

Unit Guide

ECE4042
Communications theory
Semester 2, 2017

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Unit handbook information

Synopsis

This unit will cover aspects of physical layer communications which are relevant to modern communication systems. Digital modulation techniques, including quadrature modulation and orthogonal frequency division multiplexing (OFDM) will be covered. The effects of noise on bit error rates will be covered, along with techniques to reduce them, including matched filtering and equalisation. Information theory covers questions of capacity, diversity, and error correction coding. Finally the use of multiple input multiple output (MIMO) communication systems will be covered.

Mode of delivery

Malaysia (Day)

Workload requirements

3 hours lectures and 3 hours laboratory and practice classes, and 6 hours of private study per week

Unit relationships

Prerequisites

ECE2041 or ECE2401

Prohibitions

ECE5042

Co-requisites

None

Chief Examiner(s)

[Professor Manos Varvarigos](#)

Unit Coordinator(s)

Name: Dr Yi Hong

Email: Yi.Hong@monash.edu

Campus Coordinator

Name: Ir Dr Joanne Lim Mun Yee

Email: Joanne.Lim@monash.edu

Building: 2, Room: 2-4-36

Consultation hours: Room 2-4-36 or email for an appointment

Lecturer(s)

Name: Ir Dr Joanne Lim Mun Yee

Email: Joanne.Lim@monash.edu

Building: 2, Room: 2-4-36

Academic Overview

Program Education Objectives

The Electrical and Computer Systems engineering discipline expects to produce graduates, who are:

1. competent in Electrical and Computer Systems engineering
2. responsible and effective global citizens
3. leaders in their chosen profession or society at large.

Program Outcomes

The Electrical and Computer Systems engineering discipline has developed a set of Program Outcomes (POs) for all of its graduates based on the competencies required by the Malaysian Engineering Accreditation Council.

Program Outcomes (POs)	Activities used in this unit to develop POs, achievement of Bloom's domains and complex problem solving
PO1 Electrical and Computer Systems Engineering Knowledge: Apply knowledge of mathematics, natural science, engineering fundamentals and specialisation in Electrical and Computer Systems engineering to the solution of complex engineering problems	Cognitive: Cognitive: Theoretical lecture material, prescribed texts and recommended reading, tutorial problems, laboratory experiments, assessments
PO2 Problem Analysis: Identify, formulate, survey research literature and analyse complex Electrical and Computer Systems engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences	Cognitive: Cognitive: Theoretical lecture material, prescribed texts and recommended reading, tutorial problems, laboratory experiments, assessments
PO3 Design/Development of Solutions: Design solutions for complex Electrical and Computer Systems engineering problems and design systems, components or processes that meet specified needs.	Cognitive: Psychomotor:
PO4 Research-based Investigation: Conduct investigations of complex Electrical and Computer Systems engineering problems using research-based knowledge and research methods including design of experiments, (analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Cognitive:
PO5 Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex Electrical and Computer Systems engineering problems, with an understanding of the limitations	Cognitive: Psychomotor: Cognitive: Theoretical lecture material, prescribed texts and recommended reading, tutorial problems, laboratory experiments

Program Outcomes (POs)	Activities used in this unit to develop POs, achievement of Bloom's domains and complex problem solving
PO6 Engineer and Society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex Electrical and Computer Systems engineering problems	Affective:
PO7 Environment and Sustainability: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex Electrical and Computer Systems engineering problems in environmental contexts.	Cognitive: Affective:
PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Affective:
PO9 Communication: Communicate effectively on complex Electrical and Computer Systems engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Affective:
PO10 Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings	Affective:
PO11 Lifelong Learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	Affective:
PO12 Project Management and Finance: Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to manage projects	Cognitive: Affective:

Teaching and learning method

The unit consists of lectures, laboratory and practice/tutorial classes. Learning in the unit is mainly through problem solving in practice/tutorial and laboratory classes and private study.

There is 1-hour of practice/tutorial and 2-hours of laboratory classes scheduled each week.

Monash aims to provide a learning environment in which students receive a range of ongoing

feedback throughout their studies. In this unit it will take the form of group feedback via practice classes, individual feedback, peer feedback, self-comparison, verbal and written feedback, discussions in class, as well as more formal feedback related to assignment marks and grades. Students/You are encouraged to draw on a variety of feedback to enhance their/your learning.

