

TELE3113

Analog & Digital Communications

Course Outline – Semester 2, 2015

Last update: 20 July

Never Stand Still

Faculty of Engineering

School of Electrical Engineering and Telecommunications

Course Staff

Course Convenor: **A/Prof. Wei Zhang**, Room 325, w.zhang@unsw.edu.au

Course Website: <http://moodle.telt.unsw.edu.au/course/view.php?id=15986>

Consultations Hour:

2pm-3pm Monday

Other Consultation Time: Available upon an appointment made and confirmed by email.

Contact Hours

The course consists of 3 hours of lectures, a 1-hour tutorial, and a 3-hour laboratory session each week. **Tutorial** starts in week **3** and **labs** start in week **4**.

	Day	Time	Location
Lecture	Tuesday	9:00– 11:00	Ainsworth Building G02
	Wednesday	12:00–13:00	Electrical Engineering G24
Tutorial	Monday	10:00 – 11:00	Electrical Engineering 225
Lab	The schedule of multiple Lab sessions are at: http://www.timetable.unsw.edu.au/current/TELE3113.html		

Course Aims

TELE3113 is the first course in telecommunication, introducing the fundamental concepts in both analogue and digital communications. It comprises analogue modulation (AM, DSB, SSB, QAM, FM and PM) and demodulation techniques, digital baseband modulation (PAM, PWM, PPM, PCM, DM and line coding) and passband modulation (M-ary signal, ASK, PSK, FSK, QPSK, QAM) techniques, multiplexing techniques, and, signal detection theory, information theory, and channel coding.

The course aims to assist students to be familiar with fundamentals of telecommunications, develop understanding of analogue and digital communication systems, and deduce and analyse the performance of a communication system.

Lecture Schedule

TELE3113 S2, 2015	Tuesday 9-11 am Wed 12-13 noon	Topics	Reference [1]
Week 1	28 July 29 July	Introduction	Chapter 1
Week 2	4 Aug 5 Aug	Fourier Analysis & Random Process	Chapters 2 & 8
Week 3	11 Aug 12 Aug	Amplitude Modulation	Chapter 3
Week 4	18 Aug 19 Aug	Angle Modulation	Chapter 4
Week 5	25 Aug 26 Aug	Pulse Modulation (1)	Chapter 5
Week 6	1 Sept 2 Sept	Pulse Modulation (2)	Chapter 5
Week 7	8 Sept 9 Sept	Baseband Data Transmission	Chapter 6
Week 8	15 Sept 16 Sept	Digital Band-pass Modulation	Chapter 7
Week 9	22 Sept 23 Sept	Detection Theory	Chapter 10
Mid semester break (September 26- October 5)			
Week 10	6 October 7 October	Detection in Digital Communications	Chapter 10
Week 11	13 October 14 October	Information Theory	[2]
Week 12	20 October 21 October	Channel Coding	[2]

[1] Simon Haykin and Michael Moher, *Introduction to Analog & Digital Communications*, Second Edition, John Wiley & Sons, 2006.

[2] John G. Proakis and Masoud Salehi, *Digital Communications*, 5th Ed., McGraw-Hill, 2008.

Assessment

- Laboratory work 20% (5 labs, 4 marks each)
- Assignments 20% (2 assignments, 10 marks each)
- Final Exam (3 Hours) 60%

Credits

- 6 Units of Credit (UoC) value for the course
- 10-12 hours of expected workload per week throughout the 13 week semester

Relationship to Other Courses

TELE3113 is a pre-requisite for all professional electives offered in the Telecommunication option. It assumes basic competency in the second year electronics and systems courses, and requires a mathematical ability of at least up to second year.

TELE3113 is the minimum pre-requisite for TELE4651 Wireless Communication Technologies, TELE4652 Mobile and Satellite Communication Systems, and TELE4653 Digital Modulation and Coding.

Assumed Knowledge: It is assumed that the student has a background in calculus, electronics, signals and systems, and probability theory. It is assumed that the student has basic knowledge of programming language such as MATLAB or C.

Following Courses

TELE4651 Wireless Communication Technologies
TELE4652 Mobile and Satellite Communication Systems
TELE4653 Digital Modulation and Coding

Learning Outcomes

After successful completion of this course, students should

1. be familiar with both time and frequency domain representations of signals;
2. be familiar with analogue/digital modulation and demodulation techniques;
3. be able to perform error performance analysis of a digital telecommunication system.

This course is designed to provide the above learning outcomes that arise from targeted graduate capabilities listed in **Appendix A**. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in **Appendix B**). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in **Appendix C**.

