltage and current values in an RC or RL circuit that is charging or discharging.
   j. Explain the difference between time constants and reactance.

2. Learning Activities:
   a. Reading assignments: Chapter 22 in the text book. (F1)
   b. Work problems and questions as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
   c. Perform respective labs. (C5, C6, C15, C16, C17, C18, C19, C20)

3. Lesson Outline
   a. L/R time constants
   b. High voltage in RL circuits
   c. RC time constant
   d. Charge and discharge curves
   e. Long and short time constants

G. Lesson Seven: Alternating Current Circuits

1. Lesson Objectives: Upon successful completion of this Lesson the student will be able to:
   a. Explain why opposite reactance in series cancel.
   b. Determine the total impedance and phase angle of a series circuit containing resistance, capacitance, and inductance.
   c. Determine the total current, equivalent impedance, and phase angle of a parallel circuit containing resistance, capacitance, and inductance.
d. Define the terms real power, apparent power, volt-ampere reactive, and power factor.
e. Calculate the power factor of a circuit.

2. Learning Activities:
a. Reading assignments: Chapter 23 in the text. (F1)
b. Work problems and questions as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
c. Perform respective lab. (C5, C6, C15, C16, C17, C18, C19, C20)

3. Lesson Outline
   a. AC circuits with resistance but no reactance.
   b. Xl circuits
   c. Xc circuits
   d. Series reactance and resistance
   e. Parallel reactance and resistance
   f. Series-parallel reactance and resistance
   g. Real power

H. Lesson Eight: Complex Numbers for AC Circuits

1. Lesson Objectives: Upon successful completion of this lesson, the student will be able to:
a. Explain the j operator.
b. Define a complex number.
c. Add, subtract, multiply, and divide complex numbers.
d. Explain the difference between the rectangular and polar forms of a complex number.
e. Convert a complex number from polar to rectangular form and vice versa.
f. Explain how to use complex numbers to solve series and parallel AC circuits containing resistance, capacitance, and inductance.

2. Learning Activities:
a. Reading assignments: Chapter 24 in the text. (F1)
b. Work problems and questions as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
c. Perform respective lab. (C5, C6, C15, C16, C17, C18, C19, C20)

3. Lesson Outline:
a. Positive and negative numbers.
b. J-operators.
c. Complex numbers and their application to AC circuits.
d. Impedance in complex form.
e. Operations with complex numbers.
f. Magnitude and angle of complex numbers.
g. Polar form of complex numbers.

h. Converting polar to rectangular form.
i. Complex numbers in series and parallel circuits.

I. Lesson Nine: Resonance

1. Lesson Objectives: Upon successful completion of this lesson, the student will be able to:
   a. Define the term resonance.
   b. List four characteristics of a series resonant circuit.
   c. List three characteristics of a parallel resonant circuit.
   d. Explain how the resonant frequency formula is derived.
   e. Calculate the Q of a series or parallel resonant circuit.
   f. Calculate the equivalent impedance of a parallel resonant circuit.
   g. Explain what is meant by the bandwidth of a resonant circuit.
   h. Calculate the bandwidth of a series or parallel resonant circuit.
   i. Explain the effect of varying L or C in tuning an LC circuit.
   j. Calculate L or C for a resonant circuit.

2. Learning Activities:
   a. Reading assignments: Chapter 25 in the text. (F1)
   b. Work problems and questions as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
   c. Perform respective lab. (C5, C6, C15, C16, C17, C18, C19, C20)

3. Lesson Outline:
   a. The resonant effect.
   b. Series and parallel resonance.
   c. Resonant frequency
   d. Q-magnification factor at resonance.
   e. Bandwidth
   f. Tuning and mistuning.
   g. Analysis of series and parallel resonant circuits.
   h. Damping of parallel resonant circuits.
   i. Choosing L and C for a resonant circuit.

J. Lesson Ten: Filters

1. Lesson Objectives: Upon successful completion of this lesson, the student will be able to:
   a. State the difference between a low-pass and a high-pass filter.
   b. Explain what is meant by pulsating direct current.
   c. Explain how a transformer acts as a high-pass filter.
d. Explain how an RC coupling circuit couples alternating current but blocks direct current.

e. Explain the function of a bypass capacitor.

f. Calculate the cutoff frequency, output voltage, and phase angle of basic RL and RC filters.

g. Explain the operation of band-pass and band-stop filters.

h. Explain why log-log graph paper or semi-log graph paper is used to plot a frequency response.

i. Define the term decibel.

j. Explain how resonant circuits can be used as band-pass or band-stop filters.

k. Describe the function of a power-line filter and a television antenna filter.

2. **Learning Activities:**
   a. Reading assignments: Chapter 26 in the text. (F1)
   b. Work problems and questions as assigned. (F1, F2, F3, F4, F8, F12, C1, C5, C6, C15, C16, C17, C18, C19, C20)
   c. Perform respective lab. (C5, C6, C15, C16, C17, C18, C19, C20)

3. **Lesson Outline:**
   a. Examples of filtering.
   b. Direct current combined with alternating current.
   c. Transformer and capacitive coupling.
   d. Bypass capacitors.
   e. Filter circuits.
   f. High-pass and low-pass filters.
   g. Decibels and frequency response curves.
   h. Resonant filters.
   i. Interference filters.