Learning outcomes

1. Knowledge of the fundamental limits of communication in noisy band limited channels
2. Knowledge of digital modulation techniques and the advantages and disadvantages of different techniques
3. Understanding of the properties of different communication channels and how channels can be modelled mathematically
4. Knowledge of the properties of modern error correcting codes
5. Understanding of how orthogonal frequency division multiplexing and multiple input multiple output (MIMO) multiple antenna systems can be used in modern communication systems and the advantages and limitations of their use
6. Understanding of the statistical nature of communication
7. Skills to design and simulate modern communication systems using industry standard simulation tools.

OBE requirements to learning outcomes (LOs)

1. Apply the properties of different communication channels, how channels can be modelled mathematically, and the properties of modern error correcting code in noisy communication band limited channels,. (LO1, LO3 and LO4 - Aus Campus)
2. Evaluate orthogonal frequency division multiplexing, multiple input multiple output (MIMO) for multiple antenna systems, digital modulation techniques in statistical nature of modern communication. (LO2, LO5 and LO6 – Aus Campus)
3. Develop skills to design and simulate modern communication systems using industry standard simulation tools. (LO7 – Aus Campus)

Relationship between Unit Learning Outcomes and Program Outcomes

Learning Outcomes (LOs) for Outcome Based Education (OBE) requirements	Handbook Learning Outcomes (LOs)
LO1 Apply the properties of different communication channels, how channels can be modelled mathematically, and the properties of modern error correcting code in noisy communication band limited channels.	LO1 Knowledge of the fundamental limits of communication in noisy band limited channels
	LO3 Understanding of the properties of different communication channels and how channels can be modelled mathematically
	LO4 Knowledge of the properties of modern error correcting codes

LO2 Evaluate orthogonal frequency division multiplexing, multiple input multiple output (MIMO) for multiple antenna systems, digital modulation techniques in statistical nature of modern communication	LO2 Knowledge of digital modulation techniques and the advantages and disadvantages of different techniques
	LO5 Understanding of how orthogonal frequency division multiplexing and multiple input multiple output (MIMO) multiple antenna systems can be used in modern communication systems and the advantages and limitations of their use
	LO6 Understanding of the statistical nature of communication
LO3 Develop skills to design and simulate modern communication systems using industry standard simulation tools.	LO7 Skills to design and simulate modern communication systems using industry standard simulation tools.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1	√											
LO2		√										
LO3					√							

Your feedback to us

One of the formal ways students have to provide feedback on teaching and their learning experience is through the Student Evaluation of Teaching and Units (SETU) survey. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied with and areas for improvement.

Previous student evaluations of this unit

In response to previous SETU results of this unit, the following changes have been made:

- Extra tutorial questions and a new set of lecture slides on Information Theory were introduced.

Student feedback has highlighted the following strength(s) in this unit:

The tutorials were helpful.

If you wish to view how previous students rated this unit, please go to:

<https://unitevaluations.connect.monash.edu.au/unitevaluations/index.jsp>

Unit schedule

Week	Lecture	Tutorial	Lab	Assignment activity
1	Course overview and revision on signal processing.	No tutorial	No lab	Prepare for Lab 1. Understand basic Matlab coding.
2	Probability and signal theory. Revision of basic baseband and sampling theory.	Tutorial 1	Lab 1	Ch1 and Ch2
3	M –ary waveforms Signal space representation ISI and Equalization	Tutorial 2	Lab 2	Ch3
4	Matched filter and error probability Maximum likelihood detection	Tutorial 3	Lab 3	Ch4
5	Coherent and noncoherent detection Channel coding waveforms and parity .	Tutorial 4	Lab 4	Ch5
6	Convolutional encoding and decoding.	Tutorial 5	Lab 5	Ch6
7	Channel coding - Maximum likelihood sequence decoding, hard and soft	Tutorial 6	Lab 6	Ch7
8	Shannon capacity	Tutorial 7	Lab 7	Ch8 Mid semester test (5 th September TBC)

9	Introduction to multiple access systems Spread spectrum overview, pseudo noise sequences Direct sequence and frequency hopping spread spectrum Commercial applications of CDMA	Tutorial 8	Lab 8	Ch9
Mid semester break				
10	Communications Link Analysis Error performance degradation	Tutorial 8	Assignment	Ch10 Assignment due in week 10 (2nd October TBC) Assignment Presentation TBC
11	Source coding for digital data Characterisation of fading channels Time and frequency coherence	Tutorial 9	Assignment	Ch11 Assignment Presentation TBC
12	Statistical Channel model Time, antenna and frequency diversity, Wideband systems Impact of channel uncertainty Cellular systems	Tutorial 9	Assignment	Ch11 Assignment Presentation TBC
SWOT VAC				
	Examination period	LINK to Assessment Policy: http://www.policy.monash.edu/policy-bank/academic/education/assessment/assessment-in-coursework-policy.html		

