Spring 2015
Circuit Analysis 1

Catalog Course Description and Topics Covered:
EE2415 Circuit Analysis 1 (3 lecture hours and 1 lab hour)
Basic circuit concepts of resistor, inductor, and capacitor (RLC) components. Kirchhoff's laws, resistive network analysis, power calculations, loop and node equations, topology, basic network theorems. Dependent sources and operational amplifiers. Computer-assisted solution of circuit problems. Elementary transient time-domain analysis. Introduction to frequency domain analysis and Bode plots. Steady state A-C phasor analysis, including element laws and phasor diagrams. Problems and experimental demonstrations will be covered during recitation and laboratory sessions.

EE 2415 is the first complete course on electric circuit theory and analysis. The course begins with topics on basic elec-trical engineering quantities and variables and quickly progresses into a review of the fundamental network laws (Ohm's and Kirchhoff's). Following this review is an introduction into voltage and current sources. Resistors and basic resistor networks and operations are covered next. A set of network theorems are developed from the application of the fundamental laws on resistive networks. Matrix methods are applied to the generation and solution of a system of linear network equations (MAME and NAME). The second part of the course begins with the introduction into energy storage elements – the capacitor and the inductor. The behavioral characteristics of the elements in the time-domain are ex-plored with the application of differential equations on the analysis equations. Complete time-domain solutions of first and second order network are developed. The course ends with the application of steady-state concepts on RLC net-works, and the development and application of phasors.

Pre-Requisites:
Grade C or better in EE 1205, MATH 2425
Co-requisites:
MATH 3319, PHYS 1444.

Instructor:
David Wetz, Ph.D.
Office: NH537 and ELB 124,126, and 219
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Phone: 817-272-0719

GTA: Iragaba Intwari, Yi Li

Office Hours:
M-W 2:00 P.M – 3:20 P.M. I have an open door policy so please feel free to stop by my office or lab any time. If I am able, I am happy to help.

Course Website:
Blackboard

Times and Location:

EE 2415-001	CIRCUIT ANALYSIS I (Lecture)	TuTh 9:30AM - 10:50AM	NH 106
EE 2415-101	CIRCUIT ANALYSIS I (Laboratory)	MoWe 9:00AM - 9:50AM	WH 221
EE 2415-102	CIRCUIT ANALYSIS I (Laboratory)	TuTh 11:00AM - 11:50AM	TBD

Required Textbook:
R.C. Dorf and J.A. Svoboda, Introduction to Electric Circuits, 9th Edition, John Wiley & Sons, Inc., March 2013, ©2014, ISBN : 978-1-118-56058-7.

Grading:
Attendance: 5%
Pop Quizzes (5-7 of them): 10%
Homework: 15%
MidTerm Exam 1: 22.5%
MidTerm Exam 2: 22.5%
Final Exam: 35%

Elements Contributing to Grading

Class Attendance: At the University of Texas at Arlington, taking attendance is not required. Rather, each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, it is my decision to make attendance mandatory. If you have a really good excuse, email me in advance.

Pop Quizzes: There will be periodic quizzes. Some will be announced while others will not so be prepared every class. These will be concept quizzes to test your basic knowledge of the materials being taught. They are designed to help you, not hurt you! Do not fear them; just be prepared for them. I will allow you to drop your single lowest quiz grade.

Homework: There will be weekly homework assignments to help you practice the material. I am fine with you working together in small groups to get homework assignments done however everyone must submit their own assignment. If you let one-person work on it and you don't do your own and learn the material, you will regret that decision when it comes to the test so please take this seriously. Some homework assignments may utilize the UTA online HW site and some will be from the text or instructor.

