CENTRAL TEXAS COLLEGE
SYLLABUS FOR ENGR 2305
Electrical Circuits I

Semester Hours Credit: 3

I. INTRODUCTION

Electrical Circuits I, ENGR 2305, is a three-semester hour course that is the basic theory of Electrical Circuits, using calculus, involving the description Basic circuit elements. Topology of electrical networks; Kirchhoff 's laws; node and mesh analysis; DC circuit analysis; operational amplifiers; transient and sinusoidal steady-state analysis; AC circuit analysis; first- and second-order circuits; Bode plots; and use of computer simulation software to solve circuit problems.

A. This course is occupationally related and serves as preparation for careers in engineering. This course satisfies lower division, undergraduate requirements for most degrees in engineering.

B. Co-requisite: MATH 2414

II. Learning Outcomes

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

A. Explain basic electrical concepts, including electric charge, current, electrical potential, electrical power, and energy.(F1,F2,F4,F12)
B. Apply concepts of electric network topology: nodes, branches, and loops to solve circuit problems, including the use of computer simulation.(F1,F2,F4)
C. Analyze circuits with ideal, independent, and controlled voltage and current sources.(F4,F7,F9)
D. Apply Kirchhoff's voltage and current laws to the analysis of electric circuits.(F4,F7,F9)
E. Explain the relationship of voltage and current in resistors, capacitors, inductors, and mutual inductors.(F4,F7,F9,F10)
F. Derive and solve the governing differential equations for a time-domain first-order and second-order circuit, including singularity function source models.(F3,F4,F9,F10,F12)
G. Determine the Thevenin or Norton equivalent of a given network that may include passive devices, dependent sources, and independent sources in combination. (F4,F9,F11)
H. Analyze first and second order AC and DC circuits for steady-state and transient response in the time domain and frequency domain. (F4,F7,F10)
I. Derive relations for and calculate the gain and input impedance of a given operational amplifier circuit for both DC and frequency domain AC circuits using an ideal operational

amplifier model.(F4,F9,F10,F11)

J. Apply computer mathematical and simulation programs to solve circuit problems.(F4,F9,F10)

III. INSTRUCTIONAL MATERIALS

A. Text:

The instructional materials identified for this course are viewable through www.ctcd.edu/books

B. Other Materials: A graphing calculator is required. It is recommended that students who choose to purchase a graphing calculator use the TI-84.

IV. COURSE REQUIREMENTS

A. Assignments will be made daily. All assignments are to be completed by the following class meeting. Assignments may be collected and examined at any time.

B. Students are expected to attend every class and to arrive at each class on time and remain in class for the entire class period. Students who are absent from class 12.5% of the number of class meetings for any reason will be dropped from the class with a grade of "F". Instructors may choose to lower a student's grades because of tardiness.

C. The instructor will post office hours after the semester commences. Consult the instructor during office hours. If your visit may tend to be lengthy, make an appointment with the instructor so that he may set aside some time for you.

V. EXAMINATIONS

A. Examinations will be given at the end of each unit. If a unit is short and simple, it might be included with another short, simple unit for one exam. A final exam will be given and students must take the final exam in order to pass the course. The final exam date is announced about two weeks prior to the examination week.

C. Students who miss an exam should discuss with the instructor the circumstances surrounding the absence. The instructor will determine whether a make-up exam is to be given. Make-up examinations are given by appointment only.

VI. SEMESTER GRADE COMPUTATIONS

A. Your point total is determined by adding the points earned on each unit examination. Your letter grade for the course is then determined by the following formula:

$$\frac{\text{Your Point Total}}{\text{Total Points Possible}} \times 100$$

If the result is between	90	and 100	your grade is a(n) A
	80	89	B
	70	79	C
	60	69	D
	0	59	F

** NOTE: Grade Computation is determined by instructor. Please see your instructor for how your grade will be determined. This is just an example.

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

A. Withdrawal from Course: It is the student's responsibility to officially drop a class if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file an Application for Withdrawal or an Application for Refund. The withdrawal form must be signed by the student.

