UNSW Course Outline

ELEC3104 Digital Signal Processing - 2024

Published on the 25 Aug 2024

General Course Information

Course Code : ELEC3104
Year : 2024
Term : Term 3
Teaching Period : T3
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

The modification of signals and the extraction of information from them plays a key role in almost all modern systems, i.e., the signals are represented and manipulated digitally as sequences of numbers. Think about what this means in the context of commonly used devices

such as smartphones – everything from reducing background noise during phone calls, to playing music, to recording videos and to AI-based recommendations are all examples of signal processing systems and all of them are ultimately implemented in terms of additions, multiplications and comparisons of numbers! Understanding the fundamentals of how mathematical manipulation of sequences of numbers relate to understanding and modifying signals is the first step in designing these sorts of systems. This course will introduce you to these concepts.

The syllabus includes the following topics: 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.

Course Aims

This is a core course that develops foundational knowledge in digital signal processing. It builds on the understanding of linear system theory acquired in circuits and signals and provides the prerequisite knowledge necessary to undertake courses in advanced digital signal processing, multimedia signal processing, data science, etc.

The course aims to equip students with:

1. An understanding of the time and frequency domain representations of signals and systems.
2. 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.
3. An understanding of multi-rate processing and multi-rate systems.

Relationship to Other Courses

This is a L3 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.

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.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Analyse linear time-invariant systems
CLO2 : Demonstrate competency in time and frequency domain analysis of signals and systems including transform methods
CLO3 : Design and analyse digital filters for a given specification
CLO4 : Implement a simple multi-rate system

Course Learning Outcomes	Assessment Item
CLO1 : Analyse linear time-invariant systems	• Progress Test • Project • Final Exam
CLO2 : Demonstrate competency in time and frequency domain analysis of signals and systems including transform methods	• Progress Test • Project • Final Exam
CLO3 : Design and analyse digital filters for a given specification	• Project • Final Exam
CLO4 : Implement a simple multi-rate system	• Project • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Tiered Learning Taxonomy (TLT) Framework

- Tiered Learning Taxonomy (TLT) is a self-driven learning framework for analysing students' depth of knowledge or for measuring how well a student understands a topic.
- TLT divides the learning curve within the course into 5 Hierarchical levels of increasing complexity in student's understanding of topics studied.

Why does this matter to you?

- The taxonomy encourages students to think about which level they are currently at with their learning, and what they need to do in order to progress to the next level.
- Within this TLT framework, students have more control and choice over how much they want to learn and deepen their knowledge.
- The TLT framework has been designed to include Pass, Credit, Distinction and High Distinction levels to help students understand the different levels (Levels 0 to 5) on the learning curve, and what they need to do to progress.
- If you are happy with your current level of learning and don't want to deepen your knowledge to progress to the next level, that is entirely your choice. At an absolute baseline, all students must achieve a Pass level (i.e. be at Level 2) as a total final mark (≥50%) at completion of the course, if you want to pass the course.
- The Course is designed to provide an increasing complexity from Pass (Level 2) to High Distinction (Level 5) levels as shown on the Taxonomy Framework diagram below.
- All **Tutorial questions** will be levelled as per the TLT for this course. You must do Level 2 (Pass) questions as a baseline. If you choose to attempt any other questions in the tutorial beyond Level 2, please complete other questions in sequential order (i.e. attempt Level 3 first, before doing Level 4 etc)

Different Stages of the TLT Framework

- **Level 0:** The students don't have any understanding about the topic, but have the pre-requisite knowledge to commence this course.
- **Level 1:** Very basic understanding, where their knowledge accrues in greater quantity. They understand all of the concepts.
- **Level 2:** Students know all the concepts and are able to link many of the concepts to each other.
- **Levels 3, 4 & 5:** All concepts known, and additionally there is a deep understanding that comes with a qualitative change in how the concepts are understood. They are able to connect the concepts in multiple ways. Surface knowledge (Levels 1 & 2) is required as a baseline, in order to develop deep knowledge

Other Professional Outcomes

Relationship to Engineers Australia Stage 1 competencies:

