School of Civil and Environmental Engineering

Term 3, 2021

GMAT4150
FIELD PROJECTS 2

COURSE DETAILS

Units of Credit	6			
Contact hours	Average 4 hours per week			
Class	Friday, 9 – 1pm		Room CE201	
Course Coordinator and Supervisor	Craig Roberts	email: c.roberts@unsw.edu.au	office: CE 412	phone: 9385 4464

INFORMATION ABOUT THE COURSE

This course builds on previous courses in years 1, 2 and 3. You should have already passed or been exempt from those courses. If you have not passed any of the year 1, 2 or 3 GMAT courses then you should contact the course convenor for advice and permission to enrol in this course.

This course changes considerably each year with new projects to challenge and educate students. The project for T3, 2021 is described below.

Prerequisite: GMAT3150 (and GMAT3700 for this project)

Monitor the class web site at moodle.telt.unsw.edu.au and your university email regularly.

HANDBOOK DESCRIPTION

See link to virtual handbook:

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/GMAT4150/

OBJECTIVES

The objectives of the course are to broaden and deepen your knowledge and experience of data acquisition and surveying instrumentation, field methods, and surveying software, by conducting your own surveys at a site remote from the UNSW campus or on it. The aim is to involve you in management aspects of field surveys, report writing as well as gaining more experience in measurement, fieldwork design, and analysis, and to give you confidence in your ability to do surveys of a type that you may not have done before at University or in employment.

This course is a capstone course in your degree.

Linking the objectives with the program outcome attributes and the assessment strategies for this course:

Objectives	**Program outcome attributes**	**Assessment**
Broaden and deepen surveying or geospatial knowledge and experience	Undertake field surveys without detailed instructions	Quality of survey results. Quantity of survey results. Report writing.
Management of surveys	Group work organised and lead by students. Ability to 'cost' the projects based on time spent on the tasks	Discussed and described in reports
Design	Design and plan the survey, test the design by implementation	Discussed and described in reports
Self-Assessment	Each student to write a report that evaluates their performance in the course	A small component of the final mark is based on a student's self-assessment report.

This course provides an environment that fosters in our students the following attributes as listed:

the skills involved in scholarly enquiry	Significant
the skills for effective communication	Significant
an in-depth engagement with relevant disciplinary knowledge in its interdisciplinary context	Significant
the capacity for analytical and critical thinking and for creative problem solving	Significant
the ability to engage in independent and reflective learning	Significant
the skills to locate, evaluate and use relevant information (Information Literacy)	Significant
the capacity for enterprise, initiative and creativity	Significant
an appreciation of and respect for, diversity	Significant
a capacity to contribute to, and work within, the international community	Some
the skills required for collaborative and multidisciplinary work	Significant
an appreciation of, and a responsiveness to, change	Some
a respect for ethical practice and social responsibility	Significant

TEACHING STRATEGIES

Different types of projects will be offered each year. This year, due to Covid restrictions, small class size and a perceived industry demand, a project based on lower cost GNSS devices has been devised.

The team of students will be expected to work closely with the project supervisor, who will monitor progress, and give advice on project progression and what assessment tasks will be submitted.

The supervisors will play the role of client and specify what tasks they want students to complete. The supervisors won't give lectures or extensive handouts describing in detail how to do the tasks. In this respect, the course is considerably different to GMAT3150. However, the supervisors will be available to give advice to students before, during and after the fieldwork.

Learning methods will be discussed at our class meetings. A significant aspect of this course is the group work and management by students. Part of the learning will include self-assessment because it is important that professional surveyors and engineers are able to assess their abilities and performance reliably.

Online classes have been timetabled from 9am each Thursday during Term 3 and a 4 hour timeslot has been set for the course so that extended field work can be carried out without clashing with other classes. Students should meet the supervisor at 9am online each Thursday and describe their planned activities for the day. It is possible to do field or computer lab work on other days as well as the timetabled class.

The teaching strategies that will be used and their rationale.

Private Study	• Join Moodle/ BBCU discussions of problems • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Laboratory Work	• Hands-on group work, designing and carrying out surveys • Collaborative report writing

Some quotes that relate well to this course:

I hear and I forget. I see and I remember. I do and I understand.

By three methods we may learn wisdom: First, by reflection, which is noblest; second, by imitation, which is easiest; and third by experience, which is the bitterest.

Confucius *Chinese philosopher & reformer (551 BC - 479 BC)*

For example: Imitation is the way lectures run (we try to teach you good ways to do things and get you to copy or implement them). Experience is what happened to you when you found that the RTK GPS can't be just picked up and used (the equipment needed to be setup and practiced). Or you had wrong scale factor entered in the EDM etc. Later in the course you can try the reflection part - when you write your report think about what you did before, at and after fieldwork; what would you do better if you were to do it again or do a similar survey elsewhere?

EXPECTED LEARNING OUTCOMES

By the end of this course you will have some experience at tackling new projects and working as part of a team. Further outcomes are listed or described in the project descriptions below.