Assessment requirements

Assessment summary

Continuous assessment: 40%

Examination (2 hours): 60%

Students are required to achieve at least 45% in the total continuous assessment component (assignments, tests, mid-semester exams, laboratory reports) and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Assessment task	Value	Due date
Weekly laboratory class	20%	At the end of the scheduled lab session
Assignment	10%	Week 9 or 10
Mid-term examination	10%	Week 7
Final examination	60%	To be advised

Bloom's Taxonomy:

Three domains of educational activities have been identified under the general taxonomy known as Bloom's.

- **Cognitive:** mental skills (*Head*)
- **Affective:** growth in feelings or emotional areas (*Heart*)
- **Psychomotor:** manual or physical skills (*Hand*)

The *cognitive* domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills.

The *affective* domain includes the attitudes with which someone deals with things emotionally, such as feelings, values, appreciation, enthusiasms and motivations.

The *psychomotor* domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution.

Key for the LO-assessment relationship table above:

Cognitive

C1	C2	C3	C4	C5	C6
Knowledge: Remembers previously learned material	Comprehension: Grasps the meaning of material (lowest level of understanding)	Application: Uses learning in new and concrete situations (higher level of understanding)	Analysis: Understands both the content and structure of material	Synthesis: Formulates new structures from existing knowledge and skills	Evaluation: Judges the value of material for a given purpose

Psychomotor

P1	P2	P3	P4	P5	P6	P7
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Perception: Senses cues that guide motor activity	Set: Is mentally, emotionally and physically ready to act	Guided Response: Imitates and practices skills, often in discrete steps	Mechanism: Performs acts with increasing efficiency, confidence and proficiency	Complete Overt Response: Performs automatically	Adaption: Adapts skill sets to meet a problem situation	Organisation: Creates new patterns for specific situations
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Affective

A1	A2	A3	A4	A5
Receiving: Selectively attends to stimuli	Responding: Responds to stimuli	Valuing: Attaches value or worth to something	Organisation: Conceptualises the value and resolves conflict between it and other values	Internalising: Integrates the value into a value system that controls behaviour

Relationship between Assessments and OBE Learning Outcomes (LOs)

Assessment		Learning Outcomes								Open-ended Labs
		LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	
1	Lab	C6	C6	P3						
2	Mid Sem Test	C4	C4							
3	Assignment	C6	C6							
4	Final Examination	C6	C6							

Relationship between Assessments and Complex Problems /Activities

	Assessment	Complex Problems							Complex Activities				
		Depth of Knowledge	Range of Requirements	Depth of Analysis	Infrequent Issues	Extent of Codes	Stakeholder Involvement	Components or Sub-problems	Range of Resources	Level of Interactions	Innovation	Consequences to Society and	Unfamiliarity
1	Lab			1					1				
2	Mid-Sem test	1	1						1				
3	Assignment	1	1						1				
4	Final Examination	1	1						1				

Hurdle requirements

The unit coordinator reserves the right to moderate the assessments given by the individual tutors. This process will occur at the end of the semester.

To achieve an overall pass grade: (i) the overall mark must exceed 50% and (ii) a mark of at least 45% in both the total of "Continuous Assessments" (i.e., cumulated mark >13.5/30) and in the "Final Examination" (i.e. final exam mark >31.5/70).

Assessment tasks

Assessment title: Weekly laboratory class

Mode of delivery: Task completed in the Lab.

Details of task: Continuous assessment of laboratory performance based on experimental set up and debugging of circuits (Simulink); recording of simulated and measured data; analysis and synthesis of data and conclusions

Release dates (where applicable): Not applicable

Word limit (where applicable): Not applicable

Due date: At the end of the scheduled lab session

Value: 20%

Presentation requirements:

Hurdle requirements (where applicable):

Individual assessment in group tasks (where applicable): Not applicable

Criteria for marking: Refer to Moodle page.

Additional remarks: Not applicable.

Assessment title: Assignment

Mode of delivery: Students have to complete the assignment in groups and present orally in week 10 (TBC).

