UNSW Course Outline

ELEC4604 RF Circuit Design - Theory and Applications - 2024

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General Course Information

Course Code : ELEC4604
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Electrical Engineering & Telecommunications
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Experience an exciting learning adventure with our Radio Frequency Circuit Design and Applications course! This course will serve as a launching pad for those interested in high-frequency technology innovation. Our inquiry-based learning methods prioritise "learning-by-

doing" and putting theoretical concepts into practical use. By attending the laboratories, you will gather unique data to identify real issues and meet practical radio frequency engineering problems. You will also learn how to conduct comprehensive electrical and electromagnetic circuit analysis, literature review, and patent searches while developing your communication skills.

This course integrates high-frequency electromagnetics, electronics, and technology knowledge. You will be able to apply theoretical concepts to real-life scenarios and develop a comprehensive project brief that showcases your skills in consolidating and communicating critical, radio frequency engineering problems. Embark on an engaging learning journey and take the first step towards your career in radio frequency theory, technology, and design with us!

Course content includes: Review of transceiver architectures; RF basics: transmission lines; Smith charts; S-parameters; RF active/passive devices and parasitics; RF and microwave technologies; Linearity and noise. Impedance matching; RF resonators; RF filters: designing and implementation of microstrip line filters, Richard's transformations, Kuroda identities; LNA: circuit architectures, impedance, noise, bandwidth, power gain; Design for maximum gain, particular gain and particular noise figure.

Course Aims

The course aims to make the student familiar with RF circuits and to enable the student to analyse, design and implement RF circuits.

The course aims to reinforce students' understanding of core radio frequency engineering principles, as well as building their capabilities in core electrical and electronics engineering practice.

In particular, the course will improve students' ability to prepare, organise and carry out experiments, analyse data, communicate the findings and meaning of their results, and work in small teams.

The development of practical laboratory and professional skills, complements the strengthening of radio frequency engineering knowledge through the practical experience of a range of unit operations.

Relationship to Other Courses

The current course is a preamble to the follow-up RF Integrated circuit design course.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the limitations of conventional low-frequency circuits and radio frequency circuit analysis.
CLO2 : Analyse and design radio frequency circuits
CLO3 : Use modern CAD design techniques to simulate RF circuits
CLO4 : Use modern instrumentation to measure the RF circuit parameters

Course Learning Outcomes	Assessment Item
CLO1 : Explain the limitations of conventional low-frequency circuits and radio frequency circuit analysis.	• Mid-term test • Final Examination • Lab Work
CLO2 : Analyse and design radio frequency circuits	• Mid-term test • Final Examination • Lab Work
CLO3 : Use modern CAD design techniques to simulate RF circuits	• Final Examination
CLO4 : Use modern instrumentation to measure the RF circuit parameters	• Lab Work • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Agilent software

Learning and Teaching in this course

The course offers hardware and software training.

Other Professional Outcomes

Engineers Australia, Professional Engineer Stage 1 Competencies

The learning outcomes of this course contribute to your development of the following EA competencies:

	EA Stage 1 Competencies	Course Learning Outcomes (CLOs)
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	2, 3, 4
PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing		1, 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		2, 3, 4
PE1.5 Knowledge of engineering design practice		2, 3, 4
PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice		2, 3, 4
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	3, 4
PE2.2 Fluent application of engineering techniques, tools and resources		3, 4
PE2.3 Application of systematic engineering synthesis and design processes		2, 3, 4
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	2
PE3.2 Effective oral and written communication (professional and lay domains)		2, 3, 4
PE3.3 Creative, innovative and pro-active demeanour		
PE3.4 Professional use and management of information		2
PE3.5 Orderly management of self, and professional conduct		
PE3.6 Effective team membership and team leadership		3, 4

Additional Course Information

The current course offers the key hardware background for wireless communication systems.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Mid-term test Assessment Format: Individual	20%	Start Date: 13/03/2024 03:00 PM Due Date: 13/03/2024 03:00 PM
Final Examination Assessment Format: Individual	60%	Start Date: examination period Due Date: Not Applicable
Lab Work Assessment Format: Group	20%	

Assessment Details

Mid-term test

Assessment Overview

The one-hour mid-term examination tests your understanding of the course material up to week 5. A marking guide and formal feedback on your assessment task will be provided within two weeks from the test time. Individual written feedback will be provided in verbal class-wide feedback during the tutorials.'

