# ENGG*2450 Electric Circuits
# Winter 2014

### UNIVERSITY of GUELPH

### School of Engineering

(Revision 0: December, 2013)

## 1 INSTRUCTIONAL SUPPORT

### 1.1 Instructor

| | |
|---|---|
| Instructor: | Julie Vale, Ph.D., EIT. |
| Office: | THRN 2345, ext. 54863 |
| Email: | jvale@uoguelph.ca |
| Office hours: | TBA on Courselink or by appointment |

### 1.2 Lab Technician

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|---|---|
| Technician: | Nate Groendyk |
| Office: | THRN 2308, ext. 53873 |
| Email: | groendy@uoguelph.ca |

### 1.3 Teaching Assistants

| GTA | Primary Task | Email | Office Hours |
|---|---|---|---|
| Anujeet Kaur | Tutorial | akaur@uoguelph.ca | TBA on Courselink |
| Ziad Abuowaimer | Tutorial | zabuowai@uoguelph.ca | TBA on Courselink |
| Jeremy Fernandes | Lab 1 | jferna05@uoguelph.ca | In lab during lab 1 |
| Raja Nutakki | Lab 2 | rnutakki@uoguelph.ca | In lab during lab 2 |
| Elisha Colmenar | Lab 3 | ecolmena@uoguelph.ca | In lab during lab 3 |
| He Ma | Lab support | hma02@uoguelph.ca | In lab |
| Xuefei (Fei) Yu | Lab support | xuefei@uoguelph.ca | In lab |
| Xuejuan (Carrie) Yan | Lab support | xuejuan@uoguelph.ca | In lab |
| Yu Tian | Lab support | ytian02@uoguelph.ca | In lab |
| Kazi Tahsin | Courselink/iClickers/Data entry | ktahsin@uoguelph.ca | None |

# 2 LEARNING RESOURCES

## 2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*2450 Courselink site. You are responsible for checking the site regularly.

## 2.2 Required Resources

1. M. Davis, *Linear Circuit Analysis* CENGAGE Learning, 1998.

## 2.3 Additional Resources

**Lecture Information:** All lecture notes will be posted on Courselink as they are finalized.

**Lab Information:** The handouts for all the lab sessions will be posted within the lab section of the Courselink page.

**Assignments:** Assignment questions are located at the end of each chapter of the course notes. Solutions to selected questions will be posted to the lecture notes section in Courselink by the instructor and the GTAs. Students are encouraged to post their attempts at solutions to the remaining questions in the discussion forums; GTAs and the instructor will monitor these discussions and will provide support to help students arrive at the correct solutions. Correct solutions will be 'pinned' by the GTAs so that they are easy to find.

Assignments are not graded.

## 2.4 Communication and Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. It is your responsibility to check the course website regularly. As per university regulations, all students are required to check their uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

# 3 ASSESSMENT

## 3.1 Dates and Distribution

**Quizzes:** (best 4 of 6)
All quizzes will be iClicker quizzes and will be held on odd weeks (i.e., 1,3,5,7,9 and 11), at the beginning of the Thursday lecture. This corresponds to Jan 9, Jan 23, Feb 6, Feb 27, Mar 13, Mar 27.

**Labs:** There is a safety quiz available online in Courselink. This is a pass/fail quiz and does not contribute to your final course grade. You must pass (80% or higher) this quiz before you are allowed to enter the lab. If you do not pass this quiz, you will not be allowed to enter the lab and you will not be allowed to submit a lab report.

See section 5.3 below for information regarding in-lab dates and times. Lab reports are due at 4:30pm exactly one week after the day that you do the in-lab component, so if your lab is on a Monday, then your submission is due the following Monday at 4:30pm. You must submit your lab using Courselink.

**Midterm**  Feb 13, in class

**Final Exam:**  Monday April 21 14:30 - 16:30, location TBD

**The breakdown for grading** the course is given below. It is based on the premise that you must pass the exams in order to pass the course while ensuring that there are no step discontinuities in the grades (e.g., getting a 50% on the final exam versus a 49% will not change your grade from 70% to 49%). Additionally, if you do better on the final exam than the midterm, the final will have a higher weighting.

