School of Electrical Engineering and Telecommunications

Term 1, 2021
Course Outline

ELEC2134
Circuits and Signals

COURSE STAFF

Course Coordinator: Prof Julien Epps, Room EE105, j.epps@unsw.edu.au
Tutorial-Laboratory Coordinator: Mr Cameron Jones, cameron.jones@unsw.edu.au

Consultations: You are encouraged to ask questions on the course material during class or on the course forum in the first instance, rather than via email. Consultation times will be held weekly, at times and locations as advised during lectures and on Moodle. For tutorial-lab-related questions, preferably post these in the discussion forums, but you are also welcome to email them directly. All email enquiries should be made from your UNSW student email address with ELEC2134 in the subject line, to ensure they will 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 information all information distributed this way, so you should take careful note of all announcements.

COURSE SUMMARY

Contact Hours

The course consists of 4 hours of lectures (5 hours during Weeks 1-4) and a 3-hour tutorial-laboratory session each week. Tutorial-laboratories run from Week 1 to Week 10.

	Day	Time	Location
Lectures	Wednesday	1 – 4pm (Sydney time) Weeks 1 – 4 1 – 3pm (Sydney time) Weeks 5 – 10	Online
	Friday	3 – 5pm (Sydney time)	Online
Tut-Labs	Mon-Fri	Enrolled times	EE224/225 or online

Context and Aims

ELEC2134 covers the fundamentals of circuit, system and signal analysis on which most other courses in the electrical engineering curriculum are built. The course provides a foundation in frequency domain analysis and in transform methods, as well as significantly extending AC analysis, transient analysis and other fundamental circuit analysis tools. Although there is a series of practical tasks in the tutorial-laboratory classes, the theory aspects of this course are the primary focus.

Indicative Lecture Schedule

Period	Summary of Lecture Program	
	Wednesday Circuit Analysis	Friday Transforms & Systems
Week 1	AC circuit analysis, AC circuit theorems, AC network functions	Fourier series
Week 2	AC power analysis	Fourier series
Week 3	AC resonance	Fourier transform
Week 4	Magnetically coupled circuits	Fourier transform
Week 5	**Wednesday March 17th 1-3pm[1]** **Mid-term exam**	Laplace transform
Week 6	Examples and Revision	Examples and Revision
Week 7	Transient analysis	Laplace transform
Week 8	Transient analysis	Laplace transform applications
Week 9	Two-port networks	Laplace transform applications
Week 10	Two-port networks, State space	Poles and zeroes

Indicative Tutorial-Laboratory Schedule

Period	Summary of Tutorial-Laboratory Program
Week 1	Tutorial-lab 1: Introduction and AC analysis[2]
Week 2	
Week 3	Tutorial-lab 2: AC Power Analysis and Fourier Analysis I
Week 4	
Week 5	Tutorial-lab 3: AC Power Analysis and Fourier Analysis II
Week 6	
Week 7	Tutorial-lab 4: Transient Analysis and Resonance Circuits
Week 8	
Week 9	Tutorial-lab 5: Magnetically Coupled Circuits
Week 10	

Assessment Summary

Tutorial-Laboratory Assessment	20%
Weekly Online Quizzes	5%
Mid-Term Exam (100 minutes)	25%
Final Exam (2 hours)	50%

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[1] Sydney time

[2] Because tutorial-laboratories start on Monday of Week 1, Tut-Lab 1 will be mainly revision from ELEC1111

COVID19 - 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 course coordinator 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, including all classes and *self-directed study*.

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 (Hons) (Electrical, Telecommunications or Quantum) or BE (Hons) ME (Electrical) program and related dual degree programs.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC1111. ELEC2134 builds heavily on ELEC1111 skills, and the content progresses quickly, so if you do not already have a mastery of ELEC1111 concepts and problem-solving, revise early and revise often (e.g. using eemedia.ee.unsw.edu.au). It is also essential that you have good mathematical skills. This course will require fluent understanding and correct application of linear algebra, complex numbers, differential calculus and integral calculus (covered in first year mathematics courses).

Following Courses

The course is a pre-requisite for core courses ELEC2133, ELEC3104, ELEC3106, ELEC3115, ELEC3105, ELEC3114, TELE3113, and other ELEC electives.

