CREDIT COURSE OUTLINE

I. COVER PAGE

(1) ENGR 6	(2) Electric Circuit Analysis with Lab	(3) 4
Number	Title	Units

(4)	Lecture / Lab Hours:			
	Total Course Hours			
		Total Lec hours:		54.00
		Total Lab hours:		54.00
		Total Contact hours:		108.00
	Lec will generate _0_ hour(s) outside work.			
	Lab will generate _0_ hour(s) outside work.			
(5)	Grading Basis:	Grading Scale Only		
		Pass/No Pass option		X
		Pass/No Pass only		
(6)	Advisories: Eligibility for English 125 and Eligibility for English 126			
(7)	Pre-requisites(requires C grade or better): PHYS 4B			
	Corequisites: MATH 7			

(8)Classification:		
	Degree applicable:	X
	Non-degree applicable:	
	Basic skills:	
(9)RC	Fulfills AS/AA degree requirement: (area)	
	General education category:	
	Major:	ENGINEERING
	Certificate of:	
	Certificate in:	
(10)CSU	Baccalaureate:	X
(11)Repeatable: (A course may be repeated three times)		0

(12) Catalog Description:
An introductory course in the analysis of DC and AC linear circuits containing resistors, inductors, capacitors, independent and dependent voltage and current sources, and operational amplifiers. Topics include Ohm's Law, Kirchhoff's Laws, loop and mesh analysis, Thevenin's and Norton's Theorems, superposition, natural and forced response in first and second order circuits, phasor analysis, resonance, and AC steady-state power.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

Upon completion of this course, students will be able to:

I. Determine unknown electrical quantities using the basic v-i characteristic equations of electrical components.
II. Solve DC circuit problems using a variety of analytical techniques.
III. Solve AC circuit problems using phasor methods.
IV. Solve steady-state AC power problems.
V. Use basic electrical test and analysis equipment in a laboratory setting.
VI. Plan, execute, and write reports for laboratory experiments.

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

I. Derive and use the v-i (voltage-current) characteristic equations for resistors, operational amplifiers, and independent and dependent power sources.
II. Solve DC electrical circuit analysis problems using Kirchhoff's voltage and current laws.
III. Apply series and parallel resistor theorems.
IV. Apply current and voltage division theorems.
V. Solve DC electrical circuit analysis problems using the analysis techniques of mesh current and node voltage.
VI. Solve DC electrical circuit analysis problems using the analysis techniques of superposition, Thevenin's Theorem, and Norton's Theorem.
VII. Derive and use the v-i characteristic equations for energy storage devices (capacitors and inductors).
VIII. Solve first order circuit problems involving energy storage devices (both natural and forced response problems).

IX. Solve second order circuit problems involving energy storage devices (both natural and forced response problems).
X. Learn and use phasor analysis techniques for solving AC steady-state circuit problems.
XI. Apply KVL, KCL, node voltage, mesh current, Thevenin's Theorem, Norton's Theorem, and superposition analysis techniques to solve AC steady-state circuit problems.
XII. Calculate power quantities in AC steady-state circuit problems using the appropriate equations and the power triangle.
XIII. Learn to competently use electrical laboratory test and analysis equipment.
XIV. Plan, execute, and write reports for laboratory experiments

IV. COURSE OUTLINE:

Lecture Content:

I. Intro: definitions of electrical circuit variables.
   1. Units
   2. Charge
   3. Current
   4. Voltage
   5. Energy
   6. Power
   7. Ideal elements

II. Ohm's Law, Kirchhoff's Laws, Sources
   1. Independent and dependent voltage and current sources
   2. Resistance and Ohm's Law
   3. Kirchhoff's Current and Voltage Laws

III. Resistive circuits with dependent and independent sources.
   1. Parallel and series resistor equivalents
   2. Current and voltage division theorems
   3. Delta-to-Wye equivalent circuits
   4. Circuits with dependent power sources
   5. Wheatstone bridge circuits
   6. Ammeters and voltmeters

IV. Techniques of Circuit Analysis
   1. Node voltage analysis method
   2. Mesh current analysis method

V. Thevenin's Theorem, Norton's Theorem, and superposition.
   1. Thevenin's Theorem
   2. Norton's Theorem
   3. Source transformations
   4. Maximum power transfer theorem
   5. Superposition

VI. Operational amplifiers.
   1. Basic model of op amp operation
   2. Inverting amp
   3. Non-inverting amp
   4. Summing amp
   5. Difference amp
   6. More sophisticated model of op amp operation

VII. Energy storage devices (capacitors and inductors).
   1. Inductors and their characteristic equation
   2. Capacitors and their characteristic equation
   3. Series and parallel combinations of energy storage
   4. Using initial conditions with energy storage devices

