School of Civil and Environmental Engineering

Term 2, 2021

GMAT1110 SURVEYING & GEOSPATIAL ENGINEERING

COURSE DETAILS

Units of Credit	**6**	
Contact hours	5 hours per week (average)	
Class	Tuesday, 9:00 – 11:00am	EEG23, Online via Moodle BB collaborate
	Wednesday, 14:00 – 16:00pm	EEG23, Online via Moodle BB collaborate
Workshop	Thursday, 9:00 – 13:00	CE G1

Course Coordinator and Lecturer Craig Roberts
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DELIVERY MODE TERM 2, 2021

This version of the course profile is dated 30/05/2021 8:34 AM.

	Online mode
Lectures	Lectures will be delivered live in lecturer room EEG23 and via BlackBoard Collaborate Ultra (BBCU) software. A link will be provided in Moodle. Lectures will be recorded and available in BBCU. A pdf copy of the lecture slides will be provided in Moodle. Attendance at lectures live or online is highly recommended but not compulsory. Students are encouraged to ask questions during the lecture, and to answer my questions, by using a microphone if they have one or typing in the chat section as the class progresses.
Workshops and quizzes	There will be four workshop sessions and five quizzes based on lecture material in this course. The workshops are designed to encourage a deeper learning of the lecture material and can be thought of as revision for the final exam. They are not assessed. I have pre-recorded worked solutions to some (not all) of the questions from the workshops and will make these recordings available on Moodle before the scheduled workshop day. If students still have questions after reviewing the video worked solutions, a F2F workshop is scheduled (see timetable). The Moodle quizzes should be attempted after the completion of the workshops and are worth a total of 15% of the final course mark. There are 2 x 2hr workshop timeslots. This is to accommodate a larger class with limited field equipment.
Fieldwork	Three compulsory on-campus practicals are scheduled this term.
Assessment	Due to the smaller class size, a mid-term exam and a final exam will be run in class.
My teaching	I have taught this course in this mode for many years (with improvements each year). Whilst this

experience	is a fundamental course, technology in the Surveying and Geospatial Engineering discipline have changed rapidly in the last two decades and this course now presents many new and exciting technologies such as GPS, GIS, Remote Sensing from satellites and UAVs (drones), laser scanning as well as levelling and total stations. I have run courses in 2020 using BBCU. I am suitably experienced with BBCU software and anticipate that students are similarly comfortable. It appears that BBCU works best with the Chrome browser on PCs, and Safari on iPads. I can help students to master the functionality live in lectures when you attend to enhance your experience.

HANDBOOK DESCRIPTION

See link to virtual handbook -

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/GMAT1110/

INFORMATION ABOUT THE COURSE

This course is fundamental to all other subsequent GMAT courses and compulsory for Surveying and Dual award (3776) students. It will form the basis for all the subsequent GMAT second year courses which will extend the concepts presented in GMAT1110. It is an elective course for Civil and Environmental Engineering students and an elective for all students in the Faculty of Engineering. It is an elective for Construction and Building Management students from the Faculty of Art, Design & Architecture (ADA). ADA students are reminded that trigonometry will be assumed knowledge.

OBJECTIVES

The aim of this course is to provide a broad overview of the surveying and geospatial engineering industry. The student is exposed to the fundamentals of basic plane surveying such as levelling, angle measurement, distance measurement, field recording of measurements, coordinate and reference systems, terrain representation, satellite techniques for surveying (GPS/GNSS) and applications of these techniques to solve some real-world problems. Geographical information systems (GIS) software is introduced and combined with GPS data captured by the student. Satellite remote sensing techniques and cartography for mapping is also presented with some hands-on activities. The theory presented in lectures will be reinforced with field practical exercises, workshop exercises and quizzes. Hopefully field practical exercises can be scheduled in the final weeks of the term (depending on the easing of restrictions).

