School of Electrical Engineering and Telecommunications

Term 1, 2020
Course Outline

ELEC3104: Digital Signal Processing (interactive online delivery)

Course Staff

Course Conveners: Dr Zhaocheng Huang zhaocheng.huang@unsw.edu.au
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Online Tutors: Benjamin Close b.close@unsw.edu.au
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Consultations: All course and lab related emails should be directed to Dr Zhaocheng Huang in the first instance. Online group discussion with tutors for 2 hour/week will be available from week 2 onwards. **ALL email enquiries should be made from your student email address with ELEC3104 in the subject line**; otherwise they will not be answered.

Keeping Informed: Announcements may be made 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.

Course Summary

Contact Hours

This course consists of the following delivery options:

- 2 hours of lectures, 2 hours of group tutorials and 2 hours laboratory session each week, **face-to-face, OR**
- All classes **online, OR**
- A **combination** of the above

These optional face-to-face hours are supplemented by pre-recorded lectures and pre-recorded tutorial problem solutions, which can be downloaded online from Moodle.

	Day	Time	Location	Name
Lectures	Thursday	6 pm – 8 pm	Rex Vowels Theatre	Dr Zhaocheng Huang Prof E. Ambikairajah
Group tutorials	Monday	12 noon- 2 pm	ChemicalSc M17	Course Conveners and Tut-lab Demonstrators
Labs (W2 – W10)	Tuesday Tuesday Thursday	10 am – 12 noon 12 noon – 2 pm 3 pm – 5 pm	ElecEng108 Interactive Lab	Tut-Lab Demonstrators
Online Discussion and Consultation (W2 – W10)	Tuesday & Friday	6 pm – 8 pm	Moodle	Online Tutors

Context and Aims

Signal Processing is the process of measuring, manipulating and analysing real-world signals. ELEC3104 Digital Signal Processing is an introductory course which takes students through the fundamentals of discrete time signal and systems theory.

Aims

The course aims to equip students with:

- An understanding of the time and frequency domain representations of signals and systems.
- The skills to identify the correct type of filter required for a given problem and to demonstrate the design and implementation of a digital filter.
- An understanding of multi-rate processing and multi-rate systems.

Indicative Course Schedule

	Topic
Week 1	Signals and Systems (Chapter 1a & 1b video lectures); [LO: 1, 2]
Week 2	DSP Fundamentals (Chapter 2a, 2b, 2c, 2d & 2e video lectures); [LO: 1, 2]
Week 3	Discrete-Time Systems (Chapter 3a & 3b video lectures); [LO: 1, 2]
Week 4	Introduction to z-Transform (Chapter 4a & 4b video lectures); [LO: 1, 2]
Week 5	Introduction to Digital Filters (Chapter 5a, 5b & 5c video lectures); [LO: 1, 2]
Week 6	Class Exam 1 (Thursday, 26 March 2020, 6 pm - 8 pm, Rex Vowels Theatre, *must be* ***face-to-face***); Release of the Mini-project
Week 7	Discrete-Time Fourier Transform (Chapter 6 video lectures); [LO: 1, 2]
Week 8	Analog Filters (Chapter 7 video lectures) & Digital Filter Design (Chapter 8a & 8b video lectures); [LO: 1, 2, 3]
Week 9	Digital Filter Design (Chapter 8c & 8d video lectures); [LO: 1, 2, 3]
Week 10	Multirate DSP (Chapter 9 video lectures); [LO: 1, 2, 3, 4]
Week 11	Class Exam 2 (Monday, 27 April 2020, 6 pm - 8 pm, Sir John Clancy Auditorium, *must be* ***face-to-face***) Mini-Project Assessment (Tuesday, 28 April 2020, *must be* ***face-to-face***)

Assessment

Exam 1 (Chapters 1 to 5) (1 hour and 30 minutes) – closed book exam	30 marks
Exam 2 (Chapters 6 to 9) (1 hour and 30 minutes) – closed book exam	30 marks
Mini-Project (Part A [20 marks] + Part B [10 marks] + *Mini-Project Progress Report [4 marks])	34 marks
**Reflection Sheets (Weeks 3, 5, 8, 10) [4 x 4 marks]	16 marks

The total marks for this course add up to 110. Your final course mark will be capped at 100.