Application for Withdrawal 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 as follows.

11 week session	Friday of the 8th week
8 week session	Friday of the 6th week
52 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.

Students who officially withdraw 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 the student a grade of "F" or "FN" for nonattendance.

B. An Administrative Withdrawal: An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on the Administrative Withdrawal Form for submission to the registrar.

C. An Incomplete Grade: The College catalog states, "An incomplete grade may be given in those cases where the student has completed the majority of the course work 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 "I" is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an "F" for the course.

D. Cellular Phones and Beeper: Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.

E. 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. Explore the website at 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.

F. Instructor Discretion: The instructor reserves the right of final decision in course requirements.

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

H. The Math Department operates an Advanced Mathematics Lab in Building 152, Room 145. All courses offered by the Math Department are supported in the lab with appropriate tutorial software. Calculators and Graph link are available for

student use in the lab. Students are encouraged to take advantage of these opportunities. See posted hours for the Walk-in tutoring and Math Lab.

VIII. COURSE OUTLINE

A. **Unit One**: Basic Concepts and Basic Laws (Chapter 1, 2)

1. Learning Outcomes: Upon successful completion of this unit, the student will be able to:
    a. Understand the different units with which engineers work.
    b. Understand the relationship between charge and current and how to use both in variety of applications.
    c. Understand voltage and how it can be used in a variety of application.
    d. Develop an understanding of power and energy and their relationship with current and voltage.
    e. Understand the volt-amp characteristics of a variety of circuit elements.
    f. Identify and understand Ohm's law.
    g. Understand the basic structure of electrical circuits, essentially nodes, loops, and branches.
    h. Understand Kirchhoff's voltage and current laws.
    i. Understand series resistance and voltage division, and parallel resistance and current division.
    j. Identify how to convert delta connected circuits to wye connected circuits and vice versa.

2. Learning Activities:

    a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
    b. Read the chapter section as assigned. (F1)
    c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

    a. Section.1.1 (Introduction)
    b. Section 1.2 (Systems of Units)
    c. Section 1.3 (Charge and Current)
    d. Section 1.4 (Voltage)
    e. Section 1.5 (Power and Energy)
    f. Section 1.6 (Circuits Elements)
    g. Section 2.1 (Introduction)
    h. Section 2.2 (Ohm's Law)

i. Section 2.3 (Nodes, Branches, and Loops)
j. Section 2.4 (Kirchhoff's Laws)
k. Section 2.5 (Series Resistors and Voltage Division)
l. Section 2.6 (Parallel Resistors and Current Division)
m. Section 2.7 (Wye-Delta Transformation)

B. **Unit Two**: Methods of Analysis and Circuits Theorems (Chapter 3, 4)

1. Unit Objectives: Upon successful completion of this unit, the student will be able to:

k. Understand Kirchhoff's current law and voltage law.
l. Develop an understanding of how to use Kirchhoff's current law to write nodal equations.
m. Develop an understanding of how to use Kirchhoff's voltage law to write mesh equations.
n. Explain how to use PSpice to solve for unknown node voltages and currents.
o. Understand how linearity works with basic circuits.
p. Understand the value of source transformation.
q. Recognize Thevenin and Norton's theorems.
r. Understand the maximum power transfer concept.

2. Learning Activities:

a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
b. Read the chapter section as assigned. (F1)
c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

a. Section 3.1 (Introduction)
b. Section 3.2 (Nodal Analysis)
c. Section 3.3 (Nodal Analysis with Voltage Sources)
d. Section 3.4 (Mesh Analysis)
e. Section 3.5 (Mesh Analysis with Current Sources)
f. Section 3.6 (Nodal and Mesh Analyses by Inspection)
g. Section 3.7 (Nodal Versus Mesh Analysis)
h. Section 3.8 (Circuit Analysis with PSpice)
i. Section 4.1 (Introduction)
j. Section 4.2 (Linearity Property)
k. Section 4.3 (Superposition)
l. Section 4.4 (Source Transformation)

m. Section 4.5 (Thevenin's Theorem)
n. Section 4.6 (Norton's Theorem)
o. Section 4.7 (Derivation of Thevenin's and Norton's Theorem)
p. Section 4.8 (Maximum Power Transfer)