Define: Final Grade := $G$, Final exam := $F$, Midterm := $M$, Laboratory reports := $L$, and Quizzes =: $Q$ (all in percent), then set

$$E := \frac{1}{0.75} \max\{0.5F + 0.25M, 0.6F + 0.15M\}$$

and

$$x := \frac{E - 40\%}{20\%}.$$

Your final grade is then given by

$$G := \begin{cases} 0.75E + 0.15L + 0.1Q, & E \geq 60\% \\ \min\{(1-x)E + x(0.75E + 0.15L + 0.1Q), \\ \qquad\qquad 0.75E + 0.15L + 0.1Q\}, & 40\% \leq E \leq 60\% \\ \min\{E, \ 0.75E + 0.15L + 0.1Q\} & E \leq 40\%. \end{cases}$$
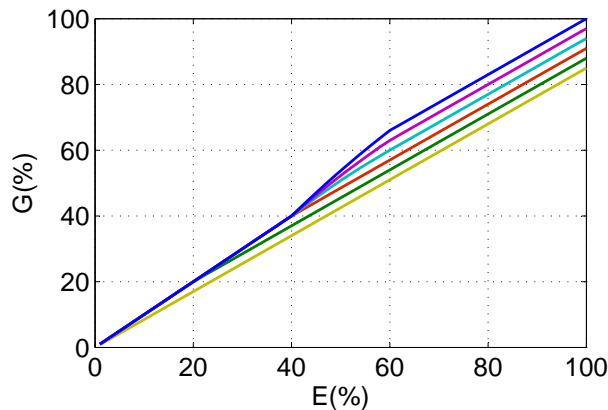


Figure 1: How your final grade varies with $E$; different lines indicate different Lab grades: $L$ ranges from 0% to 100%.

The ideal weighting (i.e., if you get over 60% on everything and do better on the final than the midterm) is

- midterm=15%
- final=60%
- labs=15%
- quizzes=10%.

## 3.2 Course Grading Policies

**Missed Assessments:** If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

**Accommodation of Religious Obligations:** If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Consideration of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

**Missed midterms and quizzes:** If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of any missed test will be added to the final exam weight. There will be no makeup tests. No extra time will be given to students who arrive late.

**Lab Work:** A lab safety quiz is available on Courselink. You will not be allowed to enter the lab until you have successfully completed this quiz.

You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

Attendance will be taken in the lab. All students are required to demo their lab during their lab session; this demo is graded. **If you are not present for your lab and your demo, you will not be allowed to submit a lab report and you will get a zero on that lab.** If you miss more than 25% of a lab period due to lateness or by leaving before you have finished the lab, you will be considered absent. Some labs are scheduled to take place over two weeks; if you complete your lab in the first week, you do not need to attend the second week.

**Pre-lab:** All of the labs have a *mandatory* prelab. Your group must submit your prelab upon arriving to your scheduled lab section. You will not be allowed to enter the lab if your prelab is incomplete. Since all lab sections are full, we can not allow you to attend a later lab if your miss your scheduled time due to a missing prelab; therefore, **if your prelab is incomplete, then you will get an automatic zero on that lab.**

**Late Lab Reports:** Late submissions of lab reports will not be accepted.

# 4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

## 4.1 Calendar Description

This course explores the fundamentals of electric circuit analysis. Course topics include: lumped circuit abstraction; circuit elements and their characteristics; Ohm's and Kirchhoff's laws; resistive circuits; nodal and mesh analysis; linearity and superposition principles; fundamental circuit theorems; introduction to the ideal operational amplifier model; energy storage elements and dynamics of first and second order circuits; alternate-current circuits and sinusoidal steady-state analysis with phasor methods; fundamentals of magnetically coupled circuits.
*Prerequisite(s):* ENGG*2400, and (PHYS*1010 or PHYS*1130)

## 4.2 Course Aims

This course explores the fundamentals of electric circuits. The course will focus on the analysis of circuits in a systems framework and will briefly explore some simple circuit design problems. The main goals of this course are to (1) teach students how to analyze circuits using a number of different methods and (2) to reinforce systems concepts introduced in 2400 using a circuits context.

## 4.3 Learning Objectives

At the successful completion of this course, a student will be able to:

1. predict a circuit's behaviour using standard systems tools including (but not limited to) Laplace transform, transfer functions, stability, step and impulse response, frequency response (including Bode plot), linearity, and time-invariance.

2. analyze a circuit using KVL, KCL, Nodal analysis, Mesh analysis, Ohm's law, superposition, Thevanin and Norton, and source transformation to obtain mathematical descriptions of the circuit.

3. describe (mathematically and graphically) the current, voltage, and power properties of elements that are part of complex circuits.

4. describe and analyze circuits in various multidisciplinary Engineering applications.

5. demonstrate basic laboratory skills, including proper safety procedures and the use of a DC power supply, DMM, signal generator, and oscilloscope.

