

ELEC1111

Electrical Circuits

Course Outline – Semester 1, 2016

Course Staff

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Consultations: You are encouraged to ask questions on the course material after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures. For tutorial and lab-related questions, please post this in the Moodle discussion forums, but you are also welcome to email them directly. ALL email enquiries should be made from your student email address with ELEC1111 in the subject line, otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle <https://moodle.telt.unsw.edu.au/login/index.php>. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Course Summary

Contact Hours

The course consists of 3 hours of lectures, a 1-hour tutorial, and a 2-hour laboratory session each week. Tutorials run from Week 2 to Week 13. Laboratories run from Week 4 to Week 13.

Lectures	Day	Time	Location
	Thursday	4pm - 6pm	CLB8
	Friday	10am – 11am	CLB8
Tutorials	Monday	1pm – 2pm	EE201
	Tuesday	10am – 11am	Ainswth101
	Tuesday	11am – 12am	Ainswth101
	Wednesday	3pm – 4pm	BUS 220
	Friday	9am – 10am	RedC M032

Context and Aims

ELEC1111 is an introductory course in Electrical Engineering, providing an introduction to simple electrical circuits as well as the technical skills to analyse such simple circuits. It is a course suitable for students pursuing further studies in electrical or telecommunications engineering as well as some other related

engineering disciplines including computer engineering. In the laboratory component, it provides hands-on experience in building and testing circuits. It is packaged in such a way that students, having taken this course, can go away and build and analyse some practical, useful devices afterwards.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction, Circuit Basics Overview + Lab Safety
Week 2	Kirchhoff's laws - Resistive circuits, Series & Parallel circuits, Power & Energy
Week 3	Nodal & Mesh analysis
Week 4	Network Theorems – Thévenin, Norton, Superposition, MPT
Week 5	Energy storage elements - inductors and capacitors, energy storage
Break	
Week 6	First order circuits – RL & RC circuits, transient responses
Week 7	Introduction to AC/sinusoidal analysis, phasors & phasor diagrams; Mid-session test
Week 8	Sinusoidal steady-state analysis, AC circuit analysis, AC power analysis
Week 9	Transformers and voltage shaping circuits
Week 10	Operational amplifiers
Week 11	Digital systems, number representation
Week 12	Combinations logic, digital circuit analysis

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 4	Laboratory introduction and administration. Safety issues. Familiarization with laboratory equipment
Week 5	Circuit construction and Kirchhoff's laws
Break	
Week 6	Series and parallel circuits
Week 7	Network theorems
Week 8	RC transients
Week 9	Operational amplifiers
Week 10	Lab Exam¹
Week 11	Lab Exam¹
Week 12	Power & Energy ²
Week 13	Digital logic circuits ²

¹ Students will sit the lab exam in either one of these two weeks (determined by course staff). No attendance is required during the other of the two weeks.

² These labs may occur in the opposite order for some students, depending on the availability of lab equipment.

Assessment Summary

Laboratory Practical Experiments	15%
Lab Exam	5%
Mid-Semester Exam	20%
Final Exam (3 hours)	60%

Course Details

Credits

This is a 6 UoC course and the expected workload is 10–12 hours per week throughout the 13 week semester.

Relationship to Other Courses

This course is an introduction to electrical engineering for both electrical and telecommunications engineering students, but is also applicable to students studying in other engineering disciplines such as mechanical, mechatronics, computer and photovoltaic/renewable energy engineering. It is a pre-requisite for many other courses both in electrical and other engineering schools.

Pre-requisites and Assumed Knowledge

There are no formal pre-requisites for this course but it is assumed that students will have a physics and mathematics background obtained at a high school (or equivalent) level. In particular, working knowledge and fluent application of basic mathematics including differentiation and integration techniques and solution of simultaneous equations is assumed. Some topics depend on familiarity with complex numbers, so if this knowledge has not been covered in other courses, some additional self-study will be required.

Following Courses

The course is an important pre-requisite for ELEC2134 Circuits and Signals and a helpful but non-critical pre-requisite for ELEC2141 Digital Circuits.

Learning outcomes

After successful completion of this course, you should be able to:

1. Use Kirchhoff's laws, circuit theorems and node voltage methodology to solve simple DC as well as AC circuits.
2. Solve simple 1st order transient circuits.
3. Apply simple steady state sinusoidal analysis to circuits.
4. Demonstrate a basic understanding of phasors and phasor diagrams for AC circuit analysis.
5. Reflect a basic understanding of transformer operation, through analysis of transformer circuits.
6. Analyse ideal operational amplifier application circuits.
7. Demonstrate basic proficiency in building basic electrical circuits and operating fundamental electrical engineering equipment.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in **Appendix A**. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in **Appendix B**). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in **Appendix C**.

