UNSW Course Outline

ZEIT3221 Signal Processing and Control - 2024

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General Course Information

Course Code : ZEIT3221
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The focus of this course is on developing principles and tools for the analysis, design, and implementation of digital (discrete-time) signal processing and control systems. The course builds upon principles and tools for the analysis of analog (continuous-time) and sampled

signals and systems learned in Signals and Systems. The course also builds upon the probability and statistics learned in Mathematics 1B and 2B, facilitating the analysis of stochastic signals and systems. The course covers the analysis of discrete-time signals in the time and frequency domain, the z-transform, the analysis, design, and implementation of FIR and IIR digital filters, the analysis of discrete-time and sampled-data state-space models, the design and implementation of state feedback controllers, the analysis of random processes including power spectral density and spectral estimation, and the design and implementation of state estimators including the Kalman filter.

Relationship to Other Courses

Prerequisite: ZEIT3215 and ZPEM2310

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Professional Engineer (Stage 1)
CLO1 : Analyse discrete-time signals in time domain and frequency domain.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.5 : Orderly management of self, and professional conduct
CLO2 : Analyse discrete-time filters in time domain, frequency domain, and z domain.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.5 : Orderly management of self, and professional conduct
CLO3 : Design and implement FIR and IIR filters.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.5 : Orderly management of self, and professional conduct

CLO4 : Analyse LTI state-space models in time domain, frequency domain, and z domain, and design LTI state feedback controllers	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.5 : Orderly management of self, and professional conduct
CLO5 : Analyse and synthesize random variables and random processes.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.5 : Orderly management of self, and professional conduct
CLO6 : Analyse stochastic LTI state-space models and design optimal state estimators.	• PEE1.2 : Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.5 : Orderly management of self, and professional conduct

Course Learning Outcomes	Assessment Item
CLO1 : Analyse discrete-time signals in time domain and frequency domain.	• Class Test 1 • Lab Summaries • Participation • Final Exam
CLO2 : Analyse discrete-time filters in time domain, frequency domain, and z domain.	• Class Test 1 • Lab Summaries • Participation • Final Exam
CLO3 : Design and implement FIR and IIR filters.	• Class Test 1 • Lab Summaries • Participation • Final Exam
CLO4 : Analyse LTI state-space models in time domain, frequency domain, and z domain, and design LTI state feedback controllers	• Class Test 2 • Lab Summaries • Participation • Final Exam
CLO5 : Analyse and synthesize random variables and random processes.	• Class Test 2 • Lab Summaries • Participation
CLO6 : Analyse stochastic LTI state-space models and design optimal state estimators.	• Class Test 2 • Final Exam • Lab Summaries • Participation

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+

» Safari 10+

** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:
IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: externalteltsupport@unsw.edu.au
Phone: (02) 9385-3331
International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Additional Course Information

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Plagiarism undermines academic integrity and is not tolerated at UNSW. *It is defined as using the words or ideas of others and passing them off as your own, and* can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters
- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class Test 1 Assessment Format: Individual	10%	Due Date: 06/08/2024
Lab Summaries Assessment Format: Individual Short Extension: Yes (2 days)	35%	
Participation Assessment Format: Individual	10%	
Class Test 2 Assessment Format: Individual	10%	Due Date: 24/09/2024
Final Exam Assessment Format: Individual	35%	

Assessment Details

Class Test 1

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Analyse discrete-time signals in time domain and frequency domain.
- CLO2 : Analyse discrete-time filters in time domain, frequency domain, and z domain.
- CLO3 : Design and implement FIR and IIR filters.

Lab Summaries

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Analyse discrete-time signals in time domain and frequency domain.
- CLO2 : Analyse discrete-time filters in time domain, frequency domain, and z domain.
- CLO3 : Design and implement FIR and IIR filters.
- CLO4 : Analyse LTI state-space models in time domain, frequency domain, and z domain, and design LTI state feedback controllers
- CLO5 : Analyse and synthesize random variables and random processes.
- CLO6 : Analyse stochastic LTI state-space models and design optimal state estimators.

Detailed Assessment Description

Lab 1: Wed Aug 14 [7%]

Lab 2: Wed Sept 11 [7%]

Lab 3: Wed Oct 2 [7%]

Lab 4: Wed Oct 16 [7%]

Lab 5: Fri Oct 25 [7%]

Participation

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Analyse discrete-time signals in time domain and frequency domain.
- CLO2 : Analyse discrete-time filters in time domain, frequency domain, and z domain.
- CLO3 : Design and implement FIR and IIR filters.
- CLO4 : Analyse LTI state-space models in time domain, frequency domain, and z domain, and design LTI state feedback controllers
- CLO5 : Analyse and synthesize random variables and random processes.
- CLO6 : Analyse stochastic LTI state-space models and design optimal state estimators.

Class Test 2

Assessment Overview

n/a

Course Learning Outcomes

- CLO4 : Analyse LTI state-space models in time domain, frequency domain, and z domain, and design LTI state feedback controllers
- CLO5 : Analyse and synthesize random variables and random processes.
- CLO6 : Analyse stochastic LTI state-space models and design optimal state estimators.

