



THE UNIVERSITY OF  
NEW SOUTH WALES  
SYDNEY · 2052 · AUSTRALIA

SCHOOL OF SURVEYING & SPATIAL INFORMATION SYSTEMS

## GMAT 3100

# SURVEYING APPLICATIONS & DESIGN

### Course Outline – Session 1, 2009

Version: 9-Feb-09

Number of students enrolled: 17

*This document, and other material, is available at the Course Website:*

<http://www.gmat.unsw.edu.au/gmat3100>

(User name and password supplied in class)

**Handbook Description: GMAT3100 Surveying Applications & Design**

UOC 6 HPW 5 S1

*Prerequisite/s:* nil *Corequisite/s:* GMAT2120, GMAT2550

This course introduces the student to a wide variety of surveying applications undertaken as part of engineering projects such as the design of surveys for set out of buildings and large structures. In addition, selected topics of specialist survey applications from: mining surveying (including azimuth transfer, north seeking gyro theodolites, plumbing of shafts and high structures), industrial surveying and alignments, tunnel surveying, hydrographic surveying, monitoring of deformations and settlement of terrain, structures and machines, design of precise engineering networks, sub mm 3 dimensional measurement surveys, and 3D laser scanning.

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## 1. Staff involved in the Course and their Contact Details

Dr. Bruce Harvey (Lecturer, Tutor and Course Convenor)

Office: EE424 (You may visit whenever I am present, see office door timetable)

Email: [B.Harvey@unsw.edu.au](mailto:B.Harvey@unsw.edu.au)

Phone: 9385 4178

Staff absence: Dr Harvey will not be at UNSW on Mon to Wed week 4 and Wed to Fri week 5 (survey camp for GMAT4150).

## 2. Proposed Course Schedule

Any changes will be notified in class and on the class web site.

Wk	Monday 10-12 Goldstein G02	Thursday 10-12 Goldstein G02
0	No class	Optional: Form groups for pracs. View class web site.
1 9 March	Course overview, intro & organisation. Revision / test of previous courses. Project Surveying Methodology	Laser scanning
2	Laser scanning	<i>Demonstrations of Laser Scanners and ATR Motorised total stations (poss by CR Kennedy or SKM) Motorised robotic instruments and automatic target recognition.</i>
3	Reflectorless EDM and high precision EDM, laser trackers, interferometers.	Mining & tunnel surveying introduction. Mine surveying video &/or 20 mins <i>iCinema Mining Scenes</i>
4	<i>No class on Monday, this lec given on another day. TBA</i> Plumbing of Shafts and High Structures. Gyros. Azimuth Transfer. Underground Traversing	Open cut mines. Height Transfer. Mine Surveying Tut
5	Setting out large and high rise structures. Tiltmeters	<i>No class on Thursday, this class given on another day. TBA</i> High Precision Theodolite use. Revision of Theodolite errors. 3D theodolite intersection measuring systems. Theodolite Intersections Case studies: Bridge survey, calibration wall.
6	High Precision Theodolites. Demo and use of T3000 theodolites, scale bar, targets. Theodolite attachments, description and demo. Observation through glass. Tut: 3D directions (cube) survey	<b>Mid session test</b>
7	Direct and alignment surveys for industrial & construction surveys.	High Precision survey techniques. Case studies: telescope axes surveys and dish surveys. 3D CoGo. Tut
8	Case Study: Haymarket tanks survey	Field exercises
9	Refraction parameters. Network datums, free network adjustments.	Advanced data analysis. Robust L1 norm adjustments. Tutorial

Wk	Monday 10-12 Goldstein G02	Thursday 10-12 Goldstein G02
10	Deformation surveys. Bridge survey example of analysis.	Free network and deformation solutions by FIXIT & Excel (Tut)
11	Hydrographic surveying. "Olympics" surveys, Astronomy (moving targets, obs in dark).	Other topics selected from: Barometric Heights, Computer – total station communications, real time monitoring, SMS etc. Inertial surveying, <i>GMAT3150 survey camp OHS &amp; admin</i>
12	Assignment 2 presentations.	Typical past exam papers (Tutorial)

### 3. Assessment in the Course

Assessment criteria and methods used will be discussed in class, including reasons for the educational approach taken. We have a small class so we have considerable flexibility with assessment methods. For example tests can 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 on assessment content, criteria, and mode via class discussions or discussions with the course convenor.