## 4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

| Graduate Attribute | Learning Objectives | Assessment |
|---|---|---|
| 1. Knowledge Base | 1,2,3,4 | Quizzes, Exams |
| 2. Problem Analysis | all | Quizzes, Exams, Labs |
| 3. Investigation | 5 | Labs |
| 5. Use of Engineering Tools | 5 | Labs |
| 6. Communication | all | Labs |
| 11. Environment, Society, Business, & Project Management | 5 | safety quiz |

## 4.5 Relationships with other Courses & Labs

**Previous Courses:**

    **ENGG*2400:** System fundamentals, linear equations, responses, solving differential equations

**Follow-on Courses:**

    **ENGG*3280:** Foundations of systems analysis

    **ENGG*3410:** Foundations of systems analysis, frequency response, RLC circuit analysis, ideal operational amplifiers

    **ENGG*3450:** Foundations of circuits analysis, DC systems, time responses, ideal operational amplifiers

    **ENGG*3510:** Foundations of circuits analysis, DC and AC systems, transformers

    **ENGG*3570:** Foundations of circuits analysis

    **ENGG*3640:** Foundations of circuits and systems analysis, time responses

    **ENGG*4550:** Foundations of circuits and systems analysis, time responses

    **ENGG*4650:** Foundations of circuits and systems analysis, time responses, frequency responses

# 5 TEACHING AND LEARNING ACTIVITIES

## 5.1 Timetable

**Lectures:**

| | | | |
|---|---|---|---|
| Tuesday | | 10:00 - 11:20 | ROZH 101 |
| Thursday | | 10:00 - 11:20 | ROZH 101 |

**Tutorials:**

| | | | |
|---|---|---|---|
| Wednesday | Sec 01 | 11:30 - 12:30 | MACK 029 |
| Wednesday | Sec 02 | 09:30 - 10:30 | RICH 2529 |
| Monday | Sec 03 | 09:30 - 10:30 | MACS 209 |
| Friday | Sec 04 | 11:30 - 12:30 | RICH 2529 |
| Monday | Sec 05 | 11:30 - 12:30 | MACK 029 |

**Laboratory:**

| | | | |
|---|---|---|---|
| Wednesday | Sec 01 | 14:30 - 16:30 | RICH 1504 |
| Wednesday | Sec 02 | 14:30 - 16:30 | RICH 1504 |
| Tuesday | Sec 03 | 15:30 - 17:30 | RICH 1504 |
| Tuesday | Sec 04 | 15:30 - 17:30 | RICH 1504 |
| Monday | Sec 05 | 11:30 - 13:30 | RICH 1504 |

Notice that some lab sections share the same lab time, these sections will be alternating weeks. A detailed schedule is shown in Section 5.3

## 5.2 Lecture Schedule

Please see the table of contents in the lecture notes on courselink for more information regarding what is contained in each chapter.

| Lecture(s) | Chapter |
|---|---|
| 1 | Chapter 1 – Introduction |
| 2-8 | Chapter 2 – Systems |
| 9-11 | Chapter 3 – Electrical Concepts |
| 12 | Midterm |
| 13-17 | Chapter 4 – Analysis |
| 18-21 | Chapter 5 – Electrical Components |
| 22-24 | Chapter 6 – Applications |

## 5.3 Lab Schedule

All of the lab sections are all full! This means that you will **not** be allowed to attend a lab section that you are not scheduled for. Please go to the laboratory time and date that corresponds to the section that you selected in webadvisor.

The lab is heavily booked this term: we have split the class into two groups. On webadvisor, your section number will look like 010xy, where x and y will be a number between 1 and 5. The x indicates your lab section and the y indicates your tutorial section. If x is an odd number, then you are in Group 1, if x is an

even number, then you are in Group 2. If you are confused about this, please ask a GTA immediately.... do not wait until it is too late and you have missed your lab time!!

**Group 1**

| Week | Lab | Due dates |
|------|-----|-----------|
| 2 | Lab 1: Introduction to circuits - Day 1 | |
| 4 | Lab 1 - Day 2 | |
| 5 | | Lab 1 Due |
| 7 | Lab 2: DC circuits - Day 1 | |
| 9 | Lab 2- Day 2 | |
| 10 | Lab 3: Transients | Lab 2 Due |
| 11 | | Lab 3 Due |

**Group 2**

| Week | Lab | Due dates |
|------|-----|-----------|
| 3 | Lab 1: Introduction to Circuits - Day 1 | |
| 5 | Lab 1 - Day 2 | |
| 6 | | Lab 1 Due |
| 8 | Lab 2: DC circuits - Day 1 | |
| 10 | Lab 2- Day 2 | |
| 11 | Lab 3: Transients | Lab 2 Due |
| 12 | | Lab 3 Due |

## 5.4   Other Important Dates

Monday, January 6 2014: First day of class

Monday, February 17 - Friday, February 21 2014: Winter Break

Friday, March 7 2014: drop date - 40th class

Friday, April 4 2014: last day of class

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# 6   LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

A lab safety quiz is available on Courselink. You will not be allowed to enter the lab until you have successfully completed this quiz.

# 7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

## 7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

# 8  ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

# 9  RECORDING OF MATERIALS

Presentations which are made in relation to course work-including lectures-cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

# 10  RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index