List of programme attributes:

- A broad engagement with the relevant disciplinary knowledge in its inter-disciplinary context
- Capacity for analytical and critical thinking and for creative problem solving
- Ability to engage independent and reflective learning
- Information literacy
- Skills for collaborative and multi-disciplinary work
- A respect for ethical practice and social responsibility
- Skills for effective communication

COURSE PROGRAM

Week No. (Start Week)	Lectures Tuesday: 9–11 EEG23/ online	Lectures Wednesday: 14-16 EEG23/online	Workshop/ Prac Thursday: 9-11 CE G8/ field	Workshop/ Prac Thursday: 11-1pm CE G8/ field
1 (31 May)	Admin, overview of SAGE (cr)	**L1**: Levelling (cr)		
2 (7 Jun)	**L2**: Orientation/ theodolites (cr)	**L3**: Distance (cr)	Prac 1A – Levelling (cr, df, op, bl)	Prac 1B – Levelling (cr, df, op, bl) (release vid 1)
3 (14 Jun)		**L4**: Coordinates and Calculations (cr)		Wkp1A/B – Level (cr)
4 (21 Jun)	**L5**: Intro to GPS (cr)	**L6:** Intro to GIS & Cartography (zd)	Prac 2A – GPS/GIS (cr, op, df, bl)	Prac 2B – GPS/GIS (cr, op, df, bl) (release vid 2)
5 (22 Jun)		**L7**: Intro to Remote Sensing (zd)		Wkp 2A/B – Ang/Dist (cr) + revision
6 (5 Jul)	**Non-teaching week**			
7 (12 Jul)	**L8**: Traverse and Control surveys (cr)	Mid Session Test (cr)		
8 (19 Jul)	(release vid 3)	**L9:** Areas and Vol (cr)		Wkp 3B – Coords & trav (cr)
9 (26 Jul)	**L10:** Construction setout (cr)	**L11:** Deformation surveys (cr)	Prac 3A – Setout (cr, op, df)	Prac 3B – Setout (cr, op, df) (release vid 4)
10 (2 Aug)	**L12:** Detail surveys and contouring (cr)	**L13:** Cadastral Surveying (cr)		Wkp 4A/B – Area, vol, const (cr)
11 (9 Aug)		Revision session (optional)		

cr – Craig Roberts, zd – Zheyuan Du, yz – Yincai Zhou, op – Olga Pimenova, df – Daniel Fowler

vid 1 = video worked solns for Wkp 1, vid 2 = Wkp 2 etc – view on Moodle

TEACHING STRATEGIES

Three main aspects of teaching will be offered in this course: lectures, workshops and field practicals.

The lectures introduce the course material and are supported by relevant chapters from the reference book for this course (Uren and Price, 5th Ed). All notes can be accessed from the class website on Moodle.

Lectures are also available in podcast form via Moodle. It is highly recommended that the student attend all lectures. I will ask questions in the lectures to stimulate debate, deepen your understanding of the topics and to give you some idea of how to apply the theory to real world situations. I encourage student questions and engagement in my lectures. A lot of reading and calculation problems outside of lectures using reference material (see below) is expected.

Workshops (formerly known as tutorials) will support the lectures. Workshop questions can be accessed from the class website. This course is computational in nature and it is very important that the student practice all the workshop problems. Note that because of Covid, I have now prepared video worked solutions of some of the problems from each of the workshops. Therefore, I will encourage you to attempt questions after the lectures without the worked video solutions. I will release the video worked solutions prior to the workshop sessions. The workshop sessions are not compulsory, but lecturers will assume that all students attending have attempted the problems and viewed the video worked solutions. The problems are very similar in nature to the sort of questions you could expect in the final exam.

Three practical exercises have been set to help the student appreciate how to apply basic surveying techniques to real world situations. In 2020 I devised online alternative field practicals, but intend to run live field exercises in 2021. **A doctor's certificate or other supporting documentation will be needed in the event that a student misses a field practical.**

Private Study	• Review lecture material and textbook • Do set workshop problems • Reflect on class problems • Download and read materials from Moodle • Keep up with notices and find out marks via Moodle
Lectures	• Find out what you must learn • See methods that are not in the textbook • Follow worked examples • Hear announcements on course changes
Workshops	• Be guided by demonstrators/ lecturer • Practice solving set problems • View video worked solutions when released • Attend workshops if you have further questions • Ask questions
Assessments (multiple choice questions, quizzes, tests, examinations, practical exercise reports etc.)	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Field practicals	• Hands-on work, to achieve practical field work tasks • Prepare concise reports in the field • Practice working in groups • Attempt, fail, learn, repeat, improve

EXPECTED LEARNING OUTCOMES

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.

