School of Electrical Engineering and Telecommunications

Term 2, 2021
Course Outline

ELEC2133
Analogue Electronics

COURSE STAFF

Course Convener: Dr. Aron Michael, Room 316 EE, a.michael@unsw.edu.au
Tutor: Dr. Aron Michael, Room 316 EE, a.michael@unsw.edu.au
Laboratory Contact: TBA

Consultations: You are encouraged to ask questions on the course material during class and consultation times. The consultation times are on Wed 2-3pm and Fri 5-6pm. Other consultation times may be arranged with the lecturer, but prior appointments must be made via email. You are welcome to email the tutor or laboratory demonstrator, 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 ELEC2133 in the subject line, otherwise they will not be answered. In this course, Moodle and MS Teams will be used as online learning and teaching platform. The course page on Moodle can be accessed at https://moodle.telt.unsw.edu.au/login/index.php. The MS Teams class for lecture, tutorial and laboratory are **CLS-ELEC2133_T2_2021_Lecture**, **CLS-ELEC2133_T2_2021_Tutorial** and **CLS-ELEC2133_T2_2021_Lab**. Students are also encouraged to post their questions on MS Teams for discussion among their peers and academic staff of the course.

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 and MS Teams. 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 a total of 4 hrs of lectures, a 1-hr of tutorial (odd week), a 2-hrs tutorial (even week), and a 3-hrs laboratory each week. Lecture will begin in week 1. Tutorials will start in week 2. Laboratory sessions will also start in week 2 for those students who are enrolled in the online lab slots and be an hour-long remote lab trial, which are intended to familiarize students with the online remote lab environment before the real laboratory sessions begin in week 3.

	Day	**Time**	**Location**
Lectures	Wednesday	9am-11am	MS Teams: **CLS-ELEC2133_T2_2021_Lecture**
	Friday	3pm-5pm	MS Teams: **CLS-ELEC2133_T2_2021_Lecture**
Tutorials	Friday	1pm-2pm (odd week) 1pm-3pm (even week)	CLB8 (Face-to-face)
	Wednesday	11am-12pm (odd week) 11am-1pm (even week)	MS Teams: **CLS-ELEC2133_T2_2021_Tutorial**
Labs	Tuesday	9am – 12pm	EE214
	Wednesday	3pm – 6pm	EE225
	Wednesday	3pm – 6pm	MS Teams: **CLS-ELEC2133_T2_2021_Lab**
	Thursday	9am – 12pm	EE214
	Thursday	12pm – 3pm	MS Teams: **CLS-ELEC2133_T2_2021_Lab**
	Thursday	3pm – 6pm	MS Teams: **CLS-ELEC2133_T2_2021_Lab**

Context and Aims

Analogue circuits are integral parts of any electronic system. They are used to realize important signal processing and conditioning functions such as amplification, comparison, waveform generation, analogue to digital and digital to analogue conversions. Analogue circuits consist of active circuit elements such as transistors and diodes in addition to resistors, capacitors, and inductors passive circuit elements often in an integrated circuit form. In previous courses, students were introduced to circuit analysis and synthesis techniques involving passive circuit elements. This course endeavours to build on this knowledge and further expand students' skill in analysing and designing analogue circuits involving transistors and diodes. The first half of the course covers: (i) the basic principle operations and device characteristics of diodes, Bipolar Junction Transistors (BJT), and Metal Oxide Semiconductor Field Effect Transistors (MOSFET) that underpin the analysis, design and implementation of analogue circuits; (ii) multi-stage linear amplifiers, operational amplifiers, effects of feedback on the performance and stability of amplifiers. The second half of the course deals with nonlinear circuits such as Schmitt triggers, waveform generators, comparators, A/D, and D/A converters. Therefore, the aims of the course are

- To develop skill and knowledge in analysis and design of analogue circuits such as amplifiers, operational amplifiers, comparators, and wave form generators.
- To introduce the basic principle operations, device and circuit characteristics of diodes and BJT and MOSFET transistors
- To develop a more thorough understanding of why analogue circuits behave in a certain way and how performances can be improved when feedback is applied.
- To develop intuitive feel for circuit analysis and design
- To introduce various A/D and D/A conversion techniques and their limitations