Assessment for the course includes:

- |                    |     |                                   |
|--------------------|-----|-----------------------------------|
| • Mid-session test | 35% | Thursday Week 6                   |
| • Assignment 1     | 15% | Submit on or before Friday Week 9 |
| • Assignment 2     | 5%  | Present on Mon Week 12            |
| • Final Exam       | 45% | In formal exam period             |

Any changes to the above assessment details will be notified in class and on the class web site. After each test a list will be available giving the marks obtained by each student. 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 tutorial and lab work in this course will not be assessed however feedback will be given to any student who requests it in the student's presence by viewing the students' notes or computer screens. Students are encouraged to do the tutorial and lab work as many of the questions are based on previous year's test and exam questions and this year's the test and exam questions may be similar to them.

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.

The mid session test will examine topics covered in the first 5 weeks of the course. The final exam will concentrate on the topics in weeks 6 to 12, but will also require some application of knowledge covered in the first five weeks.

There might be some calculation based questions in the exams but most of the questions will seek to find whether you have learnt 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 and assignment 1 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.

In 2009 Assignment 1 will require students as part of a small group to design, implement and write a report on a field exercise. There are several different field projects to choose from. Topics will be described and allocated before the Easter recess week. Each of the projects will help you learn about how to solve an unusual survey problem with the latest technology and methods. Reference material will also be provided.

Assignment 2 requires study of an international survey conference presentation (eg FIG or IAG) or survey project reports in a technical publication as published by e.g. Leica or Trimble. 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. For Assignment 2 the lecturer has collected a number of recent high quality articles that students can select from. Students are welcome to find their own article, but get the lecturer's approval before starting work on the assignment. Each student will make a 5 minute PowerPoint presentation to the class in week 12. The PowerPoint file should be submitted prior to the class in week 12. 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. It is anticipated that each student will use different source material. Further details of the assignment will be given during session.

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.

## 4. Educational Aspects of the Course

### 4.1 How this course relates to others in the program

This course builds on previous surveying courses in years 1 and 2, specifically GMAT 1110, 2120 and 2550. You should have already passed or been exempt from those courses. If you have attempted but failed any of the above courses then you should contact the course convenor. Some of the topics in this course are important for the following course GMAT3150, and possibly your final year thesis.

### 4.2 Aim of the Course

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 later 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.

### 4.3 Learning Outcomes

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.

### 4.4 Teaching Strategies

This subject was under major reconstruction in the last few years because of student feedback and retirement of previous lecturers. It has now stabilised. The current teacher will use the best of the previous lecturers teaching and reading materials, and has added new material. 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 attempt to 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 voice recorder and possibly video tape 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. The files may be large so they probably won't be available for download from the web site. Contact lecturer directly for a file. Of course such files are copyright and are not to be distributed beyond the enrolled students in the class.

Student feedback in the 2008 CATEI survey:

Student's said the best features of this course were:

- the student reports on each lecture subject were particularly useful for learning your topic and then using other peoples topics as study notes. i also found that getting us to think about ways to solve problems particularly interesting
- there weren't many tutorials, and interesting.
- The website was very useful for the class lecture notes.

Student's said this course could be improved by:

- Having more tutorials - where students practice past questions. in prep for exam
- The website was good however I assumed you wanted us to read most of the additional material however some weeks there was just too much and I thought that there was too much information in certian weeks if it was expected for us to read all of it.

Planned improvements for 2009 based on student feedback:

I will try to reduce the amount of reading by editing the material written by me and former students. I will also try to make it clear what should be read in depth and what 'skimmed' through. The number of tutorials had opposing student views. This year will try to have more tutorial time and more field work time.

### 4.5 Suggested Learning Methods

Attention at lectures will not be sufficient to learn the topics to the level required. There will be a lot of reading required, particularly in the later half of this course. There is also a significant tutorial calculation component to this course, particularly in the roads part of the course. Previous students who did not do sufficient reading or did not attempt the tutorial questions have been surprised to get very low marks. Laziness is not rewarded in this course, a good workload is!

### 4.6 UNSW Graduate Attributes

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

the skills involved in scholarly enquiry	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	Some

the skills to locate, evaluate and use relevant information (Information Literacy)	Some
the capacity for enterprise, initiative and creativity	Significant
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	
an appreciation of, and a responsiveness to, change	
a respect for ethical practice and social responsibility	

## 5. Course Resources

### 5.1 Lecture Material (check the course website for messages too):

The Powerpoint lecture slides are available for download as [PDF files](#) at the course website:

<http://www.gmat.unsw.edu.au/brh>

Monitor the site during session because it will be updated regularly. Username and password will be supplied in class. The website material is only for use by students enrolled in this course.

Also, the edited text of 2008 students' assignments, in word format, has been placed on our school's undergraduate computer lab server. The GMAT3100 folder on U drive folder is for all students to access and edit as much as they want. In 2008 one of the students' assignments was to write a chapter of a textbook on one of the GMAT3100 major topics.

### 5.2 Text and Reference Books

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

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

HARVEY B R (2006) *Practical Least Squares and Statistics for Surveyors*, Monograph No. 13, 3rd ed., School of Surveying and Spatial Information Systems, UNSW.

RÜEGER, J.M. (2003) *Electronic Surveying Instruments*. Monograph 18, School of Surveying and Spatial Information Systems, UNSW.

RÜEGER J. M. *Project Surveying, Lectures Notes* (transcript by the Students of 1996, edited by the author), **Papers, Tutorials** (prepared by the Students of 1995, edited by the lecturer) **and other Material**. School of Geomatic Engineering, UNSW, January 2001, 332 + x pages. Out of print but new versions are on class web site.

RÜEGER J M *Electronic Distance Measurement - An Introduction*. 4th ed., Springer-Verlag, Berlin-Heidelberg-New York, 1996

UREN, J. and PRICE, W.F. (2006) *Surveying for Engineers*.

### 5.3 Computational Aids

Pocket calculators are required during lectures, for tutorials and practicals in this course. They have to be hand-held, internally powered and silent. There are no other requirements for calculators in this course. They must be brought to all lectures and practicals.

Computer software relevant to this course and available in the School's computer lab EE401, includes: FIXIT3 & CivilCAD

## 6. Administrative Matters

### 6.1 Expected work load

*At UNSW, the normal workload expectations of a student are 24-28 hours per session for each unit of credit, including class contact hours, preparation and time spent on all assessable work, i.e. about 150 hours for a 6 UoC course.*

To assist students with the organisation of their studies, the expected workloads of the various components of the course are listed below. It is strongly suggested that students use the listed hours to plan their work during session.

Classes: (12 x 4 hr)	56hr
Assignments	38hr
Revision of lectures, background reading, tutorial exercises (approximately 4hr x 12wk)	56hr
Total	150hr

### 6.2 Rules

Students should read the University Calendar or Student Guide for details of University Rules and special considerations.

Students are reminded that the University regards academic misconduct as a very serious matter. Unauthorised material must not be taken into a test or examination. Any work submitted for assessment must be entirely the student's own work. The penalty for any suspected academic misconduct ranges from zero mark for the assignment or exam involved, through failure of the subject, to expulsion from the University. If absent from an examination, class test or practical, students must submit written documentation to the University, via the Student Centre in the Chancellery.

The assignment is a compulsory part of the course and must be handed in by the due date. The marks for late submissions will be reduced as follows: -20% (of the maximum mark) for up to 24 hours after the scheduled submission time, then -10% (of the maximum mark) for each additional 24 hour period late. (For example, a student submitting a report 4 days late has his/her mark reduced by 4 if the maximum mark of the submission is 10.).

If a student is unable to submit on time due to illness or other legitimate reason, then a brief written explanation must be given to the lecturer for consideration as soon as is feasible. In some cases the lecturer may grant an extension to the submission date provided he has been contacted before the due date.

Further assessment may be granted in this course at the lecturer's discretion. If further assessment is granted then performance in tutorials may be considered as well as an oral exam including use of a computer.

If students attend less than 80% of their possible classes they may be refused final assessment.

### 6.3 Plagiarism

See the UNSW web site for university policy on Plagiarism. All assessment items (eg prac reports) should be submitted with a signed Assessment Cover Sheet:

<p>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:</p> <p>Reproduce this assessment item and provide a copy to another member of the University; and/or,</p> <p>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).</p> <p>I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.</p> <p>Signed: .....date: <input type="text"/><input type="text"/><input type="text"/><input type="text"/><input type="text"/><input type="text"/></p>
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### 6.4 Grievances

In the first instance all grievances should be discussed with the lecturer involved. If the problem cannot be resolved, students should contact the School's Grievance Officer in writing.

### 6.5 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, water proof 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 your 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.***