Learning outcomes

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

1. Apply transform methods to analyse signals and continuous-time linear systems.
2. Demonstrate an understanding of how signals and linear systems interact.
3. Analyse simple and complex electric and magnetic circuits in the time and frequency domains.
4. Demonstrate an understanding of concepts related to AC power analysis.

This course addresses the Engineers Australia (National Accreditation body) Stage I competency standard as outlined in *Appendix A*.

Syllabus

Circuit Analysis: AC circuits with sinusoidal inputs in steady state, use of phasors and complex impedance in AC circuit analysis, AC power (real, reactive, apparent), power factor, leading/lagging, series and parallel resonance, transformers and coupled coils, application of network theorems in AC circuit analysis, two-port network analysis.

Transform Methods: Periodic signals and Fourier series, aperiodic signals and Fourier transform, Laplace transforms and their application to signals and circuits.

System Analysis: Linear systems and convolution, impulse response, frequency response and transfer functions, steady-state analysis of linear systems, transient analysis of 1st and 2nd order systems, circuit analysis using transform methods.

TEACHING STRATEGIES

Delivery Mode

The teaching in this course aims to establish a strong fundamental understanding of the areas covered using:
- Formal live lectures, which focus on the core analytical material in the course, together with qualitative, alternative explanations, worked examples and interactive class discussion to aid your understanding;
- Online forum discussion, online consultation and Moodle-based self-paced exercises;
- Integrated tutorial-labs, which allow for analytical skill development in a practical context and with direct guidance/feedback from course staff;
- Video lecture recordings posted via the Moodle website. Note that these video lectures are not intended as a replacement for the live lectures, and some course content may only be covered during live lectures.

Learning in this course

You are expected to attend all lectures, tutorial-labs, and mid-term exam 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, and attempt the recommended problem sets. 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. You should note that watching recordings is not a substitute for actually attending the classes, where live questions can be asked. In particular, note that having access to recorded lectures on its own does not imply improved exam preparation, without significant and consistent additional self-directed study, over a period of time that allows practice of example problems and resolution of conceptual misunderstandings.

Tutorial-Laboratory program

The integrated tutorial-laboratory sessions are designed to help you develop your analytical skills and see how they are applicable in a practical context. You may divide your time between the analytical and the laboratory components as per your convenience but you should complete both within the allocated time. The analytical problems in tutorial-labs will often be more involved than the sample problems posted to Moodle or in the recommended textbook and will also may involve more than one topic.

> *It is expected that you are able to solve the sample problems from the lectures, from the problem sheets/questions posted to Moodle and from the recommended textbook **before** undertaking the tutorial-lab questions, which will usually be more challenging.*

The tutorial-laboratory schedule is deliberately designed to provide practical, hands-on exposure to the concepts conveyed in lectures soon after they are covered in class. You are required to attend this from Week 1 to Week 10. **Tutorial-laboratory attendance will be kept, and you must attend all of each tutorial-lab**. If you complete the allocated tasks, you may use the time to revise for the course, with the assistance of the tutorial-laboratory demonstrators.

Tutorial-Laboratory Exemption

<u>There is no laboratory exemption for this course</u>. Regardless of whether equivalent labs have been completed in previous terms, all students enrolled in this course for Term 1 2021 must take the tutorial-labs. If, for medical reasons (note that a valid medical certificate must be provided), you are unable to attend a tutorial-lab, you will need to apply for a catch-up lab during another lab time, as agreed by the tutorial-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 tutorial-lab preparation and practical checkpoints (see lab manual) and the mid-term exam.

Tutorial-Laboratory Assessment (20%)

The integrated tutorial-laboratories are designed primarily to promote active learning, and you are encouraged to bring questions to the classes. The assessment during tutorial-laboratories is designed mainly to check your knowledge as you progress through each stage of the analytical and laboratory tasks. You are required to maintain a lab book for recording all your preparation, analytical working and experimental observations. A lab book is an A4 size notebook containing a mix of plain pages and graph sheets. You need to purchase your own lab book.

After completing both the analytical questions given in the lab sheet and the laboratory work, it will be assessed by the laboratory demonstrator. You must present your lab book with the analytical solutions and the practical results during this assessment. Tut-lab demonstrators may ask questions to test your knowledge of the analytical and practical parts of these tasks during these checks.

