Electrical Circuits

SECTION I: Course Overview

Course Code: ENGR340CDG
Subject Area(s): Engineering
Prerequisites: See Below
Language of Instruction: English
Total Contact Hours: 60
Recommended Credits: 4

COURSE DESCRIPTION

This course will guide you through the basic principles of ideal linear time-invariant electrical circuits and will provide you with the main tools for a full comprehension of their behavior. The basic circuit elements will be explained, together with the main laws deriving from their connection. The main methods for circuit analysis, efficiently merging the information on circuit components, and circuit topology will be introduced and described.

Properties of circuits will be studied in the time domain, where the input-output relationship leads to the convolution integral, and then extended to transformed domains – namely the frequency and Laplace transform domains – showing how the problem of circuit analysis can be correspondingly simplified. The important concepts of network function and circuit stability will be presented, leading to the definitions of circuit steady state response and alternate power analysis. Finally, basic concepts related to logic circuits will be presented, followed by a description of main semiconductor devices: diodes and transistors.

Every section of the course will be accompanied by simple practical examples in order to illustrate the main theoretical concepts. At the end of this course, you will have acquired the ability to analyze the behavior of electrical circuits, along with a comprehension of their usage in practical and meaningful applications.

LEARNING OBJECTIVES

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

- Define the basic concepts related to the lumped-circuit approximation and how to represent and to connect the main electric elements.
- Analyze a general linear time-invariant circuit.
- Demonstrate how the main transforms can be useful in order to simplify the analysis of circuits.

- Define the main concepts related to circuit stability and the possibility of representing circuits with the concept of network function.
- Predict the characterization of circuits in terms of energy exchanges among components.

PREREQUISITES

Prior to enrollment, this course requires you to have completed Calculus I and Introductory Physics courses.

SECTION II: Instructor & Course Details

INSTRUCTOR DETAILS

Name: TBA
Contact Information: TBA
Term: SUMMER

ATTENDANCE POLICY

This class will meet four times weekly for 120 minutes each session. All students are expected to arrive on time and prepared for the day's class session.

CEA enforces a mandatory attendance policy. You are therefore expected to attend all regularly scheduled class sessions, including any field trips, site visits, guest lectures, etc. that are assigned by the instructor. The table below shows the number of class sessions you may miss before receiving a grade penalty.

ALLOWED ABSENCES – SUMMER + 20 SESSIONS		
Courses Meeting X day(s) Per Week	**Allowed Absence(s)**	**Automatic Failing Grade at Xth absence**
Courses meeting **4** day(s) per week	**2** Absences	**6th** Absence

For every additional absence beyond the allowed number, your final course grade will drop down to the subsequent letter grade (ex: A+ to A). As a student, you should understand that the grade penalties will apply if you are marked absent due to tardiness or leaving class early. In the table below, you will find the grade penalty associated with each excessive absence up to and including automatic course failure.

ATTENDANCE DOCKING PENALTIES						
Absence	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
Penalty	**No Penalty**	**No Penalty**	**0.5 Grade Docked**	**1 Grade Docked**	**1.5 Grade Docked**	**Automatic Failure**
HIGHEST POSSIBLE GRADE AFTER ATTENDANCE PENALTIES						
Grade	**A+**	**A+**	**A**	**A-**	**B+**	**F**

CEA does not distinguish between excused and unexcused absences. As such, no documentation is required for missing class. Similarly, excessive absences, and the grade penalty associated with each, will not be excused even if you are able to provide documentation that shows the absence was beyond your control. You should therefore only miss class when truly needed as illness or other unavoidable factors may force you to miss a class session later on in the term.

GRADING & ASSESSMENT

The instructor will assess your progress towards the above-listed learning objectives by using the forms of assessment below. Each of these assessments is weighted and will count towards your final grade. The following section (Assessment Overview) will provide further details for each.

