# Circuits and Systems I
# ECE 201 - section 002
# Fall 2019

## Course Information

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| **Instructor:** | Dr. Shanelle N. Foster<br>Office: 3212 Engineering Building<br>Phone:(517) 432-4589<br>Email: hogansha@egr.msu.edu |
| **Instructor's Office Hours:** | M Tu W 10:30 - 11:30 am, or by appointment |
| **Course Schedule:** | Days: M W F<br>Time: 9:10 - 10 am<br>Classroom: 225 Natural Resources Building |
| **Course Website:** | D2L website: `https://d2l.msu.edu/` |
| **Prerequisites:** | MTH 133 |
| **Textbook:** | Thomas, Rosa & Toussaint<br>*The Analysis and Design of Linear Circuits*<br>Eighth Edition<br>Wiley, 2016 |

## Course Description

Resistive circuits, loop and nodal analysis, network theorems, dependent sources, capacitor and inductor circuits, transient analysis and introduction to computer-aided design.

## Course Objectives

At the completion of this course, each student should be able to do the following:

1. Understand and describe the properties of basic circuit elements including resistors, capacitors, inductors, controlled sources and op-amps.
2. Apply element constraints, connection constraints, and network theorems for circuit analysis.
3. Apply network theorems for circuit analysis.
4. Analyze DC circuits.
5. Analyze first-order RL and RC circuits and second order RLC circuits. Calculate the transient response of first and second-order circuits.
6. Enter netlists of basic circuits into Spice software and obtain simulation results.
7. Understand electrical safety.

# Course Policies

## Attendance Policy

Classroom attendance is expected for all students that appear on the official class list. Students whose names do not appear on the official class list for this course may not attend this class. Students who fail to attend the first four class sessions or class by the fifth day of the semester, whichever occurs first, may be dropped from the course. Absence is *not* an excuse for anything. **Students are expected to know exactly what is discussed in class and assigned - homework, notes, study, or changes in schedule.**

## Calculator Policy

Only simple (non-programmable/graphing) calculators are allowed in class and exams.

## E-Mail Policy

All e-mails to me regarding this course **MUST** start the subject with "**ECE201**". To request a meeting, please send an e-mail at least 24 hours in advance and suggest three days/times that are convenient for you.

## Homework Policy

Homework assignments will be posted on the course website regularly, including their due dates. Postings of new assignments will be announced in class. You **must** submit your homework **before** class on the due date. *No late homework will be accepted.*

Homework should be clean, legible, self-contained and self-explanatory. Homework must be original copies in the students' own handwriting. The final answer of every question must be enclosed with a box/circle or highlighted for the question to be graded. All assumptions must be stated and thoughts outlined. Sequences of equations and results are not adequate for a grade. There is *no partial credit* given for problems not solved to the end. Work that is not legible or well explained will not be graded.

***Homework is not designed to test.*** *Homework is meant to promote active learning and progress toward meeting the course objectives.*

## Exam Policy

The 50-minute exams are held in the classroom during the regularly scheduled class time. **There are *NO MAKEUP EXAMS.*** Exams are closed book and notes. There are *NO* formula sheets, *NO* crib sheets for the exams. **Use of cellular phones, tablets and other electronic devices is not permitted during exams.**

The two-hour final exam is also held in the classroom and will be comprehensive. ***You must obtain a passing grade on the Final Exam to pass this course.*** Students who do not take the final exam will receive a score of 0.0 in the class. Students who request a rescheduled ECE 201 Final Exam based on the MSU "3-exam in 1 day policy" must request rescheduling by e-mail to the instructor. The request must be made by Friday, December 1 and approval of the request is based on confirmation of enrollment in the classes having concurrent exams, and consistency of the final exam schedules as listed at: `https://reg.msu.edu/ROInfo/Calendar/FinalExam.aspx`.

The **tentative exam schedule (*subject to change*)**is:

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| **Midterm Exam #1** | Friday, September 27 |
| **Midterm Exam #2** | Monday, October 21 |
| **Midterm Exam #3** | Monday, November 18 |
| **Final Exam** | Thursday, December 12, 7:45-9:45 am |

## Grading Policy

Final grades for this course are earned based on your performance on exams and homework as well as classroom activities. Points are distributed as shown below.

| Homework | Classroom Activities | Midterm Exams | Final Exam |
|---|---|---|---|
| 10% | 5% | 45% | 40% |

The lowest homework score will be dropped when computing your average homework grade. Also, the lowest midterm exam score will be dropped when computing your average exam grade. Grading is assigned using the straight scale shown below.