* At the conclusion of week 9, you must submit a Mini-Project progress report (sample available on Moodle) that should be uploaded on your course Moodle by **Friday, 5 pm (week 8)**.

At the conclusion of *weeks 3, 5, 8 & 10*, you must reflect on the content that you have learnt via the production of reflection sheets (sample attached) that should be uploaded on your course Moodle by **Friday, 5 pm. Reflection sheet format is available on your course Moodle site.

Note: After submission of the reflection sheet, online tutors may contact you through Blackboard Collaborate Ultra to discuss your reflection sheet.

Course Details

Credits

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

Relationship to Other Courses

This is a 3rd year course in the School of Electrical Engineering and Telecommunications at the University of New South Wales. It is a core course for students following a BE (Electrical) or (Telecommunications) program and other combined degree programs, and an elective for Computer Engineering students.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC2134, Circuits and Signals. It is essential that students are familiar with basic circuit theory, signal analysis and transform methods. It is further assumed that students are familiar with the MATLAB environment, and have good computer literacy.

Note: MATLAB Tutorial Videos: **http://eemedia.ee.unsw.edu.au/MatlabTutorial/index.htm**

Subsequent Courses

The course is a pre-requisite for all professional electives in the Signal Processing group, including ELEC4621 Advanced Digital Signal Processing and ELEC4622 Multimedia Signal Processing.

Learning outcomes

At the end of the course students should be able to:

1. Analyse linear time-invariant systems
2. Demonstrate competency in time and frequency domain analysis of signals and systems including transform methods
3. Design and analyse digital filters for a given specification
4. Implement a simple multi-rate system

This course addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix A***.

Syllabus

Processing and analysis of continuous (analogue) and discrete-time (digital) signals. Sampling continuous signals: the sampling theorem, reconstruction, aliasing and the z-transform. Filter impulse and frequency responses, stability and digital oscillators. The Discrete Fourier Transform (DFT). Fundamentals of the design and realisation of finite impulse response (FIR) and infinite impulse response (IIR) digital filters. Linear and non-linear phase filters. Decimation, interpolation, multi-rate digital signal processing.

Teaching Strategies

Delivery Mode

The entire course will be delivered via online lectures (recorded lectures will be available) in addition to **optional** face-to-face lectures and online discussions with tutors.

Learning in this course

1. You are expected to learn from all online lectures every week and additionally you may attend optional face-to-face classes (lectures/tutorials/labs).
2. During weeks 3, 5, 8 & 10, you must reflect on the content that you have learnt via the production of a weekly reflection sheet.
3. At the conclusion of week 8, you must submit a Mini-Project progress Report
4. You must attend all the class exams and mini-project assessments.
5. Reading additional texts will further enhance your learning experience.
6. For an online course such as this, it is *vital* that you undertake adequate self-directed study every week during the term.

Mini-project

The mini-project (assessed in week 11) is designed to provide a hands-on exposure to the applications of the concepts learnt in the course in implementing a DSP system. You are strongly encouraged to discuss your mini-project implementation with your Lab tutors to complement your self-directed learning. The mini-project (individual) will be released on **Friday, 27th of March, 2020**.

Requirements to pass the course

A satisfactory performance (50% or greater) overall in the course, and in **each** of the following, is a necessary requirement to pass this course:

- Mini-Project Part A (Individual)
- At least one class exam (week 6 and 11)

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through reflections, class exams (Weeks 6 and 11), and the mini-project assessment in week 11.

Reflection Sheets (16 marks)

There is a total of 4 reflection sheets worth 4 marks each that should be uploaded on your course Moodle by Friday, 5 pm (weeks 3, 5, 8 & 10).

Class Written Exams (2 x 30 marks) – closed book exam

There are 2 class exams, both face-to-face, one in Week 6 and one in Week 11. Each exam will be 90 mins long. **You must pass at least one of the class exams to pass the course.**

Mini-Project (20 marks + 10 marks + 4 marks)

The mini-project (individual) will be released in week 6 and you are expected to complete it by the end of week 10. This mini-project must be completed individually. The mini-project will comprise three parts (Part A and Part B and mini-project progress report). Both parts A & B will be assessed in Week 11 by the lab tutors. Part A is worth 20 marks and **you must pass part A to pass the course**. Part B is an extension worth 10 marks, and the mini-project progress report is worth 4 marks.

