School of Civil and Environmental Engineering

Term 1, 2020

GMAT3100 SURVEYING APPLICATIONS AND DESIGN

COURSE DETAILS

Contact hours	6 hours per week	
Lecture Class	Monday, 1 – 3pm	Room: CLB4
	Tuesday, 1 – 3pm	Room: MAT310
Computer Lab	Tuesday, 3pm – 5pm	Room: CE201
Course Coordinator and Teacher	Dr Bruce Harvey email: B.Harvey@unsw.edu.au office: CE207 phone: 9385 4178	

COURSE PROGRAM TERM 1, 2020

If there are changes to the proposed table below, they will be updated on the class Moodle site.

Week	Monday Topic 2h	Tuesday Topic 2h	Tuesday Lab/Field 2h
1 17 Feb	Course overview, intro & organisation. Revision. Project Surveying Methodology.	Terrestrial Laser scanning	Lab: Moodle questions
2	Reflectorless EDM and 'Distos'. Case study.	Motorised TS instruments and automatic target recognition. Laser trackers.	Field: Use Laser Scanner and safety aspects. rEDM, Use ATR motorised total stations.
3	No classes week 3 (2-6 March) – many students and teacher at GMAT3150 survey camp at Berry		
4	Underground mine surveying. Tunnel surveying Guest Lec SG	Student seminar presentations (assignment 1)	Student seminar presentations (assignment 1)
5	Guest Lec: Case studies of survey projects MN	Underground Traversing & Tunnels. Gyro theodolites	PBL: Moodle based questions. Underground surveying calcs
6	Several mini pracs: parallel offsets, obs through glass, vertical shaft plumb.	No class, continue Moodle based questions.	No class
7	Shaft Heights. Open cut mines. Subsidence	Setting out large and high-rise structures. Tiltmeters	**Mid term test**
8	Direct & alignment surveys for industrial & construction surveys. 3D theodolite intersection systems.	Guest Lec: Case studies of survey projects SG	High Precision survey techniques. 3D Lines calculations
9	Easter Public Holiday – no class	Refraction parameters. Network datums, free network adjustments	PBL: telescope axes & dish surveys. Problem solving case studies: Haymarket tanks survey. Colo & SHB
10	Advanced data analysis. Bayesian & Robust L1. Deformation Monitoring & Analysis	Deformation Analysis Pt 2. Case Study – deformation monitoring. Astronomy for surveying	PBL: Advanced data analysis. Free network & deformation solutions.
11	Hydrographic surveying, Olympics surveys. Course revision	no class	no class

INFORMATION ABOUT THE COURSE

This course introduces the student to a wide variety of surveying applications undertaken as part of engineering projects. Selected topics of specialist survey applications will be dealt with using lectures, guest speakers and technology demonstrations. Topics will be selected from the following: mining surveying (including azimuth transfer, north-seeking gyro theodolites, plumbing of shafts and high structures), industrial surveying, tunnel surveying, hydrographic surveying, alignments, monitoring of deformations and settlement of terrain, structures and machines, design of precise engineering networks, project surveying methodology and advanced least squares analysis. This course builds on previous surveying courses in years 1 and 2, specifically GMAT 1110, 2120 and 2550.

Course aims: To broaden and deepen the knowledge of surveying instrumentation, to discuss equipment used in related areas of measurement, and to introduce students to specialised surveying techniques relevant to engineering and certain surveying sub-disciplines. A broad range of surveying instrumentation will be covered in this course. Our aim is to cover several topics and methods that are specialist skills of a consultant surveyor - not commonplace skills. But it does **not** aim to give the student a vast knowledge of all them. It is not expected that every graduate will need to know all of the particular topics covered, or necessarily work in these sub-discipline areas on graduation. However, some graduates will need to know some of the topic areas in great detail and may spend a considerable part of their career in one of the fields introduced in this course. Moreover, even if students do not work in the specific topic areas dealt with in the course, the educational process and underlying knowledge may valuably be applied to other surveys.

HANDBOOK DESCRIPTION

See link to virtual handbook: www.handbook.unsw.edu.au/undergraduate/courses/2020/GMAT3100

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. *A mark of at least 40% in the final examination plus mid-term test (ie 28/70) is required before the Problem Based Learning 'Quizzes are included in the final mark.* The formal exam and mid-session test scripts will not be returned, but students may discuss them individually with the course coordinator to assist with feedback. Tests will be conducted in our computer lab with all students present at one time. Computers used in tests will not have network or email access. Students can get more information on assessment content, criteria, and mode via class discussions or discussions with the course convenor.