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction and revision (recorded video) Operational Amplifiers **Assignment I released** **Fortnightly quiz 1 - released**
Week 2	Semiconductor Devices for Electronics (plus recorded videos)
Week 3	Transistor Amplifiers (BJT and MOSFET): DC and small signal **Assignment I due** **Assignment II released** **Fortnightly quiz 2 - released**
Week 4	Frequency Response of Amplifiers
Week 5	Feedback in Amplifiers (Part I) **Fortnightly quiz 3 - released**
Week 6	
Week 7	Feedback in Amplifiers (Part II) **Mid-term exam** **Assignment II due** **Assignment III released** **Fortnightly quiz 4 - released**
Week 8	Stability and Compensation in feedback amplifiers
Week 9	Non-linear Circuits – Waveform generation **Fortnightly quiz 5 – released**
Week 10	Digital-analogue interface (part I and part II) **Assignment III due**

Indicative Tutorial Schedule

Period	Summary of Tutorial Program
Week 2	Revision – circuit analysis for analogue electronics (Tut 0)
Week 3	Operational amplifiers (Tut 1)
Week 4	Transistor amplifiers – DC and small signal (Tut 2)
Week 5	BJT Transistor amplifiers – Frequency response (Tut 3)
Week 6	
Week 7	MOSFET Transistor amplifiers – Frequency response (Tut 3A)
Week 8	Feedback amplifiers (Tut 4)
Week 9	Feedback amplifiers (Tut 4)
Week 10	Waveform generators, DAC and ADC (Tut 5)

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 3	Lab I: Operational amplifier - Design (should be finished outside lab) Lab I: Operational amplifier - Gain and frequency response
Week 4	Lab I: Operational amplifier - Frequency compensation
Week 5	Lab II: Two stage amplifier - Design
Week 6	Catchup lab
Week 7	Lab II: Two stage amplifier (open loop)- input impedance, output impedance, gain, and bandwidth measurement
Week 8	Lab II: Feedback amplifier: two stage amplifiers(close-loop)-input impedance, output impedance, gain and bandwidth with various feedback factors
Week 9	Lab III: Waveform generators - Schmitt Trigger
Week 10	Lab III: Waveform generators - VCO

Assessment

Laboratory Practical Experiments (including reflection)	20%
Mid-term Exam (1 hour)	10%
Fortnightly quizzes (must be completed)	0%
Assignments (peer marking must be completed)	15%
Final Exam (2 hours)	55%

Practical project can be taken as replacement to either mid-term, assignments or part of final exam marks and will have a weighting up to 20%.

Important Health Related Notice

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

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week term.

Relationship to Other Courses

This is a 2nd year course in the School of Electrical Engineering and Telecommunications. It is a core course for students following a BE (Electrical) or (Telecommunications) program and other combined degree programs. It is a pre-requisite course for ELEC3106, ELEC3117, and ELEC4603.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC2134, Circuits and Signals. It is essential that you are familiar with fundamentals of circuit analysis techniques those concepts covered in ELEC1111 in addition to advanced techniques introduced in ELEC2134 before this course is attempted. You are strongly advised to revise those circuit analysis techniques from ELEC1111 and ELEC2134 in your own time to get yourself ready for this course. It is also further assumed that you are familiar with use of laboratory equipment such as oscilloscope, signal generator, power supply and multi-meters and have a good computer literacy.

Following Courses

The course is a pre-requisite for ELEC3106 (Electronics), ELEC3117 (Electrical Engineering Design) and ELEC4603 (Solid State Electronics).

Learning outcomes

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

1. Demonstrate the use of operational amplifiers in realizing various analogue functions.
2. Analyse and design various analogue electronic circuits based on operational amplifiers.
3. Explain the basic principle of operations of diodes, BJTs and MOSFETs.
4. Demonstrate the use of circuit models of diodes, BJTs and MOSFETs in the analysis and design of electronic circuits.
5. Analyse, design, and implement various multi-stage linear amplifier circuits.
6. Identify various feedback topologies for amplifiers and explain their advantage and disadvantage.
7. Analyse, design and implement feedback amplifiers.
8. Explain the behaviour and applications of oscillators.
9. Analyse, design and implement waveform generators and voltage control oscillators using Schmitt trigger.
10. Describe and identify the operations of various D-A and A-D convertor circuits.
11. Analyse and design typical D-A and A-D convertor circuits.