Class Participation	**10%**
Homework	**10%**
Quizzes	**15%**
Midterm Exam	**25%**
Final Exam	**40%**

The instructor will calculate your course grades using the CEA Grading Scale shown below. As a CEA student, you should understand that credit transfer decisions–including earned grades for courses taken abroad–are ultimately made by your home institution.

CEA GRADING SCALE			
Letter Grade	**Numerical Grade**	**Percentage Range**	**Quality Points**
A+	9.70 – 10.0	97.0 – 100%	4.00
A	9.40 – 9.69	94.0 – 96.9%	4.00
A-	9.00 – 9.39	90.0 – 93.9%	3.70
B+	8.70 – 8.99	87.0 – 89.9%	3.30
B	8.40 – 8.69	84.0 – 86.9%	3.00
B-	8.00 – 8.39	80.0 – 83.9%	2.70
C+	7.70 – 7.99	77.0 – 79.9%	2.30
C	7.40 – 7.69	74.0 – 76.9%	2.00
C-	7.00 – 7.39	70.0 – 73.9%	1.70
D	6.00 – 6.99	60.0 – 69.9%	1.00
F	0.00 – 5.99	0.00 – 59.9%	0.00
W	Withdrawal	N/A	0.00
INC	Incomplete	N/A	0.00

ASSESSMENT OVERVIEW

This section provides a brief description of each form of assessment listed above. Your course instructor will provide further details and instructions during class time.

Class Participation (10%): Student participation is mandatory for all courses taken at a CEA Study Center. The instructor will use the rubric below when determining your participation grade. All students should

understand that attendance and punctuality are expected and will not count positively toward the participation grade.

CLASS PARTICIPATION GRADING RUBRIC	
Student Participation Level	**Grade**
You make major & original contributions that spark discussion, offering critical comments clearly based on readings, research, & theoretical course topics.	**A+** (10.0 – 9.70)
You make significant contributions that demonstrate insight as well as knowledge of required readings & independent research.	**A/A-** (9.69 – 9.00)
You participate voluntarily and make useful contributions that are usually based upon some reflection and familiarity with required readings.	**B+/B** (8.99 – 8.40)
You make voluntary but infrequent comments that generally reiterate the basic points of the required readings.	**B-/C+** (8.39 – 7.70)
You make limited comments only when prompted and do not initiate debate or show a clear awareness of the importance of the readings.	**C/C-** (7.69 – 7.00)
You very rarely make comments and resist engagement with the subject. You are not prepared for class and/or discussion of course readings.	**D** (6.99 – 6.00)
You make irrelevant and tangential comments disruptive to class discussion. You are consistently unprepared for class and/or discussion of the course readings.	**F** (5.99 – 0.00)

Homework (10%): You will be assigned homework on a weekly basis. Homework will consist of solving problems described in class and will help build the skills necessary for the midterm and final exams.

Quizzes (15%): Quizzes will be 15 minutes long and will be taken in class. They will be useful in checking the comprehension of the main concepts of the course and evaluating the learning objectives above.

Midterm Exam (25%): The midterm exam will be 45-minutes long and will be used to evaluate your understanding and learning of the first part of the course.

Final Exam (40%): The final exam will be 90-minutes long and will consider all the topics described in the course.

REQUIRED READINGS

Reading assignments for this course will come from the required text(s) and/or the selected reading(s) listed below. All required readings–whether assigned from the text or assigned as a selected reading–must be completed according to the due date assigned by the course instructor.

I. **REQUIRED TEXT(S)**: You may purchase the required text(s) prior to departure or upon program arrival. The required text(s) are listed below:

Alexander, Charles K., and Sadiku, Matthew N.O. *Fundamentals of Electric Circuits* (6th edition). Mc Graw Hill, 2017.

Hambley, Allan R. *Electrical Engineering: Principes and Applications* (5th edition) Pearson, 2013.

RECOMMENDED READINGS & RESOURCES

The recommended reading(s) and/or text(s) for this course are below. These recommended readings are not mandatory, but they will assist you with research and understanding course content.