Assessment for the course includes:

	Name	Mark	Due
•	Mid-term test	25%	Tuesday Week 7
•	Assignments: 1 Seminar presentation	6%	Tuesday Week 4
	2 Survey (Group work)	14%	Tuesday Week 10
•	Problem Based Learning 'Quizzes'	10%	Weekly
•	Final Exam	45%	In formal exam period
•	Census date 15 Mar 2020 = end week 4.		

Supplementary Examinations for Term 1 2020 will be held on Monday 25th May – Friday 29th May (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.

	Assessment Title	Assessment Type	Weight (%)
1	Mid-term test	Test	25%
	Assessment description and feedback process:	Conventional test, but students can use computers. Individual feedback is given by the lecturer. Small class.	
2	Assignments	Report and seminar	20%
	Assessment description and feedback process:	1) This assignment requires study of an international survey conference paper (eg FIG or IAG) or journal or survey project reports in a technical publication. Students select one of the papers that relates to the topics in	

Assessment Title		Assessment Type	Weight (%)
		GMAT3100. No two students use the same material. Each student gives a 5 minute ppt or similar presentation to the class. The presentation should be a clear and concise summary of the base material and reveal an understanding of the topic. Students are informally given feedback by the peers. 2) High Precision Survey and Design. 14% Requires group work. A separate document describes the assignment in detail. The assignment changes each year. Standard process - reports marked with comments.	
3	Final Exam	Examination	45%
	Assessment description and feedback process:	Final exam in a computer lab. Students may use software to solve some questions, and type answers. Students are invited to visit the lecturer after the examination period for individual feedback. Small class.	
4	Problem Based Learning	'Quizzes'	10%
	Assessment description and feedback process:	Weekly quizzes managed through Moodle. Feedback built into the quizzes, and consultation with teacher. Audit system requires students to show their workings to the course coordinator during session. Students who perform poorly in the quizzes and workshops are recommended to discuss progress with the lecturer during the semester.	
Total Weight			**100%**

Assessment items and their relationship to Course Learning Outcomes:

1. Mid-term test

- By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for industrial (e.g. indoor) surveys, high rise construction, mining, and tunnelling; and be competent with the analysis aspects of deformation surveys including datum and free net problems.
- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.
- Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.

2. Assignments High Precision Survey, Survey Design and Seminar

- By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for industrial (e.g. indoor) surveys, high rise construction, mining, and tunnelling; and be competent with the analysis aspects of deformation surveys including datum and free net problems.
- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.
- Ability to design and execute Surveying & Geospatial measurement and data analysis for surveying projects.
- Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.
- Ability to design and execute Surveying & Geospatial measurement and data analysis for surveying projects.
- Ability to function effectively as an individual and in multicultural teams, as a team leader or manager as well as an effective team member.
- Commitment to lifelong learning and continuing professional development.

3. Final Exam

- By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error

prevention for industrial (e.g. indoor) surveys, high rise construction, mining, and tunnelling; and be competent with the analysis aspects of deformation surveys including datum and free net problems.
- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.
- Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.

4. Problem Based Learning Quizzes

- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.

Further information:

Any changes to the above assessment details will be notified in class and on the class web site. After each test each student will be given individual and detailed feedback on their test or exam paper soon after it has been marked by visiting the office of the course convenor. Further details of assessment and exam rooms will be given in classes, if in doubt contact the lecturer.

The PBL and lab work in this course will be assessed via Moodle quizzes and auditing. Feedback will be given to any student who requests it by viewing the students' notes or computer screens.

The mid-term test will examine topics covered in the first 6 weeks of the course. The final exam will concentrate on the topics in weeks 7 to 11 but will also require some application of knowledge covered in the first six weeks.

There might be some calculation based questions in the exams but most of the questions will seek to find whether you have learned some of the main facts and information, whether you understand the important aspects of the type of surveying covered in the question, and whether you can describe how you would apply the knowledge.

Some of the questions in the tests will require you to propose a solution for a non-routine survey problem that a new client might bring to a consultant surveyor. The highest marks will go to those who can propose a good method, justify it well, and communicate their proposed solution to a client clearly and reliably. Pass marks will go to those who can present a reasonable problem solution and a reasonable justification for their proposal. Note that some questions in the assessment tasks in this course have more than one correct answer and different surveyors might propose a variety of valid solutions. In such cases your answers should include justifications for your methods, you do not need to try to find or guess what the examiners own personal opinion or solution might be.

Further details will be given, and discussed in class, about the type of questions that might be in the exams and which parts (topics and expected outcomes) of the course are related to the exam. The exams are set by the course convenor and reviewed by another staff member of the school.