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

Device physics of diodes, BJTs and MOSFETs, Nonlinear transistor models: Ebers-Moll, Full and simplified models of BJTs and MOSFETs (inc. small-signal models). Zener diodes, DC biasing, biasing using current sources, operating point, large-signal analysis, Linearization, small-signal analysis, Input and output impedances. Voltage gain. Current gain, Transimpedance gain, Transconductance gain, Two-ports. Feedback amplifiers: Effects of feed-back in amplifiers; stability and compensation techniques, Circuits with non-ideal op-amps. Common base, emitter and collector amplifiers; Common gate, drain, and source; Differential pairs, Multistage amplifiers, Cascades,

Cascodes; AC response of amplifiers, Miller effect, Non-linear circuits: Oscillator, Schmitt trigger. A-D and D-A converter principles.

TEACHING STRATEGIES

Delivery Mode

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

- Online lectures on MS Teams, which provide students with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding. The lectures will be recorded and available on MS Teams for the students to watch them at the time and place of your convenience.
- Face-to-face or online tutorials on MS Teams, which allow you to apply concepts introduced in lecture in solving analytical and design-based problems.
- Face-to-face or remote laboratory sessions on MS Teams, which support the formal lecture material and provide you with Pspice circuit simulation, and measurement skills. Students will have access to web-based oscilloscope, signal generator and multi-meter through MS Teams. They will be able to perform measurement remotely and analyse the results which will give them practical understanding of the theoretical concepts covered in the lectures.
- Tutorial and summary videos, which support the formal tutorial and lecture sessions by allowing students to revise recorded videos of complete tutorial problem solutions and summary of important concepts in the course at the time and place of your convenience.
- Online quizzes and stack questions, which allow students to assess themselves and get feedback to support their self-direct learning and understanding of materials covered in the course.

Learning in this course

You are expected to attend all the online lectures, tutorials and labs in order to maximize learning. You must prepare well for your laboratory classes and your lab work will be assessed. 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. Group learning is also encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending online classes throughout the course.

Lecture classes

The lectures form the core of this subject. Topics presented in lectures will generally be followed by detailed examples to provide students with the real-life applications. Detailed explanations of the topics will be available to students in the form of lecture slides, lecture videos and notes which will be uploaded on Moodle and the prescribed textbook. The online lectures will be recorded and available to

Tutorial classes

The tutorial problems provide students with in-depth quantitative understanding of the topics covered in lectures. The problems will be posted on Moodle prior to the tutorial classes. Students are encouraged to attempt them before coming to the tutorial. Discussion forum for the tutorial problems will be made available on Moodle for students to post their solutions and discuss. During the tutorial session, solutions for the problems will be covered focusing on the challenges and issues raised by students in the discussion forum. Since there will not be enough time to cover all problems during the tutorial class, the tutorial will focus on selected problems and high-level discussion. Complete worked out solutions in the forms of text and videos will be uploaded on Moodle after the tutorial so that students can go through them at their time of convenience. To further support the tutorial, summary videos on important concepts related to materials covered in each tutorial have been prepared and will be made available before the tutorial. Students can watch the summary video before attempting the tutorial problems. They can also use the videos for quick revision on important topics to prepare themselves for formative and summative assessments in the course. 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.

