ELEC2134
Circuits and Signals

Course Outline – Semester 1, 2017

Australia's Global University | Faculty of Engineering | School of Electrical Engineering and Telecommunications

Course Staff

Course Convener and Lecturer: A/Prof Julien Epps, Room MSE545, j.epps@unsw.edu.au
Laboratory demonstrators: TBA. Laboratory Coordinator: Mr Malcolm Wong

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 held weekly, at times as advised during lectures. For tutorial and lab-related questions, preferably post these 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 ELEC2134 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, and a 3-hour tutorial-laboratory session each week. Laboratories run from Week 3 to Week 12.

Lectures	**Day**	**Time**	**Location**
	Wednesday	2pm – 4pm	Ainsworth G03
	Thursday	12am – 1pm	Ainsworth G03
Tutorial-Labs	Mon-Fri	Enrolled times	EE125

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 is 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 lab program, the theory aspects of this course are the primary focus.

Indicative Lecture Schedule

Period	Summary of Lecture Program	
	Wednesday Circuit Analysis	**Thursday Transform Methods & Appl.**
Week 1	AC circuit analysis	Fourier series
Week 2	AC circuit theorems, AC network functions	Fourier series
Week 3	AC power analysis	Fourier series
Week 4	AC power analysis, AC resonance	Fourier transform
Week 5	AC resonance	Fourier transform
Week 6	Magnetically coupled circuits	Fourier transform
Week 7	**Mid-session exam**	Laplace transform
Break		
Week 8	Magnetically coupled circuits	Laplace transform
Week 9	Transient analysis	Laplace transform
Week 10	Transient analysis	Laplace transform applications
Week 11	Two-port networks	Laplace transform applications
Week 12	Two-port networks	Poles and zeroes

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 3	Tutorial-lab 1: Introduction and AC analysis
Week 4	
Break	
Week 5	Tutorial-lab 2: AC Power Analysis and Fourier Analysis I
Week 6	
Week 7	Tutorial-lab 3: AC Power Analysis and Fourier Analysis II
Week 8	
Week 9	Tutorial-lab 4: Transient Analysis and Resonance Circuits
Week 10	
Week 11	Tutorial-lab 5: Magnetically Coupled Circuits
Week 12	
Week 13	Catch-up

Assessment Summary

Tutorial-Laboratory Assessment	20%
Mid-Semester Exam (100 minutes)	30%
Final Exam (2 hours)	50%

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 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 or Telecommunications) or BE (Hons) ME (Electrical) program and other dual degree programs.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC1111/ELEC1112. ELEC2134 builds heavily on ELEC1111 skills, and the content progresses quickly, so if you do not feel comfortable with 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 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 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 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 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

Transform Methods: Periodic signals and Fourier series, aperiodic signals and Fourier transform, Laplace transforms and their application to signals and circuits.
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.
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 at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures, which focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- Integrated tutorial-labs, which allow for analytical skill development in a practical context and direct guidance/feedback from course staff;
- Video lectures posted via the Moodle website. Note that these the video lectures are not intended as a replacement for the face-to-face lectures, and some course content may only be covered during face-to-face lectures.

Learning in this course

You are expected to attend all lectures, tutorial-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, 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. Where possible, Echo360 will be used to record the actual classes, for revision purposes. 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 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 you will be given in these sessions will tend to be more involved than the sample problems posted to Moodle or in the recommended textbook and will also tend to involve more than one topic.
It is expected that you are able to solve the sample problems from the lectures, problem sheets/questions posted to Moodle and the recommended text book prior to undertaking the tutorial-lab questions.

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 3 to Week 12. Tutorial-laboratory attendance WILL be kept, and you MUST attend all tutorial-labs.

Tutorial-Laboratory Exemption

There is no laboratory exemption for this course. Regardless of whether equivalent labs have been completed in previous semesters, all students enrolled in this course for Semester 1, 2017 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 semester. Ongoing assessment occurs through the tutorial-lab preparation and practical checkpoints (see lab manual) and the mid-semester exam.

Tutorial-Laboratory Assessment (20%)

The integrated tutorial-laboratories are primarily to promote 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 your 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. 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 code (if relevant), and your understanding of the topic revealed through lab staff questions (which may include related analytical questions). **Attendance and participation in at least nine tutorial-laboratory classes, together with completion of the tutorial-laboratory exercises, is a requirement to pass this course.**

Mid-Semester Exam (30%)

There will be one mid-semester examination, testing your understanding of the principles and your analytical skills through a number of set problems.

- Mid-Semester Exam: Wednesday, 12th April, 2017: 2-4pm
- Location of the exam will be confirmed prior to the exam
- Covers all lecture material taught in weeks 1-6

If for medical reasons (valid medical certificate must be provided) or any other reasons, you are unable to attend the mid-semester 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 convenor).

- The final exam will be 2 hours long
- The final exam consists of 4 questions (with many parts) and all of them must be answered

The final exam will cover all chapters/topics covered in the semester. **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-semester exam	✓	✓	✓	✓
Final exam	✓	✓	✓	✓

Course Resources

Textbooks

Prescribed textbook

- "Fundamentals of Electric Circuits", Alexander and Sadiku, McGraw-Hill. Problem sets issued by lecturing staff will refer to the 5th 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].

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 UNSW 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 policy states 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, just as professional behavior is an expectation of a graduate engineer. 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/TWEET, 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 regular feedback over the last 3-4 years from ELSOC committee members and other class representatives, ELEC2134 has been recently (2015) structured in a way that encourages tutorial attendance and promotes in-class individual and group discussion of challenging analytical concepts. In 2017 more self-study examples/problems and worked solutions will be included to support this, and the tutorial-laboratory exercises will be further improved.

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	