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

Example: After successfully completing this course, you should be able to:

	Learning Outcome	**EA Stage 1 Competencies**
1.	*Apply surveying/geospatial knowledge learnt so far in the program to design surveys using a range of equipment to solve challenging problems.*	*PE1.1, PE1.5, PE2.1, PE2.2, PE3.3*
2.	*Manage a team to solve problems, meet deadlines with appropriate outcomes and communicate these results in report form and/or via a presentation to "clients".*	*PE1.5, PE2.4, PE3.2, PE3.5, PE3.6*
3.	*Analyse and assess data and produce suitable geospatial products that are client ready.*	*PE1.2, PE1.3, PE2.3, PE3.4*
4.	*Provide a thorough and critical self-assessment of individual performance and provide this to supervisors.*	*PE1.6, PE3.1, PE3.3*

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

COURSE PROGRAM

During the week 1 class, students will choose tasks to perform within the Project (described below). There will be activities to perform in week 1, so make sure you attend.

The timetabled class is Thursday 9am onwards online each and every week. The 4-hour timeslot is intended so that you can do fieldwork and or lab work for this project on some days (not necessarily every week) without interruptions from other classes. Of course, you are encouraged to spend some other time on meetings, calculations, report writing, etc. Descriptions of the projects, site photos and maps, WH&S forms, etc., will be discussed at the meeting in week 1.

The field surveys will be conducted as group work. Students within a group do not necessarily all do the same tasks. For example, one student might take on management duties and organise logistics while other students concentrate on design, pre-fieldwork calculations and preparations, etc. It is up to the groups to ensure all students contribute appropriately, as discussed in ENGG1000. The course coordinator may assign different marks to individual students, at their discretion, based on student activity in the field and in the lab.

Equipment

Students will help source low-cost GNSS equipment from local suppliers and test performance over a range of scenarios based on their own locally designed test beds. Depending on covid restrictions, gear from the survey store may also become available. Students wishing to collect survey equipment from the survey store will liaise with the project supervisor. There is no person permanently in the survey store so students will need to organise times of collection and return of equipment carefully.

PROJECT

This project will be supervised by Craig Roberts. Recent renewal of GNSS constellations and decommissioning of older Block IIA and IIR GPS satellites has seen a plethora of new, open GNSS signals raining down on users. The days of the relatively protected big GNSS manufacturers (Trimble, Leica, Topcon) who had developed (or purchased) patented techniques to overcome anti-spoofing signal encryption on legacy signals, are over. All new signals are now open for tracking and this liberty has encouraged a host of innovative, new GNSS manufacturers onto the market. Added competition means lower prices for comparative devices and the former Captains of high precision GNSS positioning are being challenge by these new market entrants. But are the new players equally reliable for professional surveyors who require reliability, ease of use, precision and accuracy?

This project will attempt to source three new GNSS devices and compare them vs the school's Leica Viva instrument (one of the Big 3). Students will conduct a literature review tracking the evolution of these changes through to the current situation and describe the diverse range of GNSS positioning options available to surveyors. Students will also research previous comparison tests of competing GNSS devices and devise their own range of criteria to test performance. As part of this, they may consult current professional surveyors to tailor their criteria.

Proposed tasks associated with this project

1) Students will search for SCIMS control around the site.
2) Students will undertake a literature review of various documents relevant to the tasks such as: ICSM SP1 (v1.7 & v2.2), Surveyor General's Directions no. 1, 2, 4, 7, 9 & 12, GDA technical manual and develop their survey design in concert with these documents.
3) Survey test beds designed to test criteria will be devised. Locality sketches drafted.
4) Measurement techniques such as static GNSS, NRTK (within CORSnet-NSW), PPK will be investigated as suitable to the proposed project.
5) Techniques such as AUSPOS, PPP, virtual RINEX will also be considered as part of this project.
6) Design of tiltable pole using cheap components will be considered*. (Details on moodle)
7) Depending on COVID restrictions, a small conventional survey in a tunnel at Central station to support a feasibility study on indoor positioning will be designed and conducted*.(Details on moodle)

** Proposed tasks may change depending on circumstances*

Proposed week-by-week activities:

Note these week-by-week activities will likely change at the agreed discretion of the group. During down times in early weeks, students should commence SCIMs searching and literature review in preparation for the survey design as well as sourcing and familiarising themselves with the operation of equipment and software (such as Leica Infinity or proprietary GNSS software) in preparation for field capture, processing and report development. Also note that two other possible minor field projects could augment this project depending on circumstances. These relate to providing control in a tunnel for a feasibility study into a Hyperlocal Navigation Challenge grant with Transport for NSW. This is to support researchers from Cohda Wireless. Another possible project is testing and external IMU as a cheap device to realise a tiltable pole for GNSS positioning.

Week 1: Explanation of projects, agreed division of responsibilities, preparation of documentation (WH & S, time sheets), desktop reconnaissance, preparation for design of surveys, begin literature review on evolution of GNSS signals, current status and high precision positioning techniques (multi-GNSS, NRTK, PPK, PPP, SBAS) and their access in Australia.