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

	Learning Outcome	**EA Stage 1 Competencies**
1.	*Practice some basic field surveying techniques such as handheld GPS and GIS, levelling, and use of a total station to acquire raw field observations and set out of a minor structure.*	*PE1.2, PE1.5, PE2.2, PE2.3*
2.	*Develop efficient field work practices such as skill with various surveying instruments, forward planning for survey tasks, production of clear field notes and redundant field checks to ensure accuracy.*	*PE1.1, PE1.5, PE2.1, PE2.2, PE2.4, PE3.2, PE3.3, PE3.6*
3.	*Undertake basic survey computations from raw field observations to support a range of surveying and engineering applications such as levelling and terrain representation, area and volume calculations, traversing and construction set out.*	*PE1.1, PE1.2, PE2.3, PE3.4*
4.	*Understand the theory behind the various surveying and geospatial techniques presented in this course and be able to critically assess the quality of geospatial data.*	*PE1.1, PE1.2, PE3.1*

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

ASSESSMENT

Field practicals:

The field practicals are designed to be conducted by a student group in a prescribed location on campus at a set time. Short reports and field notes will be submitted to the prac demonstrator at the completion of the exercise.

Online Assignment/ Quiz

As the workshops will not be assessed, a series of online quizzes on Moodle will be given to students to test their knowledge at that stage of the curriculum. More instructions will be given in the lectures. Questions will require some calculation and preparation before a nominated solution can be given. Please note that these exercises are not only assessable but can be seen as revision for the final exam.

Mid-session test:

The mid-session test will be multiple choice and test all material up to and including week 5 (but not the traverse lecture material). Prac 1 & 2, Wkp 1 & 2 and lectures 1 – 7 are included.

Final Exam:

The final exam will be external and will cover all material from the session. Students are required to score at least 30% in the final exam to pass 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.

Assessment for the course includes:

•	Practical reports (3)	30%	Due at completion of exercise
•	Mid-session test	15%	In week 7
•	Online assignment/ quiz (5)	15%	During session
•	Final Exam	40%	In formal exam period

Assessment Criteria for Online/ Field Practicals

Comments: Field practicals are a great opportunity to put theory into practice. Previous students have always rated field practicals very highly.

Field practicals are compulsory. Students must wear closed shoes. This is a strict WHS requirement.

Marking scheme: Depending on the exercise, marks will be allotted for clear and concise field notes (please do not re-write "pretty" field notes for submission. Only original field notes will be accepted so try to make them neat as you work), computations as per instructions, correctness of working, accuracy of observations, completion of all tasks, field sketches (where required), relevant comments or answers to specific questions asked in instructions and submission by allotted deadline. Details of individual assessment is contained in prac instructions for each prac available on Moodle.

Penalties for field practicals: Late submissions will attract a penalty of 10% per day late.

Feedback: The prac supervisor will attempt to mark the prac exercise within 2 weeks of completion and return the marked exercise with annotations to the prac group. An overall report will be sent to all students with generic feedback for all and a class discussion in the lecture period will also take place to reinforce any issues that arose.

Objectives and learning outcomes: The student will learn about survey design, time management, meeting time constraints, producing results in the field, logistics, field preparation, concise report writing and field note taking, producing results to tolerance despite conditions, working safely and in accordance with WHS.

Assessment Criteria for mid-session test

Comments: The mid-session test will be multiple choice and test all material up to and including week 5 (but not the traverse lecture material). Prac 1 & 2, Wkp 1 & 2 and lectures 1 – 7 are included. There are no past papers for the mid-session test. All the material is already tested in workshops, practicals, lectures & quizzes etc.

Marking scheme: The mid-session test is multiple choice. Some questions will be worth 1 mark, some 2 marks and some more complex questions will be worth 4 marks. Zero marks for incorrect answers.

