School of Electrical Engineering & Telecommunications

UNSW Engineering

TELE4651

Wireless Communication Technologies

Term 3, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Jinhong Yuan	j.yuan@unsw.edu.au		EE408	93854244

Lecturers

Name	Email	Availability	Location	Phone
Min Qiu	min.qiu@unsw.edu.au		320	

Tutors

Name	Email	Availability	Location	Phone
Qingqing Cheng	qingqing.cheng@unsw.edu.au		320	

Lab Staff

Name	Email	Availability	Location	Phone
Shane Xie	yixuan.xie@unsw.edu.au		EE426	

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

Digital wireless transmission and receiving technologies: signal processing for wireless communications, modulation, demodulation, Nyquist pulse shapes, maximum likelihood detection, error performance, symbol synchronization and time recovery, frame synchronization, channel estimation and equalization.

Wireless Communications Channels: time-variant multipath fading, Doppler shift, shadowing effect, time selective channel, frequency selective channel, the effects of fading on wireless transmission.

Narrowband and Wideband Transmissions: wireless communication performance, space diversity, time diversity and frequency diversity techniques, direct spread-spectrum communications, DS-CDMA, frequency hopping, OFDM techniques, single-carrier-FDE, linear least squares estimation, frequency-offset, software-defined radio (SDR) designs and their applications.

Course Aims

This is an advanced course in telecommunications, providing detailed knowledge of the fundamental concepts in wireless communications and in-depth discussions on several selected areas, namely, digital transmission and receiving techniques, antenna diversity techniques, wideband transmissions and receiving with software-defined radio (SDR) designs. This course is a professional elective offered in the Telecommunication option. It assumes basic competency in the second year electronics and systems courses and the third year TELE3113 Introduction of Analogue and Digital Communications, and requires a mathematical ability of at least up to second year.

Aims: This course aims to:

1. Make the student familiar with the basic principles of information transmission in wireless channels.
2. Make the student familiar with wireless transmission techniques and their applications.
3. Enable the student to do analysis and design transmission and receiving algorithms.

Course Objectives

At the end of this course the student will:

- be familiar with wireless channel models and the effects of fading on the transmitted signals.
- have developed an understanding of various diversity techniques.
- have developed an understanding of wideband transmission technologies.
- have developed an understanding of SDR technologies for wireless communications.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Understand and apply the principles, algorithms and technologies used in transmission of information in wireless mobile channels	PE1.1, PE1.2, PE1.5, PE1.6, PE2.1
2. Understand and apply software-defined radio technologies for implementing various transmission and receiving schemes	PE1.1, PE1.2, PE1.3, PE2.1
3. Explain the operation of example algorithms, and discuss the effects of the varying the parameter values within these	PE1.2, PE1.6, PE2.1
4. Analyse the performance of wireless communication systems	PE1.1, PE1.2, PE1.6, PE2.1, PE2.3
5. Apply principles and techniques to communications systems design or undertake further research	PE1.1, PE1.2, PE1.4, PE1.5, PE2.3

Teaching Strategies

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:
• Formal lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
• Tutorials, which allow for exercises in problem solving and allow time for you to resolve problems in understanding of lecture material;
• Laboratory sessions, which support the formal lecture material and also provide you with practical construction, measurement and debugging skills;
• Video lectures, small periodic quizzes (non-assessed), etc.

Learning in this course

You are expected to attend all lectures, tutorials, labs, and mid-term exams 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/video, 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 face-to-face classes throughout the course.

Tutorial classes

You should attempt all of your problem sheet questions in advance of attending the tutorial classes. 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. Group learning is encouraged. Answers for these questions will be discussed during the tutorial class and the tutor will

cover the more complex questions in the tutorial class. In addition, during the tutorial class, 1-2 new questions that are not in your notes may be provided by the tutor, for you to try in class. These questions and solutions may not be made available on the web, so it is worthwhile for you to attend your tutorial classes to gain maximum benefit from this course.

Laboratory program

The 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 laboratory from Week 1 to Week 10. Laboratory attendance WILL be kept, and you are encoraged to attend at least labs 0-4.

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.

