



THE UNIVERSITY OF
NEW SOUTH WALES
SYDNEY · 2052 · AUSTRALIA

SCHOOL OF SURVEYING & SPATIAL INFORMATION SYSTEMS

GMAT 3700

Precise GPS Positioning

Course Outline – Session 2, 2009

Version: 10/7/2009

*This document, and other material, is available at the Course Website:
<http://www.gmat.unsw.edu.au/wang/gmat3700/home.htm>*

(User name and password supplied in class)

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1. Staff involved in the Course and their Contact Details

1.1 Lecturer and Course Convenor: Dr. Jinling Wang (JLW)

Office: EE405 (Whenever present, you may just drop in)
Email: Jinling.Wang@unsw.edu.au
Phone: 9385 4203

1.2 Practical/Computing Supervisor: Nathan Knight

Contact details:

Office: EE402 (Whenever present, you may just drop in)
Phone: 54185
Email: Nathan Knight <z3263690@student.unsw.edu.au>

1.3 Staff absences during session:

Dr. Jinling Wang will be off campus for the periods of 22-25/9/2009. During this period, he can be contacted by email at the above email address.

2. Educational Aspects of the Course

2.1 How this course relates to others in the program

This 6 UoC course is one of the core subjects in the undergraduate program (3741). The course is built upon the second year courses GMAT2130, GMAT2550 and GMAT2700. This course introduces principles of precise GPS positioning, focusing on training skills in analytical thinking, problem solving and team work. This course will lay a foundation for the fourth year course GMAT9211.

This course is jointly taught with GMAT9212 Precise GPS Positioning.

2.2 Aims of the Course

This course aims to introduce you to:

- (a) the basic concepts of precise GPS positioning;
- (b) the practical procedures of establishing GPS control networks;
- (c) the quality analysis of GPS positioning results;
- (d) the concept of legal traceability and testing procedures of precise GPS positioning.

2.3 Learning Outcomes

By the end of this session you should be able to:

- a) Understand the basic principles of precise GPS positioning,
- b) Master the practical elements of planning and executing GPS surveys,
- c) Appreciate the advantages and limitations of the various GPS surveying techniques,
- d) Understand the use of precise GPS surveys in establishing geodetic networks;
- e) Explain the applications and future trends of precise GPS positioning.

2.4 Teaching Strategies

A variety of teaching activities will be conducted to achieve optimal teaching and learning outcomes. Major teaching activities in this course are:

- 1) Regular lectures;
- 2) Tutorials and computing tasks;
- 3) GPS practical;
- 4) Regular quizzes, and discussions on the questions from the quizzes;
- 5) Essay writing;
- 6) Class discussions.

2.5 Suggested Learning Methods

The most important factors in learning are students' commitment and learning methods. You are encouraged to attend all the lectures and other teaching activities. In addition, relevant resources on the web (visit the course website for details) are of great help in understanding the basic concepts discussed in the lectures and the trends in the discipline of surveying and spatial information systems.

Based on some studies by John Biggs, most active students in the class do not just listen, see, collect notes and take notes, but most importantly, they will *“express understanding; raise issues, speculate, solve problems, discuss, answer questions and reflect”*.

In this course, students are encouraged to pay attention to both theoretical and practical aspects of GPS positioning. The concepts and theories involved can be better understood through the practicals and discussions in the class. Students are strongly encouraged to attend all the lectures and do sufficient preparation for class discussions on selected topics.

2.6 UNSW Graduate Attributes

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

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	Significant
the skills to locate, evaluate and use relevant information (Information Literacy)	Some
the capacity for enterprise, initiative and creativity	Minimal
an appreciation of and respect for, diversity	Minimal
a capacity to contribute to, and work within, the international community	Minimal
the skills required for collaborative and multidisciplinary work	
an appreciation of, and a responsiveness to, change	Some
a respect for ethical practice and social responsibility	

2.7 Course Evaluation and Development

The University has implemented a former procedure to collect your feedback on the course through the Course and Teaching Evaluation and Improvement (CATEI) Process.

Feedback from previous years has been considered in the course design in this session. For example, based on the suggestions from S2 2008, the planned improvements for this session are: 1) More time slots are to be scheduled for GPS practicals; 2) More discussions on the detail of the assessment tasks are given in the course outline.

To achieve the optimal teaching and learning outcomes, your feedback on the course and the teaching activities will be periodically gathered during the session, using various means. All the constructive suggestions will be carefully considered during the teaching activities.

3. Proposed Course Schedule

(Any changes will be notified in the class and at the course website).