Relationship of Assessment Methods to Learning Outcomes

	Learning Outcomes			
Assessment	**1**	**2**	**3**	**4**
Class Exam 1 (30 marks)	✓	✓	-	-
Class Exam 2 (30 marks)	✓	✓	✓	✓
Mini-Project (Part A [20 marks] + Part B [10 marks]) + Mini-Project Progress report [4 marks]	✓	✓	✓	✓
Reflection Sheets (Weeks 3, 5, 8, 10) (16 marks)	✓	✓	✓	✓

Course Resources

Reference books

- A. V. Oppenheim, R. W. Schafer, & P. Buck, Discrete-Time Signal Processing, Prentice-Hall, 2010.
- S. K. Mitra, Digital Signal Processing, McGraw-Hill, 2011.
- J. Proakis & D. Manolakis, Digital Signal Processing, Prentice-Hall, 2007.
- A. Antoniou, Digital Signal Processing – Signals, Systems and Filters, McGraw-Hill, 2016

On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

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 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.

Student Responsibilities and Conduct

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

Workload

It is expected that you will spend at least **twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including online discussions, face-to-face tutorial-labs 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 this online study with employment and other activities.

Attendance and Online Participation

Weekly participation in online discussion with the assigned tutor is vital for this course. If you do not participate in the weekly discussion you may be removed from this course.

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. As of Term 1 2020, assessment of applications for Special Consideration will be managed centrally and the University has introduced a “fit to sit/submit” rule. You will no longer be required to take your original documentation to The Nucleus for verification. Instead, UNSW will conduct source checks on documentation for verification purposes. 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. If you sit an exam or submit an assignment, you are declaring yourself well enough to do so.

Continual Course Improvement

This course is being offered in both face-to-face and online delivery modes, and your feedback is valuable to improve the course. Please forward any feedback (positive or negative) on the course to the course convener or via the myExperience process.

In recent years, the course has been modified based on student feedback in the following ways: (i) online support from tutors has been increased, (ii) a miniproject has been introduced to allow the application of DSP theory to practical design problems, (iii) the course has undergone a Digital Uplift, to introduce new animations, interactive visualisations and interactive problem-solving for self-learning, and (iv) reflection sheets have been introduced to encourage self-learning skills.

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: Engineers Australia (EA) Professional Engineer Stage 1 Competency

Program Intended Learning Outcomes
1. Knowledge and skill base **Analytical skills**, **understanding of fundamental theory**, specialist and in-depth electrical engineering knowledge, **lifelong independent learning** and research skills
2. Engineering application ability **Complex problem-solving skills**, **effective application of electrical engineering techniques**, **critical thinking**, **design skills**, project management, application of environmentally sustainable practice
3. Professional and personal attributes **Communication skills**, **professional ethics**, team building and **interpersonal skills**, **creativity** and entrepreneurship, leadership skills, safe engineering practice

Those **bold** skills and competencies listed above are addressed by this course.

School of Electrical Engineering and Telecommunications

ELEC3104 Digital Signal Processing (Guided Online Delivery) – T1, 2020

Student Reflection Sheet (**Handwritten and one page ONLY**)

Name: **zID:** **Week:**

1. Please provide a list of DSP related concepts you learnt during week 1 to 3/week 4 & 5/week 7 & 8/week 9 & 10:

2. Please reflect on everything related to DSP that you learnt this week and write a short summary of what you think you learnt well (and what skills it led to) and what you think you did not learn well.

3. Please rate how well you think you acquired the following skills this week (as a score out of 100):

Program Intended Learning Outcomes (Engineers Australia Stage 1 Competency)	**Learning contribution to skill (out of 100)**
1. Knowledge and skill base Analytical skills, understanding of fundamental theory, and lifelong independent learning	
2. Engineering application ability Complex problem-solving skills, effective application of electrical engineering techniques, critical thinking, and design skills	
3. Professional and personal attributes Communication skills, professional ethics, interpersonal skills, and creativity	

4. Did you spend the stipulated 12-15 hours studying for this course? If not, why? And what extra support do you need to reach this 12-15 hours?