| **Score** | $\geq 90\%$ | $\geq 85\%$ | $\geq 80\%$ | $\geq 75\%$ | $\geq 70\%$ | $\geq 65\%$ | $\geq 60\%$ | $< 60\%$ |
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| **Grade** | 4.0 | 3.5 | 3.0 | 2.5 | 2.0 | 1.5 | 1.0 | 0.0 |

## Code of Ethics and Professional Conduct

Students are expected to adhere to the Spartan Code of Honor which states,

**"As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do."**

In addition, Article 2.III.B.2 of the Student Rights and Responsibilities (SRR) states that

**"The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards."**

The Electrical and Computer Engineering Department adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations. (See Spartan Life: Student Handbook and Resource Guide and/or the MSU Web site: `www.msu.edu`.)

Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com web site to complete any course work in this course. *Students who violate MSU academic integrity rules may receive a penalty grade, including a failing grade on the assignment or in the course.* Contact your instructor if you are unsure about the appropriateness of your course work. (See also the Academic Integrity webpage.)

Article 2.III.B.4 of the Student Rights and Responsibilities (SRR) for students at Michigan State University states:

**"The student's behavior in the classroom shall be conducive to the teaching and learning process for all concerned."**

You are expected to develop and refine professional skills during this course. Late arrivals, sleeping, ringing cellular phones, and reading the newspaper are a few of many unprofessional behaviors that are deemed unacceptable for this course. If you find that you are having trouble keeping up with assignments or other aspects of the course, make sure that you let your instructor know as early as possible. As you will find, building rapport and effective relationships are key to becoming an effective professional. Make sure that you are proactive in informing your instructor when difficulties arise during the semester so that we can help you find a solution.

Article 2.III.B.10 of the SRR states that

**"The student and the faculty share the responsibility for maintaining professional relationships based on mutual trust and civility."**

General Student Regulation 5.02 states: "No student shall . . . interfere with the functions and services of the University (for example, but not limited to, classes. . . ) such that the function or service is obstructed or disrupted. *Students whose conduct adversely affects the learning environment in this classroom may be subject to disciplinary action.*

As members of a learning community, **students are expected to respect the intellectual property of course instructors**. All course materials presented to students are the copyrighted property of the course instructor and are subject to the following conditions of use:

1. Students *may not* record lectures or any other classroom activities.
2. Students *may not* share the recordings with other students enrolled in the class.
3. Students *may not* post the recordings or other course materials online or distribute them to anyone not enrolled in the class without the advance written permission of the course instructor and, if applicable, any students whose voice or image is included in the recordings.
4. Commercialization of lecture notes and university-provided course materials *is not* permitted in this course.
5. *Any student violating the conditions described above may face academic disciplinary sanctions.*

## Confidentiality Limits

As the instructor, I must report the following information to other University offices (including the MSU Police Department) if you share it with me:

- Suspected child abuse/neglect, even if this maltreatment happened when you were a child,
- Allegations of sexual assault or sexual harassment when they involve MSU students, faculty, or staff, and
- Credible threats of harm to oneself or to others.

These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In almost all cases, it will be your decision whether you wish to speak with that individual. If you would like to talk about these events in a more confidential setting you are encouraged to make an appointment with the MSU Counseling Center.

## Accommodations for Students with Disabilities

*From the Resource Center for Persons with Disabilities (RCPD):*
Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may

be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a Verified Individual Services Accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date may not be honored.

### Honor's Option

Any student desiring to take this course as an "Honor's Option" must submit the form on the Registrar's Office website by the **Wednesday, September 4**. Honor's option students are required to complete a project, assigned by the instructor. You must earn a satisfactory grade (3.5 or higher) to be awarded an honor's option.

## Important Dates

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| **Monday, September 2** | No class - Holiday |
| **Wednesday, September 4** | The last day to *add* this course. |
| **Wednesday, September 4** | The last day to add an *Honor's Option* for this course. |
| **Monday, September 23** | The last day to *drop* this course with *no refund* and *no grade* reported. |
| **Friday, September 27** | Midterm Exam #1 |
| **Monday,October 21** | Midterm Exam #2 |
| **Monday, November 18** | Midterm Exam #3 |
| **Wednesday, November 27** | The last day to request a rescheduled final exam based on the MSU "3-exam in 1 day policy" |
| **Friday, November 29** | No class - Holiday |
| **Friday, December 6** | No class - Design Day |
| **Thursday, December 12** | Final Exam, 7:45 - 9:45 am |

