ENGG*2450 Electric Circuits
Winter 2016

UNIVERSITY of GUELPH

School of Engineering

(Revision 0: December, 2015)

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1 Instructional Support

1.1 Instructor

Instructor:	Julie Vale, Ph.D., P.Eng.
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Office hours:	Wednesday 13:30-14:30 in THRN 1425, or by appointment

1.2 Sessional

Instructor:	Ahmed Mahmood, Ph.D.
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Office hours:	TBD, or by appointment

1.3 Lab Technician

Technician:	Nate Groendyk
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1.4 Teaching Assistants

GTA	Primary Task	Email	Office Hours
David Weales	Tutorial	dweales@uoguelph.ca	by appointment
Hitesh Chillappagari	Tutorial	hchillap@uoguelph.ca	by appointment
Abu Siddique	Lab 1	asiddi04@uoguelph.ca	In lab
Mohammed Elmahgiubi	Lab 2	melmahgi@uoguelph.ca	In lab
Ahmed Elshamli	Lab 3	ashamli@uoguelph.ca	In lab
Peixin Liu	General support and courselink	lpeixin@uoguelph.ca	In lab
Simranjit Sahni	General support	ssahni@uoguelph.ca	In lab

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 lab manual is in 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.

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 mail.uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

Important: When writing email to course staff (instructors, TAs, or lab techs), please be professional in your communication. Unprofessional emails will not be responded to. This includes those using l33t, text messaging shorthand, a complete lack of punctuation or capitals, etc.

Furthermore, Miss., Mrs., Ms., and Mr. are inappropriate forms of address for any faculty member who has a PhD. When communicating with the course instructor, (verbally or via email), please use Julie, Dr. Vale, or Professor. Emails using Miss., Mrs., or Ms. will not be responded to.

3 Assessment

3.1 Dates and Distribution

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 dates and due-dates. Pre-labs are due 48hours prior to the beginning of to your scheduled lab section. You must submit your lab and pre-lab using Courselink.

There are **NO** lab exemptions for this course.

Quizzes: There are two quizzes. These are preparatory/review quizzes for the midterm and final exam and will be held on Tuesday Feb 9 and Thursday April 7. Each quiz is 20 minutes, multiple choice, held at the beginning of the lecture. No extra time will be given to students who arrive late. If you miss quiz 1, or do better on the midterm, the weight will be placed on the midterm. If you miss quiz 2 or do better on the final, the weight will be placed on the final.

Tutorials: (best 4 of 6) Attendance will be taken at tutorials. Completed worksheets must be submitted at the end of the tutorial period. These worksheets will be graded. Tutorial sections are full, so please attend your assigned tutorial section.

Midterm Thursday, February 11, in class

Final Exam: Wednesday, April 13, 19:00-21:00, 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%).

Define Final Grade := G, Final exam := F, Midterm := M, Laboratory reports := L, Quiz 1 =: Q_1, Quiz 2 =: Q_2, and tutorials =: T (all in percent).

If you do better on the final than midterm, more weight is placed on the final:

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

Finally, if the overall exam grade is less than 60%, we use a linear interpolation to de-weight the quizes, tutorials, and labs. This yields the desired reuslt of making it difficult (but not impossible) to pass the course if you fail both the midterm and the final, while removing any step discontinuities in the grade. To achieve this, we use the following scaling factor

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

Your final grade is then given by

$$G := \begin{cases} 0.75E + 0.02Q_1 + 0.03Q_2 + 0.15L + 0.05T, & E \geq 60\% \\ \min\{(1-x)E + x(0.75E + 0.02Q_1 + 0.03Q_2 + 0.15L + 0.05T), & \\ \qquad 0.75E + 0.02Q_1 + 0.03Q_2 + 0.15L + 0.05T\}, & 40\% \leq E \leq 60\% \\ \min\{E,\ 0.75E + 0.02Q_1 + 0.03Q_2 + 0.15L + 0.05T\} & E \leq 40\%. \end{cases}$$

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

- midterm=15%
- final=60%
- labs=15%
- quiz 1=2%
- quiz 2=3%
- tutorials = 5%

A MATLAB-based grade calculator is provided on courselink if you wish to experiment with different possible grade outcomes.

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 midterm: If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of midterm 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.

Missed quizzes: If you miss a quiz for any reason, the weight of the quiz will be added to the midterm for quiz 1 and the final exam for quiz 2. There will be no makeup quizzes. 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.

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.

Pre-lab: All of the labs have a *mandatory* prelab. You will not be allowed to enter the lab if your prelab is incomplete. Prelabs are due 48hours before you enter the lab. You should look at the feedback you receive before entering the lab to ensure that you are adequately prepared.

Late Lab Reports: Late submissions of lab reports will be penalized at a rate of 10% **per hour**.

All labs and prelabs are submitted via courselink. It is **your** responsibility to ensure that your lab has been properly submitted, not your lab partner's. Double check that the correct file has been uploaded to the drop box. If you upload the incorrect file or fail to upload properly and do not fix the problem before the due date, you will be penalized according to the late submission rules: **there will be NO exceptions.** If you are having trouble submitting to courselink, email a copy of your report to the TA or submit a hard-copy **before** the deadline to provide proof that you completed the lab on time. A date stamp on a soft copy file **DOES NOT** constitute proof of timely completion.

Missed tutorials: If you miss 1-2 tutorials, those tutorials will be given a grade of zero and will count towards the best 4 of 6 grade; no documentation or requests for accommodation are required. If you miss three or more tutorials and wish to request accommodation, you must have grounds for granting academic consideration or religious accommodation for **all** of the missed tutorials. In this case, each completed tutorial will count for 1.25% towards the tutorial grade and any remaining wieght (of the 5% available for tutorials) will be added to the final exam weight. There will be no makeup tutorials. No extra time will be given to students who arrive late.

Bonus mark cap: There are some bonus marks available in this course; however, no single assessment grade can be greater than 100%.

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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

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 Outcomes

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

1. predict a circuit's behaviour (for DC, AC, and other inputs) 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, power, and energy properties of elements (resistors, capacitors, inductors, opamps, ideal sources, and dependant sources) 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, Tutorials, Exams
2. Problem Analysis	all	Quizzes, Tutorials, 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		16:00 - 17:20	ROZH 101
Thursday		16:00 - 17:20	ROZH 101
Labs/Tutorials:			
Monday	Sec 01	09:30 - 11:30	RICH 1504
Tuesday	Sec 02	12:30 - 14:30	RICH 1504
Wednesday	Sec 03	09:30 - 11:30	RICH 1504
Thursday	Sec 04	12:30 - 14:30	RICH 1504
Friday	Sec 05	09:30 - 11:30	RICH 1504

Tutorials and labs share a time-slot and will follow the schedule as shown below:

Week	
1	Tutorial
2	Lab 0 - Safety and introduction to circuit building and measurement devices
3	Lab 1 - Transient lab
4-5	Tutorial
Reading week	
6-7	Lab 2 - Opamps
8	Tutorial
9-10	Lab 3 - Thevanin and Norton
11-12	Tutorial

5.2 Lecture Schedule

The following is a rough guideline for the lecture schedule and topis. 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**	**Topics**
1	Chapter 1 – Introduction	

Lecture(s)	Chapter	Topics
2-8	Chapter 2 – Systems	Static/dynamic, LTI, stability, Laplace, transient, steady state, DC gain, AC signals, first and second order system responses, complex numbers and phasors, series and parallel connections
9-12	Chapter 3 – Electrical Concepts	Current and charge, voltage and energy, ground, measuring current and voltage, KCL, KVL, Generalized Ohm's law (for Impedances), current and voltage dividers, short and open circuits, AC power, Complex power
13-17	Chapter 4 – Electrical Components	Resistors, capacitors, inductors, dependent sources, and op-amps, including definition of impedances. DC, transient, switched, and AC behaviour. Energy and power behaviour (active and passive elements). Equivalent circuits, including source transformation and Thevanin and Norton.
18-21	Chapter 5 – Analysis	Nodal, mesh, and superposition
22-24	Chapter 6 – Applications	Sensors, filters, and controllers

5.3 Lab Schedule

Remember that your pre-labs are due 48hours prior to the start of your lab session.

Week	Lab	Due dates
1	Do your safety quiz (online)	
2	Lab 0: Safety and introduction to circuit building and measurement devices	No prelab, no report, attendance mandatory
3	Lab 1 - Transient lab	
4		Lab 1 due
5		
Reading week		
6	Lab 2: Op-amps (day 1)	
7	Lab 2: Op-amps (day 2)	
8		Lab 2 due
9	Lab 3: Thevanin and Norton (day 1)	
10	Lab 3: Thevanin and Norton (day 2)	
11		Lab 3 due
12		

5.4 Other Important Dates

Monday, January 11 2016: First day of class

Monday, February 15 - Friday, February 21 2016: Winter Break

Friday, March 11 2016: drop date - 40th class

Friday, April 8 2016: last day of class

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