Rizzoni, G. *Fundamentals of Electrical Engineering.* Mc Graw Hill, 2009, 726 pp.

Chua, Leon O., Desoer, Charles A., and Kuh, Ernest S. *Linear and Nonlinear Circuits* Mc Graw Hill, 1987, 839 pp.

https://en.wikibooks.org/wiki/Signals_and_Systems

ADDITIONAL RESOURCES

In order to ensure your success abroad, CEA has provided the academic resources listed below. In addition to these resources, each CEA Study Center provides students with a physical library and study areas for group work. The Academic Affairs Office at each CEA Study Center also compiles a bank of detailed information regarding libraries, documentation centers, research institutes, and archival materials located in the host city.

- **UNH Online Library**: As a CEA student, you will be given access to the online library of CEA's School of Record, the University of New Haven (UNH). You can use this online library to access databases and additional resources while performing research abroad. You may access the UNH online library here or through your MyCEA Account. You must comply with UNH Policies regarding library usage.

- **CEAClassroom – Moodle**: CEA instructors use Moodle, an interactive virtual learning environment. This web-based platform provides you with constant and direct access to the course syllabus, daily schedule of class lectures and assignments, non-textbook required readings, and additional resources. Moodle includes the normal array of forums, up-loadable and downloadable databases, wikis, and related academic support designed for helping you achieve the learning objectives listed in this syllabus.

  During the first week of class, CEA academic staff and/or faculty will help you navigate through the many functions and resources Moodle provides. While you may print a hard copy version of the syllabus, you should always check Moodle for the most up-to-date information regarding this course. The instructor will use Moodle to make announcements and updates to the course and/or syllabus. It is your responsibility to ensure that you have access to all Moodle materials and that you monitor Moodle on a daily basis in case there are any changes made to course assignments or scheduling.

  To access Moodle: Please log-in to your MyCEA account using your normal username and password. Click on the "While You're Abroad Tab" and make sure you are under the "Academics" sub-menu. There you will see a link above your schedule that says "View Online Courses" select this link to be taken to your Moodle environment.

COURSE CALENDAR *Electrical Circuits*			
SESSION	**TOPICS**	**ACTIVITY**	**READINGS & ASSIGNMENTS**
1	**Course Introduction:** Review Syllabus, Classroom Policies **Basic Concepts:** Definitions of voltage, current, power, circuit elements	Course Overview Discussion in class	Alexander & Sadiku 2017: Chapter 1: Par. 1, 2, 3, 4, 5, 6
2	**Basic laws:** Linearity, time-invariance, Ohm's law, Kirchhoff's laws, nodes, branches, loops **Methods of Analysis (I):** Nodal analysis	Discussion in class	Alexander & Sadiku 2017: Chapter 2: Par. 1, 2, 3, 4, 5, 6 Chapter 3: Par. 1, 2, 3
3	**Methods of Analysis (II):** Mesh analysis, nodal vs. mesh analysis	Discussion in class	Alexander & Sadiku 2017: Chapter 3: Par. 4, 5, 6, 7
4	**Circuit Theorems:** Main properties of circuits, Thevenin's & Norton's theorems	Discussion in class	Alexander & Sadiku 2017: Chapter 4: Par. 1, 2, 3, 4, 5, 6, 7, 8 Assignments: Methods of circuit analysis
5	**FIRST QUIZ**		
	Operational Amplifiers: Inverting, noninverting, summing and difference amplifier **Capacitors & Inductors**: Definitions and importance in circuit analysis	Discussion in Class	Alexander & Sadiku 2017: Chapter 5: Par. 1, 2, 3, 4, 5, 6, 7, 8 Chapter 6: Par. 1, 2, 3, 4, 5
6	**First-order Circuits:** Description of simple circuits and their analysis in the time-domain	Discussion in Class	Alexander & Sadiku 2017: Chapter 7: Par. 1, 2, 3, 4, 5, 6, 7
7	**Sinusoids & Phasors:** Circuit elements, Kirchhoff's laws in the phasor domain **Sinusoidal Steady-state Analysis:** Node and mesh analysis in the phasor domain	Discussion in Class	Alexander & Sadiku 2017: Chapter 9: Par. 1, 2, 3, 4, 5, 6, 7 Chapter 10: Par. 1, 2, 3, 4, 5, 6, 7