Final Exam

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Analyse discrete-time signals in time domain and frequency domain.

- CLO2 : Analyse discrete-time filters in time domain, frequency domain, and z domain.
- CLO3 : Design and implement FIR and IIR filters.
- CLO4 : Analyse LTI state-space models in time domain, frequency domain, and z domain, and design LTI state feedback controllers
- CLO6 : Analyse stochastic LTI state-space models and design optimal state estimators.

General Assessment Information

Class Test 1: Tues Aug 6 [10%]

Lab 1: Wed Aug 14 [7%]

Lab 2: Wed Sept 11 [7%]

Class Test 2: Tues Sept 24 [10%]

Lab 3: Wed Oct 2 [7%]

Lab 4: Wed Oct 16 [7%]

Lab 5: Fri Oct 25 [7%]

Final Exam [35%]

Participation [10%]

Participation grades will be based on engagement at lecture, tutorial, and laboratory sessions:

HD: A consistently highly engaged student, involved, questioning, and pro-active in lectures, tutorials, and laboratories.

DN: An intermittently highly engaged student, involved, questioning, and pro-active in lectures, tutorials, and laboratories.

CR: A consistently moderately engaged student, involved, questioning, and pro-active in lectures, tutorials, and laboratories.

PS: An intermittently moderately engaged student, involved, questioning, and pro-active in lectures, tutorials, and laboratories.

FL: A disengaged student, both uninvolved and inactive in lectures, tutorials, and laboratories.

Class tests will be one hour long and invigilated. A formula sheet will be provided. The use of technology beyond a non-programmable calculator will not be permitted.

There will be five *lab summaries* to be prepared, each worth 7%, and submitted one week after the corresponding second lab session, in general.

The *final exam* will be two hours long and invigilated. A formal sheet will be provided. The final exam will be graded out of 50. Your exam grade in excess of 15 will contribute to your course grade.

Feedback before census date

Class test 1 will be held in week 4, feedback, grades and worked solutions will be given to students before the census date (11 August).

Late Submission of Assessment

Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that an assessment item is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.

Use of Generative AI in Assessments

PLANNING ASSISTANCE

As this assessment task involves some planning or creative processes, you are permitted to use software to generate initial ideas. However, you must develop or edit those ideas to such a significant extent that what is submitted is your own work, i.e. only occasional AI generated words or phrases may form part of your final submission. It is a good idea to keep copies of the initial prompts to show your lecturer if there is any uncertainty about the originality of your work.

Grading Basis

Standard

Requirements to pass course

Overall passing mark is set at 50%.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	1. Discrete-time Systems
Week 2 : 22 July - 26 July	Lecture	2. Fourier Analysis
Week 3 : 29 July - 2 August	Lecture	3. Discrete-time Filters
	Laboratory	1A. Fourier Analysis
Week 4 : 5 August - 9 August	Lecture	4. z-Transform
	Laboratory	1B. Fourier Analysis
	Assessment	Class Test 1: Tuesday August 6
Week 5 : 12 August - 16 August	Laboratory	2A. Discrete-time Filters
	Assessment	Lab Summary 1 Due Wed Aug 14
Week 6 : 19 August - 23 August	Lecture	5. Filter Design
	Laboratory	2B. Filter Design
Week 7 : 9 September - 13 September	Lecture	Slack
	Laboratory	3A. Filter Design
	Assessment	Lab Summary 2 Due Wed Sept 11
Week 8 : 16 September - 20 September	Lecture	6. Feedback Control
Week 9 : 23 September - 27 September	Lecture	7. Frequency Response Methods
	Laboratory	3B. Filter Design
	Assessment	Class Test 2: Tues Sept 24
Week 10 : 30 September - 4 October	Lecture	8. State-Space Methods
	Laboratory	4A. Feedback Control
	Assessment	Lab Summary 3 Due Wed Oct 2
Week 11 : 7 October - 11 October	Lecture	9. Discrete-time Control
	Laboratory	4B. Feedback Control
Week 12 : 14 October - 18 October	Lecture	Slack
	Laboratory	5A. Discrete-time Control
	Assessment	Lab Summary 4 Due Wed Oct 16
Week 13 : 21 October - 25 October	Lecture	Review
	Laboratory	5B. Discrete-time Control
	Assessment	Lab Summary 5 Due Fri Oct 25

Attendance Requirements

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

Course Resources

Prescribed Resources

Signal Processing for Communications, P. Prandoni and M. Vetterli, EPFL Press, 2008.

This text is freely and legally available online at www.sp4comm.org

Recommended Resources

Signals, Systems, and Inference, A. V. Oppenheim and G. C. Verghese, Pearson, 2017.

A preliminary version of this text is freely and legally available online at the MIT OCW site https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-011-introduction-to-communication-control-and-signal-processing-spring-2010/readings/MIT6_011S10_notes.pdf

Feedback Control of Dynamic Systems, G. Franklin, D. Powell, and A. Emami-Naeini, Pearson, 2019.

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the "On-going Student Feedback" link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Matt Woolley		Building 15, Room 119		by appointments	No	Yes