C. **Unit Three**: Operational Amplifiers and Capacitors and Inductors (Chapter 5, 6)

1. Unit Objectives: Upon successful completion of this unit, the student will be able to:

   a. Identify how real operational amplifiers (op amps) function.
   b. Apply the inverting op amp to create summers.
   c. Apply the in op amp to create a difference amplifier.
   d. Understand the volt-amp characteristics of capacitors and inductors and their use in basic circuits.
   e. Understand how capacitors behave when combined in parallel and in series.
   f. Describe how to create integrators using capacitors and op amp.
   g. Describe how to create differentiators and their limitation.

2. Learning Activities:

   a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
   b. Read the chapter section as assigned. (F1)
   c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

   a. Section 5.1 (Introduction)
   b. Section 5.2 (Operational Amplifiers)
   c. Section 5.3 (Ideal Op Amp)
   d. Section 5.4 (Inverting Amplifier)
   e. Section 5.5 (Noninverting Amplifier)
   f. Section 5.6 (Summing Amplifier)
   g. Section 5.7 (Difference Amplifier)
   h. Section 5.8 (Cascaded Op Amp Circuits)
   i. Section 6.1 (Introduction)
   j. Section 6.2 (Capacitors)
   k. Section 6.3 (Series and Parallel Capacitors)
   l. Section 6.4 (Inductors)

m. Section 6.5 (Series and Parallel Inductors)

D. **Unit Four** First and second order circuits. (Chapter 7, 8).

1. Unit Objectives: Upon successful completion of this unit, the student will be able to:

   a. Understand solution to unforced, first order linear differential equation.
   b. Understand the solution of general second order differential equations.
   c. Solve problems involving how to determine initial and final values.

2. Learning Activities:

   a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
   b. Read the chapter section as assigned. (F1)
   c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

   a. Section 7.1 (Introduction)
   b. Section 7.2 (The Source-Free RC Circuit)
   c. Section 7.3 (The Source-Free RL Circuit)
   d. Section 7.4 (Singularity)
   e. Section 8.1 (Introduction)
   f. Section 8.2 (Finding Initial and Final Values)
   g. Section 8.3 (The Source-Free Series RLC Circuit)
   h. Section 8.4 (The Source-Free Parallel RLC Circuit)
   i. Section 8.5 (Step Response of a Series RLC Circuit)
   j. Section 8.6 (Step Response of a Parallel RLC Circuit)
   k. Section 8.7 (General Second-Order Circuits)

E. **Unit Five**: AC Circuits: Sinusoids and Phasors, Sinusoids Steady-State Analysis (Chapter 9, 10)

1. Unit Objectives: Upon successful completion of this unit, the student will be able to:

   a. Define sinusoids and phasors.
   b. Explain the phasors relationships for circuit's elements.

c. Understand the concepts of impedance and admittance.
d. Apply Kirchhoff's laws in frequency domain.
e. Analyze electrical circuits in the frequently domain using nodal analysis.
f. Analyze electrical circuits in the frequently domain using mesh analysis.

2. Learning Activities:

a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
b. Read the chapter section as assigned. (F1)
c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

a. Section 9.1 (Introduction)
b. Section 9.2 (Sinusoids)
c. Section 9.3 (Phasors)
d. Section 9.4 (Phasors Relationship for Circuit Elements)
e. Section 9.5 (Impedance and Admittance)
f. Section 9.6 (Kirchhoff's Laws in Frequency Domain)
g. Section 10.1 (Introduction)
h. Section 10.2 (Nodal Analysis)
i. Section 10.3 (Mesh Analysis)
j. Section 10.4 (Superposition Theorem)
k. Section 10.5 (Source Transformation)
l. Section 10.6 (Thevenin and Norton Equivalent Circuits)
m. Section 10.7 (Op Amp AC Circuits)