Details of task: Students will be given a title on communications theory. Students will be required to provide some preliminary literature review on the latest technology. Students are expected to show their understanding through oral presentation. Outline of the expected presentation and marking criterion will be provided.

Release dates (where applicable): Week 6 or 7

Word limit (where applicable): Not applicable

Due date: Week 9 or 10

Value: 10%

Presentation requirements: Refer to Moodle.

Hurdle requirements (where applicable): Not applicable

Individual assessment in group tasks (where applicable): Refer to Moodle.

Criteria for marking: Refer to Moodle.

Additional remarks: None

Assessment title: Mid-term examination

Mode of delivery:

Details of task: The mid-semester test will be held on 5th September (TBC). Time and classroom of the examination will be confirmed later.

Release dates (where applicable): Not applicable

Word limit (where applicable): Not applicable

Due date: Week 7

Value: 10%

Presentation requirements: Not applicable

Hurdle requirements (where applicable): 10%

Individual assessment in group tasks (where applicable): Not applicable

Criteria for marking: Not applicable

Additional remarks: Not applicable

Examination(s)

Exam title: Final examination

Weighting: 60%

Length: 2 hours

Type (Open/closed book): Closed book

Hurdle requirements (where applicable): Not applicable

Electronic devices allowed: See below

Remarks (where applicable): -

Calculators

A list of the Faculty of Engineering approved calculators and the process for obtaining a sticker is available online at:

<http://www.eng.monash.edu.au/current-students/calculators.html>

IMPORTANT: Only these listed calculators with the authorised Monash University-Science or Monash University-Engineering STICKER will be allowed into the examination by the invigilators.

Graphical calculators and programmable calculators are not permitted in exams.

APPROVED Scientific Calculators:

Caieion: FM-83

Canon: F720, F720i

Casio: fx-82, fx-83, fx-85, fx-100, fx-115, fx-350, fx-570, fx-911, fx-991 and fx-992 series

Citizen: SR-135, SR-260, SR-270, SR-275

Hewlett Packard: HP-6s, HP-8s, HP-9s, HP-10s, HP-30s

Texas instruments: TI-30 and TI-34 series

Texet: Albert 2, Albert 3, Albert 5

Sharp: EL-506, EL-509, EL-520 and EL-531WH series

IMPORTANT: Only these listed calculators with the authorised **“Monash University -Science” or “Monash University-Engineering” STICKER** will be allowed into the examination by the invigilators.

The sticker will be available from the Faculty office ground floor building 72. You must bring your calculator with you to the Faculty office at any time during the semester to receive a sticker. We recommend you do this well in advance of the exam.

Extensions and penalties

Due dates and extensions

The due dates for the submission of assignments are given in the previous section. Please make every effort to submit work by the due dates. Students are advised to NOT assume that granting of an extension is a matter of course.

If you need an extension for any of the assignments, you must submit a written request 48-hours *before* the due time and date, and attach supportive evidence such as medical certificate.

The form should preferably be forwarded as an email attachment, sent to the unit coordinator. The email should be sent from your University email address with your name typed in lieu of signature.

Note that other lecturers cannot grant extensions. Lecturer-in-charge (unit coordinator) will indicate at the time of granting the extension whether any penalty in marks will apply to the submitted work.

If an extension is granted, the approval must be attached to the assignment.

Late assignment

If you are late in applying for an extension or you don't have a good reason, you should still submit the work, but 10% of the total marks available for that assessment component will usually be deducted for each day late.

No assignment will be accepted once an assignment has been returned to the class.

Deferred tests and examinations may be granted in cases of extenuating personal circumstances such as serious personal illness or bereavement.

Remember, you are required to keep an up-to-date copy of all submitted assignments to safeguard against the loss of work through accident or error.

Returning assignments

Return dates

Students can expect assignments to be returned within two weeks of the submission date or after receipt, whichever is later.

Assessment for the unit as a whole is in accordance with the provisions of the Monash University Education Policy at:

<http://www.policy.monash.edu/policybank/academic/education/assessment/index.html>

Feedback on assignment will be provided on the unit's website.

Resubmission of assignments

Resubmissions are not allowed.

Plagiarism and collusion

Intentional plagiarism or collusion amounts to cheating under Part 7 of the Monash University (Council) Regulations.

Plagiarism: Plagiarism means taking and using another person's ideas or manner of expressing them and passing them off as one's own. For example, by failing to give appropriate acknowledgement. The material used can be from any source (staff, students or the internet, published and unpublished works).