Teaching Strategies

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

- Formal face-to-face 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;

During the lecture, theories and other relevant information will be expounded by the lecturer. Core materials of the course will be elaborated with a variety of practical examples of communications systems. As the course emphasizes interactive learning, students are encouraged to ask questions and express feedback during the lectures.

The tutorial provides students in-depth quantitative understanding of analogue/digital modulation/demodulation techniques. Students will practise their problem-solving skills in the form of discussion and class exercises.

The laboratory work offers students hands-on experience in generating and detecting wireless data signals in various modulation formats, and thus helps students understand the core materials of the course.

Learning in this Course

You are expected to attend all lectures, tutorials, labs, and final exam in order to maximise learning. You must prepare well for your laboratory classes and your lab work will be assessed. In addition to the lecture notes, 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.

Assessments

Laboratory Assessments (20 marks):

- There are 5 laboratory experiments to complete in total from week 4 to week 13. All experiments will be performed on the TIMS systems, in part using the MATLAB interface.
- Students must attend the laboratory every fortnight at their allotted time. If students find they must miss a lab session for any reason (illness, family or work commitments), they are required to contact the lecturer and make alternative arrangements PRIOR TO the lab session in question. Students who have not done so will receive a mark of zero for the missed lab session – there will be no exceptions. Some lab periods may need to be rescheduled due to public holidays, and the announcement of alternative arrangements will be made during the lectures.
- Students must be marked off by a lab demonstrator at the end of each lab session and have their mark recorded by the demonstrator. It is the responsibility of the student to make sure this is done. If no mark is recorded at the end of the lab for whatever reason, a mark of zero will be given – once again, there will be no exceptions.
- Students are required to maintain a laboratory journal, and the marks obtained directly correspond to the quality of this journal. The journal should record all

equipment settings and connections, as well as any measurements and observations made. It is important for all engineers to accurately document all experimental work, and emphasis is placed on the lab journal in this course to ensure that students develop this important attribute of a professional engineer.

Assignments (20 marks):

- The assignment allows self-directed study leading to the solution of partly structured problems. Marks will be assigned according to how completely and correctly the problems have been addressed, the quality of the code written for the assignment (must be attached to the report), and the understanding of the course material demonstrated by the report.
- There are two assignments to complete in total. The details of the two assignments will be made available on the course website, in week 6 and 10, respectively. The assignments are to be submitted to the lecturer's email (w.zhang@unsw.edu.au) in PDF file with an email subject "**TELE3113 Assignment (student ID & name)**". Students must submit the assignments on or before the due date. Later submission will attract a penalty of 2 marks per day late (including weekends).

Final Exam (60 marks):

The final examination is a standard closed-book 3-hour written examination, held after week 13, comprising not more than seven compulsory questions. The final examination will test students' understanding of the course material and analytical skills. Assessment is a graded mark according the correct fraction of the answers to the exam questions.

Relationship of Assessment Methods to Learning Outcomes

Assessment	Learning outcomes		
	1	2	3
Laboratory assessments	✓	✓	-
Assignments	✓	✓	✓
Final exam	✓	✓	✓

Course References

❖ Prescribed textbooks

1. Simon Haykin and Michael Moher, [Introduction to Analog & Digital Communications](#), 2nd Ed, John Wiley & Sons, 2006.

❖ Reference books

2. John G. Proakis and Masoud Salehi, [Digital Communications](#), 5th Ed., McGraw-Hill, 2008.

3. Simon Haykin, [Communication Systems](#), 4th Ed, John Wiley & Sons, 2000.

On-line Resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials. 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).

Other Matters

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 <http://www.lc.unsw.edu.au/plagiarism>. To find out if you understand plagiarism correctly, try this short quiz: <https://student.unsw.edu.au/plagiarism-quiz>.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see <https://my.unsw.edu.au/student/atoz/ABC.html>), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to 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.

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.

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 should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult <https://my.unsw.edu.au/student/atoz/SpecialConsideration.html>.

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 Course and Teaching Evaluation and Improvement Process. 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.

Course Evaluation and Development

- Any feedback on the course to improve the quality of learning and teaching is appreciated. Please feel free to talk to your lecture staff about it.
- Students' feedback is gathered periodically on-class and such feedback will be considered carefully with a view to acting on it constructively wherever possible.
- The feedback is gathered using various means, including the Course and Teaching Evaluation and Improvement (CATEI) tool.

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:

<http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures>

<https://my.unsw.edu.au/student/atoz/ABC.html>

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;

- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through assignment work.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	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	✓
	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	
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	✓