School of Electrical Engineering and Telecommunications

Summer Term, 2021
Course Outline

ELEC1111
Electrical Circuit Fundamentals

(Old title: Electrical & Telecommunications Engineering)

COURSE STAFF

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Laboratory Contact: Xinhong Yang (Sam; xinhong.yang@student.unsw.edu.au)

Consultations: You are encouraged to ask questions on the course material during or after the online lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during the first lecture, as well as on Moodle (https://moodle.telt.unsw.edu.au/login/index.php), which is the online learning and teaching management platform used in this course. You can also post questions on Moodle discussion forums (highly encouraged). You are welcome to email the tutors or laboratory contact, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with "**ELEC1111**" in the subject line; otherwise they may not be answered.

Keeping Informed: All announcements regarding the course and its assignments will be made via Moodle. Announcements may also be made during classes, but everything will be formally posted on the "Course Announcements" forum of ELEC1111 in Moodle. 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:

- Lectures (Online only): 8 hours every week, starting from Week 1.
- Tutorials:
  - Class tutorials (Online only): 4 hours every week, starting from Week 1.
  - Independent tutorials (Online only): to complete at your own pace, starting from Week 1.
- Laboratory Experiments (Online only): 4 hours every week, starting from Week 1.
- Consultation time: 2 hrs per week, starting from Week 1.

Session	Day	Time	Location
Lectures	Monday	11am - 1pm	Online via Microsoft Teams
	Tuesday	11am - 1pm	
	Wednesday	9 am- 11 am	
	Thursday	11 am- 1pm	
Tutorials	Thursday	2 pm-4 pm	Online via Microsoft Teams
	Friday	9 am-11 am	
Laboratories	Wednesday	11 am-1 pm/ 2 pm-4 pm	Online via Microsoft Teams
	Friday	11 am-1 pm/ 2 pm – 4 pm	

Note: As Jan 26th Tuesday is a public holiday, the lecture on that day will be preponed to Monday (25th Jan) from 2 pm-4 pm.

Context and Aims

Can you imagine your life without electricity, computers or mobile phones? Circuits are all around us. Electrical engineers are most commonly associated with the development of circuits, but they are not the only ones who know about or work with circuits. All engineers need to have a basic understanding of the relationship between electricity, electrical energy, electronic instrumentation and measurements. Mechanical engineers use circuits, for example, when designing motors or controls for spacecrafts. Robotics are usually considered a Computer Science specialty, but it is hard to imagine doing anything in robotics without considerable knowledge of electrical circuits. ELEC1111 is an introductory course in Electrical Engineering, which provides an introduction to fundamental electrical elements and circuits, as well as the technical skills to analyse such circuits.

The aims of the course are to:

- Provide students with analytical and practical experience with electrical circuits.
- Ensure that students' design skills are adequate and to the level desirable for a professional engineer.
- Give students the opportunity to improve the design and practice skills required by professional engineers.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction, Circuit Basics, Ohm's law, Sources and Diodes
	Kirchhoff's laws, Series & Parallel, Nodal and Mesh Analysis
Week 2	Circuit Theorems (Superposition, Thevenin, Norton, Source Transformation)
	Capacitors and Resistor-Capacitor (RC) Circuits
Week 3	Inductors and Resistor-Inductor (RL) Circuits
	Mid-term exam, TBA
Week 4	Operational Amplifiers (Op Amps)
	AC Analysis I - Phasor and Impedance
Week 5	AC Analysis II - Circuit Theorems and AC Op Amps
	AC Power

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 1	Lab/Experiment 1: Familiarization with Laboratory Equipment
	Lab/Experiment 2: Series and Parallel Circuits
Week 2	Lab/Experiment 3: Circuit Construction and Kirchhoff's Laws
	Lab/Experiment 4: Circuit Theorems
Week 3	Lab/Experiment 5: RC & RL Transients
	Lab/Experiment 6: Operational Amplifiers (Op Amps)
Week 4	Lab/Experiment 7: AC Circuits
	Lab Exam Preparation, TBA
Week 5	**Lab Exam, TBA**
	Lab Exam, TBA

Assessment

1. Mid-term Exam	25%
2. Laboratory Assessment and Exam	20%
4. Final Exam	55 %
Total:	100%

- The **mid-term exam** is scheduled in **Week 3** of the term.
- The **laboratory exam** will take place in **Week 4** of the term.

