UNSW Course Outline

GMAT3700 Geodetic Positioning and Applications - 2024

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General Course Information

Course Code : GMAT3700
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Concepts of geodetic positioning using GPS/GNSS. History of geodetic datums in Australia. Introduction to GNSS including GPS, GLONASS, BeiDou, Galileo, QZSS and IRNSS. Satellite orbit representation, analysis of GPS/GNSS carrier phase positioning, differential GNSS, integer

ambiguity resolution, static baseline survey, control network design and adjustments, data formats/ protocols, height determination using GPS/GNSS, datum transformations, PPP, online satellite positioning services (govt/commercial), RTK, NRTK and CORS. Rapid Static field project logistics, design, execution, processing, network adjustment and reporting. Discussion of modern geodesy: VLBI, SLR, DORIS & GNSS; gravity field mapping & mass transport; geodetic services and applications; the IAG and the Global Geodetic Observing System. Datum modernisation in Australia plus standards and specifications for geodetic control.

Course Aims

The course introduces the principles of precise GPS/GNSS positioning for precise surveying and geodetic applications

The course gives the student practical advice on establishing GPS/GNSS control networks using static techniques, including the use of online processing services and Precise Point Positioning

The course will outline the fundamentals and modern concerns of geodesy, including recent developments in, and applications of, global and satellite geodesy

The course will describe today's geodetic technologies and global services, to support the surveying and geospatial disciplines, the geosciences and the community at large

Relationship to Other Courses

This course is a 3rd year undergraduate 6 UOC course in the B.E. programs. GMAT2700 and GMAT2550 are pre-requisite. This course extends the conepts presented in GMAT2700 in a practical sense and with applications.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the principles of GNSS precise positioning using carrier phase measurements, including the mathematical algorithms
CLO2 : Describe the GNSS errors and how differential techniques can be used to improve positioning accuracy
CLO3 : Explain the different ways in which a GNSS "survey" can be conducted, for different applications, and the planning and testing procedures necessary
CLO4 : Explain the role precise GNSS positioning plays in support of geospatial data acquisition, point coordination,and modern geodesy

Course Learning Outcomes	Assessment Item
CLO1 : Explain the principles of GNSS precise positioning using carrier phase measurements, including the mathematical algorithms	• Critical Review/ class presentation submission • Workshops and mini-quizzes. • Final examination • Group Field exercise report
CLO2 : Describe the GNSS errors and how differential techniques can be used to improve positioning accuracy	• Critical Review/ class presentation submission • Workshops and mini-quizzes. • Final examination • Group Field exercise report
CLO3 : Explain the different ways in which a GNSS "survey" can be conducted, for different applications, and the planning and testing procedures necessary	• Critical Review/ class presentation submission • Workshops and mini-quizzes. • Final examination • Group Field exercise report
CLO4 : Explain the role precise GNSS positioning plays in support of geospatial data acquisition, point coordination,and modern geodesy	• Critical Review/ class presentation submission • Workshops and mini-quizzes. • Final examination • Group Field exercise report

Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate

Learning and Teaching in this course

A variety of teaching activities will be included to achieve the optimal teaching and learning outcomes. Major teaching activities in this course are:

1. Weekly lectures – Live in CEG1 & CE101 and online with BBCU
2. Field exercise on campus
3. Quizzes, hands-on workshops & discussions
4. Class presentation
5. Final examination

The lectures will provide the foundation to the course. Students are encouraged to come to lectures live and interact and ask questions. The workshops, computational exercises, field exercise/ processing and quizzes/exam are intended to deepen the concepts introduced in lectures. The critical review and class presentation encourage the student to indulge in one specialist area relating to course and share with the class.

The most important factors in learning are the students' commitment to learning. **Participation is everything**. In addition, relevant resources given are of great help in understanding the basic concepts of GPS/GNSS positioning discussed in the lectures. An important component of this course will be based on the actual design of a static GPS field exercise, the processing of the data collected and the subsequent report writing. The workshop exercises support this major submission.

