



UNSW Course Outline

TELE3113 Analogue and Digital Communications - 2024

Published on the 16 Feb 2024

General Course Information

Course Code : TELE3113

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

Telecommunications traces its roots to ancient civilizations using visual signals. The advent of the telegraph in the 19th century marked a transformative milestone, paving the way for inventions like the telephone and the use of radio waves. Over time, continuous innovations,

including fibre optics and the internet, have shaped telecommunications into a vital component of global connectivity.

This course provides students with a foundational understanding of principles and techniques in transmitting and receiving information. Beginning with fundamental concepts such as signals, spectrum analysis by Fourier series and transform, and phasor representation, the course explores analogue communication, encompassing amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM). Related topics to AM include envelopes, sidebands (DSB-SC, SSB, VSB), detection and quadrature multiplexing. Students delve into the intricacies of analogue signal transmission, receivers, noise sources and modelling. They learn to analyze and design systems for conveying information effectively using continuous signals.

Shifting the focus to digital communications, the course covers topics such as analogue to digital conversion by sampling, quantisation, encoding, baseband pulse modulation (PAM, PWM, PPM, PCM, DM), and line coding. This is followed by digital passband modulation techniques (Binary and M-ary signalling ASK, PSK, FSK), multiplexing techniques (frequency/time division multiplexing (FDM/TDM), noise in digital systems, and intersymbol interferences. Furthermore, the fundamentals of channel coding and error detection and correction are covered and eventually, an entire communications system built using the techniques and schemes learnt throughout this course is reviewed through examples.

Through hands-on experiments in the laboratory, students gain proficiency in both analogue and digital communication systems, preparing them for taking more advanced courses such as TELE4651 - Wireless Communication Technologies, TELE4652 - Mobile and Satellite Communication Systems, and TELE4653 - Digital Modulation and Coding, to deepen their understanding and take careers in telecommunications, networking, and related fields.

Course Aims

As it is the first course on telecommunications, and it is a core course for students pursuing a B.E. degree in Electrical Engineering or Telecommunications, this course aims to provide basic knowledge on techniques employed in analogue and digital communications. By the course's conclusion, you should be able to:

- Acquire familiarity with the essential elements of analogue and digital communication systems,
- Implement analogue and digital modulation and multiplexing techniques,
- Understand signal sampling and quantisation concepts in analogue to digital conversion,
- Understand the impact of noise on signals in a communication system and the phenomenon

of intersymbol interference,

- Acquire familiarity with error detection and correction in digital communications and implement a simple channel coding scheme.

Relationship to Other Courses

This is a 3rd-year course offered in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge:

The pre-requisite for the course is 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 the relevant materials from previous courses, in particular, ELEC2134 (Transforms & Systems: Fourier Series and Transform) and MATH2099 (Probability and Statistics + Linear Algebra) courses.

Following Courses:

TELE3113 is a pre-requisite for all professional electives offered for BE in Telecommunications. This course builds the ground for courses such as TELE4651 (Wireless Communication Technologies), TELE4652 (Mobile and Satellite Communications Systems), and TELE4653 (Digital Modulation and Coding).

Course Learning Outcomes

| Course Learning Outcomes |
|--|
| CL01 : Apply both time and frequency domain representations of signals |
| CL02 : Explain analogue and digital modulation and demodulation techniques |
| CL03 : Implement noise and error analysis of an analogue or digital telecommunication system |

| Course Learning Outcomes | Assessment Item |
|--|--|
| CL01 : Apply both time and frequency domain representations of signals | <ul style="list-style-type: none">• Laboratory Practical Experiments• Mid-term exam• Final Examination |
| CL02 : Explain analogue and digital modulation and demodulation techniques | <ul style="list-style-type: none">• Laboratory Practical Experiments• Mid-term exam• Final Examination |
| CL03 : Implement noise and error analysis of an analogue or digital telecommunication system | <ul style="list-style-type: none">• Laboratory Practical Experiments• Mid-term exam• Final Examination |