Collusion: Collusion means unauthorised collaboration with another person on assessable written, oral or practical work and includes paying another person to complete all or part of the work. Where there are reasonable grounds for believing that intentional plagiarism or collusion has occurred, this will be reported to the Associate Dean (Education) or delegate,

Referencing requirements

Refer to the assignment handouts and the unit website for referencing requirements.

To build your skills in citing and referencing, and using different referencing styles, see the online tutorial Academic Integrity: Demystifying Citing and Referencing at <http://www.lib.monash.edu.au/tutorials/citing/>

Assignment submission

Hard Copy Submission:

Assignments must include a cover sheet. The coversheet is accessible via the Monash portal page located at <http://my.monash.edu.au> under the heading 'Learning and teaching tools'. Please keep a copy of tasks completed for your records.

Online Submission: If Electronic Submission has been approved for your unit, please submit your work via the Moodle site or other; as directed by your demonstrator for this unit.

Please keep a copy of tasks completed for your records.

If Electronic Submission has been approved for your unit, use Moodle for submission.

Remember that, just as for hard copy submissions, you should arrange your study /workload so as to allow plenty of time for last minute hitches. Computer problems/ busy servers will NOT be an

excuse for an extension. Do not leave electronic submission of your assignment to the last minute.

Assignment coversheet

All assignments need to be submitted with a coversheet.

The Faculty assessment coversheet is accessible on the Faculty website under Current Students, Undergraduate and Graduate Coursework Students, Assessment, exams and results at:

<http://www.eng.monash.edu.au/current-students/download/assessment-coversheet.pdf>

Feedback to you

The assessment methods in this unit have been designed to deliver accurate feedback as soon as possible to facilitate effective learning process. Please make the best use of the feedback mechanism by clarifying and asking more questions when the feedback are given.

- Laboratory sessions: Tutors are available to answer your questions. Comments given to you at the end of the laboratory session are meant to help you shape a better understanding of the topic and improve the quality of your laboratory assignments. Further queries may be raised during the tutorial sessions for clarification.
- Tutorial: Work solutions are available. The lecturer/tutor will explain in detail upon request during the tutorial sessions.
- Mid-semester test: One of the most important feedback mechanism preparing you for the final examination and identify current weakness in understanding. Pay attention to the discussion/review session after the test.
- All written works submitted for assessment will be returned within 2 weeks of submission.

Learning resources

Recommended textbooks

- Bernard Sklar, Digital Communications: Fundamentals and Applications, Second Edition, Prentice Hall, 2001.
- David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005.

Study resources

Available through the unit website.

Monash Library Unit Reading List (if applicable to the unit):

<http://readinglists.lib.monash.edu/index.html>

Required resources

Students generally must be able to complete the requirements of their course without the imposition of fees that are additional to the student contribution amount or tuition fees. However, students may be charged certain incidental fees or be expected to make certain purchases to support their study. For more information about this, go to Administrative Information for Higher Education Providers: Student Support, Chapter 21, Incidental Fees at: <http://www.innovation.gov.au/HigherEducation/TertiaryEducation/ResourcesAndPublications/Pages/default.aspx>

Other information

Policies

Monash has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and to provide advice on how they might uphold them. You can find Monash's Education Policies at:

<http://www.policy.monash.edu/policy-bank/academic/education/index.html>

Graduate Attributes Policy

<http://www.monash.edu/policy-bank/academic/education/course-governance-and-design/course-design-policy>

Student Charter

<http://www.monash.edu/students/policies/student-charter.html>

Student Services

The University provides many different kinds of services to help you gain the most from your studies. Contact your tutor if you need advice and see the range of services available at:

<http://www.monash.edu.my/Student-services/>

Monash University Library

The Library and Learning Commons, Monash University Malaysia Campus, provides a range of services and resources that enable you to save time and be more effective in your learning and research.

Go to <http://www.lib.monash.edu.my> or the library tab in my.monash portal for more information.

Disability Support Services

Students who have a disability, ongoing medical or mental health condition are welcome to contact Disability Support Services.

Disability Support Services also support students who are carers of a person who is aged and frail or has a disability, medical condition or mental health condition.

Disability Advisers visit all Victorian campuses on a regular basis.

- Website: monash.edu/disability
- For information and referral, telephone: Student Adviser, Student Community Services at 03 55146018
- Drop In: Student Community Services Department, Level 2 Building 2, Monash University Malaysia Campus
- Email: disabilitysupportservices@monash.edu (Disability Support Services, Monash University Australia)

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