- The date of the **final exam** will be announced by the University.

For further details on assessment tasks and their marks please refer to the Assessment section of this document.

Important Health Related Notice

Note: This notice is for specifically for students having course related face to face activity (in summer term all the course components will be delivered in online)

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the Nucleus: Student Hub. If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for special consideration through the Special Consideration portal. To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this form.

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the Safe Return to Campus guide for students for more information on safe practices.

COURSE DETAILS

Credits

ELEC1111 is a 6 UoC course. The expected average workload is approximately **30 hours per week** throughout the 5-week term, including face-to-face contact hours and self-studying.

Relationship to Other Courses

This is a 1st year course in the School of Electrical Engineering and Telecommunications. It is an introduction to electrical engineering, not only for Electrical and Telecommunications Engineering students, but also for other engineering disciplines across the faculty. It is a pre-requisite for many other courses both in electrical and other engineering schools.

Pre-requisites and Assumed Knowledge

There are no particular pre-requites for this subject, but it is essential to have physics and mathematics background at high-school level.

Following Courses

This course is a pre-requisite for Circuits and Signals (ELEC2134).

Learning outcomes

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

LO1. Systematically analyse DC and AC electrical circuits by deriving and solving equations using circuit laws and theorems.
LO2. Obtain the transient and steady state behaviour of a first order circuit.
LO3. Apply phasors and sinusoidal steady state analysis to AC circuits.
LO4. Apply concepts of DC and AC circuit analysis in circuits with ideal operational amplifiers.
LO5. Demonstrate competency in building basic electrical circuits, operate fundamental electrical engineering equipment, work in a laboratory environment and follow work health and safety (WHS) regulations.
LO6. Evaluate relevant information to design simple engineering systems that use electrical circuits.
LO7. Validate analysis results experimentally and/or using basic simulation software.

The course delivery methods and course content address several core UNSW graduate attributes. These include:

- The capacity for analytical and critical thinking and for creative problem solving.
- The ability to engage in independent and reflective learning.
- Information Literacy – the skills to locate, evaluate, and use relevant information.
- The capacity for enterprise, initiative, and creativity.
- The skills of effective communication.

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

Fundamental analogue electrical elements: sources, resistors, capacitors, inductors, diodes; Fundamental DC and AC circuit analysis techniques: Ohm's and Kirchhoff's laws, nodal and mesh analysis, circuit theorems (superposition, source transformation, Thévenin & Norton equivalents), phasors, impedances, AC power; Fundamental DC and AC analogue electrical circuits: resistor-capacitor (RC) and resistor-inductor (RL) circuits, operational amplifiers.

TEACHING STRATEGIES

Delivery Mode

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

- Formal lectures (online), which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding.
- Tutorials (online), which allow for exercises in problem solving and allow time for you to resolve problems in understanding of lecture material.
- Laboratory sessions (online), which support the formal lecture material and provide you with practical construction, measurement and debugging skills.

Learning in this course

You are expected to attend all lectures, tutorials, labs, and the mid-term exam to maximize learning. You must prepare well for your tutorial classes. The importance of adequate preparation prior to each tutorial cannot be overemphasized, as the effectiveness and usefulness of the tutorial depends to a large extent on this preparation. You must also prepare well for your laboratory classes, as you will be tested for this preparation at the beginning of each lab session. In addition to the lecture notes/videos, you should read relevant sections of the recommended text. Reading additional texts will further enhance your learning experience. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending classes in online format throughout the course.