Seminar Assignment requires study of an international survey conference presentation (e.g. FIG or IAG) or journal or survey project reports in a technical publication as published by e.g. Leica or Trimble. For Assignment 1 the students are to select one of the FIG presentations that relates to the topics in GMAT3100. Students should then advise the lecturer of their selection so that no two students use the same material, so get the lecturer's approval before starting work on the assignment. Each student will make a 5 minute PowerPoint presentation to the class. The PowerPoint file should be submitted at least 3 hours prior to the class. No other report needs to be submitted but the presentation should be a clear and concise summary of the base material and reveal an understanding of the topic. Source material is available from the lecturer. Further details of the assignment will be given during session.

Consultant surveyors doing the type of work covered in this course often create innovative solutions to new projects. Some of these surveyors do a series of projects over many years such that they become routine, but build valuable expertise. It is somewhat rare for these professional surveyors to publicise their work or their solutions for the benefit of our students. However sometimes they do take the time and effort to present their best projects at surveyors' conferences and in technical magazines or submit them for Excellence Awards that professional associations conduct.

Rules for practical / field classes

This course involves a small amount of field work. If there is light rain field work is on, if rain is heavy then the practical might be postponed. Do not assume a class will be cancelled, attend on time and ask the supervisor. Practical classes take place in a variety of weather. Do not forget umbrellas, waterproof jackets, hats, sun cream, sturdy footwear (thongs or sandals are not acceptable), warm clothes, etc.

The practical exercises form an important part of the subject. A good deal of time and care has gone into the organisation of these classes to ensure that you get the maximum benefit from the time that you spend and the equipment which is available. Most practicals will be done in groups of students. It is important that each student within a group gets experience in each aspect of each practical.

The location of fieldwork will depend on the state of construction on campus. Supervisors will advise you of the site and OHS matters. If you have any questions or doubts about an OHS matter discuss it with you supervisor. Students are required to read the supplied instructions well before the exercise is commenced. ***Any equipment lost or damaged will have to be paid for by the group.***

TEACHING STRATEGIES

This course is currently taught by UNSW academic Bruce Harvey and industry experts as guest lecturers if they available. Emphasis is placed on problem solving skills and application to real case studies from consulting surveying. The lectures give an overview of problems and methods, but not all the details. The lecturers ask questions during the lecture periods that stimulate thought into the topics. The aim is to involve students in the class, to deepen their understanding of the topics, and to give them confidence in their ability to design and undertake high precision, or unusual consulting surveys.

In this course in recent years we have placed more emphasis on problem solving skills and application to real case studies from consulting surveying. The lectures will attempt to give an overview of problems and methods, but not all the details. The lecturer will ask questions during lectures that stimulate thought into the topics. The aim is to involve you in the class, to deepen your understanding of the topics, and to give you confidence in your ability to design and do high precision or unusual consulting surveys.

We will ECHO360 record many of the lectures. These are not intended to be a substitute for class attendance but may be useful for students who can't avoid missing a class and for those who attend the class but want to rehear part of it to aid their understanding. Of course, such files are copyright and are not to be distributed beyond the enrolled students in the class.

Previous students' feedback in the annual myExperience surveys rated this course taught very highly. One of the suggestions for improvements was to have more active learning time. In 2019 we are able to do this. Some of our classes will include PBL (problem based learning) and it is suggested that students spend more of their own time doing additional problem solving. I am available outside class time to help with questions.

In our lectures in 2019 and 2020 the quantity of words in PowerPoint slides will be reduced and the amount of student activity, thinking, talking, and interaction will be increased to try to make class attendance more worthwhile.

Suggested Learning Methods

Attendance and attention at lectures is strongly recommended, but it will not be sufficient to learn the topics to the level required. There will be a lot of reading required in this course. Previous students who did not do enough reading or did not attempt the supplied lab questions have been surprised to get very low marks. *At UNSW, the normal workload expectations of a student are about 150 hours for a 6 UoC course, including class contact hours, preparation and time spent on all assessable work.*

If you want some help with goal and time management, motivation, work and study management, or well-being then I suggest you visit http://www.thefridge.org.au/ .It might give you some new or useful ideas.

OBJECTIVES

To broaden and deepen the knowledge of surveying instrumentation, to discuss equipment used in related areas of measurement and to introduce students to specialised surveying techniques relevant to engineering and industry. A broad range of Survey instrumentation other than GPS and photogrammetry will be covered in this course; the latter two topics are covered in other courses.

The aim of this subject is to cover several topics and methods that are specialist skills of a consultant surveyor, not common place skills. But it does **not** aim to give you a vast knowledge of all them. We do not expect that every graduate will need to know all of the particular topics covered or necessarily work in these topics in the future. However, some graduates will need to know some of the topic areas in great detail and may spend a considerable part of their career in one of the fields introduced in this course. Moreover, even if you don't work in the specific topic areas of this year's course, the educational process and underlying knowledge may valuably be applied to other surveys.

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

Graduate Attribute	Involvement in this course
the skills involved in scholarly enquiry	Significant – a vast quantity of material and reference matter to be studied and reflected on in the portfolio
an in-depth engagement with relevant disciplinary knowledge in its interdisciplinary context	Significant, this is probably the main attribute for this course
the capacity for analytical and critical thinking and for creative problem solving	Significant – applying surveying technologies and methods creatively to particular specific case problems
the ability to engage in independent and reflective learning	Some – as per the portfolio assignment
the skills to locate, evaluate and use relevant information (Information Literacy)	Some
the capacity for enterprise, initiative and creativity	Significant – designing creative survey solutions to problems
an appreciation of and respect for, diversity	
a capacity to contribute to, and work within, the international community	
the skills required for collaborative and multidisciplinary work	Some – group field work
an appreciation of, and a responsiveness to, change	Some – applying new methods and new technology creatively, not just reading text books for solutions to problems
a respect for ethical practice and social responsibility	Some – considering the consequences of our surveys
the skills of effective communication	Significant – group work, oral presentation, written assignments

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.	Be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for industrial (e.g. indoor) surveys, high rise construction, mining, and tunnelling; and be competent with the analysis aspects of deformation surveys including datum and free net problems.	*PE1.1, PE1.2, PE1.3, PE1.5*
2.	In-depth technical competence in Surveying & Geospatial technologies,	*PE1.1, PE1.2, PE1.3, PE2.2*

Learning Outcome		EA Stage 1 Competencies
	methodologies and practice.	
3.	Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.	*PE1.3, PE1.5, PE2.1, PE2.3*
4.	Ability to design and execute Surveying & Geospatial measurement and data analysis for surveying projects.	*PE1.3, PE1.5, PE2.2, PE2.3, PE2.4, PE3.4*
5.	Ability to function effectively as an individual and in multicultural teams, as a team leader or manager as well as an effective team member.	*PE3.2, PE3.6*
6.	Commitment to lifelong learning and continuing professional development.	*PE3.1, PE3.5*

PENALTIES

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

RELEVANT RESOURCES

- There is no textbook.
- The PowerPoint lecture slides are available for download as pdf files the course Moodle website: Monitor the site during session because it will be updated regularly. Additional materials also provided on Moodle.
- This course has a lot of reading material available on the class web site and elsewhere. You are advised to find some of the material that interests you the most and study it, for the other material skim through it at a level that you know what is there and where to find it if you need it later. The objectives of this course are to introduce you to several different types of specialist consulting surveying, not to make you an expert in all the topics. So the assessment tasks will NOT seek to find if you have read and memorised it all. The assessment tasks will seek to find if you have read some of the material and studied (by reflection) some of the topics in some depth.

Reference Books

The relative importance of class notes and reference books, and purchase details will be discussed in class.

CASPARY W (2000) *Concepts of Network and Deformation Analysis*, Monograph No. 11, 3rd impression, School of Geomatic Engineering, UNSW

HARVEY BR (2016) *Practical Least Squares and Statistics for Surveyors*, Monograph No. 13, 3rd ed., UNSW.

OGAJA CA (2011) *Geomatics Engineering: a practical guide to project design*. CRC Press ISBN 978-1-4398-1743-8

RÜEGER JM (2003) Electronic *Surveying Instruments* Monograph 18, School of Surveying and Spatial Information Systems, UNSW A free copy will be supplied to all students in this course in 2015.

RÜEGER JM (1996) *Project Surveying*, Lecture Notes, Papers, Tutorials and other Material, School of Geomatic Engineering, UNSW, Jan 2001, 332 + x pages Out of print but new versions of parts of it are on class web site.

RÜEGER JM (1996) *Electronic Distance Measurement - An Introduction*, 4th ed., Springer-Verlag, Berlin-Heidelberg-New York,
http://www.springer.com/earth+sciences+and+geography/geophysics/book/978-3-540-61159-2

UREN J and PRICE WF *Surveying for Engineers, 6th Edition or later*

VOSSELMAN G and MAAS H-G (2010) *Airborne and Terrestrial Laser Scanning* Whittles ISBN 978-1904445-87-6

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

All assessment items should be submitted with a signed Assessment Cover Sheet:

I declare that this assessment item is my own work, except where acknowledged, and has not been submitted for academic credit elsewhere, and acknowledge that the assessor of this item may, for the purpose of assessing this item:

Reproduce this assessment item and provide a copy to another member of the University; and/or,

Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.

Signed: .....date: ☐☐ ☐☐ ☐☐

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations: student.unsw.edu.au/special-consideration
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC and SURVSOC

Refer to Academic Advice on the School website available at:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

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