Syllabus

The first part of the course will introduce and cover circuit variables and elements, methods and techniques for the analysis of DC circuits, energy storage elements, and RL and RC first-order circuits. Following this, AC circuit theory will be covered, including an introduction to sinusoidal steady-state analysis, phasors, AC circuit analysis techniques, and ideal transformers and voltage shaping elements. Digital circuits will be studied, covering truth tables and boolean algebra, two-level combination logic and binary arithmetic. During the course, students will be exposed to, and become familiar with, fundamental laboratory devices, equipment and safety.

Teaching Strategies

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures;
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material;
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills;
- Video lectures posted via the Moodle website. Note that these the video lectures are not generally intended as a replacement of the face-to-face lectures.

Learning in this course

You are expected to attend all lectures, tutorials, labs, and mid-semester exams in order to maximise learning. You must prepare well for your laboratory classes and your lab work will be assessed. In addition to the lecture notes/video, you should read relevant sections of the recommended text. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

Lectures

Recorded video lectures will be made available to students to support the scheduled face-to-face lectures. Where possible, Echo360 will be used to record the actual classes, for revision purposes. You should note that watching recordings is no substitute for actually attending the classes, where live questions can be asked. In particular, note that having access to recorded lectures does not imply improved exam preparation, without significant and consistent additional self-directed study through the semester.

Tutorial classes

You are required to attend tutorials from Week 2 to Week 13 as specified in the *Contact hours* on Page 2. **Tutorials are not in place as another form of lecture. It is important that you come to tutorials prepared and ready with questions to ask the tutor.** The tutorial sessions are intended to be interactive, allowing students to participate in the solving of problems.

Note that no marks are awarded directly for any part of the tutorial program in this course. However, they should still be treated as an important aspect of the course, not to be taken lightly. There are three components of the tutorial program:

1. Sets of problems are provided to give personal practice in solution and understanding. These problems will be related to recent lecture material with an

emphasis on the basic concepts. Solutions to a majority of these problems will be provided only after students have had sufficient time to attempt the problems.

2. Demonstrations of important problem solving techniques by tutors.
3. Additional tutorial problems may be provided with no solutions for the benefit of further study.

Laboratory program

You are required to attend laboratory from Week 4 to Week 13 as outlined in the *Contact hours* on Page 2. Laboratory attendance WILL be kept, and you MUST attend at least 80% of labs.

You must view the safety lecture in Week 1 and complete the online quiz before being allowed to undertake the labs from Week 4. The safety lecture and quiz can be found via Moodle (search Electrical Engineering OH&S, use keyword elec mood).

Laboratory Purchase

The following items will be required in the laboratory:

- Soldering and components kit - \$10.
- Safety goggles - \$5 (or bring your own)

Optional items:

- Prototyping board - \$15 (essential if you are continuing with EE&T). **You will need access to one for the lab exam.**

Pay at School Office in Elec. Eng. Building (room EEG1) for soldering and components kit. Once a receipt is issued, pick up the items from the Electronic Workshop (room EEG14A)

Laboratory Exemption

There is no laboratory exemption for this course. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled in this course for Semester 2, 2014 must take the labs. If, for medical reasons, (note that a valid medical certificate must be provided) you are unable to attend a lab, you will need to apply for a catch-up lab during another lab time, as agreed by the laboratory coordinator.

Assessment

You are expected to view all lectures, and attend all tutorials, labs and quizzes, in order to maximize learning. It is a UNSW requirement that you attend at least 80% of your classes. **It is important to prepare your tutorial questions in advance of attending the tutorial classes. You must prepare well for your laboratory classes, and will be tested on this preparation at the beginning of each lab exercise.** In addition to the lecture notes and video lectures, you should read relevant sections of the recommended text. Group learning is also encouraged.

Activity	Assessment	Remarks
Laboratory practical experiments	15%	Must attend at least 7/8 labs and obtain a pass mark average
Laboratory practical test	5%	Must pass to pass course
Mid-session assessment	20%	Week 7 – Thursday 4pm in regular lecture time (further instructions advised in lectures)
Final written examination	60%	Must pass to pass course
TOTAL	100%	

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the lab checkpoints (see lab manual), lab exams and the mid-semester exam.

As shown in the assessment table above, there are three main components to the overall assessment, namely:

1. Laboratory assessment:

You are required to maintain a lab book for recording your observations. A lab book is an A4 size notebook containing a mix of plain pages and graph sheets. You have to purchase your own lab book from any stores.

It is essential that you complete the laboratory preparation before coming to the lab. You are required to write the aim of the experiment and draw the circuit diagram if any in your lab book. This will be verified and signed by your demonstrators in the lab. You will be recording your observations/readings in your lab book first and then complete and submit the results sheet before leaving the lab.

After completing each experiment, your work will be assessed by the laboratory demonstrator. Both the results sheet and your lab book will be assessed by the laboratory demonstrator.

A practical test will be run during the laboratory periods later in the session, typically Weeks 10 and 11. **You need to attend at least 80% of the labs AND attain a pass assessment in labs AND pass the lab test to pass the course.**

You must hand in a **signed safety form** before starting the practical laboratory component. If you attend laboratory sessions without having submitted a signed safety form the marks for those labs will be **zero**.

A satisfactory performance in the laboratory component is a necessary requirement to pass this course. This means that even if you score 100% on the final written examination and on the quizzes, you will not pass the course if your laboratory assessment is not satisfactory.

In Summary to pass the laboratory component and therefore the course you MUST do all of the following:

- **Hand in a signed Safety Form.**
- **For ELEC1111 during Weeks 4-13, attend at least 7 out of 8 lab classes plus the lab test (or have handed in medical certificates)**
- **Obtain a pass mark average for the laboratory experiments.**
- **Pass the LAB EXAM.**

2. Mid-session test: There will be a midsession assessment in Week 7. This will be an examination scheduled on Thursday in the lecture time, i.e. in the usual class, and may cover course content up to the end of Week 6.

3. Final examination: the final exam will be a closed book exam 3 hour for ELEC1111. In principle, the examination may cover any aspect of the course that has been presented in lectures, tutorials and/or laboratories. **You MUST pass the final exam to pass the course.**

Note: For all class assessment tasks i.e. Laboratory and quizzes, if you are unable to attend for medical or other serious reasons (e.g. a death in the family) you must follow the Special Consideration process outlined below. If for medical reasons or any other reasons, you are unable to attend the mid-semester exam, you may instead be given an oral examination of approximately 1 hour.

Relationship of Assessment Methods to Learning Outcomes

Assessment	Learning outcomes						
	1	2	3	4	5	6	7
Laboratory practical assessments	✓	✓	✓	-	✓	✓	✓
Lab exam	✓	-	-	-	-	-	✓
Mid-semester exam	✓	✓	-	-	-	-	-
Final exam	✓	✓	✓	✓	✓	✓	-

Course Resources

Textbooks

Prescribed textbook

- “Fundamentals of Electric Circuits”, Alexander and Sadiku, McGraw-Hill. This is also the text for second-year Electrical Engineering.

Reference books

- L.S. Bobrow, Elementary Linear Circuit Analysis, Oxford, 1987 [P621.3192/106]. This was a previous text for this course and also for ELEC2031.
- J.F. Wakerly, Digital Design: Principles and Practices, 3rd Edition, Prentice-Hall, 2000 [P621.395/100]. The previous edition was the text for this course and also for ELEC1041.
- R.L. Boylestad, Introductory Circuit Analysis, 9th Edition, Prentice-Hall, 2000 [PQ621.3815/198].
- K.J. Breeding, Digital Design Fundamentals, 2nd Edition, Prentice-Hall, 1992 [P621.3815/214].
- J.R. Cogdell, Foundations of Electrical Engineering, 2nd Edition, Prentice Hall, 1990 [P621.3/198].
- J. Millman and A. Grabel, Microelectronics, McGraw-Hill, 1987 [P621.38173/68].

On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. Assessment marks will also be made available via Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

Other Matters

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see <http://www.lc.unsw.edu.au/plagiarism>. To find out if you understand plagiarism correctly, try this short quiz: <https://student.unsw.edu.au/plagiarism-quiz>.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see <https://my.unsw.edu.au/student/atoz/ABC.html>), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult <https://my.unsw.edu.au/student/atoz/SpecialConsideration.html>.

Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and

modify our delivery and assessment methods. In 2015 we aim to improve the feedback on laboratory assessment, based on 2014 feedback.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:

<http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures>
<https://my.unsw.edu.au/student/atoz/ABC.html>

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.

- Developing digital and information literacy and lifelong learning skills through assignment work.
- Developing ethical practitioners who are collaborative and effective team workers, through group activities, seminars and tutorials.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	PE1.4 Discernment of knowledge development and research directions	
	PE1.5 Knowledge of engineering design practice	✓
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	✓
	PE2.2 Fluent application of engineering techniques, tools and resources	✓
	PE2.3 Application of systematic engineering synthesis and design processes	
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	
	PE3.2 Effective oral and written communication (professional and lay domains)	✓
	PE3.3 Creative, innovative and pro-active demeanour	✓
	PE3.4 Professional use and management of information	✓
	PE3.5 Orderly management of self, and professional conduct	✓
	PE3.6 Effective team membership and team leadership	