Lectures

Recorded lecture videos will be made available to students after the scheduled online lecture has concluded. Students should note that watching recordings is no substitute for attending the online classes, where live questions can be asked. Note that having access to recorded lectures does not imply improved exam preparation, without significant and consistent additional self-directed study through the term.

Tutorials

In these two-hour sessions, students will solve the given problems in online session by applying their learnings from the lectures. The tutors will mentor the students to solve the questions correctly and will check their solutions. The tutorials are offered in the online delivery mode. In these sessions' students are allowed to share their screen and discuss the possible solutions and discuss their ideas.

Independent tutorials: These are pre-recorded solutions of typical tutorial questions, that you can watch at your own pace. It is strongly encouraged that you attempt to solve the questions of these tutorials before watching the videos to observe the methods and theory used in each question. The format of the videos is typically 3 - 5 minutes long, which is a lot more concentrated than a normal tutorial class. It is expected that you spend at least one hour per week on solving and watching these tutorials.

Laboratory sessions

The laboratory schedule is deliberately designed to provide practical, hands-on exposure to the concepts conveyed in lectures soon after they are covered in class. Students are required to attend the laboratories in online format as outlined in the Contact Hours. The laboratories are an integral part of learning in this course as they allow you to build/configure circuits, measure, and observe in real life the theory of the lectures. You are expected to attend all labs, and the lab exam. You must prepare well for your laboratory classes as your lab work will be assessed during each lab session.

NOTE: *There is no laboratory exemption for this course*. Regardless of whether equivalent labs have been completed in previous terms, all students enrolled in this course 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

The assessment scheme in this course reflects the intention to assess your learning progress throughout the term. Ongoing assessment occurs through the mid-term exam, lab experiments (see lab manual), online tutorial quizzes and the lab exam[1].

Mid-Term Exam

There will be an exam scheduled in **Week 3**, which tests your general understanding of the course material. It is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any course material up to RL Circuits (the starting of week 3). Marks will be assigned according to the correctness of the responses. This exam accounts for **25%** of the total course mark (see page 2).

Laboratory Assessment

Laboratories are primarily about learning, and the laboratory assessment is designed to check your knowledge as you progress through each stage of the laboratory tasks. There is only an online option for laboratory. The laboratory manual, which contains the instructions on the laboratory experiments and equipment, will be provided in a PDF file on Moodle. You are required to **record your observations** in the laboratory manual to receive your lab mark. Several **online training videos** have been created to help you to familiarise with the laboratory equipment and how to use it properly. These videos are available on Moodle as well as on the PDF version of the laboratory manual via provided hyperlinks.

NOTE: Students must **upload the completed work health and safely (WHS) form** to the submission page provided on Moodle before attending the first practical laboratory session. If a student attends a laboratory session without having submitted a signed OH&S form, the lab demonstrators will NOT assess the student's lab work until the form is submitted **[This WHS form submission is not mandatory for online laboratory, but it is a good practice to follow]**

The laboratory assessment comprises of two parts:

1. *Pre-lab exercises*, which accounts for 20% of your lab assessment mark. These are questions that must be completed and answered before you attend each of the lab sessions. Students without a completed pre-lab exercise will NOT be allowed to participate in the experiment.
2. *Lab experiments*, which accounts for 80% of your lab assessment mark. This includes your measurements, graphs, and answers to lab questions completed in your laboratory manual. The experimental part **must** be completed within the allocated 2 hours of each lab session. It will be marked throughout the experiment by your lab demonstrators on your lab manual.

The laboratory assessment accounts for **10%** of your total course mark out of the 20% allocated mark (see page 2).

Laboratory Exam

To check whether you have achieved the practical learning outcomes for the course, you will be examined in a laboratory session. In **Week 4**, after all the lab experiments have been completed, a practical exam will take place. Laboratory exams are practical exams that include an experiment with its relevant analytical calculations. The exam will be based on what you have learned in your laboratory classes and the applied theory from lectures. Marks will be awarded for the correct understanding of practical and relevant theoretical concepts, correct operation of laboratory equipment, and correct interpretation of measured results. The lab exam accounts for **10%** of your total course mark out of the 20% allocated mark (see page 2).