VIII. Response of RL and RC circuits (first order circuits).
   1. Natural response of RL circuits
   2. Natural response of RC circuits
   3. Step response of RL and RC circuits
   4. Sequential switching
   5. Integrating amplifiers

IX. Response of RLC and other second order circuits.
   1. Series RLC circuits, natural and forced response
   2. Parallel RLC circuits, natural and forced response
   3. Other second order circuits

X. Sinusoidal excitation and phasors.
   1. Sinusoidal sources
   2. Phasors
   3. Passive elements in the frequency domain

XI. Steady-state AC analysis.
   1. Kirchhoff's laws in the frequency domain
   2. Series, parallel and Delta-to-Wye equivalents in the frequency domain
   3. Node voltage and mesh current analysis methods in the frequency domain
   4. Thevenin and Norton equivalents in the frequency domain
   5. Superposition in the frequency domain
   6. Phasor diagrams

XII. AC steady-state power.

1. Instantaneous power
2. Average and reactive power
3. The rms value and power calculations
4. Complex power
5. Power calculations
6. The power triangle

Lab Content:

LAB EXPERIMENTS
A. Power in DC circuits
B. Linear and non-linear resistance
C. Thevenin's theorem and maximum power transfer
D. Intro to operational amplifiers
E. Intro to the oscilloscope
F. RC transients
G. Natural response of a series LRC circuit
H. Node voltage, mesh current, and superposition
I. Capacitance and inductance
J. Tunable band-pass filter
K. Design project

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

I. Sample Text Title:
1. Recommended - Nilsson and Riedel *Electric Circuits,* ed. 9 Pearson, 2010,
2. Recommended - Boylestad, Robert *Introductory Circuit Analysis,* ed. 12 Prentice Hall, 2010,
3. Recommended - Boylestad, Robert *Introductory Circuit Analysis, Laboratory Manual,* ed. 11 Prentice Hall, 2006,

II. Other Readings
1. Recommended - *1. Electric test and analysis equipment manuals. 2. Instructor prepared laboratory instructions.*

___ Global or international materials or concepts are appropriately included in this course
___ Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing Check either 1 or 2 below			
X	***1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.***		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
	a) essay exam(s)		d) written homework
	b) term or other paper(s)		e) reading reports
X	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:
Formal laboratory reports based on experimentation.

B. Problem Solving Computational or non-computational problem-solving demonstrations, including:			
X	a) exam(s)	X	d) laboratory reports
	b) quizzes		e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:
1.Circuit analysis and other computational problems are assigned throughout the course. Occasionally design problems are also assigned.

2.Exams are computational and problem solving in nature.

3.Laboratory reports require analysis and synthesis of measured data taken during lab periods using laboratory test equipment.

C. Skill demonstrations, including:			
X	a) class performance(s)		c) performance exams(s)
	b) field work		d) other (specify)

Required assignments may include but are not limited to the following:
1. Use of electrical lab test equipment.
2. Must assemble circuits from electrical components.

D. Objective examinations including:			
	a) multiple choice		d) completion
	b) true/false		e) other (specify):
	c) matching items		

COURSE GRADE DETERMINATION:
Description/Explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.
Exams 70% Homework 10% Lab reports 20%

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):	College-Level Criteria Met YES	NO
Textbook	X	
Reference materials		X
Instructor-prepared materials	X	
Audio-visual materials		X

Indicate Method of evaluation:

Used readability formulae (grade level 10 or higher)	
Text is used in a college-level course	X
Used grading provided by publisher	
Other: (please explain; relate to Skills Levels)	

Computation Level (Eligible for MATH 101 level or higher where applicable)	X	
Content		
Breadth of ideas covered clearly meets college-level learning objectives of this course	X	
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	X	
Requires independent thought and study	X	
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	X	

List of Reading/Educational Materials
Recommended - Nilsson and Riedel *Electric Circuits,* ed. 9 Pearson, 2010,
Recommended - Boylestad, Robert *Introductory Circuit Analysis,* ed. 12 Prentice Hall, 2010,
Recommended - Boylestad, Robert *Introductory Circuit Analysis, Laboratory Manual,* ed. 11 Prentice Hall, 2006,

Comments:

_____ This course requires special or additional library materials (list attached).
This course requires special facilities:
__X__ Laboratory with electrical test equipment: power supplies, function generators, oscilloscopes, circuit boards and components

Attached Files:

BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 101. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least three major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.

(eligibility for English 126) (as outcomes for English 262) __X__ Using phonetic, structural, contextual, and dictionary skills to attack and understand words. __X__ Applying word analysis skills to reading in context. __X__ Using adequate basic functional vocabulary skills. __X__ Using textbook study skills and outlining skills. __X__ Using a full range of literal comprehension skills and basic analytical skills such as predicting, inferring, concluding, and evaluating.	1. Reading engineering textbook. 2. Reading instructor prepared lab instructions. 3. Reading electrical test equipment manuals.
(eligibility for English 125) (as outcomes for English 252) __X__ Writing complete English sentences and avoiding errors most of the time. __X__ Using the conventions of English writing: capitalization, punctuation, spelling, etc. __X__ Using verbs correctly in present, past, future, and present perfect tenses, and using the correct forms of common irregular verbs. __X__ Expanding and developing basic sentence structure with appropriate modification. __X__ Combining sentences using coordination, subordination, and phrases. __X__ Expressing the writer's ideas in short personal papers utilizing the writing process in their development.	1. Writing descriptions of experimental procedures. 2. Writing summaries of experimental results. 3. Writing conclusions based on laboratory results.

Check the appropriate spaces.
_____ Eligibility for Math 101 is advisory for the target course.
__X__ Eligibility for English 126 is advisory for the target course.
__X__ Eligibility for English 125 is advisory for the target course.

If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.

CONTENT REVIEW

MATH 7 DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

PHYS 4B PHYSICS FOR SCIENTISTS AND ENGINEERS

REQUISITES

Corequisite -- MATH 7 DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

- Use matrices and their applications to solve linear systems of equations.
- Find the solutions to first order and higher order differential equations and apply them to various application problems.
- Find the solutions to systems of differential equations using matrix methods.
- Use Laplace transforms to find the solution to initial value problems.

- Solve DC electrical circuit analysis problems using Kirchhoff's voltage and current laws.
- Solve DC electrical circuit analysis problems using the analysis techniques of mesh current and node voltage.
- Solve DC electrical circuit analysis problems using the analysis techniques of superposition, Thevenin's Theorem, and Norton's Theorem.
- Solve first order circuit problems involving energy storage devices (both natural and forced response problems).
- Solve second order circuit problems involving energy storage devices (both natural and forced response problems).
- Apply KVL, KCL, node voltage, mesh current, Thevenin's Theorem, Norton's Theorem, and superposition analysis techniques to solve AC steady-state circuit problems.

Subject Prerequisite -- PHYS 4B PHYSICS FOR SCIENTISTS AND ENGINEERS

• understand basic concepts and fundamental laws in thermodynamics, electricity, and magnetism. • understand basic concepts and fundamental laws in electricity and magnetism. • calculate the electric potential of various charge configurations. • relate electric field and electric potential. • determine the capacitance of various electrical systems. • work basic problems involving electrical circuits.	• Derive and use the v-i (voltage-current) characteristic equations for resistors, operational amplifiers, and independent and dependent power sources. • Solve DC electrical circuit analysis problems using Kirchhoff's voltage and current laws. • Apply series and parallel resistor theorems. • Apply current and voltage division theorems. • Solve DC electrical circuit analysis problems using the analysis techniques of mesh current and node voltage. • Solve DC electrical circuit analysis problems using the analysis techniques of superposition, Thevenin's Theorem, and Norton's Theorem. • Derive and use the v-i characteristic equations for energy storage devices (capacitors and inductors). • Solve first order circuit problems involving energy storage devices (both natural and forced response problems). • Solve second order circuit problems involving energy storage devices (both natural and forced response problems). • Learn and use phasor analysis techniques for solving AC steady-state circuit problems. • Apply KVL, KCL, node voltage, mesh current, Thevenin's Theorem, Norton's Theorem, and superposition analysis techniques to solve AC steady-state circuit problems. • Calculate power quantities in AC steady-state circuit problems using the appropriate equations and the power triangle.

ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

1. _____ The prerequisite/corequisite is required by law or government regulations.
   Explain or cite regulation numbers:
2. _____ The health or safety of the students in this course requires the prerequisite.
   Justification: Indicate how this is so.
3. _____ The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
   Justification: Indicate how this is so.
4. _____ The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.
   Justification: Indicate how this is so.
5. _____ Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
   Justification: Cite the statistical evidence from the research.
6. _____ The prerequisite course is part of a sequence of courses within or across a discipline.
7. __X__ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:
   UCD ENGR 17 has requisites of Math 22B (prev. or conc.) and Phys 9C. Cal Poly SLO EE 201 has requisites of Math 244 (prev. or conc.) and Phys 133. CSUS ENGR 017 has requisites of Math 045 and Phys 011C (one may be taken conc.).