TELE3113

Analogue and Digital Communications

Term 1, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Deepak Mishra	d.mishra@unsw.edu.au	Via Email & MS Teams	Room 417, EE Building G17	+61 (2) 9385 3860

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

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week term. The syllabus includes:

- Telecommunication Fundamentals: Free space propagation characteristics, Fourier transform, phasors, spectrum analysis, random signals.
- Analogue communications: Continuous wave modulation (AM, DSB, SSB, VSB, QAM, FM, and PM), complex envelope, receivers, error and noise analysis.
- Digital communications: Sampling, quantisation, baseband techniques (PAM, PWM, PPM, PCM, DM, and line coding), band-pass techniques (ASK, FSK, PSK, M-ary signalling), multiplexing techniques (FDM, TDM, and quadrature multiplexing), inter-symbol interference and eye diagrams, error and noise analysis.
- Communication Systems: Analogue and Digital PSTN, 5G Cellular Networks, Data Communication Networks, WiFi, Satellite Communication fundamentals.

Course Aims

TELE3113 is a main and pre-requisite course in telecommunications that introduces the fundamental concepts and techniques of both analogue and digital communications. This course aims to enable students to be familiar with fundamental concepts and issues, to develop a good understanding of basic analogue and digital communication techniques, and to perform a simple analysis and assessment of system performance.
From a system engineering perspective, we will find that the developments and advances of telecommunication technologies are closely related to those of electrical engineering and computer engineering. For students who undertake studies in fields other than telecommunications, this course will provide an in-depth overview of the fundamentals as well as modern techniques and systems in the telecommunication field.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Understand and apply both time and frequency domain representations of signals	PE1.1, PE1.2, PE2.2
2. Understand and explain analogue and digital modulation and demodulation techniques	PE1.1, PE1.2, PE1.3, PE2.1, PE2.2, PE2.3
3. Understand and be able to implement noise and error analysis of an analogue or digital telecommunication system	PE1.2, PE1.3, PE2.2, PE2.3

Teaching Strategies

Delivery Mode: The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal online lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- Online Tutorials which allow for exercises in problem-solving and allow time for you to resolve problems in understanding of lecture material;
- Laboratory sessions, face-to-face (F2F) and online both, which support the formal lecture material and provide you with practical construction, measurement and debugging skills;

Learning in this course: You are expected to attend all lectures, tutorials, labs, and mid-term exams 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. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW assumes that a self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

Lectures: The lectures provide the students with an explanation of the core materials in the course. There will be 4 hours of lectures per week, with corresponding lecture notes.

Tutorial classes: The tutorials enable students to apply various methods to quantitatively analyse the fundamentals of communication systems. You should attempt all of your problem sheet questions in advance of attending the tutorial classes. The importance of adequate preparation before each tutorial cannot be overemphasised, as the effectiveness and usefulness of the tutorial depend 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.

Laboratory program: The laboratories provide students with hands-on experience to analyse, design, and test communication systems. The laboratory experiments are concerned with modelling various signals on the one hand, and with carrying out different operations upon signals (e.g. filtering, sampling, demodulating) on the other. This approach intends to provide insights into the properties of, and relationships between, signals which are fundamental to communications engineering.
Students are expected to prepare for each of the laboratory experiments before coming into the lab. Every student is required to keep an individual record of all the experiments, preferably in the form of a bound book.

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

Relationship to Other Courses: This is a 3rd-year course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge: Pre-requisite for the course: ELEC2134.
It is essential that the students have shown competency in mathematics, electronics, signals and systems in Year 1 and Year 2. They are strongly advised to review previous ELEC2134 and MATH2099 courses materials.

Following Courses: TELE3113 is a pre-requisite for all professional electives offered for BE in Telecommunications. This course builds the ground for courses like TELE4651, TELE4652, and TELE4653

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the lab checkpoints (see lab manual), and the mid-term online exam. The concluding assessment will be based on an online final examination which is mandatory to be passed to pass the course.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Laboratory Practical Experiments	30%	25/04/2022 12:00 AM	1, 2, 3
2. Final Examination	50%	Not Applicable	1, 2, 3
3. Mid-term exam	20%	14/03/2022 11:00 AM	1, 2

Assessment 1: Laboratory Practical Experiments

Start date: 21/02/2022 12:00 AM
Due date: 25/04/2022 12:00 AM

At the end of each lab experiment, the student will be assessed by a lab demonstrator on the successful completion of the experiment and understanding of the experiment and results obtained. Students will be assessed individually

Assessment criteria

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 store.

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.

At the end of each lab experiment, the student will be assessed by a lab demonstrator on the understanding and successful completion of the experiment and the results obtained. Students will be assessed individually.

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 and your understanding of the topic covered by the lab.

Assessment 2: Final Examination

The exam in this course is a standard closed-book 2 hours written examination. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding

of the course material in a controlled fashion. Questions may be drawn from any aspect of the course, unless specifically indicated otherwise by the lecture staff.

Assessment criteria

The exam in this course is a standard online 2 hours written examination. University approved calculators are allowed. The examination tests analytical and critical thinking and a general understanding of the course 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. Please note that you must pass the final exam in order to pass the course.

Assessment 3: Mid-term exam

Start date: 14/03/2022 09:00 AM
Due date: 14/03/2022 11:00 AM

There will be a midterm exam conducted in week 5. The exact time will be announced later in the course newsletter which should be regularly checked by students

Assessment criteria

The mid-term 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 material already covered in the course schedule. 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.