Course Learning Outcomes

- CLO1 : Explain the limitations of conventional low-frequency circuits and radio frequency circuit analysis.
- CLO2 : Analyse and design radio frequency circuits

Detailed Assessment Description

The mid-term test will consists of several standard questions including the recapitulation of basic high frequency electromagnetics concepts as well as new ecercises mathematical reprsentation of RF circuits.

Assessment Length

50 min

Final Examination

Assessment Overview

The final exam is to be held at the end of the term during the formal exam period. It is a standard closed-book 2-hour written examination. Questions may be drawn from any aspect of the course unless specifically indicated otherwise by the lecturer. The examination will test students' understanding of the course material and analytical skills. Assessment is a graded mark

according to the correct fraction of the answers to the exam questions.

Course Learning Outcomes

- CLO1 : Explain the limitations of conventional low-frequency circuits and radio frequency circuit analysis.
- CLO2 : Analyse and design radio frequency circuits
- CLO3 : Use modern CAD design techniques to simulate RF circuits
- CLO4 : Use modern instrumentation to measure the RF circuit parameters

Assessment Length

2 hours

Assignment submission Turnitin type

This is not a Turnitin assignment

Lab Work

Assessment Overview

This will be based on the practical design, software and measurements of RF circuits. Each laboratory group will be responsible for designing and executing a set of circuit and electromagnetic simulations and radio frequency measurements and presenting the data in a report. The feedback on laboratory work will be provided throughout the laboratory sessions of the course.

Course Learning Outcomes

- CLO1 : Explain the limitations of conventional low-frequency circuits and radio frequency circuit analysis.
- CLO2 : Analyse and design radio frequency circuits
- CLO4 : Use modern instrumentation to measure the RF circuit parameters

General Assessment Information

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the quiz and the mid-semester exam.

Assessment information is provided during the lecture and laboratory hours.

Grading Basis

Standard

Requirements to pass course

The pass PS cutoff mark in 50.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	Introduction and recapitulation of fundamental concepts.
Week 2 : 19 February - 25 February	Lecture	Theory background.
	Laboratory	Computer-aided design (CAD)
Week 3 : 26 February - 3 March	Lecture	Theory background.
	Laboratory	CAD
Week 4 : 4 March - 10 March	Lecture	Current radio frequency technologies.
	Laboratory	CAD
Week 5 : 11 March - 17 March	Lecture	Components. Mid-term exam.
	Laboratory	Measurements of radio frequency components
Week 6 : 18 March - 24 March	Lecture	Flexibility week
	Laboratory	Flexibility week: Optional lab experiment,
Week 7 : 25 March - 31 March	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 8 : 1 April - 7 April	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 9 : 8 April - 14 April	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 10 : 15 April - 21 April	Laboratory	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 11 : 22 April - 28 April	Lecture	Radio frequency devices.
	Lecture	Measurements of radio frequency components.
Week 12 : 29 April - 5 May	Lecture	Theory background.
	Laboratory	CAD

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

General Schedule Information

Laboratory session will start in week 2.

Course Resources

Prescribed Resources

Textbook:

https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780131471375

Recommended Resources

Additional recommended textbooks will be indicated in the lecture week 1.

Additional Costs

N/A

Course Evaluation and Development

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.

We have continued to evaluate and modify our delivery and assessment methods because of previous feedback obtained for
this course and our efforts to provide a rich and meaningful learning experience.
In 2018, a few students expressed interest in visiting the antenna range testing facilities and the Giga-Hertz laboratory at CSIRO. In response to this request, two visits to these facilities at CSIRO were organised to. in 2019.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Rodica Ramer		room 308	61 2 9385 4759		No	Yes
Lecturer	King Yuk (Eric) Chan		325			No	No
Teaching assistant	Yunhao Fu					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with

your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date

class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/ Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the

assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

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.

Use of AI for assessments

Your work must be your own. If you use AI in the writing of your assessment, you must acknowledge this and your submission must be substantially your own work. More information can be found on this website.

Workplace Health & Safety (WHS)

WHS for students and staff is of utmost priority. Most courses involve laboratory work. You must follow the rules about conduct in the laboratory. About COVID-19, advice can be found on this website.

School Contact Information

Consultations: Lecturer consultation times will be advised during the first lecture. 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 ELEC/TELExxxx 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.

Student Support Enquiries

For enrolment and progression enquiries please contact Student Services

Web

Electrical Engineering Homepage