School of Electrical Engineering & Telecommunications

UNSW Engineering

ELEC4604

RF Circuit Design - Theory and Applications

Term 1, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Rodica Ramer	ror@unsw.edu.au		room 308	61 2 9385 4759

Lecturers

Name	Email	Availability	Location	Phone
King Yuk (Eric) Chan	kyc@unsw.edu.au		325	

Demonstrators

Name	Email	Availability	Location	Phone
Yunhao Fu	yunhao.fu@unsw.edu.au			

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

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

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)

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, 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

Course Details

Units of Credit 6

Summary of the Course

Lectures

The class lectures will cover a range of RF theory and applications topics. They will revise essential RF topics like transmission line theories, and Smith Charts studied in electromagnetics engineering classes, e.g., ELEC3115. The presentations will discuss the S- parameters critical for any RF system and its constituent functional blocks. Essential building blocks of a standard RF system will be studied and analysed separately. RF components include matching networks, resonators, RF filters, RF amplifiers, etc. Other later topics include noise and linearity principles and RF technologies.

Laboratory work

The laboratory work allows the student to measure and characterise the RF components and circuits and develop sufficient competency in utilising unique equipment such as the vector network analyser. Simulation experiments will expose students to state-of-the-art CAD software for RF design. The students will be offered to use Agilent Advanced Design System (ADS) software. ADS is the industry leader in high-frequency design. It supports system and RF design engineers in developing all RF designs, from simple to the most complex, from RF/microwave modules to integrated MMICs for communications and aerospace/defence applications. The use of ADS for this class is an attempt to offer our students the best exposure to the current unique simulators available in the RF industry and research. The UNSW ELEC 4604 students benefit from the ADS software donation for the course. All laboratory work must be recorded in a lab book and not on loose sheets of paper. The demonstrator will mark the lab work during the lab session.

Homework

The lectures can only cover the course material to a certain depth; students must read the textbook and reflect on its content as preparation for the classes to fully appreciate the course material. Students are encouraged to read the textbook and reference materials. Home preparation for laboratory exercises provides the student with a quantitative understanding of the experiment.

Self-guided tutorials

The self-guided tutorials provide the student with an in-depth quantitative understanding of RF circuit analysis. The tutorials take the student through all critical course topics and aim to exercise the students' RF circuit analysis skills. The students are strongly encouraged to complete all the tutorials; the tutorial sessions may discuss the problems. Tutorials may be interleaved with the lecture sessions.

Refer to the course schedule.

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.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Understand and explain the limitations of conventional low frequency circuit and microwave circuit analysis	PE1.2, PE1.3
2. Analyse and design microwave circuits	PE1.1, PE1.3, PE1.4, PE1.5, PE1.6, PE2.3, PE3.1, PE3.2, PE3.4
3. Use modern CAD design techniques to simulate RF circuits	PE1.1, PE1.2, PE1.3, PE1.4, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE3.2, PE3.6
4. Use modern instrumentation to measure the RF circuit parameters	PE1.1, PE1.2, PE1.3, PE1.4, PE1.5, PE1.6, PE2.1, PE2.2, PE2.3, PE3.2, PE3.6

Teaching Strategies

The course consists of the following elements: lectures, laboratory work, homework and tutorial work.

Lectures

The lectures, delivered in the class, will cover a range of RF topics. They will begin with a revision of basic RF topics like transmission line theory, Smith Charts taught in ELEC3115. Noise and linearity principles, S-parameters will be taught as they are essential performance parameters for any RF system and its constituent +functional blocks. The essential building blocks of a standard RF system will be considered and analysed separately. They include RF components such as matching networks, resonators, RF filters, RF amplifiers, RF oscillators, and RF mixers.

Laboratory work

The laboratory work provides the student with opportunity to measure and characterize the RF components and circuits, and develop sufficient competency in utilizing special pieces of equipment such as the vector network analyser. Simulation experiments will expose students to the state of the art CAD software for RF design.

The students will be offered to use Agilent Advanced Design System (ADS) software. ADS is the industry leader in high-frequency design. It supports system and RF design engineers developing all types of RF designs, from simple to the most complex, from RF/microwave modules to integrated MMICs for communications and aerospace/defense applications. The use of ADS for this class is an attempt to offer to our students the best exposure to current best special simulators available in RF industry and research. ADS was donated to UNSW for one more year use in the ELEC 4604 subject. All laboratory work must be recorded in lab book and not in loose sheets of paper. The lab work will be marked by the demonstrator during the lab session.

Home work

The lectures can only cover the course material to a certain depth; students must read the textbook and reflect on its content as preparation for the lectures to fully appreciate the course material. Students are encouraged to read the text book and reference materials. Home preparation for laboratory exercises provides the student with quantitative understanding of the experiment.

Self-guided tutorials

The self guided tutorials provide the student with in-depth quantitative understanding of RF circuit analysis. The tutorials take the student through all critical course topics and aim to exercise the students RF circuit analysis skills. The students are strongly encouraged to complete all the tutorials; the problems may be discussed in the tutorial sessions. These tutorial sessions are interspersed with the lab times.

Refer to the course schedule.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Mid term test	20%	15 March	1, 2
2. Final Examination	60%	Not Applicable	1, 2, 3, 4
3. Lab Work	20%	Not Applicable	1, 2, 4

Assessment 1: Mid term test

Start date: 15 March
Assessment length: 50 min
Due date: 15 March

Midterm test will be an examination of the material presented up to week 5.

Assessment 2: Final Examination

Assessment length: 2 hours

Final exam to be held at the end of term during the formal exam period.

Assessment 3: Lab Work (Group)

This will be based on the practical design, software and measurements of RF circuits.

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.

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 13 February - 17 February	Lecture	Introduction and recapitulation of fundamental concepts.
Week 2: 20 February - 24 February	Lecture	Theory background.
	Laboratory	Computer-aided design (CAD).
Week 3: 27 February - 3 March	Lecture	Theory background.
	Laboratory	CAD
Week 4: 6 March - 10 March	Lecture	Current radio frequency technologies.
	Laboratory	CAD
Week 5: 13 March - 17 March	Lecture	Components. Mid-term exam.
	Laboratory	Measurements of radio frequency components.
Week 6: 20 March - 24 March	Lecture	Flexibility week.
	Laboratory	Flexibility week. Optional lab experiment.
Week 7: 27 March - 31 March	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 8: 3 April - 7 April	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 9: 10 April - 14 April	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.
Week 10: 17 April - 21 April	Lecture	Radio frequency devices.
	Laboratory	Measurements of radio frequency components.

Resources

Prescribed Resources

Textbook:

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

Academic Honesty and Plagiarism

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.

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.

Academic Information

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. **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.

Dates to note

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

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/policy), 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 formal classes and *independent, self-directed study*. In periods where you 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.

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.

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.unsw.edu.au/engineering/our-schools/electrical-engineering-telecommunications/student-life/resources

Disclaimer

This Course Outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Synergies in Sound 2016

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	✓
PE3.2 Effective oral and written communication in 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	✓