The instructor reserves the right to make changes or modifications to this syllabus as needed

8	**AC Power Analysis:** Definitions and properties of power in the phasor domain	Discussion in Class	Alexander & Sadiku 2017: Chapter 11: Par. 1, 2, 3, 4, 5, 6, 7, 8
9	**Frequency Response:** Definition and properties of the frequency response of a circuit	Discussion in Class	Alexander & Sadiku 2017: Chapter 14: Par. 1, 2, 3, 4, 5, 6, 7 Assignments: Analysis of electrical circuits in the time domain, AC power analysis and frequency response
10	**SECOND QUIZ**		
	The Laplace Transform: Definition and properties	Discussion in class	Alexander & Sadiku 2017: Chapter 15: Par. 1, 2, 3
11	**The Inverse Laplace Transform:** Partial fraction expansion	Discussion in class	Alexander & Sadiku 2017: Chapter 15: Par. 4
12	**The Convolution Integral:** The impulse response and its use in circuit analysis	Discussion in class	Alexander & Sadiku 2017: Chapter 15: Par. 5, 6
13	**Applications of the Laplace Transform:** Analysis of circuits in the general case	Discussion in class	Alexander & Sadiku 2017: Chapter 16: Par. 1, 2, 3
14	**Transfer Function & Stability of Circuits:** Importance and use in circuit analysis	Discussion in class	Alexander & Sadiku 2017: Chapter 16: Par. 4, 6.1 Assignments: The use of Laplace transform in circuit analysis, Review course material for midterm
15	**MIDTERM EXAM**		
16	**Fourier Series:** Generalities	Discussion in class	Alexander & Sadiku 2017: Chapter 17: Par. 1, 2, 3
17	**The Fourier Series in Circuit Analysis:** Applications	Discussion in class	Alexander & Sadiku 2017: Chapter 17: Par. 4, 5, 8
18	**Fourier Transform:** Introduction & properties	Discussion in class	Alexander & Sadiku 2017: Chapter 18: Par. 1, 2, 3

19	**The Fourier Transform in Circuit Analysis:** Comparison with the Laplace transform and applications	Discussion in class	Alexander & Sadiku 2017: Chapter 18: Par. 4, 5, 6, 7 Assignments: The Fourier transform
20	**THIRD QUIZ**		
	Logic Circuits: Basic concepts	Discussion in class	Hambley 2013: Chapter 7: Par. 1, 2, 3
21	**Diodes:** Basic diode concepts and circuits	Discussion in class	Hambley 2013: Chapter 10: Par. 1, 2, 3, 4, 5, 6, 7, 8
22	**FORTH QUIZ**		
	Field-effect Transistors (FETs): Generalities on NMOS and PMOS transistors	Discussion in class	Hambley 2013: Chapter 12: Par. 1, 2, 3, 4, 5, 6, 7
23	**Bipolar Junction Transistors (BJTs):** Generalities on BJTs	Discussion in class	Hambley 2013: Chapter 13: Par. 1, 2, 3, 4, 5, 6, 7, 8, 9
24	**Final Review Session**	In class review	Review all course material
25	**FINAL EXAMINATION**		

SECTION III: CEA Academic Policies

The policies listed in this section outline general expectations for CEA students. You should carefully review these policies to ensure success in your courses and during your time abroad. Furthermore, as a participant in the CEA program, you are expected to review and understand all CEA Student Policies, including the academic policies outlined on our website. CEA reserves the right to change, update, revise, or amend existing policies and/or procedures at any time. For the most up to date policies, please review the policies on our website.

Class & Instructor Policies can be found here
General Academic Policies can be found here