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams | Echo 360

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 | 1 |
| PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing | | 1,3 |
| PE1.3 In-depth understanding of specialist bodies of knowledge | | 2, 3 |
| PE1.4 Discernment of knowledge development and research directions | | |
| PE1.5 Knowledge of engineering design practice | | |
| PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice | | |
| PE2: Engineering Application Ability | PE2.1 Application of established engineering methods to complex problem solving | 2, 3 |
| PE2.2 Fluent application of engineering techniques, tools and resources | | 2, 3 |
| PE2.3 Application of systematic engineering synthesis and design processes | | |
| PE2.4 Application of systematic approaches to the conduct and management of engineering projects | | |
| PE3: Professional and Personal Attributes | PE3.1 Ethical conduct and professional accountability | |
| PE3.2 Effective oral and written communication (professional and lay domains) | | |
| PE3.3 Creative, innovative and pro-active demeanour | | |
| PE3.4 Professional use and management of information | | |
| PE3.5 Orderly management of self, and professional conduct | | |
| PE3.6 Effective team membership and team leadership | | |

Assessments

Assessment Structure

| Assessment Item | Weight | Relevant Dates |
|---|--------|----------------|
| Laboratory Practical Experiments Assessment Format: Individual | 30% | |
| Mid-term exam Assessment Format: Individual | 20% | |
| Final Examination Assessment Format: Individual | 50% | |

Assessment Details

Laboratory Practical Experiments

Assessment Overview

Laboratory sessions are designed to apply students' understanding of the lecture material through experiments, wherein they record details in a laboratory notebook. Students performance will be assessed by a lab demonstrator based on the successful completion of experiments, the obtained results, comprehension, and the presentation of the laboratory notebook. While students usually work in groups of two, assessments will be conducted individually.

Course Learning Outcomes

- CL01 : Apply both time and frequency domain representations of signals
- CL02 : Explain analogue and digital modulation and demodulation techniques
- CL03 : Implement noise and error analysis of an analogue or digital telecommunication system

Mid-term exam

Assessment Overview

The mid-term examination is designed to evaluate your overall comprehension and analytical thinking regarding the course material. Questions may cover any of the course material already taught thus far. The exam comprises up to 3 mandatory questions and has a duration of one hour. Marks will be assigned according to the accuracy of the responses, either partially or in full. Verbal class-wide feedback will be given during lectures and individual feedback will also be provided upon request.

Course Learning Outcomes

- CL01 : Apply both time and frequency domain representations of signals

- CL02 : Explain analogue and digital modulation and demodulation techniques
- CL03 : Implement noise and error analysis of an analogue or digital telecommunication system

Final Examination

Assessment Overview

The examination for this course is a standard closed-book 2-hour written test, comprising up to 5 mandatory questions. University-approved calculators are allowed for use. This exam assesses analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may cover any aspect of the course unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the accuracy of the responses, either partially or in full.

Course Learning Outcomes

- CL01 : Apply both time and frequency domain representations of signals
- CL02 : Explain analogue and digital modulation and demodulation techniques
- CL03 : Implement noise and error analysis of an analogue or digital telecommunication system

General Assessment Information

The assessment structure in this course is designed to gauge your learning progress consistently throughout the term. Continuous assessment includes lab assessments and the mid-term exam. The final evaluation relies on the passing of the final examination to successfully complete the course.

Grading Basis

Standard

Requirements to pass course

To successfully complete the course, you must pass the final exam by achieving a minimum score of 50% out of 100%, which is equivalent to 25 marks out of 50. Additionally, you need to achieve a total of at least 50 marks, considering the sum of marks from all three assessment components.

