THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY · 2052 · AUSTRALIA

SCHOOL OF SURVEYING & SPATIAL INFORMATION SYSTEMS

GMAT 2500
Surveying Computations and CAD

Course Outline – Session 1, 2009

Version: 9-Feb-09

Number of students enrolled: 9

This document, and other material, is available at the Course Website:
http://www.gmat.unsw.edu.au/gmat2500
(User name and password supplied in class)

Hand book description:
UOC 6 HPW 5 S1
Prequisite/s: nil *Corequisite/s:* nil *Excluded:* nil
(However it is assumed that most students will have studied GMAT1110 or a similar course.)

Principles of survey calculations. Radiation, intersection, resection, and trilateration calculations. Traversing: fieldwork, calculations, error detection and adjustment. Detail surveys with engineering surveying CAD software: data transfer with survey instruments, plan editing, and contouring from a digital terrain model. Cadastral calculations. Land Subdivisions in CAD. Design and computation of horizontal and vertical curves for roads, rail and pipelines in CAD.

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1. Staff involved in the Course and their Contact Details

1.1 Lecturer and Course Convenor:

Dr. Bruce Harvey (BRH)
Office: EE424 (You may visit whenever I am present, see office door timetable)
Email: B.Harvey@unsw.edu.au Phone: 9385 4178

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

1.2 Other Lecturers:

Dr. Yincai Zhou (YZ) Office: EE407 (Available most of the time)
Email: Y.Zhou@unsw.edu.au Phone: 9385 5252

Rod Eckels (RE) Email: rod@slekce.com No Office on campus

2. Proposed Course Schedule

Changes will be notified in class and on the class web site. Lecturer's initials included.

Wk	Wed 9 – 11 Lecture EE G24	Thu 1 – 4 Lab EE401a
0	Purchase class notes. Form groups for pracs. View class web site. BRH	No class
1 *11 March*	Introduction to Course. Principles of Calculation. Revision of Trig, Coordinates, Bearing and Distance Calculations. BRH	Coordinates, Bearing and Distance Calculations. BRH
2	Intersection and Resection BRH	Intersection. Resection: graphical & numerical BRH
3	Loop Close "Missing Data" Problems Traverse Field Method. RE	Prac: EDM Loop Traverse, Quad. Lab: Missing Data Problems. RE
4	Traverse Adjustment Calculations. Bowditch. Blunder detection. RE	Prac: MGA Closed Line Traverse, Willis St. RE
5	Introduction to CAD and CivilCAD. Demo of LISCAD software. YZ	Lab: Traverse Calculations. + Catch up on previous tutorials and pracs RE
6	Lab: Nikon or Sokkia Total Station data collection for detail survey, entry of codes for CAD, electronic recording. BRH	MID SESSION TEST in lab EE401 YZ
7	Coordinate geometry (COGO) in CCAD. Detail Survey plans in CivilCAD YZ	Lab: CivilCAD, Manual Data Entry and using downloaded data, data editing and plan drawing, Terrain Modelling YZ
8	Cadastral calculations: areas, rural road Intersections, 2 lot subdivisions, PO comparison. BRH	Cadastral calculations BRH
9	Subdivision Design and drawing in CivilCAD YZ	Outline drawing for subdivision design with the use of Insert, COGO and Survey functions YZ
10	Road Curve calculations. RE	Road Centreline Calculations RE
11	Road Design using CivilCAD. YZ	CivilCAD Road exercises: alignments, cross sections, long sections. 3D views YZ
12	Problem solving. Revision. Future of surveying computations. BRH	Problem solving "Horner's" problems Finalise lab and tutorial exercises. Typical "past" Final Exam paper BRH

3. Assessment in the Course

Assessment criteria and methods used will be discussed in class, including reasons for the educational approach taken. We have small class sizes 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.

Proposed assessment for the course includes:

• Mid-session test	30%	On Thursday week 6
• Lab work	30%	
• Final Exam	40%	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 exam paper soon after the exam 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.

Demonstrate all your **Lab exercise** programs to a supervisor for comments and marking. You are allowed to help each other learn in lab classes but are not allowed to blindly copy someone else's work. You may be asked to demonstrate and explain the work you have done in the computer lab classes. The requirements for lab work are given in the lecture and textbook files. Students are urged to manage their workload and make regular submissions during session.

The tutorial/lab work will be marked in the student's presence by viewing the students' notes or computer screens and immediate feedback will be given. There is no need to rewrite the work or to submit formal well written reports. Generally the work will not be collected or be examined in detail unless a student has had difficulties getting correct or good quality output. Generally, tutorial/lab marks will be assigned using a mastery scheme, i.e. if the work is acceptable it will get full marks if it is not acceptable it will get zero marks, students can resubmit in this case.

The computer lab and tutorial exercises (except those in weeks 11 and 12) and field work reports, should be submitted for marking within one week of when they are covered in class. For example the week 3 exercises are due before 2pm in the Thursday lab class in week 4. If in doubt contact the lecturer. All work must be completed by the end of week 12. Each of the 9 lab exercises is worth 2 marks; the two practicals are worth 6 marks each. This component of the assessment also includes students' contributions to the class text book such as worked examples.