Other Professional Outcomes

This course aims to introduce you to:

1. Fundamentals of Modern Geodesy, its applications & technologies, as well as how it is organised at a global, international level (IAG, IGS, GGOS)
2. Review of Australian datums and contemporary international datums
3. Precise GPS/GNSS positioning, including observation modelling & data processing
4. Practical procedures for GPS/GNSS, including fieldwork and computations using Leica Infinity
5. Precise GPS/GNSS positioning modes: Static, RTK, CORS, SBAS, PPP, NRTK, Multi-GNSS
6. Datum modernisation issues for precise GPS/GNSS positioning, especially in Australia
7. Standards and Practices for control surveying with GNSS, S/G directions #9 & #12, GDA Technical Manual.
8. Enable the student to research an associated topic in this space and present it to the class.

Additional Course Information

In 2024, I will introduce a new exercise relating to python programming with the Geodepy suite. This extends the GDA Technical manual exercise and is based on a recent Hons Research thesis.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Critical Review/ class presentation submission Assessment Format: Individual	20%	Start Date: 02/08/2024 11:00 AM Due Date: Not Applicable
Workshops and mini-quizzes. Assessment Format: Individual	22%	Start Date: Not Applicable Due Date: Not Applicable
Final examination Assessment Format: Individual	33%	Start Date: Formal Exam Period Due Date: Not Applicable
Group Field exercise report Assessment Format: Group	25%	Start Date: Not Applicable Due Date: 26/07/2024 11:00 AM

Assessment Details

Critical Review/ class presentation submission

Assessment Overview

Critical review and class presentation. Students select a research topic. Present in week 10 to class. 5 mins. Feedback at end of presentation.

Course Learning Outcomes

- CLO1 : Explain the principles of GNSS precise positioning using carrier phase measurements, including the mathematical algorithms
- CLO2 : Describe the GNSS errors and how differential techniques can be used to improve positioning accuracy
- CLO3 : Explain the different ways in which a GNSS "survey" can be conducted, for different applications, and the planning and testing procedures necessary
- CLO4 : Explain the role precise GNSS positioning plays in support of geospatial data acquisition, point coordination,and modern geodesy

Detailed Assessment Description

In Moodle

Submission notes

see moodle

Assignment submission Turnitin type

Not Applicable

Workshops and mini-quizzes.

Assessment Overview

In lab workshops backed up by some follow on quizzes. Feedback on moodle and with lecturer.

Course Learning Outcomes

- CLO1 : Explain the principles of GNSS precise positioning using carrier phase measurements, including the mathematical algorithms
- CLO2 : Describe the GNSS errors and how differential techniques can be used to improve positioning accuracy
- CLO3 : Explain the different ways in which a GNSS "survey" can be conducted, for different applications, and the planning and testing procedures necessary
- CLO4 : Explain the role precise GNSS positioning plays in support of geospatial data acquisition, point coordination,and modern geodesy

Detailed Assessment Description

Details In Moodle

Submission notes

see moodle

Assignment submission Turnitin type

Not Applicable

Final examination

Assessment Overview

Final 2hr exam in exam period

Course Learning Outcomes

- CLO1 : Explain the principles of GNSS precise positioning using carrier phase measurements, including the mathematical algorithms
- CLO2 : Describe the GNSS errors and how differential techniques can be used to improve positioning accuracy
- CLO3 : Explain the different ways in which a GNSS "survey" can be conducted, for different applications, and the planning and testing procedures necessary
- CLO4 : Explain the role precise GNSS positioning plays in support of geospatial data acquisition, point coordination,and modern geodesy

Detailed Assessment Description

In class

Submission notes

F2F exam

Assignment submission Turnitin type

Not Applicable

Group Field exercise report

Assessment Overview

Practical GNSS exercise. Submit a report around 20 pages based on your field observations and analysis.

Feedback will be returned in 2 weeks.

Course Learning Outcomes

- CLO1 : Explain the principles of GNSS precise positioning using carrier phase measurements, including the mathematical algorithms
- CLO2 : Describe the GNSS errors and how differential techniques can be used to improve

positioning accuracy
- CLO3 : Explain the different ways in which a GNSS "survey" can be conducted, for different applications, and the planning and testing procedures necessary
- CLO4 : Explain the role precise GNSS positioning plays in support of geospatial data acquisition, point coordination,and modern geodesy

Detailed Assessment Description

In Moodle

Submission notes

see moodle

Assignment submission Turnitin type

Not Applicable

General Assessment Information

NOTE: This differs from the Assessment in the course outline slightly. Please follow this guide.

