BUTTE COLLEGE
COURSE OUTLINE

I. **CATALOG DESCRIPTION**

ENGR 17 - Electrical Circuits and Devices **4 Unit(s)**

Prerequisite(s): PHYS 42, MATH 40 (or concurrent enrollment)
Recommended Prep: NONE

Transfer Status: CSU/UC
51 hours Lecture
51 hours Lab

An introduction to the analysis, construction and measurement of electrical circuits. Use of analytical techniques based on the application of circuit laws and network theorems. Basic use of electrical test and measurement instruments including multimeters, oscilloscopes, power supplies, and function generators. Use of circuit simulation software. Interpretation of measured and simulated data based on principles of circuit analysis for Direct Current (DC), analysis, transient, and sinusoidal steady-state Alternating Current (AC) conditions containing resistors, capacitors, inductors, dependent sources, operational amplifiers and /or switches. Elementary circuit design. Practical considerations such as component value tolerance and non-ideal aspects of laboratory instruments. Construction and measurement of basic operational amplifier circuits. Natural and forced responses of first and second order RLC circuits; the use of phasors; AC power calculations; power transfer; and energy concepts. (C-ID ENGR 260/260L).

II. **OBJECTIVES**

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

A. Analyze DC circuits to find current, voltage, resistance, power, and/or energy.
B. Draw and label circuit diagrams and show thorough mathematical solutions.
C. Apply different circuit analysis techniques and demonstrate a process for selecting an appropriate technique for a given problem.
D. Solve circuits containing two or more Op Amps.
E. Find the transient response and complete response for RC, RL, and RLC circuits involving DC sources.
F. Solve AC circuits by using Phasors.
G. Calculate average and complex power for AC circuits.
H. Access and use the most basic functions of electrical test and measurement equipment including oscilloscopes, multimeters, function generators and power supplies. (Lab)
I. Read circuit schematics and construct linear circuits using resistors, capacitors, inductors, and/or op amps. (Lab)
J. Measure resistance, DC and AC voltages, current, and power, and experimentally verify the results for a variety of electrical circuits. (Lab)
K. Test circuits, analyze data and compare measured performance to theory and simulation. (Lab)
L. Use a circuit simulation program (PSPICE, MultiSIM) and other computer applications (MATLAB, MS Excel) to predict or describe circuit behavior. (Lab)
M. Troubleshoot and repair simple electric circuits. (Lab)
N. Record and document results of lab work using text and graphs. (Lab)
O. Work effectively in groups by sharing responsibilities and collaborating on findings. (Lab)

III. **COURSE CONTENT**

A. **Unit Titles/Suggested Time Schedule**

Lecture

Topics	Hours

1. Ohm's Law	3.00
2. Electrical Power and Energy	3.00
3. Kirchhoff's Laws	3.00
4. Equivalent Circuits	4.00
5. Voltage and Current Division	3.00
6. Dependent Sources	3.00
7. Nodal and Mesh Analysis	3.00
8. Thevenin and Norton Equivalent Circuits	4.00
9. Superposition	3.00
10. Operational Amplifiers and Analysis using Ideal Models	4.00
11. Voltage gain and current limitations of non-ideal op amp circuits	3.00
12. Transient and Complete response of RC, RL, and RLC Circuits	3.00
13. Sinusoidal steady-state analysis including phasors, complex impedance, and power factor	6.00
14. Frequency response of first and second order AC circuits	3.00
15. AC Power including power transfer and power factor correction	3.00
Total Hours	51.00

Lab

Topics	Hours
1. Test and measurement equipments: Use of each item for specific purposes.	6.00
2. Circuit construction techniques for laboratory use ("breadboarding")	6.00
3. Component identification and labeling; nominal and measured values; limitations on voltage, current, power dissipation	6.00
4. Verifying lecture concepts: Kirchoff's Current Law (KCL); Kirchoff's Voltage Law (KVL); Ohm's Law; Voltage and Current Division; Power dissipation; Series and Parallel Circuits; Equivalent circuits; Thevenin equivalent circuit; and Superposition	12.00
5. Operational Amplifiers and the practical voltage and current limits on the output of these devices	6.00
6. Step response of RL, RC, and RLC circuits	6.00
7. Frequency response of RL, RC, and RLC circuits (including resonance)	6.00
8. Laboratory Safety	3.00
Total Hours	51.00

IV. **METHODS OF INSTRUCTION**

A. Lecture
B. Class Activities
C. Homework: Students are required to complete two hours of outside-of-class homework for each hour of lecture
D. Laboratory Experiments

V. **METHODS OF EVALUATION**

A. Exams/Tests
B. Quizzes

C. Research Projects
D. Homework
E. Lab Projects
F. Laboratory Reports

VI. EXAMPLES OF ASSIGNMENTS

A. Reading Assignments
   1. Read the chapter on equivalent circuits and be able to discuss derivations in class.
   2. Read the oscilloscope owners manual and be prepared to discuss and apply information to analysis of results in class.

B. Writing Assignments
   1. In a 3 page paper explain the physical principles and characteristics of common circuit elements including resistors, inductors, capacitors, transistors and diodes.
   2. In a 3 page paper concisely and accurately describe source bench laboratory activities including goals, process and results.

C. Out-of-Class Assignments
   1. Research operating specs for elements online and be prepared to discuss effects on circuits in class.
   2. Research the circuitry for a cappuccino machine and write a 2 page summary including diagram.

VII. RECOMMENDED MATERIALS OF INSTRUCTION

Textbooks:

A. Nilsson, J. & Riedel, S. Electric Circuits. 10th Edition. Prentice Hall, 2014.
B. Thomas, R.E., Rosa, A.J., Toussaint, G.J. The Analysis and Design of Linear Circuits. 7th Edition. Wiley, 2012.

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