UNSW Course Outline

ZEIT8009 Global Navigation Satellite Systems (GNSS) - 2024

Published on the 30 Jun 2024

General Course Information

Course Code : ZEIT8009
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 : Online
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Since the early 1990s, there has been a significant surge in the utilisation of Global Navigation Satellite Systems (GNSS) like the Global Positioning System (GPS) for precise position determination on Earth. This exponential growth in GNSS adoption has transformed various

industries and applications. Today, the availability of GPS and other GNSSs allows us to determine our precise location and direction.

This course provides an overview of these techniques and is supported by appropriate exercises to help students acquire all the essential concepts of GNSS systems. It initially explores the system essentials, including structure fundamentals, characteristics, and principles. The course also introduces a range of augmentation techniques and GNSS/Inertial integration based on Kalman Filters, as well as Differential GNSS techniques and GNSS applications.

Course Aims

This course aims to:

1) Explain the fundamentals of GNSS principles and the operation of GNSS.

2) Understand the operation of Kalman filter-based GNSS/INS integrated systems for different applications.

3) Understand the GPS errors and how Differential GPS can be used to improve positioning accuracy.

4) Discuss the applications of GNSS and its importance in society today, reporting on their utility and limitations.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : On successful completion of this program, the student will be able to explain the fundamentals of Global Navigation Satellite Systems and operation of these systems.
CLO2 : On successful completion of this program, the student will be able to understand the operation of Kalman filter-based GNSS/INS integrated systems for different applications.
CLO3 : On successful completion of this program, the student will be able to understand the GPS errors and how Differential GPS can be used to improve positioning accuracy.
CLO4 : On successful completion of this program, the student will be able to discuss the applications of GNSS and its importance in society today, reporting on their utility and limitations.

Course Learning Outcomes	Assessment Item
CLO1 : On successful completion of this program, the student will be able to explain the fundamentals of Global Navigation Satellite Systems and operation of these systems.	• Test 1 • Test 2 • Test 3 • Report
CLO2 : On successful completion of this program, the student will be able to understand the operation of Kalman filter-based GNSS/INS integrated systems for different applications.	• Test 2 • Report
CLO3 : On successful completion of this program, the student will be able to understand the GPS errors and how Differential GPS can be used to improve positioning accuracy.	• Test 3 • Report
CLO4 : On successful completion of this program, the student will be able to discuss the applications of GNSS and its importance in society today, reporting on their utility and limitations.	• Test 3 • Report

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

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

Other Professional Outcomes

At the successful conclusion of this course, students will, at minimum, be able to:

1. Explain the fundamentals of GNSS principles and the operation of GNSS.
2. Understand the operation of Kalman filter-based GNSS/INS integrated systems for different

applications.
3. Understand the GPS errors and how Differential GPS can be used to improve positioning accuracy.
4. Discuss the applications of GNSS and its importance in society today, reporting on their utility and limitations

Outcomes-Assessment Matrix

Assessment item	LO 1	LO 2	LO 3	LO 4
Test 1	X			
Test 2	X	X		
Test 3	X		X	X
Assignment	X	X	X	X

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
Test 1 Assessment Format: Individual	15%	Start Date: 05/08/2024 12:05 AM Due Date: 11/08/2024 11:55 PM
Test 2 Assessment Format: Individual Short Extension: Yes (2 days)	15%	Start Date: 19/08/2024 12:05 AM Due Date: 25/08/2024 11:55 PM
Test 3 Assessment Format: Individual Short Extension: Yes (2 days)	15%	Start Date: 23/09/2024 12:05 AM Due Date: 29/09/2024 11:55 PM
Report Assessment Format: Individual Short Extension: Yes (2 days)	55%	Due Date: 13/10/2024 11:55 PM

Assessment Details

Test 1

Assessment Overview

Tests are open for one week; students may start the test when ready. Each test must be completed by nominated close dates. The test can only be attempted once and the mark will be

based on that attempt. Please note that the test is timed, and as many questions as possible must be completed within the set time. Noncompletion of an online test by the required date will result in a mark of zero being awarded for that test. There will be no extensions granted to the completion date for the test. Test 1 covers weeks 1-3.

Course Learning Outcomes

- CLO1 : On successful completion of this program, the student will be able to explain the fundamentals of Global Navigation Satellite Systems and operation of these systems.

Test 2

Assessment Overview

Tests are open for one week; students may start the test when ready. Each test must be completed by nominated close dates. The test can only be attempted once and the mark will be based on that attempt. Please note that the test is timed, and as many questions as possible must be completed within the set time. Noncompletion of an online test by the required date will result in a mark of zero being awarded for that test. There will be no extensions granted to the completion date for the test. Test 2 covers weeks 5-6.

Course Learning Outcomes

- CLO1 : On successful completion of this program, the student will be able to explain the fundamentals of Global Navigation Satellite Systems and operation of these systems.
- CLO2 : On successful completion of this program, the student will be able to understand the operation of Kalman filter-based GNSS/INS integrated systems for different applications.

Test 3

Assessment Overview

Tests are open for one week; students may start the test when ready. Each test must be completed by nominated close dates. The test can only be attempted once and the mark will be based on that attempt. Please note that the test is timed, and as many questions as possible must be completed within the set time. Noncompletion of an online test by the required date will result in a mark of zero being awarded for that test. There will be no extensions granted to the completion date for the test. Test 3 covers weeks 9-11.