Laboratory program

The laboratory schedule is deliberately designed to provide practical exposure to the concepts conveyed in lectures. The laboratories are running in **hybrid**: **face-to face** and **online**. Students will be able to operate web-based instruments that are connected to the laboratory experiments remotely if they are enrolled into the online sessions. There will be three laboratory experiments in the course, each of which consisting of either two or three parts. The experiments are supported with detailed theoretical background in addition to concepts introduced in

lectures and design guidelines that they are required to step through to complete preliminary preparatory problems. Students must attend the laboratory having read the laboratory notes and completed the preliminary laboratory problems. Laboratory demonstrator will mark the students' preliminary preparatory solutions. **They will not be marked and lose points if they are attending the remote laboratory session without completing the preliminary preparatory design tasks.** Based on the design, the lab demonstrator will set up their designed circuit on the ELEC2133 PCB board by simply plugging-in resistors and capacitors with the designed values. The students can then remotely reconfigure the electrical connections and perform measurement. They will be able to monitor the component values plugged onto the board remotely through remotely web-connected cam and will be able to operate the laboratory equipment remotely as if they are working in the lab in-person. To help them with monitoring the set up and conducting measurement, manuals have also been prepared for them to refer in the laboratory manual.

Regular laboratory sessions will run from **week 3 to week 10** every week. To help students familiarize with the remote lab environment and settings, there will be a trial laboratory session in **week 2**. Laboratory attendance WILL be kept, and you **MUST attend at least 80% of the labs in order to pass the course**.

The laboratory manual will be made available on Moodle. All data and marks will be recorded in spaces provided in the laboratory manual. The student will share those data with the marker on MS Teams in the case of online laboratories to be marked and signed off for each check point.

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 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 through the term. Ongoing assessment occurs through the lab checkpoints (see lab manual), lab reflections, three assignments and the mid-term exam. There is an option for students to undertake practical project as a substitute to the assignments, mid-term and final-term exam assessments with the maximum mark capped to 20%.

Laboratory Assessment

The laboratory work will contribute to 15% of the overall mark. It is essential that you complete the laboratory preparation before coming to the lab. Your laboratory preparation will be marked and checked. Each lab exercise will have three checkpoints. Each checkpoint is expected to be completed in one week or less. It will be marked and signed off by your dedicated laboratory demonstrators. Although there is only one check point for each week, there are a number of results that you are required to demonstrate when marked for the check point. Therefore, you are strongly advised to: (i) record results in spaces provided in the laboratory manual; (ii) save the data plotted on the laboratory PC. Demonstrators will be available to help students with any questions or difficulties.

Upon completion of a checkpoint, you will be required to fill in an online Microsoft form (the link of which will be provided later) in which you can enter your details including bench numbers to be on the marking queue sheet and wait for the laboratory assessor to mark your work. You may continue working on the subsequent lab design tasks while waiting to be assessed. You will be required to show the measurements you took and answer questions asked by the assessor to demonstrate your understanding of the ideas addressed within each task. The marking guidelines are provided in the laboratory manual.

Students will work in pair but be marked individually. Each student will be asked a couple questions for individual marking. There will also be a group mark for demonstrating the required lab tasks in pair.

Laboratory Reflection

You will be required to write an individual laboratory reflection at the end of lab I, lab II, and lab III. Detail on how to write and what to include in the reflection will be provided. The reflection does not have a word limit but is not expected to be long and generally less than 500 words. It can be handwritten as long as it is legible. You will submit the reflection online on Moodle after you are marked for the lab either in the same or following week. It will contribute 5% towards the overall mark. The assessment will provide you with the opportunity to reflect on your laboratory

experience, what you have learnt from the experience and give your general feedback about the lab tasks. It will also help us to improve the delivery of the lab and better support your individual needs based on your experience and feedback.

Fortnightly quizzes

There will be fortnightly quizzes throughout the term. The purpose of the quizzes is to keep students up to date with the lecture material and to test their basic understanding of the course concepts. The fortnightly quizzes will not contribute to the overall mark. However, the quizzes are mandatory component of the overall assessment and **students must attempt all quizzes to pass this subject. Moreover, for each quiz not attempted within the due date, you may lose one mark.** Each quiz will consist of a number of multiple-choice questions and will be marked according to the number of correct answers. Each quiz will be available for a period of two weeks and the results per quiz will be published at the end of the period.

The quizzes will be delivered through Moodle and will each be made available for a period of two weeks from Saturday 9:00am to the following Saturday at the same time after which a new quiz will become available. The first quiz will be released at end of week 1.

Mid-Term Exam

The mid-term examination in this course is a 1-hour supervised test based on two design questions. Questions will be drawn from the first five topics of the course (week 1- week 4), unless specifically indicated otherwise by the lecturer. It will contribute 10% to the overall mark. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion.

Assignment

The assignments, which will consist of analysis and design problems, form 15% of the overall mark. There will be three assignments for this course. They will be released on Moodle at the end of week 1, 3 and 6. The assignments are to be submitted online on Moodle and due at the end of week 3, 6 and 9, respectively. Late submission will attract a penalty of 5% per day (including weekends).

Assignments will be peer assessed. This means that you will mark the assignment submissions of your peers and your peers will mark your submission. Each student will be allocated three assignment submissions to mark and each submission will be marked by three students. The average mark given by the three students will be the mark for the submission. Detail rubrics and solution will be provided to help students with marking. Further information on peer marking will be made available on Moodle in due course. **It should be noted that your peer marking will be given a mark, which contributes to your overall assignment mark. Therefore, it is important to make sure that you undertake the peer markings in order not to lose any marks for the assignments.**

The assignments will consist of one or more analytical and design problems and students are required to provide a complete solution. Students will be expected to work independently and be able to justify any unique design choices along the way.

Practical projects

Practical projects are relatively challenging analogue electronics type projects that involve design, simulation, implementation, and report tasks. Students who opt for this option can propose project(s) or take up one of the projects which will be released early in week 2. The projects proposed by the students need to be submitted by the end of week 1 on Moodle and must be approved by the course convener. Once approved or signed up for one of the practical projects, students will have till week 10 to complete the project and submit a report on the project. The report can be written document showing all the design, analytical, simulation and implementation of the project. The report can also be submitted in the form of recording video which may clearly cover all design, analytical and simulation and implementation tasks. The key assessment criteria here is the connections students can make between their practical work and the topics covered in the course. It assesses the application of knowledge acquired in the course in executing the practical project. The maximum mark for the practical project will be capped to 20% depending on the quality of work undertaken. For example, students who go extra mile to design and get PCB made will be given more marks as compared to those who implement their design on a breadboard. Note that this is an individual project, and any form plagiarism would have serious consequences. The students who would sign up for the practical projects can use the project mark to replace any assessment in the course except the laboratory. For example, if a student receives the full 20% for the project, then they can request the final exam to weight only 35% or the assignment to weigh 0% and final exam 50%. Many other combinations are possible.

Final Exam

The final examination in this course is a standard closed-book 2-hour written examination, comprising four compulsory questions. It is worth 55% of the overall mark. 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 (including laboratory), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses. *Please note that you must pass the final exam in order to pass the course.*

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes										
Assessment	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Laboratory practical assessments	✓	✓	-	-	✓	✓	✓	-	✓	-	-
Laboratory reflection	✓	✓	-	-	✓	✓	✓	✓	✓	-	-
Fortnight online quizzes	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓
Assignment	✓	✓	-	✓	✓	✓	✓	-	✓	-	-
Mid-term exam	✓	✓	✓	✓	✓	-	-	-	-	-	-
Practical projects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Final exam					✓	✓	✓	✓	✓	✓	✓

COURSE RESOURCES

Textbooks

Prescribed textbook

- Sedra & Smith, *Microelectronic Circuits*, 6th ed, Oxford University Press, 2011

Reference books

- Richard C. Jaeger, Microelectronic Circuit Design, 5th Edition.
- Millman & Grabel, *Microelectronics,* McGraw Hill, 2nded., NY
- Burns & Bond, *Principles of Electronic Circuits*, PWS, 2nd ed, 1997
- Higgins, *Electronics with digital and Analog Integrated Circuits*, 1983.
- Bogart, *Electronic Devices and Circuits*, 3rd ed, Merril, 1993.
- Horowitz & Hull, *The Art of Electronics*, 2nd ed, Cambridge University Press, 1989.

On-line resources

Moodle

The course web page is hosted on the UNSW's Moodle server, which can be accessed at: https://moodle.telt.unsw.edu.au/login/index.php. All lectures, tutorial, lab, video and any other notes will be available on this page, as well as access to the fortnightly quizzes, student marks, discussion forums and official course announcements. It is a requirement of the course that students check this page for new announcements on a daily basis.

MS Teams

The course has MS Teams for lecture, tutorial and laboratory. The classes are **CLS-ELEC2133_T2_2021_Lecture, CLS-ELEC2133_T2_2021_Tutorial** and **CLS-ELEC2133_T2_2021_Lab** respectively. All lectures and tutorial videos are recorded and made available on MS Teams for students to watch them at any time and place of their

convenience. The classes on MS Teams will also be used to make announcements and students are required to check messages on daily basis.

Mailing list

Announcements concerning course information will be given on MS Teams during lecture and/or on Moodle and/or via email (which will be sent to your student email address).

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 **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both 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 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 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.

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. The following modifications are incorporated into the course

- The course has gone through Digital uplift. The purpose of the digital uplift is to enhance student experience in the course and support student learning. The uplift includes
    - Computer typed tutorial solutions: the previous tutorial solutions were hand-written, and they were problems with legibility. There were also errors in the solutions. These problems are now addressed in the new computer typed solutions.
    - Recorded tutorial solution videos: the benefit of tutorials has been reiterated strongly by students. With 1 hour of tutorial, it is often not possible to cover all tutorial problems. In order to address both the benefit of tutorial and coverage of tutorial problems, the tutorial solutions are now video recorded as they are being solved to provide additional virtual tutorial experience. Moreover, students will be able to watch the tutorial videos at their time of convenience.
    - Recorded summary videos: summary videos for each tutorial topic have been recorded. Students can watch those videos before coming to tutorial or attempting tutorial problems. In addition to supporting tutorial, the summary video will also help students with quick revision on important concepts in the course. Students are strongly advised to watch these videos (summary and tutorial videos) to get themselves ready exams in a short time possible.
    - Animations: In order to better illustrate the operational principle of diodes, BJT transistors, MOSFETs, Schmitt trigger and waveform generators, a number of animations have been created. Most of the animations are interactive and allow students to change parameters and variables to observe effect in a system.
    - Online assignment and reflection submission: in previous year assignment and reflection submissions were made in person by handing over a hard copy. This year, assignments and reflections will be submitted online on the Moodle web page of the course.
    - Peer assessment (marking): assignment marking will be peer based this year. Each assignment submission will be randomly allocated to three students and each student will be allocated to mark three submissions. Peer assessment allows students to learn from the assessment experience as it requires them to first understand the problem and its solution and then apply it when marking. It will also allow them to learn from other peers and more importantly allow them to reflect on their submission from their peer's point of view.
    - STACK questions: the questions will allow students to have the same problem but with different parameters and variables and thus conduct individual assessment. Students will be able to solve large problem in step-by-step manner and thus facilitate self-direct study.
    - Remote laboratory: Laboratory will be conducted remotely through Microsoft Teams. Students will be given access to laboratory PC which is interfaced to web-based measurement equipment (oscilloscope, signal generator, multimeter) that are in turn connected to the laboratory experiments which are already implemented on the ELEC2133 PCB platform. The platform is especially designed to allow designed components to be easily plugged in and circuits to be reconfigured using jumpers. Once students provide their design values to the lab demo. The lab demo will set-up the desired circuit by simply plugging in those values on the board and give the students remote control to the laboratory PC through Microsoft Teams so that they can perform measurements.

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 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 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	1,2,3,4,5,6,7,8, 9,10,11
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	2,5,7,9,11
	PE1.3 In-depth understanding of specialist bodies of knowledge	1,2,3,4,5,6,7,8, 9,10,11
	PE1.4 Discernment of knowledge development and research directions	
	PE1.5 Knowledge of engineering design practice	1,2,3,4,5,6,7,8, 9,10,11
	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	2,5,7,9,11
	PE2.2 Fluent application of engineering techniques, tools and resources	2,5,7,9,11
	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)	2,5,6,7,9
	PE3.3 Creative, innovative and pro-active demeanour	2,5,7,9
	PE3.4 Professional use and management of information	2,5,6,7,9
	PE3.5 Orderly management of self, and professional conduct	
	PE3.6 Effective team membership and team leadership	