Assessment marks will be awarded according to your analytical work, how much of the lab you were able to complete, your understanding of the experiments conducted during the lab, the quality of the simulations/code (if relevant), and your understanding of the topic revealed through lab staff questions (which may include related analytical questions). **Attendance and full participation in at least nine tutorial-laboratory classes, together with completion of the tutorial-laboratory exercises, is a requirement to pass this course.**

Weekly Online Quizzes (5%)

Each week starting from the end of Week 1, an online quiz related to the materials covered in the previous week of the course will become accessible. Once a quiz is made available online, you can complete the quiz at your own convenience, but the deadline for each quiz is one week from the opening date. The length of each quiz may vary from 30 minutes to 1 hour, depending on the difficulty level. You will have three attempts for each quiz and will receive instant feedback after every attempt. You will be marked on your last attempt. The average mark of the 9 quizzes accounts for the total mark of this assessment (5% of your total course mark).

Mid-Term Exam (25%)
There will be one mid-term examination, testing your understanding of the principles and your analytical skills through a number of set problems.
- Mid-Term Exam: Wednesday, 17th March, 2021, 1-3pm
- The location of the exam will be confirmed prior to the exam (there will be multiple locations)
- Covers all material taught in weeks 1-4 (both lecture and tutorial-lab)
- All questions must be answered

If for medical reasons (valid medical certificate must be provided) or any other reasons, you are unable to attend the mid-term exam, you may be given an oral examination of approximately 1 hour.

Final Exam (50%)
There will be one final examination, testing your understanding of the principles and your analytical skills through a number of set problems. If for medical reasons (note that a valid medical certificate must be provided to the university) you are unable to attend the final exam, you will be given another exam (either oral or written, at the discretion of the course coordinator).
- The final exam will be 2 hours long
- All questions must be answered

The final exam will cover all chapters/topics covered in the term. **You must pass this final exam to pass the course.**

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes			
Assessment	**1**	**2**	**3**	**4**
Tutorial-Laboratory assessments	✓	✓	✓	✓
Mid-term exam	✓	✓	✓	✓
Final exam	✓	✓	✓	✓

COURSE RESOURCES

Textbooks

Prescribed textbook

- "Fundamentals of Electric Circuits", Alexander and Sadiku, McGraw-Hill.

  e-book available via https://www.library.unsw.edu.au/

  Problem sets issued by lecturing staff will refer to the 6th Edition of this text.

Example reference books
- L.S. Bobrow, "Elementary Linear Circuit Analysis", Oxford, 1987 [P621.3192/106].
- J. Svoboda, & R. Dorf, "Introduction to Electric Circuits", 9th edition, Wiley & sons, 2014.
- A. Hambley, "Electrical Engineering Principles and Applications", Prentice Hall, 2002.
- S. Franco, "Electric Circuits Fundamentals", Saunders College Publishing, 1995.
- R.L. Boylestad, Introductory Circuit Analysis, 9th Edition, Prentice-Hall, 2000 [PQ621.3815/198].
- 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].

Online 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 UNSW 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 **fifteen 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 prepare for assessments, the workload may be greater. Over-commitment has been a source of failure for a number of 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.

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

You must submit all assignments and attend all examinations scheduled for your course. Assessment of applications for Special Consideration is managed centrally. You no longer need to take your original documentation to The Nucleus for verification. Instead, UNSW conducts source checks on

documentation for verification purposes. 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. If you sit an exam or submit an assignment, you are declaring yourself well enough to do so.

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.

Based on feedback over recent years, selected ELEC2134 topics have been removed, tutorial-laboratory exercises have been revised, more time has been allocated for the transforms topics, and new textbook-based learning materials are being trialled.

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

APPENDIX A

Engineers Australia (EA) Professional Engineer Competency Standards

Competency Standards		Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	1, 2, 3, 4
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	1, 2, 3, 4
	PE1.3 In-depth understanding of specialist bodies of knowledge	1, 2, 3, 4
	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	4
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	1, 2, 3, 4
	PE2.2 Fluent application of engineering techniques, tools and resources	1, 2, 3, 4
	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, 4
	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	2, 4
	PE3.6 Effective team membership and team leadership	