Week 2: Continue literature review and extract relevant sections as pertains to the design of the survey task. Discuss design of various testbeds. Status of sourcing equipment. Develop logistics around testing gear and then transporting between users. Contact relevant surveyors for their experience in developing a testbed. Discuss using Leica Vivas as "control" for this project (or other forms of control).

Week 3: Live online visit of each site by each student (ie walk around site with camera and discuss with team) for reconnaissance. Augment the survey design to ensure all criteria will be tested. Discuss logistics of rotating gear to each student site and access to gear and how it will be transported between students.

Week 4: Prepare a group report detailing the literature review, site design for each site and the criteria to be tested. Report due by Friday of week 4. The report will also include the WH&S documentation, time sheets and a description of each of the tasks.

Week 5: First attempt at field work. Compare and contrast results and discuss successes/failures based on first fieldwork attempt. What can be improved? Make adjustments to the plan and arrange all necessary unfinished logistics.

Week 6: Individual student interviews with supervisor. Re-visit fieldwork with remaining two GNSS devices. Note: all devices should be tested at all 3 student test sites. Process data from field work using Leica Infinity or other software. Each student should individually process their own fieldwork. Prepare for any follow-up field visit. Consider design for "Hyperlocal Navigation Challenge" control survey*. Consider design for tiltable pole testing*.

Week 7: Compare all results and tabulate and compare results. Can you draw any preliminary conclusions? Should other tests be designed to augment/ clarify preliminary results.

Week 8: Report writing. Allocate tasks amongst students to write toward a single report comprising individual parts. Group discussion to distil the outcomes of this testing. What would a professional surveyor want to know as an outcome of your research?

Week 9: Compile a group report detailing the literature review and motivation for the testing, current state of positioning modes, devices tested, test-bed designs, criteria tested, results, discussion, recommendations. Include WH & S documentation and time sheets. (Note: The Hyperlocal Navigation Challenge and tiltable pole tests will manifest as separate and considerably smaller reports.)

Week 10: Project presentations to invited guests. Project group report submission. Time sheets and self-assessment to be provided at a specified date in week 11.

The reports should be in **electronic form** as a single MS Word format document that includes at least a title page, contents, summary, results, report, plans, input and output files. Spreadsheets, appropriate software output files that support your project. Name the files clearly. Field sheets (if applicable) and any other paper documents should be scanned for submission. The report should be professionally prepared for the client and copies may be adapted for presentation to the Surveying and Spatial profession.

Although the final submission is a group report, there needs to be a breakdown of which individual student performed which task. This will be accompanied by a signed sheet from all group participants agreeing with their specific contribution to the final report and associated time sheets. An individual self-assessment report is required.

ASSESSMENT

There is no final examination in this course.

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below for each project separately.

Each student should include a time sheet indicating the time spent on this course – in much the same way as a business would use to charge a client for work on a project. It should include travel and meeting time. Students should not spend more than 150 hours on the course. However students should not 'waste' time doing idle activities merely to accumulate time for the project. Students will be required to submit a formal documented self-assessment on their participation in this course. Students who spend too few hours on this course have probably not contributed significantly; that affects their own learning and the group's output. The main reason for including time sheets in the course is because some parts of industry report that some graduates are not experienced at recording total time spent on a project and the consequences for budgeting and quoting for future projects.

As a management exercise, the final reports should include a hypothetical costing of the "job". Students are expected to have group meetings regularly and keep minutes and action items of those meetings. Students are to prepare all necessary WH&S documentation and to submit this to their supervisor.

Feedback for all reports will be given as soon as possible after submission. Details of the Self-assessment task will be given in a separate file on the class website.

Project A: Low-cost Multi-GNSS positioning testing

Assessment Criteria for Project A are as follows:

Project team (group) report (30%) (Due: 4pm, 8 October 2021) Will be assessed based on the following criteria

- Written presentation 5%
- Literature Review - Evolution of GNSS signals and positioning 5%
- Current status of GNSS positioning modes and options available in Australia 10%
- Previous comparison tests and criteria to test for this project 5%
- Individual design sites for testing multi-GNSS 5%

Final (individual) report and presentation (60%) (Due: 4pm, 18 November 2021) will be assessed based on the following criteria:

- Written presentation 5%
- Review of other work 5%
- Quality of project work (design and justification of the case study) 15%
- Results and interpretation 15%
- Conclusions and recommendations 10%
- Individual class presentations (10%) (Thursday, Week 10, a separate document will describe the details)

Individual self-assessment (10%) (Due: Tuesday 4pm, 23 November 2020) will be assessed based on the following criteria:

- Insight of self-assessment 8%
- Written presentation 2%

PENALTIES

Late work will be penalised at the rate of 10% per day after the due time and date have expired.

RELEVANT RESOURCES

- GMAT3700 notes
- Various documents and tools from NSW Spatial Services and Geoscience Australia
- Additional materials provided on Moodle.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

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

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

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

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Academic Advice on the School website available at:

https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership