

Course Syllabus (Summer 2019)

CET141: Introduction to Electric Circuits and Digital Electronics

Course Information

Prerequisite: N.A.

Schedule: Refer to class webpage

Classroom: SR3C

Instructor: Dr.KIM Noori

Contact: noori.kim@digipen.edu

Office Hours: Class time or by appointment

Class Webpage: cet141s19-a.sg at <http://distance.sg.digipen.edu>

The website is accessible via student's DIT login credential.

Description

The module covers the topics necessary to develop understanding of simple electric circuits. Initially, the topics cover basic elements of the circuits, their properties and parameters, as well as the fundamental laws required to design and analyze such circuits. Then the module discusses use of transistors and logic gates, and finally concentrates on combinatorial logic and sequential logic elements of digital circuits.

Although the capacitive and inductive effects are covered in the module, ideal passive linear circuits (RLC) and active linear circuits with AC sources are left in the background, leaving more space for the topics related to electronic circuits operating on digital signals.

Reference

- Nilsson J., Riedel S., "Electric circuits", 10th Edition, Pearson.
- Sarah Harris and David Harris, "Digital Design and Computer Architecture, ARM Edition", Morgan Kaufmann

Module Topics

Unit 1. Analog circuits introduction (4 days)

Day 1. Introduction to analog circuits

- Overview of the course
- Potential and flow of modalities (or fields)
- Analog circuit basics: Electric current, Voltage, Resistance, Power, Energy
- Laws: Ohm's law, Kirchhoff laws
- Voltage division and current division
 - Software: LTspice
 - Hardware/components: Nil.

- Participation Test 1 (PT1): Devices introduction & LTspice (Offline submission)

Day 2. Resistive circuits practice

- Dependent voltage and current sources
- Wheatstone bridge circuits
- Delta-to-wye circuits
 - Software: waveform
 - Hardware/components: resistors, breadboard, LED, push button, Digilent device, DMM, AA battery *4 (individual preparation required)

- Participation Test 2 (PT2): Current, Voltage, and Wheatstone Bridge (Offline submission) + Wheatstone bridge implementation (lab)

Day 3. Op-amps with a feedback loop

- Operational amplifiers basics, Feedback (negative, positive)
- Various resistive circuits with op-amps
 - Software: waveform
 - Hardware/components: same as day 2 + LP324 op-amp or LM741 op-amp
- Participation Test 3 (PT3): Op-amp circuits practice (Offline submission) + a simple op-amp circuit implementation (lab)

Day 4. Test and review (End of Unit 1)

- Practice
- Quiz 1

Unit 2: RC/RL circuits (4 days)

Day 5. Capacitance (C) and inductance (L)

- Capacitance/Inductance (C and L) basics
 - 1st order partial differential equation solution basics
 - Software: Nil
 - Hardware/components: capacitor
 - Participation Test 4 (PT4): Simple Capacitance/Inductance topic (Online quiz)
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Day 6. RC/RL circuits in time domain

- RC, RL circuits analysis, RC + op-amp, RL + op-amp
 - Software: Nil
 - Hardware/components: Nil
 - Participation Test 5 (PT5): RC/RL circuits in time domain analysis (Offline submission)
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Day 7. Frequency domain circuit analysis

- Phasor concepts
 - Impedance: Circuit components representation in the phasor domain
 - Complex circuits analysis in Phasor domain
 - Software: Nil
 - Hardware/components: Nil
 - Participation Test 6 (PT6): Phasor and impedance practice (Offline submission)
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Day 8. Test and review (End of Unit 2)

- Practice
 - Quiz 2
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Unit 3: Digital Circuits introduction and combinational logics (4 days)

Day 9. Introduction to Digital circuits

- Digital circuit basic concepts (Digital disciplines)
 - Diodes, Transistors (BJT, MOSFET)
 - Boolean recap, Sum of product, Product of sum (SOP, POS), Boolean simplification: Karnaugh map
 - Logic gates
 - Software: Nil
 - Hardware/components: Nil
 - Participation Test 7 (PT7): Introduction to Digital circuits (Online quiz)
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Day 10. Combinational logic application (I)

- Adder, Subtractor
- Encoder, Decoder
- Practical session: an adder construction using Logic gates
 - Software: Waveform
 - Hardware/components: Same as Day 2 + 74HC00,04,02,32,86,11 * 2 each
- Participation Test 8 (PT8): Combinational logic application I (Online quiz) + “Not a Prime” Detector implementation (lab)

Day 11. Combinational logic application (II)

- Multiplexer, Demultiplexer
- Delay and timing in combinatorial logics
- Practical session: an adder construction using Multiplexers
 - Software: Waveform
 - Hardware/components: Same as Day 10 + 74HC151* 2
- Participation Test 9 (PT9): Combinational logic application II (Online quiz) + an adder construction using Multiplexers (lab)

Day 12. Test and review (End of unit 3)

- Practice
- Quiz 3

Unit 4: Sequential logics (4 days)

Day 13. Sequential logic introduction

- Introducing clock signals in circuits
- Latches (SR), Flip-flops (D, JK, T), Memory units
- Sequential logic applications: Multivibrators, Counters
- Delay and timing in sequential logics
 - Software: Nil
 - Hardware/components: Nil
- Participation Test 10 (PT10): Sequential logic (Online quiz)

Day 14. State machine I

- State machine basics
- Moore state machine, Mealy state machine
 - Software: Nil
 - Hardware/components: Nil
- Participation Test 11 (PT11): State machine I (Online quiz)

Day 15. State machine II

- State machines more examples
 - Software: Waveform
 - Hardware/components: same as Day 10 + 74HC74 * 3
- Participation Test 12 (PT12): State machine II (Online quiz) + State Machine Sequence Detector implementation (lab)

Day 18. Test and review (End of unit 4)

- Practice
- Quiz 4

Day 16. Guest lecture I (Continental Automotive)**Day 17. Guest lecture II (Continental Automotive)**

Grading Policy

Grades will be derived from various assessments such as labs, tests, exams and class participation.