Assessment for the course consists of:

- Workshops and mini-quizzes: 27% (2 +2 +2 +2 +4 +2 +2 +2 +4 +5)
  - (Wkp 1, 2, 3, prac planning, 5, Quiz 1, 2, 3, GDA tech manual and Geodepy exercises)
- Class presentation submission: 15%
- Group Field exercise report: 25%
- Final examination: 33%

Workshops and Mini-Quizzes

There will be 5 workshops during this course. Workshop 1, 2, 3 and the prac planning exercise in week 5 will require attendance and participation to score a maximum of 2 marks each. Workshop 4 will be to ensure all students have access to the Leica Infinity sw and can process. Workshop 5 will entail computation and submission of results and be worth 4 marks. To reinforce the learning experience, three short mini-quizzes based on material presented in previous lectures will be given during the lecture/ workshop period worth 2 marks each. A GDA assignment in week 1 will be worth 4 marks and this will be followed by a new assignment introducing Geodepy – python programming to extend the GDA Tech manual work (5 marks).

Critical Review and Class Presentation

Students choose a topic, critically review this topic and prepare a concise presentation to be delivered live (or pre-recorded). Instructions for assessment are given and in short comprise a)

presentation; b) clarity; and c) in-depth discussion and full referencing. Due Tuesday 30 July 4pm. The 5 min presentation in class will also be delivered in Week 10. Attendance by all students will be compulsory for all presentations.

GNSS Practical and Computations Report

A GNSS static prac will be designed by the student cohort. One block of students comprising 4 groups each will design the field logistics. Each student will be a member of a group of 3 students. Groups will be finalised during the first weeks of the course. Group practical reports will be assessed with respect to: a) presentation; b) field notes & computations; and c) in-depth discussions on GPS baseline processing, network adjustment and any other relevant issues. Further information about the practicals will be distributed during the lectures and will be made available on the class web site. Due Friday 26 July.

Final Examination

The final examination will cover all topics related to precise positioning and modern geodesy.

Grading Basis

Standard

Requirements to pass course

Hard work

Course Schedule

Attendance Requirements

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

General Schedule Information

See Moodle for schedule details: Course: GMAT3700 - Precise Positioning & Apps - 2024 T2 | UNSW

Please note week 6 is UNSW Flexibility Week. Lectures and workshops will not run.

Course Resources

Prescribed Resources

The lectures and moodle site will contain numerous links and items of interest for the student.

These will be discussed in lectures.

Recommended Resources

GPS for Land Surveyors, Van Sickle, J. (4th Edition) 2015 https://www.e-education.psu.edu/geog862/node/1407

Position, Navigation, and Timing Technologies in the 21st Century: Integrated Satellite Navigation, Sensor Systems, and Civil Applications, Volumes 1 and 2 (in UNSW Library e-book)

Handbook of GNSS, Teunissen, P. & Montenbruck, O. 2017. (e-book Library)

Introduction to GPS, A. El-Rabbany, Artech House, Mobile Comms series, 2002.

GNSS Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and More, B. Hofmann-Wellenhof, H. Lichtenegger & E. Wasle, Springer Verlag, Wien New York, ISBN 978-3-211-73012-6, 516pp, 2008.

Global Positioning System: Signals, Measurements and Performance, P. Misra & P. Enge, Ganga-Jamuna Press, 2001.

GPS Satellite Surveying, A. Leick

Guide to GPS Positioning, D. Wells, et al., Canadian GPS Associates, 1986.

GPS MOOC https://www.youtube.com/watch?v=o1Fynh6LKU&list=PLGvhNIiu1ubyEOJga50LJMzVXtbUq6CPo

MISSION EARTH**,** Angermann, Pail, Seitz, Hugentobler, 2022 – (see Moodle)

Course Evaluation and Development

Students will receive feedback during and after lab exercises. Lectures will be interactive and seek student insight. The field practical exercise will give great opportunity for learning and feedback as students will work in groups and seek the same outcome from their observations. This course has been enhanced by student feedback from MyExperience.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Craig Roberts		CE412	61293854464	Office hours	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

Final Examinations

Final Exams in T2 2024 will be held on campus between the 9th - 22nd August, and Supplementary Exams between the 2nd - 6th September 2024. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.