Course Schedule

| Teaching Week/Module | Activity Type | Content |
|------------------------------------|---------------|---|
| Week 1 : 12 February - 18 February | Lecture | <ul style="list-style-type: none"> • Course overview, • Fundamentals of signals, and • Review of Fourier analysis and Phasors. |
| | Workshop | • Fourier Domain Analysis and Phasor Diagrams |
| Week 2 : 19 February - 25 February | Lecture | • Amplitude modulation: AM, DSB-SC, QAM, SSB, VSB |
| | Workshop | • Amplitude Modulation (Part 1) |
| | Laboratory | • Introduction to TIMS and MATLAB |
| Week 3 : 26 February - 3 March | Lecture | • Angle modulation: PM, FM |
| | Workshop | • Amplitude Modulation (Part 2) |
| | Laboratory | • Amplitude Modulation |
| Week 4 : 4 March - 10 March | Lecture | <ul style="list-style-type: none"> • Noise in analogue communications, and • Mid-term Revision |
| | Workshop | • Angle Modulation |
| | Laboratory | • Double and Single Sideband Modulation |
| Week 5 : 11 March - 17 March | Lecture | • Analogue to digital (I): Sampling & analogue pulse modulation (PAM, PWM, PPM) |
| | Workshop | • Noise in Analogue Communications |
| | Laboratory | <ul style="list-style-type: none"> • Optional Catchup Lab • Revision Session (Labs 1 - 3) |
| Week 7 : 25 March - 31 March | Lecture | <ul style="list-style-type: none"> • Analogue to digital (II): Quantisation, encoding, • Digital pulse modulation (PCM, DM, DPCM), and • Multiplexing (TDM, FDM, QM) |
| | Workshop | • Digital Baseband Communications |
| | Laboratory | • Frequency Modulation |
| Week 8 : 1 April - 7 April | Lecture | • Digital band-pass modulation: ASK, FSK, PSK, M-ary signalling |
| | Workshop | • Digital Bandpass Communications |
| | Laboratory | • Sampling and Time Division Multiplexing |
| Week 9 : 8 April - 14 April | Lecture | <ul style="list-style-type: none"> • Noise in Digital Communications, • Intersymbol Interference, and • Fundamentals of channel coding and error detection and correction |
| | Workshop | • Digital Bandpass Communications |
| | Laboratory | • Digital Signals: Eye Patterns and Line Codes |
| Week 10 : 15 April - 21 April | Lecture | <ul style="list-style-type: none"> • An entire communications system built using the techniques and schemes learnt throughout this course is reviewed through examples, and • Course revision, and • Revision of Past Year Exam Papers (I): Structure and topics |
| | Workshop | <ul style="list-style-type: none"> • Transmission and Noise in Digital Communications, and • Revision of Past Year Exam Papers (II): Sample questions |
| | Laboratory | <ul style="list-style-type: none"> • Optional Catchup Lab • Revision Session (4-6) |

Attendance Requirements

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

General Schedule Information

The course comprises two sessions of 2-hour lectures, a 1-hour tutorial, and a 3-hour laboratory session each week. Lectures and tutorials commence in Week 1, followed by lab sessions

starting from Week 2 (you will have in total 6 lab sessions in Weeks 2-4 followed by a catch-up session in Week 5, and Weeks 7-9 followed by a catch-up session in Week 10). All lectures, tutorials, and labs will be conducted in person (face-to-face), but recordings of lectures and tutorials will be accessible on Moodle. The following tables illustrate the topics covered in lectures and laboratory sessions.

Course 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 announcements, video recordings, and weekly 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

- B. P. Lathi and Zhi Ding, *Modern Digital and Analog Communication Systems*, 5th ed. New York: Oxford University Press, 2019.
- Rodger E. Ziemer and William H. Tranter, *Principles of Communications*, 7th ed. New York: John Wiley & Sons Incorporated, 2014.
- Leon W. Couch, *Modern Communication Systems*, N.J.; London: Prentice Hall International, 1995.

Course Evaluation and Development

Continual Course Improvement: This course is under constant revision to improve the learning outcomes for all students. Please share your feedback (positive or negative) on the course with the course convener. We have also an **Open Forum** on Moodle where you can anonymously post your technical questions, answers, and comments. An Open Forum is available on Moodle for anonymous discussions via posting technical questions, suggestions, and comments or answering them. You can also share your comments via the online student survey 'myExperience' in the second half of the term.

In response to valuable feedback received in the past and our commitment to delivering an enriching learning experience, we have consistently assessed and adjusted our delivery and assessment approaches. Key improvements made in recent terms include:

- Maintaining the weightage of laboratory experiments-based assessment (including pre-lab work) at 30%.
- Introduction of course revision sessions in the week preceding both mid-term and final exams.
- Fine-tuning of lectures and lab experiments by removing less significant content.
- Providing a preview of the upcoming week's lab experiment in the Friday lecture.
- Incorporating 10-minute feedback/query time for students after every 30 minutes of teaching in lectures.
- Enhancing slides and lecture contents with more interactive problem-solving exercises in tutorials.
- Provision of handwritten notes alongside lecture slides, both visible together on the screen.

Staff Details

| Position | Name | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|-------------------|------------------|-------|----------|-------|----------------------|-------------------------------------|-----------------|
| Convenor | Mohammad Rowshan | | | | Via Email & MS Teams | Yes | Yes |
| Lecturer | Mohammad Rowshan | | | | | No | No |
| Head demonstrator | Xinyi Gu | | | | Via Email | 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 policies. 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 Plagiarism

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](#)