Additional Course Information

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 4th year course in the School of Electrical Engineering and Telecommunications. It is an elective course for students following a BE (Electrical) or (Telecommunications) program and other combined degree programs, and an elective for Computer Engineering students.

This course provides advanced knowledge of wideband wireless communication techniques to enable the students to design advanced wireless communication systems. It includes the topics of digital transmission and receiving technologies, channel impairments and the associated mitigation techniques, diversity techniques, Wideband OFDM transmission and multiple-input/multiple-output communications. It serves as an excellent basis from which to commence research in the area. Various aspects of the course bring students up to date with the very latest developments in the field, as seen in recent international conferences and journals, and some of the laboratory work is designed in the style of an empirical research investigation.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is TELE3113 Introduction of Analogue and Digital Communications (or equivalent). Knowledge from TELE4653 is highly desirable. It is essential that you are familiar with digital signal, modulation and detection before this course is attempted. It is further assumed that students are familiar with LabView and Matlab, and have good computer literacy. Students who are not confident in their knowledge from previous digital communications courses (especially the topics mentioned) are strongly advised to revise their previous course materials as quickly as possible to avoid difficulties in this course.

COURSE STAFF

Course Convener:

Prof. Jinhong Yuan, j.yuan@unsw.edu.au and Dr. Min Qiu, min.qiu@unsw.edu.au

Tutor: Dr. Qingqing Cheng, qingqing.cheng@unsw.edu.au

Laboratory Contact: Dr. Shane Xie, yixuan.xie@unsw.edu.au

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 advised during lectures. 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 TELE4651 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.

Contact Hours

The course consists of 2-3-hour lectures per week, 1-hour tutorial per week, and a 3-hour laboratory session per fortnight (except the first two weeks when you have one lab session per week).

	Day	Time	Location

Lectures	Monday	10 - 13 (week 1- 3) 10 - 12 (week 5-10)	OMB149
	Tuesday	9- 12 (Week 4)	TBC
Tutorials	Thursday	10 - 11 (week 1-10)	Cancel
	Friday	10 - 12 (week 1-10)	ElecEngG23
Labs			
	Tuesday	12 - 15	EE426 In Lab
	Wednesday	09 - 12	EE426 In Lab
	Thursday	12 - 15	EE426 In Lab

Assessment

Major changes from previous years:

In this course, we are going to introduce **Tiered Learning Taxonomy (TLT) Framework** to evaluate students' **lab works**. This framework was borrowed from Professor Eliathamby Ambikairajah, who proposed and successfully implemented this framework in ELEC3104. Some details of TLT are as follows.

Tiered Learning Taxonomy (TLT) Framework

- Tiered Learning Taxonomy (TLT) is a self-driven learning framework for analysing students' depth of knowledge or for measuring how well a student understands a topic.

- TLT divides the learning curve within the course into 5 Hierarchical levels of increasing complexity in student's understanding of topics studied.

Why does this matter to you?

- The taxonomy encourages students to think about which level they are currently at with their learning, and what they need to do in order to progress to the next level.

- Within this TLT framework, students have more control and choice over how much they want to learn and deepen their knowledge.

- The TLT framework has been designed to include Pass, Credit, Distinction and High Distinction levels to help students understand the different levels (Levels 0 to 5) on the learning curve, and what they need to do to progress.

- If you are happy with your current level of learning and don't want to deepen your knowledge to progress to the next level, that is entirely your choice. At an absolute baseline, all students must achieve a Pass level (i.e. be at Level 2) as a total final mark (≥50%) at completion of the course, if you want to pass the course.

- The Course is designed to provide an increasing complexity from Pass (Level 2) to High Distinction (Level 5) levels as shown on the Taxonomy Framework diagram below.

Different Stages of the TLT Framework

- **Level 0:** The students don't have any understanding about the topic, but have the pre-requisite knowledge to commence this course.

- **Level 1:** Very basic understanding, where their knowledge accrues in greater quantity. They understand all of the concepts.

- **Level 2:** Students know all the concepts and are able to link many of the concepts to each other.

- **Levels 3, 4 & 5:** All concepts known, and additionally there is a deep understanding that comes with a qualitative change in how the concepts are understood. They are able to connect the concepts in multiple ways. Surface knowledge (Levels 1 & 2) is required as a baseline, in order to develop deep knowledge

Relationship between Levels and required lab works:

All **Lab Works in TELE4651** will be levelled as per the TLT for this course. You must do **Level 2 (Pass)** lab works as a baseline, which includes **Lab 0- Lab 4**. If you choose to attempt any other lab works beyond Level 2, please complete other labs in sequential order (i.e. attempt **Level 3 (Credit, Lab 5)** first, before doing **Level 4 (Distinction, Lab 6)** and then **Level 5 (High Distinction, Lab 7)**.)

Please note that TLT framework only applies to the Lab works in TELE4651.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. LabVIEW Test and Pre-Labs	10%	Not Applicable	1, 3, 4, 5
2. Laboratory Practical Experiments amd Report	40%	Not Applicable	1, 3, 4, 5
3. Midterm Examination	20%	Not Applicable	1, 2, 3, 4, 5
4. Final Examination	30%	Not Applicable	1, 2, 3, 4, 5

Assessment 1: LabVIEW Test and Pre-Labs

Every lab session will have prelab that should be completed and handed in before you starting the associated lab session in room EE426 or Online (You must hand in the prelab in the first 15 minutes of your lab session). The prelab includes a mixture of problems and programming to prepare you for that week's experiment. You may work on the prelab with your lab partner but not with other students and all work must be your own. You may not participate in the lab without a prelab. Copying another student's prelab is considered cheating and the appropriate action will be taken. All prelab assignments will be due at the beginning of each lab. No late prelabs will be accepted as you need to be prepared for the lab.

After completing each experiment, your work will be assessed by the laboratory demonstrator. Both the results sheet and your lab book will be assessed by the laboratory demonstrator.

Assessment marks will be awarded according to your preparation (completing set preparation exercises and correctness of these or readiness for the lab in terms of pre-reading), how much of the lab you were able to complete, your understanding of the experiments conducted during the lab, the quality of the code you write during your lab work (according to the guidelines given in lectures), and your understanding of the topic covered by the lab.

Assessment 2: Laboratory Practical Experiments amd Report

Laboratories are primarily about learning, and the laboratory assessment is designed mainly to check your knowledge as you progress through each stage of the 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 have to purchase your own lab book from any stores.

It is essential that you complete the laboratory preparation before coming to the lab. You are required to write the aim of the experiment and draw the circuit diagram if any in your lab book. This will be verified and signed by your demonstrators in the lab. You will be recording your observations/readings in your lab book first and then completing and submitting the results sheet before leaving the lab.

The purpose of the lab report is to discuss what was observed in the lab and to answer several questions related to wireless communication engineering. The lab report is an opportunity to synthesize what was learned. The questions will be based on what you have learned/observed in your laboratory classes and lectures, and marks will be awarded for the correct understanding of practical and relevant

theoretical concepts, correct operation of laboratory equipment, and correct interpretation of measured results. The report for each lab is due at the beginning of the next lab.

Assessment 3: Midterm Examination

The mid-session examination tests your general understanding of the course material, and is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any course material up to the end of week 5 (TBC). It may contain questions requiring some (not extensive) knowledge of laboratory material, and will definitely contain numerical and analytical questions. Marks will be assigned according to the correctness of the responses.

Assessment 4: Final Examination

The test in this course is a standard closed-book 2 hour written examination, comprising five or upto five compulsory questions. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material and lab 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.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction to wireless communications and digital communications overview
Week 2	**LabVIEW Test** Review of signal processing fundamentals I: signals and stochastic processes, Fourier transforms, sampling theorem, discrete-time processing of continuous-time signals
Week 3	Review of signal processing fundamentals II: frequency response of random signals, power spectrum, bandwidth, complex envelope notation, up/down conversion, complex baseband representation, complex baseband equivalent channel
Week 4	Quadrature pulse amplitude, modulation, PAM, QAM, transmit energy, transmit bandwidth, additive white Gaussian noise channels Optimal pulse shapes for AWGN, Nyquist pulse shapes, implementing optimal pulse shapes using multi-rate identities Maximum likelihood detection with additive white Gaussian noise, probability of error analysis, Sample timing offset, algorithms for sample timing
Week 5	**Mid-Term Test** Narrowband frame synchronization, channel estimation, linear least squares estimation Frequency selective channels, least squares channel estimation, direct least squares equalizer estimation
Week 6	Revision:
Week 7	Frequency offset estimation and correction, requency domain equalization, DFT Single carrier frequency domain equalization (SC-FDE), OFDM, the cyclic prefix
Week 8	Single carrier frequency domain equalization (SC-FDE), OFDM, the cyclic prefix Comparison between SC-FDE and OFDM, carrier frequency offset estimation and channel estimation in OFDM
Week 9	Introduction to propagation, large-scale fading, link budgets, path loss

	Small-scale fading, coherence time, coherence bandwidth, Rayleigh fading
Week 10	Probability of error in fading channels, receive diversity, selection diversity and maximum ratio combining, probability of error with diversity Sources of diversity, Alamouti space-time code, transmit beamforming
Optional	Introduction to MIMO wireless communication, spatial multiplexing Receivers for spatial multiplexing, performance analysis Dealing with practical impairments in MIMO communication systems, channel estimation and synchronization Introduction to MIMO-OFDM, highlights of the IEEE 802.11n standard

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 1	Self-paced training of LabView on your own PC/Laptop. Lab0: LabVIEW (Lab starts from this week.)
Week 3	Lab1: Part 1 Introduction to NI LabVIEW Lab1: Part 2 Introduction to NI RF Hardware
Week 5	Lab 2: Part 1 Modulation and Detection Lab 2: Part 2 Pulse Shaping and Matched Filtering
Week 6	Catch-up Lab
Week 7	Lab 3: Synchronization
Week 8	Lab 4: Channel Estimation & Equalization
Week 9	Lab 5: Frame Detection & Frequency Offset Correction
Week 10	Lab 6: OFDM Modulation & Frequency Domain Equalization
Week 10 + Study Week	Lab 7: Synchronization in OFDM Systems Catch-up Labs
Optional	Lab 8: Channel Coding in OFDM Systems

View class timetable

Timetable

Date	Type	Content
Week 1: 12 September - 16 September	Lecture	Introduction to wireless communications and digital communications overview
	Laboratory	Self-paced training of LabView on your own PC/Laptop. Lab0: LabVIEW (Lab starts from this week.)

	Tutorial	Tute 1
	Reading	Lecture Notes Page 1-40 LabVIEW: Online Self-paced training from NI
Week 2: 19 September - 23 September	Assessment	**LabVIEW Test**
	Lecture	Review of signal processing fundamentals I: signals and stochastic processes, Fourier transforms, sampling theorem, discrete-time processing of continuous-time signals
	Laboratory	Self-paced training of LabView on your own PC/Laptop. Lab0: LabVIEW (Lab starts from this week.)
	Tutorial	Tute 2
	Reading	Lecture Notes Page 41-62 Lab Note: Lab 1, Prepare for Lab 1
Week 3: 26 September - 30 September	Lecture	Review of signal processing fundamentals II: frequency response of random signals, power spectrum, bandwidth, complex envelope notation, up/down conversion, complex baseband representation, complex baseband equivalent channel
	Laboratory	Lab1: Part 1 Introduction to NI LabVIEW Lab1: Part 2 Introduction to NI RF Hardware
	Tutorial	Tute 3
	Reading	Lecture Notes Page 61-107 Lab Note: Lab 1, Prepare for Lab 1
Week 4: 3 October - 7 October	Lecture	Quadrature pulse amplitude, modulation, PAM, QAM, transmit energy, transmit bandwidth, additive white Gaussian noise channels Optimal pulse shapes for AWGN, Nyquist pulse shapes, implementing optimal pulse shapes using multi-rate identities Maximum likelihood detection with additive white Gaussian noise, probability of error analysis, Sample timing offset, algorithms for sample timing

	Laboratory	Lab1: Part 1 Introduction to NI LabVIEW Lab1: Part 2 Introduction to NI RF Hardware
	Tutorial	Tute 4
	Reading	Lecture Notes Page 125-153 Lab Note: Lab 2, Prepare for Lab 2
Week 5: 10 October - 14 October	Assessment	**Mid-Term Test**
	Lecture	Narrowband frame synchronization, channel estimation, linear least squares estimation Frequency selective channels, least squares channel estimation, direct least squares equalizer estimation
	Laboratory	Lab 2: Part 1 Modulation and Detection Lab 2: Part 2 Pulse Shaping and Matched Filtering
	Tutorial	Tute 5
	Reading	Lecture Notes Page 167-179 Lab Note: Lab 3, Prepare for Lab 3
Week 6: 17 October - 21 October	Lecture	Revision
	Laboratory	Catch-up Lab
	Tutorial	
Week 7: 24 October - 28 October	Lecture	Frequency offset estimation and correction, requency domain equalization, DFT Single carrier frequency domain equalization (SC-FDE), OFDM, the cyclic prefix
	Laboratory	Lab 3: Synchronization
	Tutorial	Tute 6
	Reading	Lecture Notes Page 181-196 Lab Note: Lab 3, Prepare for Lab 4
Week 8: 31 October - 4 November	Lecture	Single carrier frequency domain equalization (SC-FDE), OFDM, the cyclic prefix Comparison between SC-FDE and OFDM, carrier frequency offset estimation and channel estimation in OFDM

	Laboratory	Lab 4: Channel Estimation & Equalization
	Tutorial	Tute 7
	Reading	Lecture Notes Page 197-229 Lab Note: Lab 4, Prepare for Lab 5
Week 9: 7 November - 11 November	Lecture	Introduction to propagation, large-scale fading, link budgets, path loss Small-scale fading, coherence time, coherence bandwidth, Rayleigh fading
	Laboratory	Lab 5: Frame Detection & Frequency Offset Correction
	Tutorial	Tute 8
	Reading	Lecture Notes Page 229-253 Lab Note: Lab 5, Prepare for Lab 6
Week 10: 14 November - 18 November	Lecture	Probability of error in fading channels, receive diversity, selection diversity and maximum ratio combining, probability of error with diversity Sources of diversity, Alamouti space-time code, transmit beamforming
	Laboratory	Lab 6: OFDM Modulation & Frequency Domain Equalization Lab 7: Synchronization in OFDM Systems
	Tutorial	Tute 9
	Reading	Lecture Notes Page 253-265 Lab Note: Lab 6 and Lab 7
Study Week: 21 November - 24 November	Tutorial	Optional: Tute 10
	Topic	OPTIONAL: Introduction to MIMO wireless communication, spatial multiplexing Receivers for spatial multiplexing, performance analysis Dealing with practical impairments in MIMO communication systems, channel estimation and synchronization Introduction to MIMO-OFDM, highlights of the IEEE 802.11n standard

	Laboratory	Catch-up Lab

Resources

Prescribed Resources

Textbooks

Textbook

- Andrew Goldsmith, Wireless communications, Cambridge University Press, 2005.

You may want to check the coverage of this text before purchasing, as some topics in the syllabus are not featured. Unfortunately there is no single text that covers all topics in a satisfactory depth. Additional references, listed below and at the end of some lecture note sets, will in combination provide complete coverage of the course. Lecture notes will be provided, however note that these do not treat each topic exhaustively and additional reading is required.

Reference books

- B. Vucetic and J. Yuan: *Space-time coding: John Wiley and Sons*, 2003.
- Simon Heykin and Michael Moher, “Modern Wireless Communications”, Pearson Prentice Hall, 2005.
- Gordon L. Stuber, Principles of Mobile Communication, Boston, MA: Kluwer Academic Publishers, 1996.
- Theodore S. Rappaport, Wireless Communications: Principles and Practice. Upper Saddle River, NJ: Prentice-Hall, 1996.

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 student email address).

Recommended Resources

Lecture Notes and Lab Notes will be provided to students.

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. 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.

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.engineering.unsw.edu.au/electrical-engineering/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

SDR@WCL

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	