## Course Material

- **Chapter 1: Introduction**
  - 1-1 About the Book
  - 1-2 Symbols and Units
  - 1-3 Circuit Variables: Current, Voltage, Power, Passive Sign Convention, Ground, Conservation of Energy, Conservation of Power
  - 1-4 Computational and Simulation software: PSPICE and MATLAB
- **Chapter 2: Basic Circuit Analysis**
  - 2-1 Element Constraints: Electrical Network, Circuit, Resistance, Ohm's Law, V-I Characteristics, Conductance, Power, Resistor, Color Code, Precision Resistors, Ratings, Open and Short Circuits, Switches, Independent Voltage Sources, Independent Current Sources
  - 2-2 Connection Constraints: Kirchhoff's Current Law, Kirchhoff's Voltage Law
  - 2-3 Combined Constraints: Examples using KCL, KVL, Assigning Reference Marks
  - 2-4 Equivalent Circuits: Series Resistance, Parallel Resistance, Special Cases, Approximations, Equivalent Voltage Sources, Equivalent Current Sources, Source Transformations, Delta-to-Wye and Wye-to-Delta Transformations, Redundant Elements
  - 2-5 Voltage and Current Division: Voltage Divider Rule, Special Cases, Potentiometers, Current Divider Rule, Special Cases, Meter Movements, Wheatstone Bridge
- **Chapter 3: Circuit Analysis Techniques**
  - 3-1 Node-voltage analysis: Element Inspection Rule, Writing Node Equations by Inspection, Cramer's Rule, Evaluating Determinants, Node Analysis with Voltage Sources, Supernode
  - 3-2 Mesh-Current Analysis: Element Inspection Rule, Writing Mesh Equations by Inspection, Mesh Analysis with Current Sources, Supermesh
  - 3-3 Linearity Properties: Superposition Principle, Proportionality Property, Transfer Function, Unit Output Method
  - 3-4 Thevenin and Norton Equivalent Circuits: Thevenin's Theorem, Norton's Theorem, Relationships
  - 3-5 Maximum Signal Transfer: Maximum Power Transfer Theorem, Maximum Efficiency Theorem
  - 2-7 Computer-Aided Circuit Analysis: SPICE, MATLAB
- **Chapter 4: Active Circuits**
  - 4-1 Linear Dependent Sources: Voltage Controlled Sources, Current Controlled Sources, SPICE Models
  - 4-2 Analysis of Circuits with Dependent Sources: Node-Voltage Analysis, Mesh-Current Analysis, Thevenin and Norton Equivalent Circuits
  - 4-4 The Operational Amplifier: Notation, Ideal and Commercial Op-Amps, Non-inverting Amplifier, Zero Volt - Zero Current Property, Modeling a Non-inverting Amplifier, Limitations Due to the Power Supply, Voltage Follower, Inverting Amplifier and Model, Differential Amplifier and Model, Op-Amp Circuit Analysis, Bridge-T Amplifier
- **Chapter 6: Capacitance and Inductance**
  - 6-1 The Capacitor: V-I Relationship of Capacitance, Plotting Power and Energy with SPICE, Capacitor, Modeling a Capacitor with Ideal Elements
  - 6-2 The Inductor: V-I Relationship of Inductance, Plotting Power and Energy with SPICE, Inductor, Modeling an Inductor with Ideal Elements
  - 6-4 Equivalent Capacitance and Inductance: Series and Parallel Combinations of Capacitance, Series and Parallel Combinations of Inductance

- **Chapter 7: First- and Second-Order Circuits**
  - 7-2 First-Order Circuit Step Response: Step Response of an RC Circuit, Algorithm for any One Capacitance Circuit, Time Constant, Interpretation of the Time Constant, Step Response of an RL Circuit, Algorithm for any One Inductance Circuit, Time Constant, Sequential Switching, Algorithm for Sequential Switching, PSpice Simulation with Switches
  - 7-4 First-Order Circuit Sinusoidal Response: Natural and Forced Response, RC Circuits
  - 7-5 The Series RLC Circuit: Natural Response, Characteristic Equation, Overdamped, Critically Damped and Underdamped Response, SPICE
  - 7-6 The Parallel RLC Circuit: Natural Response, Characteristic Equation, Overdamped, Critically Damped and Underdamped Response, SPICE
  - 7-7 Second-Order Circuit Step Response: Complete Response of a Series RLC Circuit with a Step Input, SPICE