The **Mid session exam** will be conducted in EE401A computer lab. It will involve written questions on the exam paper. A sample 'past paper' will be supplied well before the exam. The marking criteria will place a strong emphasis on correct answers for calculation style questions, so students will be advised in this course on how to provide independent checks for their work and sufficient time will be provided in the examination to do the check calculations.

The **Final exam** will be in the exam period and will be conducted in EE401A computer lab. It will involve written questions on the exam paper plus use of software on a computer. A sample 'past paper' will be supplied well before the exam.

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. Course Resources

4.1 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/gmat2500

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.

4.2 Text and Reference Books

A text book has been written specifically for this course by the main lecturer. The contents of the book change as the software and instruments change and as the lecturer learns better ways to communicate the material. The 2008 class of students suggested we should print out the text book and sell it at start of course and provide pdfs on line. They said that any changes or updates during the session are OK, as long as the pdf versions on line are up to date. It is not compulsory to buy the paper version.

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

4.3 Computational Aids

Computer software relevant to this course and available in the School's computer lab EE401. We will use MS Excel spreadsheets in the lab, students who do not have that software on their home computers will be advised on how to get free open source equivalent software and how to use it. We will use CivilCAD version 6 software in our labs. CivilCAD software is too expensive for students to buy, but we do have a small supply of USB based copies of the software that can be borrowed by students for home use if required, contact Dr Zhou. We may also be able to provide free educational versions of another CAD software for students to use and explore at home. Students may use any calculator they wish in this course, however in examinations they may not used pre programmed calculators with, for example, close or resection programs.

5. Educational Aspects of the Course

Former students have asked me to keep the course outline as short as possible, others want details. However, UNSW does require detailed discussions of educational aspects. Be assured that personally the course convenor and the other lecturers do treat the educational aspects as very important and spend considerable effort designing and improving the course. So in order to keep this document short, the aims objectives goals expectations and outcomes of the various class topics and assessment tasks will be discussed in class and/or within the individual documents for the assignments, lecture notes etc. An advantage of our small class enrolment is that each individual student can have many one to one discussions with the course convenor in his office or by phone or email. These discussions can be at the level of for example "why are we learning this topic" to the level of "I get the wrong answer or I don't know how to do the calculations for this tutorial question, please help me".

2007 was the first year this course was offered. In 2007 and 2008 the entire course was taught be the course convenor. In 2009 three lecturers are involved. The individual lecturers will be introduced with their backgrounds etc in class.

Feedback from the 2007 and 2008 students via the CATEI process: 100% of students indicated satisfaction with the overall quality of the course. The ratings of all 10 questions were very high. The written comments were all very positive and pleasing. Several aspects of the course were listed as best aspects, by different students. One suggested improvement was a comment about the frustrating CAD package. My (BRH) reply: We use a commercial package, so we don't have source code or in-depth knowledge of the internal workings of the software. It does sometimes do strange things, however it is improving as new versions of the software are loaded and our instructions become easier to follow. The strengths and weakness of various commercial CAD software with surveying modules, will be discussed in class.

5.1 How this course relates to others in the program

This course builds on previous surveying calculation courses in first year, especially GMAT 1110. You should have already passed or been exempt from that course. If you have not attempted GMAT1110 or attempted it but failed, then you should contact the course convenor. The course also builds on MS Excel knowledge and skills learnt in ENGG1811. Most of the topics in this course are useful for future survey courses: (GMAT) 2130, 2550, 3150, 4150, 4400, and 4450. There is also a connection to GMAT2120 that many students study at the same time as this course. You can use the data from one of the practical classes in GMAT2120 to practice resection calculations that are taught in this course.

5.2 Aim of the Course

Calculations and plan drawing are a traditional part of surveyors' work and many fields of surveying involve data collection, calculations and presentation of results using computers. Computers make our work easier and sometimes better quality.

Using computer aided drafting (e.g. CivilCAD and AutoCAD) software to process surveying data for design and plan production purposes is an important and essential skill for surveying graduates. This course introduces surveying/civil CAD packages commonly used in engineering surveying. Instructions are given in data entry, data reduction, graphics and attributes editing, contouring and plan drawing for detail survey, subdivision and road design.

The aim of this course is **not** to acquire a vast knowledge of all the options/steps available in CivilCAD nor is it to remember all the equations used in plane survey computations. The aim of the course is to enable students to solve plane survey computation problems and to be able to learn to use any of the currently available surveying CAD packages or those developed in the future.

5.3 Learning Outcomes

By the end of this course students should be able to solve the following calculation problems using a variety of approaches and computing resources including manual calculation, calculators, spreadsheets (MS Excel or open source equivalents) and CAD software with surveying modules:

- Bearing and Distance, Coordinates
- Intersection and Trilateration
- Resection
- Traverse Adjustment Calculations
- Missing Data Problems
- Road Intersections
- Subdivision calculations
- More complex road calculations
- Theodolite, level, GPS.

You will also have some experience with upload and download of Survey Instrument data to computers.