Course Learning Outcomes

- CLO1 : On successful completion of this program, the student will be able to explain the fundamentals of Global Navigation Satellite Systems and operation of these systems.
- CLO3 : On successful completion of this program, the student will be able to understand the GPS errors and how Differential GPS can be used to improve positioning accuracy.
- CLO4 : On successful completion of this program, the student will be able to discuss the

applications of GNSS and its importance in society today, reporting on their utility and limitations.

Report

Assessment Overview

This assignment is a report on a GNSS/INSS integration application. The assignment requires higher-order independent thinking beyond the ability to read, comprehend, and remember the information provided in the textbook. It will help draw together all of the discrete areas studied in each chapter. Students are expected to undertake a significant effort to complete the assignment. Marks for the assignment will be allocated based on the effort and the depth of understanding demonstrated. The assignment is to be submitted via Moodle Assignment submission area. More detailed information will be found on Moodle under the Assignment Information page for each assessment item. The assignment has two parts.

Part 1 requires students to write a review of GNSS and INS integration techniques for a particular application, such as land, marine, air vehicle or spacecraft.

Part 2 requires students to investigate a detailed or novel application of GNSS.

Course Learning Outcomes

- CLO1 : On successful completion of this program, the student will be able to explain the fundamentals of Global Navigation Satellite Systems and operation of these systems.
- CLO2 : On successful completion of this program, the student will be able to understand the operation of Kalman filter-based GNSS/INS integrated systems for different applications.
- CLO3 : On successful completion of this program, the student will be able to understand the GPS errors and how Differential GPS can be used to improve positioning accuracy.
- CLO4 : On successful completion of this program, the student will be able to discuss the applications of GNSS and its importance in society today, reporting on their utility and limitations.

General Assessment Information

All marks obtained for assessment items during the session are provisional. The final mark, as published by the university following the assessment review group meeting, is the only official mark.

Quiz 1 will be due in week 4, and feedback and grades will be given to students before the census date (August 11).

Late submissions:

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. A grade of 0 will be applied.

Use of Generative AI in Assessment:

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. If the outputs of generative AI such as ChatGPT form a part of your submission, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

Grading Basis

Standard

Requirements to pass course

The overall pass mark is 50% with the given weightings. This means students are not required to pass any one particular piece of assessment; you need to achieve at least 50 marks out of a total of 100 marks to pass this course. There is no minimum mark for any part of the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Chapters 1, 2 Introduction to GNSS
	Reading	Chapters 1, 2 Introduction to GNSS
Week 2 : 22 July - 26 July	Lecture	Chapters 3, 8,10 Signals, receivers, errors
	Reading	Chapters 3, 8,10 Signals, receivers, errors
Week 3 : 29 July - 2 August	Lecture	Chapter 9 Link budgets, interference, jamming
	Reading	Chapter 9 Link budgets, interference, jamming
Week 4 : 5 August - 9 August	Assessment	Test 1 due (Census Date 11 Aug)
Week 5 : 12 August - 16 August	Lecture	Chapter 13 Kalman filters and sensor integration
	Reading	Chapter 13 Kalman filters and sensor integration
Week 6 : 19 August - 23 August	Lecture	Chapter 13 GNSS/Inertial integration navigation system
	Reading	Chapter 13 GNSS/Inertial integration navigation system
	Assessment	Test 2 due
Week 7 : 9 September - 13 September	Lecture	Chapter 12 Differential GPS (DGPS)
	Reading	Chapter 12 Differential GPS (DGPS)
Week 8 : 16 September - 20 September	Lecture	Chapters 4-7 Non-GPS GNSS
	Reading	Chapters 4-7 Non-GPS GNSS
Week 9 : 23 September - 27 September	Lecture	Chapter 14 GNSS applications
	Reading	Chapter 14 GNSS applications
	Assessment	Test 3 due
Week 10 : 30 September - 4 October	Assessment	Report focused
Week 11 : 7 October - 11 October	Assessment	Report due

Attendance Requirements

Not Applicable - as no class attendance is required

Course Resources

Prescribed Resources

Compulsory Text

Kaplan, E. D., & Hegarty, C. (Eds.). (2017). *Understanding GPS/GNSS: principles and applications*. Third editon. Artech house.

Recommended Resources

Recommended texts

Grewal, M. S., Andrews, A. P., & Bartone, C. G. (2020). Global navigation satellite systems, inertial navigation, and integration. Fourth Edition. John Wiley & Sons.

Groves, P.D., Principles of GNSS, Inertial and Multisensor Integrated Navigation Systems, Second version. Artech House, Boston.

Recommended textbooks are textbooks that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.Kaplan & Hegarty has more detail on non-GPS systems, while Grewal et al and Groves are generally easier to follow. UNSW library has ebooks for the above textbooks.

A variety of additional resource materials will also be made available through the Moodle page. These comprise recorded lectures, online videos, and live virtual sessions. Please note that by joining any virtual live sessions, you are giving consent for recording the session. Live virtual lecture sessions and guest seminars are provided. The online sessions are recorded and made available to students for later viewing. Guest seminar(s) will be arranged to understand better how space systems engineering concepts are applied in real space projects. Attendance at the guest seminar is not mandatory. However, I encourage you to attend as the invited speakers work on real space projects. The time and title of guest seminars will be posted on the Moodle site.

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	Lily Qiao		Bldg 16, Room 204		Email to book an appointment	No	Yes