NOTE: You **MUST** attend at least **6 out of the 7** lab experiments **AND** pass the laboratory assessment **AND** pass the lab exam to pass the course. A satisfactory performance in both lab assessments and the lab exam is a necessary requirement to pass this course. This means that even if you score 100% on the final written examination

[1] For all assessment tasks, i.e., laboratories and the mid-term exam, if the student is unable to attend for medical or other serious reasons, the student must present medical certificates and/or other documentation within 3 days of the assessment. If this is not done within the required period, then no consideration will be given.

and on the quizzes, **you will not pass the course** if your overall mark for lab assessments and the lab exam is not satisfactory.

Final Exam

The exam in this course is a 2-hour open-book written examination. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course that has been presented in lectures, tutorials and/or laboratories, unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses. The final exam mark accounts for **55%** of the total course mark (see page 2).

NOTE: You **MUST** achieve a minimum of **45 marks out of 100** in the final exam to pass the course.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes						
Assessment	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**LO6**	**LO7**
Mid-term exam	✓	✓	✓	-	-	✓	-
Laboratory assessment & exam	✓	-	-	✓	✓	-	✓
Final exam	✓	✓	✓	✓	-	✓	-

COURSE RESOURCES

Textbooks

Prescribed textbook

- C. K. Alexander and M. N. O. Sadiku, *Fundamentals of Electric Circuits*, 6th ed., New York, NY, USA: McGraw-Hill, 2017.

Available at UNSW Bookshop, UNSW Library, McGraw-Hill website, or online retailers.

Other reference books

- R. C. Dorf and J. A. Svoboda, *Introduction to Electric Circuits*, 9th ed., Hoboken, NJ: John Wiley and Sons, 2013.
- J. D. Irwin and R. M. Nelms, *Basic Engineering Circuit Analysis*, 11th ed., Hoboken, NJ: John Wiley and Sons, 2015.

On-line resources

Moodle

As a part of the teaching component, the online teaching and learning management system known as Moodle will be used to disseminate teaching materials and host forums. As the course progresses, students' marks from assessments such as labs and the quizzes will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Simulation

Students are **strongly encouraged to familiarise** themselves with simulation tools, as well as measuring and interpreting results of simulations.

There are several simulation programs that can be used not only for this course, but also for the rest of your Electrical Engineering degree. One online simulation platform is a browser-based applet for simulation of electric circuits available at http://www.falstad.com/circuit. It is a simple-to-use and easy-to-understand online application that allows you to simulate simple electric circuits. It is also very simple to share cases and simulations with others. For those of you looking for a more sophisticated software to perform simulations, you can refer to MATLAB and Simulink: https://au.mathworks.com, LabVIEW: https://www.ni.com/en-au/shop/labview.html, OrCAD PSpice Designer: http://www.orcad.com/products/orcad-pspice-designer/overview, and Quite Universal Circuit Simulator: http://qucs.sourceforge.net. PSpice, MATLAB, and LabVIEW are most commonly used programming software in Electrical Engineering, which are worth learning at early stages in your degree.

OTHER MATTERS

Dates to note

Important Dates available at: https://student.unsw.edu.au/dates

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 https://student.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://student.unsw.edu.au/guide), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **30 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face/online 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 Behavior

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 can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the "fit to sit/submit" rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see https://student.unsw.edu.au/special-consideration.

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 online student survey myExperience. 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.

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:
https://student.unsw.edu.au/guide
https://www.engineering.unsw.edu.au/electrical-engineering/resources

APPENDICES

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 address 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.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
- Developing citizens who can apply their discipline in other contexts, are culturally aware and environmentally responsible, through interdisciplinary tasks, seminars and group activities.

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 ..	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	