Penalties: The mid-session test will be conducted in exam conditions. Cheating will not be tolerated.

Feedback: At the request of the class by the lecturer, feedback can either be given on the day of the test after completion and submission of the test, or at a later revision date during the course.

Objectives and learning outcomes: The mid-session test is a good guide for students and the lecturer to see how you are travelling during the course up to this point. Students who perform poorly should seek extra help from the lecturer and work harder.

Assessment Criteria for workshops/ quizzes

Comments: The workshops are not assessed but give a good opportunity for students to exercise their knowledge from the lectures. Five Moodle quizzes have been developed to provide assessment for the lecture and workshop material. These quizzes are only worth 15% in total but students should note that by preparing for and performing well in these quizzes indicates a mastery of the material.

Marking scheme: Students will see that the quizzes are similar to workshop problems and have been broken into parts according to a multiple-choice style rubric. Various marks are indicated at the start of the Moodle quiz. All quizzes are timed, so from commencement the clock is ticking. This is all explained in lectures and in the first page of each quiz.

Penalties: The quizzes are usually open for 1 week only. The only penalty is for not finishing in time. The solution is to start early and not leave until the last minute.

Feedback: The quizzes have built in feedback.

Objectives and learning outcomes: Time management is an important outcome. The questions are designed to exercise theory in an applied way and also under some time pressure.

Assessment Criteria for final exam

Comments: The final exam covers all material; however students should know that there will be one Levelling and one Traverse question in the exam making up around half of the assessment. This is because both these topics are considered fundamental.

Marking scheme: The marks (and part marks) will be listed at the start of each question. The exam is written with a mix of computational and theory style questions. Students should look at how many marks are allocated to each question and provide answers in accordance with the value of the marks allocated (ie don't spend 30 mins on a question worth only 2 marks out of 100!).

Penalties: Penalties are in accordance with standard UNSW exam practice.

Feedback: Students may contact the lecturer during or after the final exam for individual feedback.

Objectives and learning outcomes: The exam is designed to cover the broad range of topics covered in GMAT1110. Some questions will be applied and require the student to use their knowledge to answer a question that may require aspects from various topics within the curriculum. On the whole, questions are very similar to those given in the workshop examples. There are currently no past papers, but a practice exam is used for revision in week 11.

Supplementary Examinations for Term 2 2021 will be held on Monday 6th September – Friday 10th September (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

RELEVANT RESOURCES

Lecture Material (check the course website):

http://moodle.telt.unsw.edu.au

The Powerpoint lecture slides and other documents are available for download as PDF files at the course website.

Lectures can also be viewed as Echo/ BBCU recordings. Recordings of some workshop questions provided.

Text and Reference Books

Text book:

Uren, J & Price, WF. "Surveying for Engineers", 5th edition, 2010

(available in bookshop – compulsory to purchase for B Eng(Surveying) and Dual award (3776) students only. Optional for other students)

Reference book:

- Uren, J & Price, WF. "Surveying for Engineers", 4th edition, 2006

- Schofield, W. "Engineering Surveying", 4th edition, 1993

- Bannister, A., Raymond, S. Baker, R. (1992) Surveying, 6th Edition, Pitman, London.

- Kavanagh, B.F. (2003) Surveying: Principles and Applications, 6th Ed, Prentice Hall, ISBN 0-13-099582-7

Computational Aids

Pocket calculators are required during lecturing hours, for workshops, field practicals as well as exams in this course. They have to be hand-held, internally powered and silent. They must be brought to all lectures and practicals.

Students may bring their own calculators to the exam but they must be approved calculators. The list of "approved" calculators is the same as that published by the Board of Studies NSW at https://student.unsw.edu.au/exam-approved-calculators-and-computers

Students must attain a tamper proof sticker from the Engineering Student Centre to guarantee that their calculator is approved for the final exam.

PENALTIES

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

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 Key Contacts on the Faculty website available at:
https://www.unsw.edu.au/engineering/student-life/student-resources/key-contacts

I hope you enjoy your first journey into the wonderful world of Surveying and Geospatial Engineering

Craig Roberts 25 May, 2021

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