The Course Learning Outcomes (LOs) contribute to the Engineers Australia (National Accreditation Body) Stage I competencies as outlined below

Engineers Australia (EA), Professional Engineer Stage 1 Competencies

PE1: Knowledge and Skill Base:

PE1.1 Comprehensive, theory-based **understanding of underpinning fundamentals**: LO 1, 2

PE1.2 Conceptual understanding of underpinning maths, **analysis**, statistics, **computing**: LO 1, 2

PE1.3 In-depth understanding of specialist bodies of **knowledge**: LO 2, 3, 4

PE1.4 Discernment of knowledge development and research directions: NA
PE1.5 Knowledge of **engineering design** practice: LO 3, 4
PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice: NA

PE2: Engineering Application Ability:
PE2.1 Application of established engineering methods to **complex problem solving**: LO 2, 3, 4
PE2.2 Fluent **application of engineering techniques**, tools and resources: LO 1, 2, 3, 4
PE2.3 Application of systematic engineering synthesis and design processes: NA
PE2.4 Application of systematic approaches to the conduct and management of engineering projects: NA

PE3: Professional and Personal Attributes:
PE3.1 Ethical conduct and professional accountability: LO 4
PE3.2 Effective **oral and written communication** (professional and lay domains): LO 4
PE3.3 **Creative, innovative** and pro-active demeanour: LO 3, 4
PE3.4 Professional use and management of information: NA
PE3.5 Orderly management of **self, and professional conduct**: LO 4
PE3.6 Effective team membership and team leadership: NA

This course is also designed to provide the course learning outcomes which arise from targeted graduate capabilities. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (also listed below).

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

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 independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
- Developing citizens who can apply their discipline in other contexts, are culturally aware and environmentally responsible, through interdisciplinary tasks, seminars and group activities

Additional Course Information

Learning in this course:

1. You are expected to learn from all lectures every week and participate in the weekly compulsory labs with allocated lab demonstrators.
2. **Student Commitment:** A minimum of 15 hours per week, including self-study, is required to successfully complete all assessments
3. You must prepare well for your weekly MATLAB coding laboratory discussion with the demonstrators
4. Each week, you must reflect on the content that you have learnt from the topics that have been taught in the lectures.
5. You must attend all the labs, quizzes, mini-project sessions, assessments and exams.
6. Reading additional textbooks will further enhance your learning experience.
7. Group learning is also encouraged (each lab group will have 16 students per lab demonstrator).
8. For a primarily face-to-face course such as this course, it is *vital* that you undertake adequate self-directed study every week during the term. The Tiered Learning Taxonomy (TLT) - A self-

driven learning framework which is presented below will help guide you on this.

Course Design: The course has been re-designed in 2021 based on the Tiered Learning Taxonomy (TLT), a self-driven learning framework Tutorials, mini-projects, and final exams are all based on TLT principle.

Workload: It is expected that you will spend at least **fifteen hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including online discussions, online 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.

Weekly Laboratory classes:

The laboratory program is an important aspect of this course and will **commence in Week 1**. Through the laboratory component, you will progressively encounter the elements of the syllabus. The laboratory sessions are designed to help you develop your practical skills using MATLAB. The aim of the laboratory component is to apply the analytical subject material in practical scenarios, where the skills and knowledge you learn throughout the course will be used in real engineering design work.

Laboratory Exemption:

There are no laboratory exemptions for this online course. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled must participate in the labs, quizzes, mini-project etc. If for medical reasons, you are unable to attend a lab, please contact your assigned demonstrator and provide a valid medical certificate.

Protocol for Consultations:

- If you have any questions, you can ask your laboratory demonstrator(s) to answer any technical or administrative questions during the allocated laboratory times or via email. Alternatively, students may also send their questions via email the head lab demonstrator Dr Sirojan Tharmakulasingam s.tharmakulasingam@unsw.edu.au
- You are welcome to contact me for any course-related matters, particularly regarding the integrated lectures and tutorials.
- All email enquiries should be made from your UNSW student email address (please do not use any other email address) with ELEC3104 in the subject line, to ensure that they can be

addressed promptly.

Primary Learning Mode Summary

Course Delivery:

- *Lectures and Tutorials Integrated:* 3-hour weekly sessions delivered face-to-face.
- *Laboratories:*
  - 1.5-hour weekly sessions on Thursdays for approximately 16 students per group, delivered in-person
  - Optional 3-hour laboratory available on Wednesdays.

Assessments:

Progress Test (20%): Multiple Choice Quiz and Lab Work Evaluation

- *Week 3 (Thursday Lab):*
  - 20-minute Multiple Choice Quiz (Closed Book) with 4 Analytical questions and 2 MATLAB questions (Topics 1 & 2).
  - 10-minute Lab work evaluation during the lab session (Topics 1 & 2).
- *Week 5 (Thursday Lab):*
  - 20-min Multiple Choice Quiz(Closed Book) with 6 Analytical questions(Topics 1 to 4).
  - 10-minute Lab work evaluation during the lab session (Topics 3&4).

***Mini*-Project (30%):**

- *Week 10 (20-minute Oral Presentation Exam for Mini-Project):*
  - Scheduled on Wednesday (9am - 12noon) and Thursday (9am -12 noon and 3pm - 7 pm). Specific time slots will be notified in Week 9.

Final written Exam (50%):

- Closed book, 2-hour duration covering lecture content from Weeks 1 to 10.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Progress Test Assessment Format: Individual	20%	Start Date: week 1 Due Date: week 5
Project Assessment Format: Individual	30%	Start Date: Week 5 Due Date: Week 10
Final Exam Assessment Format: Individual	50%	Start Date: Week 11 or Week 12

Assessment Details

Progress Test

Assessment Overview

Throughout the course, there will be several progress assessments, including quizzes and lab work tasks. These assessments are designed to test your understanding of Digital Signal Processing concepts and evaluate your ability to apply them using MATLAB. Each assessment will be marked against specific criteria, and you will receive oral feedback on your performance. These assessments provide an opportunity to demonstrate your knowledge at Level 1 of the TLT framework.

Course Learning Outcomes

- CLO1 : Analyse linear time-invariant systems
- CLO2 : Demonstrate competency in time and frequency domain analysis of signals and systems including transform methods

Detailed Assessment Description

Progress Test (20%): Throughout the course, there will be several progress assessments, including quizzes and lab work tasks. These assessments are designed to test your understanding of Digital Signal Processing (DSP) concepts and evaluate your ability to apply them using MATLAB. Each assessment will be marked against specific criteria, and you will receive oral feedback on your performance. These assessments provide an opportunity to demonstrate your knowledge at Level 1 of the TLT framework.

Progress Test (20%): Two Multiple Choice Quizzes (closed book) & Lab Work Progress (Weeks 3 & 5 - oral assessment)
[2 quizzes (20 min each): 12% (6% each) & 2 lab work progress (10 min each): 8% (4% each)]

Multiple Choice Quiz (12%) – closed book

Multiple choice quizzes in Weeks 3 and 5 test your understanding of the Digital Signal Processing (DSP) concepts taught in the integrated lecture and tutorial classes. The multiple choice questions are at Level 1 of the TLT framework.

In Weeks 3 and 5, there will be a 20-minute multiple choice quiz (each worth 6%) consisting of 6 multiple choice questions. Quiz 1 will include 4 analytical questions (covering Topics 1 and 2) and 2 MATLAB questions. Quiz 2 will include 6 analytical questions covering Topics 1, 2, 3, and 4. The quizzes will be conducted during the Thursday laboratory class. Only one attempt of each of these quizzes is allowed. There will be no negative marking of multiple-choice questions – you will only receive marks for correct answers and will not be marked down for incorrect answers.

Lab Work Progress (8%):

Laboratory work progress is assessed in Weeks 3 and 5 to gauge your skills in applying DSP concepts using MATLAB. The lab work consists of DSP-based questions for which the MATLAB implementation and results are provided. You are required to understand the code and results and relate them to the lecture content. Following this, there are 2 to 4 DSP exercises per topic without provided MATLAB solutions. The exercises are at Level 1 of the TLT framework.

In Weeks 3 (MATLAB exercises for Topics 1 & 2) and 5 (MATLAB exercises for Topics 3 & 4), your skills in implementing DSP concepts learnt in the lecture classes will be assessed (10-minute oral assessment) using MATLAB. You must write MATLAB code for these exercises in advance of your lab work progress assessment. During the assessment, you will run your code for these exercises in front of the lab demonstrator and demonstrate the results. The demonstrator will ask questions about your code implementation to assess your understanding and application of the concepts in your MATLAB-based lab work.

Assessment Length

20-minute Multiple Choice Quiz and 10-minute Lab work Progress

Assessment information

Mid-term written exam (no marks allocated – self assessment) – closed book

There is a sample written exam paper available on Moodle under the Week 6 folder. This closed book exam will be 1.5 hours long and will cover all the topics from lectures in Weeks 1 to 4 (inclusive). The exam consists of analytical questions with multiple parts. These questions must

be answered according to the Tiered Learning Taxonomy Framework . You should complete this exam in Week 6 by yourself and check your answers against the model answers provided. This closed book mid-term exam will help you assess your understanding of the topics covered from weeks 1 to 4, and it will test your analytical and critical thinking skills.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

AI Tools: Use of AI tools (such as ChatGPT) for your learning in this course is allowed but you are responsible for everything you produce – designs, codes, graphs, etc. (keeping in mind that the output from AI tools can be incorrect). **Any use of AI tools must be declared**. AI tools are not permitted during assessments.

Project

Assessment Overview

The mini-project (individual work) will be released at the end of Week 5 and is designed to provide hands-on exposure to the applications of the concepts learned in the course by implementing a digital signal processing system.

The mini-project will be assessed in week 10 through a 20-minute individual oral presentation and a question-and-answer session with a panel of lab demonstrators. During this assessment, you will need to explain your implementation (based on a working demonstration and suitable analyses) and demonstrate your understanding (through verbal answers to questions from the demonstrators, which may cover all topics in the course relevant to the project work). Mini-project marks will be awarded by the lab demonstrators, and feedback will be provided in class during marking.

The mini-project is designed to increase in complexity from Pass (Level 2) to High Distinction (Level 5) levels as per the TLT framework. This framework enables students to continuously self-

assess their skill level while undertaking the project.

Course Learning Outcomes

- CLO1 : Analyse linear time-invariant systems
- CLO2 : Demonstrate competency in time and frequency domain analysis of signals and systems including transform methods
- CLO3 : Design and analyse digital filters for a given specification
- CLO4 : Implement a simple multi-rate system

Detailed Assessment Description

Mini-project: The mini-project (individual work) will be released at the end of Week 5 and is designed to provide hands-on exposure to the applications of the concepts learned in the course by implementing a digital signal processing system. The mini-project is designed to increase complexity from Pass (Level 2) to High Distinction (Level 5) levels according to the TLT framework. The taxonomy encourages students to think about which level they are currently at with their mini-project learning and what they need to do in order to progress to the next level. You are strongly encouraged to discuss your mini-project implementation with your lab demonstrators to complement your self-directed learning.

Mini-project oral presentation exam (30%)

The mini-project (individual work) will be released at the end of Week 5 (Friday 11 October) and you are expected to complete it by Tuesday 12 November of Week 10. This mini-project must be completed individually; it is not a team project. The mini-project will be assessed in Week 10 through a 20-minute individual oral presentation and a question-and-answer session with a panel of lab demonstrators. During this assessment, you will need to explain your implementation (based on a working demonstration and suitable analyses) and demonstrate your understanding (through verbal answers to questions from the demonstrators, which may cover all topics in the course relevant to the project work). Mini-project marks will be awarded by the lab demonstrators, and feedback will be provided in class during marking.

The mini-project is designed to increase in complexity from Pass (Level 2) to High Distinction (Level 5) levels as per the TLT framework. This framework enables students to continuously self-assess their skill level while undertaking the project.

The mini-project oral presentation exam will be marked on the basis of:

- Depth of understanding of the project
- Successful implementation of the project
- Presentation of the results

- Ability to answer questions
- Clarity of communication exhibited in the presentation

You must submit your presentation slides (format will be given in Week 9) by Week 10 (Monday 11 November). Please note that there will be **no** requirement for a mini-project report submission.

You must pass the mini-project oral presentation examination.

Assessment Length

20-minute oral presentation

Hurdle rules

You must pass the mini-project oral presentation examination.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

AI Tools: Use of AI tools (such as ChatGPT) for your learning in this course is allowed but you are responsible for everything you produce – designs, codes, graphs, etc. (keeping in mind that the output from AI tools can be incorrect). **Any use of AI tools must be declared**. AI tools are not permitted during assessments.

Final Exam

Assessment Overview

There will be one final examination, testing understanding of the principles and analytical skills through a number of set problems. Marks will be assigned according to the correctness of the responses and the TLT level of the questions attempted by the students.

Course Learning Outcomes

- CLO1 : Analyse linear time-invariant systems
- CLO2 : Demonstrate competency in time and frequency domain analysis of signals and systems including transform methods
- CLO3 : Design and analyse digital filters for a given specification
- CLO4 : Implement a simple multi-rate system

Detailed Assessment Description

Final written exam (50%) – closed book

There will be one final written examination, covering the lecture content from weeks 1 to 10, testing your understanding of the principles and your analytical skills through a number of set problems. Marks will be assigned according to the correctness of the responses and the TLT level of the questions attempted by the students.

A sample paper will be released on Moodle in Week 10.

You must pass the final closed-book written examination.

Assessment Length

2 hours

Assessment information

Detailed assessment description

You are required to answer only **4 questions** (each question will have multiple parts). However, if you answer more than 4 questions (which is NOT recommended), we will select the best 4 questions. **Please note that the maximum mark you can get is dependent on your choice of questions.** The final exam questions will be presented in the TLT framework as follows:

- The exam will be in the following layout:
  - Four questions under TLT- Level 2 (4 x16 marks)
  - One question under TLT- Level 3 (26 marks)
  - One question under TLT- Level 4 (26 marks)
  - One question under TLT- Level 5 (32 marks)
- In doing the exam, you can choose which questions you want to complete, depending on what Level you are aiming for:
  - If you are aiming to achieve **Level 2**, you will need to **answer all four questions under Level 2**.
  - If you are aiming to achieve **Level 3**, you will need to answer **any three Level 2 questions and one Level 3 question**.
  - If you are aiming to achieve **Level 4**, you will need to answer **any two Level 2 questions, one Level 3 question and one Level 4 question**.
  - If you are aiming to achieve **Level 5**, you will need to **answer any one of the Level 2 questions, one Level 3 question, one Level 4 question and one Level 5 question.**
- Under the TLT framework, the maximum marks you can achieve are as follows:
  - If you complete all four questions under Level 2 correctly, the maximum mark you can

achieve is 64.
- If you complete any three questions under Level 2 correctly and one Level 3 question correctly, the maximum mark you can achieve is 74.
- If you complete any two questions under Level 2 correctly, one Level 3 question correctly, and one Level 4 question correctly, the maximum mark you can achieve is 84.
- If you complete any one question under Level 2 correctly, one Level 3 question correctly, one Level 4 question correctly, and one Level 5 question correctly, the maximum mark you can achieve is 100.

Hurdle rules

You must pass the final closed-book written examination.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

AI tools are not permitted during assessments.

General Assessment Information

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through assessments such as the multiple choice quizzes and laboratory work progress (Weeks 3 & 5) and the mini-project project oral presentation exam in Week 10 and then the final written exam. All assessments are linked to the Learning outcome.

Grading Basis

Standard

Requirements to pass course

Requirements to pass the overall course: To pass this course, students must achieve the following:

(a) An overall satisfactory performance with a total final mark of 50% or greater

(b) A minimum of 50% in each of the following components

- The mini-project oral presentation exam
- The final closed-book written exam

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Reading	Lecture notes Available on Moodle
Week 1 : 9 September - 15 September	Lecture	Topic 1: DSP fundamentals: • Discrete-time signals & difference equations • Time and frequency domain analysis • Sampling theorem & aliasing • A/D conversion & quantisation errors
Week 2 : 16 September - 22 September	Lecture	Topic 1: DSP Fundamentals and Topic 2: Discrete- time systems: • Z-Transform and Discrete Time Fourier Transform (DTFT) • Discrete time systems including Cascade & Parallel systems • Pole-zero descriptions & stability • Convolution
Week 3 : 23 September - 29 September	Lecture	Topic 2: Discrete- time systems and Topic 3: Digital filter fundamental: • FIR & IIR filters • Magnitude & Phase responses • Phase & Group delays • Min/Max phase filters and all pass filters • Bandwidth & cut off frequencies of filters Quiz 1(Topics 1 & 2) & Lab work progress (Topics 1 & 2)
Week 4 : 30 September - 6 October	Lecture	Topic 3: Digital filter fundamentals and Topic 4: Digital resonator fundamentals • Second order IIR resonant filter • Stability of a second order filter • Digital Oscillator implementation
Week 5 : 7 October - 13 October	Lecture	Topic 4: Digital resonator fundamentals Quiz 2 (Topics 1 to 4) & Lab work progress (Topics 3 & 4)
Week 6 : 14 October - 20 October	Other	Flexibility Week – No new material taught Mid-term written exam (no marks allocated – self assessment) – closed book
Week 7 : 21 October - 27 October	Lecture	Topic 5: Digital filter designs • Introduction to analogue filters • FIR linear phase filter design using Windowing method • IIR filter design using Impulse invariant & bilinear transformations • IIR filter design using pole-zero placements.
Week 8 : 28 October - 3 November	Lecture	Topic 5: Digital filter designs
Week 9 : 4 November - 10 November	Lecture	Topic 6: Multirate systems • Decimation & Interpolation • Implementation and analysis of simple multirate systems • Modulation using sinusoidal carriers and associated Spectra
Week 10 : 11 November - 17 November	Lecture	Topic 6: Multirate systems Mini-project oral assessment

Attendance Requirements

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

General Schedule Information

- Students are strongly encouraged to attend all classes.
- Weekly participation in the scheudled labs is vital for this course. If you do not participate in

the weekly labs you may be removed from this course.
- The provieded Course Schedule is indicative only. There may be minor changes to topics covered in each week based on class discussion and questions.

Course Resources

Prescribed Resources

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

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

Recommended Resources

Reference books

- E. Ambikairajah, ELEC3104: Lecture Notes, (2024)
- A. Andreas, Digital Filters Analysis Design and Signal Processing, McGraw-Hill, 2018.

https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780071846035

- 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

Additional Costs

Not Applicable

Course Evaluation and Development

This course is being offered for the third time based on the TLT framework. The TLT framework includes six hierarchical levels, and the taxonomy encourages students to assess their current level of learning and identify what they need to do to progress to the next level. As a result of the feedback received over the past two years, and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods:

1. The majority of students appreciated the TLT framework when offered in 2021 and 2022, as it provides a self-assessment tool for measuring how well a student understands a topic.

2. Many students found that the TLT framework encouraged them to push themselves to achieve a higher level of understanding.
3. Many students found the three-hour labs too long and not effective. For this year, we have reduced it to a 1.5-hour lab plus 3 hours of optional lab time.
4. Many students found the ratio of 20-25 students to 1 lab demonstrator was not effective, so we have now reduced the number to 8-10 students per lab demonstrator.
5. To ensure we can make adaptive changes to the course delivery and labs throughout the term, a weekly **comments link on SurveyMonkey via Moodle** has been introduced. You are encouraged to provide feedback every week during the term.

Your feedback is valuable to improve the course. Please forward any feedback (positive or negative) on the course:

- Towards Week 10, you will be asked by UNSW to provide feedback via the online student survey myExperience.
- You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Professor Eliathamby Ambikairajah		Elec Eng 226		In person: Tuesdays and Wednesdays (weeks 1 to 11)	No	Yes

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 polices. 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 Plagarism

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