The composition of grades is as follows:

- 4 In-class quizzes/demo: 60% total. 15% each * 4.
- 12 Participation tests: 40% total. 3.333% each * 12.
- Passing range (100%-70%): A (93% or above), B+ (87%), B (83%), B- (80%), C+ (77%), C (73%), C- (70%)

Do note that the number of assignments & quizzes may vary in order to meet the proficiency requirements of the course. In the event of changes, the total grades per category will remain unchanged while each category will update such that grades are evenly distributed across each entry within.

Attendance Policy

Attendance is **mandatory**. Students are expected to **notify the lecturer** if they are unable to attend class for any reason. A 1 week grace will be given before and after the class for the student to submit the notice. It is highly recommended for student to send the notice via email to keep a digital record of the notice.

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Each absence case will be reviewed on a case-by-case basis and students may be required to provide document proof to back their reasons given.

Typical valid reasons are those that fall within the domain of medical (with valid medical certificate) and compassion (with document proof).

Any reasons that are deemed to be personal and/or due to negligence will be rejected. Examples are like oversleeping, working on another assignment/project/course, uncertain if class is being held, going on a family holiday... etc.

A **5% penalty** from the course total will be given for each unexcused absence.

Submission Requirement Policy

In order to properly grade works submitted, all source code and assets are required for assessment.

Detailed instructions and requirements will be listed in each assignment submission page.

You are expected to follow all instructions and meet all requirements stated.

Grades will be given based only on what is submitted to the school's course management system (Moodle) and no exceptions will be allowed.

Source, header, data, and README files must start with the following header:

```
/******  
filename Example.c or Example.s  
author John Smith  
email john.smith@digipen.edu  
date created 1 Jan 1988  
Brief Description: A simple summary of what the code does  
*****/
```

Failure to include the mandatory header comment will result in a **20% penalty** for the assignment.

Late Submission Policy

Each assignment provided will be accompanied with a due date and time which will be clearly stated on the assignment submission page. A **100% penalty** will be imposed on any submission deemed late by the course management system (Moodle). This will also be reflected on the assignment brief.

Students may request for extensions should they provide valid reasons with documented proof to justify their case. This will be handled on a case-by-case basis by the lecturer.

Request for extensions after the deadline will not be accepted except in excruciating cases. In those cases, it will be handled on a case-by-case basis by the school.

Classroom Policy

Students are expected to behave professionally at all times with regards to classroom conduct and timely delivery of all assignments. Specific guidelines will accompany each assignment, along with a completion date. Students are expected to retain all works done until after the end of the semester.

To maintain a conducive learning environment during class, it is expected for students to...

- Be quiet during class while the lecturer is talking and to keep a low noise level at all times. This is to ensure that everyone is able to listen to the discussion and to not disturb others while doing class activities.
- Turn off your mobile phones or put them on silent mode. This is to prevent unwanted interruptions due to phones ringing or vibrating.
- Reduce use of mobile phones during class where possible. Also, playing games on any device is strictly prohibited during class time. This is to reduce distractions for everyone around including the student him/herself. Penalties may be imposed if students are caught doing so.
- Keep the classrooms clean. Eating and/or drinking in class is strictly prohibited with the exception of bottled water. Do dispose of all wastes (such as used paper, eraser crumbs, empty bottles etc.) in the garbage bins located outside classrooms.
- Do not mistreat school equipment (such as computers, keyboards, mice, monitors etc.). There will be penalties given for such abuse cases and having broken equipment will cause inconvenience for everyone in school.

Academic Integrity Policy

CET141 assignments are **NOT** group projects. They must represent a student's own individual work. It is reasonable for students for students to consult or discuss general solutions to an assignment. However, it is prohibited for students to collaborate on detailed solutions, to copy code, or to give away code.

Cheating, or academic dishonesty in any form, will not be tolerated in this course. Penalties for cheating may include receiving a zero on an assignment, or a failing grade in the course, or even expulsion from DigiPen. It is permissible to discuss assignments (not solutions) with other students in the class, but the solutions must be recognizably your own. For further details, please consult the DigiPen Academic Integrity Policy.

With the internet as a readily accessible source of information and help, students may feel that plagiarism is ambiguous and thus be unable to determine what it constitutes. Here are some general guidelines to help make the distinction:

- Do **NOT** copy-paste any works online (wholesale or otherwise). Using works that are not yours is plagiarism.
- Do **NOT** ask online communities (such as stack overflow, unity forums etc.) to solve your bugs & code issues by providing your code segments. Asking others to solve your issues is work not done by you and thus is plagiarism.
- You may learn from sources online, understand the workings and concepts, and implementing them again via **your own efforts**. A good habit is to assume that you will be tested on the things you learn online and if you are unable to answer the questions then you should not use said works.
- You may ask online communities general problems and use their insights to **work on your problem**.
- These applies to all sources on any medium (be it the internet, textbooks, friends or social media etc.). It is the content that is important, not the medium they are on.
- The bottom line test is to ask yourself "Did I work on this?" If you did not, then you should not use it. **Learn** from it and **work it out yourself**.