Attendance Requirements

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

Course Schedule

The course consists of 4 hours of lectures, a 1-hour tutorial, and a 3-hour laboratory session per week (see laboratory schedule). The lectures begin in Week 1, the Tutorials in Week 2, and the Labs in Week 2. All the lectures and tutorials will be online, whereas the labs will be face-to-face but with the online option.

View class timetable

Timetable

Date	Type	Content
Week 1: 14 February - 18 February	Lecture	Lecture 1: Course overview, Fundamentals, Communication systems, Review: Fourier and Phasors. **Introduction to TIMS: 30mins Lab Tutorial (February 16th, Wednesday)**
Week 2: 21 February - 25 February	Lecture	Lecture 2: Amplitude modulation: AM, DSB-SC, QAM, SSB, VSB
	Tutorial	Tutorial 1: Fourier Domain Analysis and Phasor Diagrams (Part 1)
	Laboratory	Lab 1: Introduction to TIMS and MATLAB
Week 3: 28 February - 4 March	Lecture	Lecture 3: Angle modulation: PM, FM
	Tutorial	Tutorial 1: Fourier Domain Analysis and Phasor Diagrams (Part 2)
	Laboratory	Lab 2: Amplitude Modulation
Week 4: 7 March - 11 March	Lecture	Lecture 4: Noise in analogue communications and **Mid-term Revision**
	Tutorial	Tutorial 2: Amplitude Modulation (Part 1)
	Laboratory	Lab 3: Double and Single Sideband Modulation
Week 5: 14 March - 18 March	Lecture	**Mid-term exam (March 14th, Monday)** Lecture 5: Analogue to digital (I): Sampling & analogue pulse modulation (PAM, PWM, PPM)
	Tutorial	Tutorial 2: Amplitude Modulation (Part 2)
	Laboratory	Optional Catchup Lab & Revision Session

Week 6: 21 March - 25 March	-- Select --	Flexibility week
Week 7: 28 March - 1 April	Lecture	Lecture 7: Analogue to digital (II): Quantisation, encoding & digital pulse modulation (PCM, DM, DPCM)
	Tutorial	Tutorial 3: Angle Modulation and Noise in Analogue Communications
	Laboratory	Lab 4: Frequency Modulation
Week 8: 4 April - 8 April	Lecture	Lecture 8: Digital band-pass modulation and Multiplexing: ASK, FSK, PSK, M-ary signalling, TDM, FDM
	Tutorial	Tutorial 4: Baseband and Bandpass Digital Communications
	Laboratory	Lab 5: Sampling and Time Division Multiplexing
Week 9: 11 April - 15 April	Lecture	Lecture 9: Noise in Digital Communications, Inter-symbol Interference, and Source Coding
	Tutorial	Tutorial 5: Noise in Digital Communications and Source Coding
	Laboratory	Lab 6: Digital Signals: Eye Patterns and Line Codes
Week 10: 18 April - 22 April	Lecture	Lecture 10: Error Detection and Correction (Only on Wednesday, as Monday is a public holiday)
	Tutorial	Tutorial 6: Error Detection and Correction. **Discussion on Previous Year Final Exam Papers**
	Laboratory	Revision or Catchup of Lab Experiments

Resources

Prescribed Resources

Prescribed Textbook

- Simon Haykin and Michael Moher, An Introduction to Analog & Digital Communications, 2nd Ed., Wiley, 2007. Hardcopy: ISBN 978-0-470-46087-0; E-book: ISBN 978-0-470-46087-0

Online resources

- *Moodle*: As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.
- *Mailing list*: Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

Recommended Resources

Other useful reference books

- Bruce Carlson, Paul B. Crilly and Janet C. Rutledge, Communication Systems: An Introduction to Signals and Noise in Electrical Communications, 4th Edition, McGraw-Hill, 2002. Hardcopy: ISBN: 0-07-112175-7
- Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons, 2001.
- Nevio Benvenuto, Roberto Corvaja, Tomaso Erseghe, and Nicola Laurenti, Communication Systems: Fundamentals and Design Methods, John Wiley & Sons, 2006. Hardcopy: ISBN: 978-0-470-01822-4
- Leon W. Couch, Modern Communication Systems: Principles & Applications, Prentice-Hall, (P621.382/84), 1995
- B. P. Lathi, Modern Digital & Analog Communication Systems, 2nd Edition, Oxford University Press, (P621.380413/15J) 2009

Course Evaluation and Development

Continual Course Improvement: This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the online student survey myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods. Improvements and modifications made in the course in response to feedback the past couple of terms:

- The weightage of laboratory experiments based assessment has been increased from 20% to 30%.
- Course revision sessions have been included in the prior week for both the mid-term and final exams.
- Lectures and lab experiments have been fine-tuned by trimming down some less-significant contents.
- Precap to the lab experiment in the upcoming week will be provided in the Wednesday lecture.

- Lectures will have three 10mins feedback/query sessions for students after every 30mins of teaching.
- Slides and lecture contents have been made more interactive with more problem-solving exercises in tutorials

Laboratory Workshop Information

Tutorials will be conducted all online like lectures, whereas the labs will run in hybrid mode. Other than online labs, the physical lab experiments will e conducted in ElecEng 219 Telecomm Lab (K-G17-219).

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

Image Credit

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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	