By the end of this course students should be able to produce surveying, road design and subdivision drawings/plans using CivilCAD v6 software package including:

- Import and edit surveying data: manually booked and electronic downloads from Total Stations
- Traverse data entry, reduction and adjustment
- Draw detail survey plans with contours using DTM/TIN methods
- Perform surveying plan editing and plotting including annotation
- Subdivision calculations and prepare subdivision plans
- Road alignment, cross sections extraction and level book data entry
- Perform basic road design principles including template design, and long and cross section plotting.

5.4 Teaching Strategies

The teaching will include 2 hour lectures and 3 hours of guided / instructed practice in the school's Surveying Computer Lab. There is a long history of teaching of the computations and the CAD topics in our school, but they were in separate courses and without field work. Over the last few years we have adopted a fresh new approach to modernise the material and the teaching methods of this course.

Two major field practical exercises are included in the course so that students can better understand the full process from data collection to data analysis and final presentation. Thus students do calculations of their

own data, not always using “text book” supplied data.

In 2009, as in previous years, we will voice record and or video tape lectures given by the course convenor. 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.

We have a small class enrolled so the lecturer of a topic will also attend all tutorial, laboratory and field classes related to that topic. Many of the lecturers will include tutorial style discussions interspersed with traditional ppt based lecturing. Generally pdf files of the lecture ppts will be available on the class web site before the lectures. However some of the lecturers like to change the content slightly during the lecture in response to student learning at the time. Some times questions are asked in the lecture to promote student involvement in the learning – in these cases the pdf files available before the lecture may not reveal the ‘answers’ to the questions. After the lectures new versions will be uploaded to the class web site. Students are asked to consider the environment before printing files onto paper.

Additional improvements planned for 2009:

- A significant effort is being made to improve the CAD part of the course. The lab questions need to be simpler and lead to more understanding of the process. In earlier years teachers have given ‘hundreds’ of step by step instructions for some exercises. Whilst this does make the students more productive, the concentration on miniature matters can lead to lack of confidence and understanding.
- Other CAD packages need to be considered. An overview and comparison of several packages is given in one lecture. Another CAD supplier will be asked to give a demo of their software.
- Add some coverage of data transfer formats e.g. dxf and LandXML in CAD
- Add total station instrument on board calculations , e.g. ht of powerlines, not just resections, radiations.

Each year we will change the contents and teaching methods of this course based on student’s performance at assessment and their feedback.

5.5 Suggested Learning Methods

This is a practical course, the more practice and experience you get the better you will understand the topic and the faster you will be able to solve problems. We suggest you spend some of your 5 hours per week study time (in addition to class time) using a computer in the lab as well as the usual study methods. There will be a lot of practical surveying data calculations and map editing work in lab exercises. In the CAD section we will have an instructed practice following each lecture to lead you go through a CAD software package.

The workload is reasonable constant during the session and starts at a considerable rate in the first week to revise material learnt in previous courses. Intentionally, there are no extremely heavy loaded weeks or easy weeks. The mid session test is after the “Easter” recess week.

It is strongly recommended that students: attend all classes; do not get too far behind with the lab work; and ask for help if you need it. It is not necessary to take detailed notes in lectures. However, it is important to complete all the lab tasks and to keep up to date. Also feel free to work independently - read references and try to solve problems yourself, do not just sit in class and follow the leader.

5.6 UNSW Graduate Attributes

This course provides an environment that fosters in our students the following attributes, those not covered in this course are dealt with in other courses in your program:

the skills involved in scholarly enquiry	Significant
an in-depth engagement with relevant disciplinary knowledge in its interdisciplinary context	Significant, at the level of competence with survey calculations and CAD that would enable summer employment in this field
the capacity for analytical and critical thinking and for creative problem solving	Significant, we are especially encouraged to find more than one way to solve the problems and ways to check or know that our answers are correct or valid
the ability to engage in independent and reflective learning	Optional, there is opportunity for students to learn more about the CAD software, to try alternative solutions to those presented in class, to read ahead through the text book, or to write their own computer programs for some of the tasks
the skills to locate, evaluate and use relevant information (Information Literacy)	
the capacity for enterprise, initiative and creativity	Significant – find alternative solution methods
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	The field practical exercises will be done as group work. Importantly note that the exercises can not physically be done by one person "doing all the work", so quality results depend on good collaboration
an appreciation of, and a responsiveness to, change	Significant
a respect for ethical practice and social responsibility	

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: Lectures and Tutorials (12 x 5 hr)	60hr
Revision of lectures, background reading, tutorial exercises (approx 7hr/wk)	90hr
Total	150hr

6.2 Rules

Students should read the University web site for University Rules, plagiarism and special considerations.

All practical reports should be submitted with a signed Plagiarism / Assessment Cover Sheet. See www.lc.unsw.edu.au/plagiarism and the UNSW web site for university policy on Plagiarism.

I/We declare that this assessment item is my/our 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: ☐☐ ☐☐ ☐☐

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

Signed: .....date: ☐☐ ☐☐ ☐☐

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Signed: .....date: ☐☐ ☐☐ ☐☐

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.

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 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.