Exams: These are self-explanatory and details will be given before each one

Lecture Schedule (tentative and easily subject to change)			
	Tues	**Thurs**	**Book Coverage**
Week 1 (Jan 18)	Introduction and class policies	Electrical quantities, system of units, charge and energy.	Chapter 1 - 1.4
Week 2 (Jan 25)	Current and voltage, power and energy.	Network models, circuit ele-ments, resistors, Ohm's law.	Chapter 1.4 - 1.8 and Chapter 2.1 - 2.4
Week 3 (Feb 1)	Independent voltage and cur-rent sources, dependent voltage and current sources.	Transducers, switches, meters, Kirchhoff's laws.	Chapter 2.5 - 2.11
Week 4 (Feb 8)	Series and parallel resistors, divider circuits, source opera-tions.	Mesh analysis matrix equation (MAME) for resistive net-works.	Chapter 3.1 - 3.6
Week 5 (Feb 15)	MAME examples and applica-tions.	Node analysis matrix equation (NAME) for resistive net-works.	Chapter 4.1 - 4.8
Week 6 (Feb 22)	NAME examples and applica-tions.	Mid-term Exam 1	
Week 7 (Feb 29)	Circuit simulators, PSPICE, source transformations, super-position.	Thevenin's and Norton's theo-rems, maximum power trans-fer.	Chapter 5.1 - 5.6
Week 8 (Mar 7)	The operational amplifier (op-amp), ideal and non-ideal op-amps.	Energy storage elements, ca-pacitors, energy stored in ca-pacitors, series and parallel capacitors.	Chapter 6.1 - 6.7 and Chapter 7.1 - 7.4
Week 9 (Mar 14)	**Spring Break**		
Week 10 (Mar 21)	Inductors, energy stored in inductors, series and parallel inductors.	Initial and final conditions in switched RC and RL circuits.	Chapter 7.5 - 7.8
Week 11 (Mar 28)	First-order RC and RL circuits, constant input, sequential switching, non-constant input, differential operators.	Circuits with two energy stor-age elements, 2nd order differ-ential equations.	Chapter 8.1 - 8.8 and Chapter 9.1 - 9.3
Week 12 (Apr 4)	Natural response characteris-tics, underdamped, critically damped, overdamped, oscilla-tory.	Forced constant excitation and complete response of a 2nd or-der RLC circuit.	Chapter 9.4 - 9.10
Week 13 (Apr 11)	Sinusoidal steady-state re-sponse of a 2nd order RLC cir-cuit.	Mid-term Exam 2	

Week 14 (Apr 18)	Phasors, phasor relationships for RLC elements.	Impedance and admittance, Kirchhoff's laws using phas-ors.	Chapter 10.1 - 10.5
Week 15 (Apr 25)	MAME and NAME using phasors.	The frequency domain, fre-quency response characteristics of linear networks.	Chapter 10.6 to 10.9
Week 16 (May 2)	Network response functions, immittance and transfer func-tions, frequency response plots, Bode plots.	Electric power, instantaneous, average, complex power, maximum power transfer.	Chapter 10.10 to 10.14 and Chapter 11.1 - 11.8
Final Exam	Thursday May 12, 2016 from 8:00 AM – 10:30 AM		

Lecture Topic Details:

1. Review of algebra and linear algebra concepts
2. Fundamentals
    a. Quantities and variables
        1. Electron energy and charge
        2. Voltage and current
        3. Energy and power
        4. Polarities and units
    b. Laws
        1. Voltage-current relationship (Ohm's law)
        2. Conservation of charge transfer (Kirchhoff's current law KCL)
        3. Continuity of voltage (Kirchhoff's voltage law KVL)
3. Voltage and current sources
    a. Independent sources
        1. Voltage sources
            i. Types and symbols
            ii. IV characteristics
            iii. Batteries
        2. Current sources
            i. Types and symbols
            ii. IV characteristics
    b. Dependent (controlled) sources
        1. Voltage sources
            i. VCVS
            ii. CCVS
        2. Current sources
            i. VCCS
            ii. CCCS
4. Resistors and simple resistor networks
    a. Resistance and conductance; construction, symbol, units
    b. Series connection
        1. Voltage divider
    c. Parallel connection
        1. Current divider
5. Network theorems I
    a. Source dominance
    b. Source combinations
    c. Source shifting
        1. e-shift operation
        2. i-shift operation
    d. Source transformations
        1. Voltage to current
        2. Current to voltage

6 Network theorems II
    a. Superposition
    b. Thevenin's theorem
    c. Norton's theorem

7. Application of network theorems to simple networks
    a. Reduction operations
    b. Elimination operation
    c. Equivalence operations
8. Vectors and matrices
    a. Definitions
    b. Mathematical operations
    c. Special matrices
    d. Matrix inverse
    e. Rank and equivalence
9. System of linear equations
    a. Dependence and independence
    b. Solutions of systems of simultaneous linear equations
10. Obtaining the system of network mesh-analysis equations
    a. Direct application of KVL, KCL, and Ohm's law
    b. Expressing the equations in vector-matrix format
11. Obtaining the system of network node-analysis equations
    a. Direct application of KVL, KCL, and Ohm's law
    b. Expressing the equations in vector-matrix format
12. Algorithms for generating matrix analysis equations
    a. Mesh-analysis matrix equation (MAME)
    b. Node-analysis matrix equation (NAME)
13. Energy storage components
    a. The capacitor
        1. Construction and symbol
        2. Charge-voltage (CV) relationship
        3. Current-voltage (IV) relationship
        4. Definition of capacitance
        5. Energy storage capacity
    b. The inductor
        1. Construction and symbol
        2. Flux linkage-current (λI) relationship
        3. Current-voltage (IV) relationship
        4. Definition of inductance
        5. Energy storage capacity

Learning Objectives and ABET Outcomes:

Number	Course Learning Objective (CLO)	ABET Outcome	Assessment Approach
1	An understanding of dependent sources and their applica-tion in generating device models.	a, e	exam problems
2	An ability to mathematically formulate multiple mesh and node analysis matrix equations for linear networks with and without dependent sources.	a, e	exam problems
3	An understanding of network theorems such as superposi-tion, Thevenin's and Norton's theorem, and maximum power transfer.	a, e	exam problems
4	An understanding of energy storage elements such as ca-pacitors and inductors, voltage and current relationships, and energy storage.	a, e	exam problems
5	An understanding of first-order RC and RL circuits, con-stant input, sequential switching, non-constant input, differ-ential operators.	a, c, e	exam problems
6	An understanding of circuits with two energy storage ele-ments, 2nd order differential equations, natural, forced, and complete response of a critically-damped parallel RLC cir-cuit.	a, e	exam problems
7	An understanding of steady-state response of an RLC cir-cuit to a sinusoidal excitation, complex exponential forcing function.	a, e	exam problems
8	An understanding of phasors, phasor relationships for RLC elements, impedance and admittance, Kirchhoff's laws us-ing phasors.	a, e	exam problems
9	The application of computer tools and software in the solu-tion of circuit design problems.	a, k	lab experiments

10	An ability to use conventional electrical engineering in-struments and equipment.	a, e, k	lab experiments
11	A working understanding of important analytical principles.	a, b, c	lab experiments
12	An ability to work as a member of a team.	d	lab experiments
13	An ability to understand and resolve professional ethical issues.	f	lab experiments

The EE undergraduate program is accredited by a body known as ABET. ABET has establish a series of outcomes for undergraduate engineering projects (designated as "a" through "k" items). Consideration of these outcomes and how EE2415 contributes to achievement and assessment of them is provided here:

a. an ability to apply knowledge of mathematics, science, and engineering; (WELL COVERED)
b. an ability to design and construct experiments, as well as to analyze and interpret data; (WELL COVERED)
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; (COVERED)
d. an ability to function on multidisciplinary teams; (NOT COVERED)
e. an ability to identify, formulate, and solve engineering problems; (WELL COVERED)
f. an understanding of professional and ethical responsibility; (COVERED)
g. an ability to communicate effectively; (NOT COVERED)
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context; (COVERED)
i. a recognition of the need for, and an ability to engage in lifelong learning; (WELL COVERED)
j. a knowledge of contemporary issues; (NOT COVERED)
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. (WELL COVERED)

General Class Information:

1. There are 32 class meetings scheduled for the 17 weeks of the Fall 2015 Semester. Twenty nine of these meetings are devoted to class lectures and three devoted to examinations – two mid-terms and one final.
2. Your 100% attendance in lectures and labs is mandatory and required. This requirement will not be waived for any reason.
3. Mid-term examinations will be given on the 6th and 12th weeks, and will be one and one half hour written exercises.
4. The final examination will be given on the 17th week and will be a comprehensive written examination. **NOTICE**: The UTA registrar has demanded a firm, unforgivable final date (one calendar day after the last final examination date) for the submission of course grades from all instructors. Because of this rigid schedule, the date and time scheduled for the final examination (**Thursday, May 12, 2016 from 8:00 am to 10:30 am)** is fixed and will not be changed for any reason. Therefore, all students, without exception, **must** take the final examination at this time.
5. You are requested to turn off any and all communication devices while in the Lecture and the Recitation/Lab Sec-tions. Communication devices of any type are not allowed to be used on any and all exams. No exceptions. Cal-culators without communication capability are permitted.
6. All examinations will be pencil, paper, and calculator exercises. All students will take these exams at the scheduled times in the classroom.
7. There will be **absolutely** no late or make-up mid-term or final examination given unless a written request has been submitted to and approved by the instructor at least two weeks prior to the examination date. As a rule, make-up examinations are several orders of magnitude more difficult than examinations given on the scheduled dates. Please be advised that illness or any other absence on the examination date does not constitute a valid reason for a make-up examination.
8. There will be five to six homework assignments, usually given on one or two-week intervals. Each assignment requires about five to ten hours for completion. These assignments will be graded and will be included as part of your total course grade. Past experience has shown that students who spend the necessary time to work these as-signments usually do quite well on the examinations. Solutions to homework problems will be e-mailed to all stu-dents by the end of the day the assignment is due. Homework turned in after the solutions have been sent out will not be counted and will receive a grade of zero.
9. In order to adhere to current privacy law requirements, class grades will not be posted. If you wish to receive your final examination paper and/or your class grade prior to their mailing by the registrar, please give me a large self-addressed and adequately stamped envelope prior to the final examination date so that I may mail your papers and grade to you.

10. Office hours are posted outside my office (NH526). If you have any questions and/or adverse difficulty with the lectures or class material, I strongly suggest that you call or e-mail me (during regular working hours, of course). If necessary, a scheduled office visit can be arranged.
11. Additional important dates:
    End of late registration: – January 22, 2016.
    Census date – February 3, 2016.
    Last day to drop classes – April 1, 2016 by 4:00 PM.
    Fall and Summer Registration Begins – April 4, 2016.
    Last day of classes – May 6, 2016

Lab Safety Training:
Students registered for this course must complete the University's required "Lab Safety Training" prior to entering the lab and undertaking any activities. Students should be notified via MavMail when their online training is available. Once notified, students should complete the required module(s) as soon as possible, but no later than their first lab meeting. **There are no exceptions to this requirement. Until all required Lab Safety Training is completed, a student will not be given access to lab facilities, will not be able to participate in any lab activities, and will earn a grade of zero for any uncompleted work.**

Electronic Communication:
UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at: http://www.uta.edu/oit/cs/email/mavmail.php.

Drop Policy:
Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/ses/fao).

Americans with Disabilities Act:
The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the Americans with Disabilities Act (ADA). All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Grade Grievances:
Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate / graduate catalog. For undergraduate courses, see:
http://wweb.uta.edu/catalog/content/general/academic_regulations.aspx#10

Academic Integrity:
All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:
I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

Instructors may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents' Rule 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Student Support Services:
UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at www.uta.edu/resources

Title IX:
The University of Texas at Arlington is committed to upholding U.S. Federal Law "Title IX" such that no member of the UT Arlington community shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity. For more information, visit www.uta.edu/titleIX.

Student Feedback Survey:
At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory will be asked to complete an online Student Feedback Survey (SFS) about the course and how it was taught. Instructions on how to access the SFS system will be sent directly to students through MavMail approximately 10 days before the end of the term. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback data is required by state law; student participation in the SFS program is voluntary.

Final Review Week:
A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures:
Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is located on the classroom or laboratory door. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will arrange to assist handicapped individuals.

Library:
The Library's website address is http://www.uta.edu/library.
The following is a list of commonly used library resources:

Library Home Page	http://www.uta.edu/library
Subject Guides	http://libguides.uta.edu
Subject Librarians	http://www-test.uta.edu/library/help/subject-librarians.php
Database List	http://www-test.uta.edu/library/databases/index.php
Course Reserves	http://pulse.uta.edu/vwebv/enterCourseReserve.do
Library Catalog	http://discover.uta.edu/
E-Journals	http://utalink.uta.edu:9003/UTAlink/az
Library Tutorials	http://www.uta.edu/library/help/tutorials.php
Connecting from Off- Campus	http://libguides.uta.edu/offcampus
Ask A Librarian	http://ask.uta.edu