Week No. (Start Date)	Monday 1-3pm EE418	Monday 3- 4pm EE401A	Thursday 9am -11am (CivEng101)
1 (20 July)	Introduction to the course Lect: GPS positioning and data analysis: An overview	Tut: Matlab and applications in GPS data analysis; GPS data format	Lect/Tut: GPS satellite orbit: Representation and calculations
2 (27 July)	Lect: GPS error sources and DGPS concept; Principle of precise GPS positioning; Baseline concept	<i>Tut: Processing GPS single point positioning data</i>	Lect/Tut: GPS satellite geometry and DOPs
3 (3 August)	Lect: GPS baseline data processing: Modelling concept	<i>Tut: Pseudo-ranges vs. carrier phases</i>	Lect/Tut: Integer ambiguity resolution
4 (10 August)	Lect: Baseline data processing: Data handling/software	<i>Tut: Baseline examples</i>	
5 (17 August)	Lect: GPS surveying: Control network/Planning and field procedures	Tut: Data processing with Leica Geo-office software package	Lect: Analysing quality of GPS baseline results
6 (24 August)	Practical-1: Static baseline surveys	Practical-1: Static baseline surveys	
7 (31 August)	Lect: From baseline to network	Lect: GPS result presentation	Practical-2: GPS control network (from week 7 to week 12)
Break (7-11 September)	Mid-Session Break	Mid-Session Break	
8 (14 September)	Lect: CORS and Network RTK; Precise Point Positioning (PPP)	Tut: Web resources on CORS networks	
9 (21 September)	Tut: Examples of GPS control network (John Ding/Nathan Night)	Essay task on precise GPS (No lecture)	
10 (5 October)	Lect: GPS online data processing (AUSPOS)	Tut: Exercises with AUSPOS	Tut: Comparing online processing packages
11 (12 October)	Lect: GPS testing & 'Best Practice' guidelines	Tut: Preparation for class discussions	
12 (19 October)	Class discussions	Class discussions	Practical Report-2 Due
13 (26 October)	Tut: Reviewing GPS network results	Revision	

4. Assessment in the Course

Assessment for the course includes:

- Essay task 15% (due week 10)
- Mini-quizzes during lectures 10%
- Tutorial submissions 10%
- GPS Practical reports 20% (due week 7/12)
- Class discussion/participation 10%
- Final exam 35% (during the formal exam period)

Mini-Quizzes:

To reinforce the learning experience, mini-quizzes will be given during the lectures. Simple questions will be asked on the material presented in the previous lecturing period.

Class Discussions/Participation:

Students should regularly attend the lectures and participate in class discussions during the lectures. In addition, students are invited to give a short presentation to the class workshop in week 12. The attendance at the scheduled classes is necessary to achieve a satisfactory learning outcome from this course. Both attendance and class discussion are equally assessed.

GPS Practical Reports:

The two GPS practicals are: a) *Static GPS Baseline Survey*; b) *Geodetic GPS Network*. Each student will be a member of a group of 3-4 students to carry out the GPS positioning exercises. Groups will be finalised during the first lecture. Students are free to select their partners. The joint (or individual) submissions for the practicals (require considerable interaction between the students *if applicable!*). Make sure that all field data are copied immediately after the fieldwork, so that all the students in the group have always access to the data. All the practical reports are assessed in terms of: a) Presentation; b) Field Notes and Computations; c) In-depth discussions on relevant issues. Further information about the practicals will be distributed during the lectures, and are available on the class web site. Rules for practicals are given in section 6 below.

The Essay task and Tutorials will be documented separately and distributed to you during the lectures and tutorial sessions. The Essay reports will be evaluated with a detailed marking schedule in three sections: a) Presentation; b) Clarity; c) In-depth discussions on relevant issues. Each tutorial task will come with the specific assessment items.

Final Exam will be in 'closed book' format, but the 'complicated' formulae to be used in the exam will be provided in the examination paper.

All assignments and assessment items 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: 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).</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>

5. Course Resources

5.1 Lecture Material (check the course website):

<http://www.gmat.unsw.edu.au/wang/gmat3700/home.htm>

The Powerpoint lecture slides are available for download as PDF files at the course website. *Electronic resources on the lecture topics are available at the course website.*

5.2 Text and Reference Books

RIZOS C, *Principles and Practice of GPS Surveying*, Monograph No. 17, School of Geomatic Eng., 1997. Also available as a HTML version (updated 1999) at:
http://www.gmat.unsw.edu.au/snap/gps/gps_survey/principles_gps.htm

Electronic resources : check the course website:
<http://www.gmat.unsw.edu.au/wang/gmat3700/home.htm>

You can also obtain assistance from the UNSW Library to seek relevant resources. One starting point for assistance is: <http://info.library.unsw.edu.au/web/services/services.html>. *The class notes, latest journal articles and references will be referred to or distributed during the lectures.*

5.3 Computational Aids

Pocket calculators are required during lectures and tutorials in this course. They have to be hand-held, internally powered and silent.

Computer software relevant to this course and available in the School's computer lab EE401a, includes: Matlab, Leica Geo-office.

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.

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.

Lectures (14 x 2hr)	28hr
Tutorials (8x1hr+3x2hr)	14hr
Class discussions and preparation for discussions (4+6hr)	10hr
GPS Practical	26hr
Preparation of tutorial/essay reports	20hr
Revision of Lectures, background reading (approximately 5hr x 12wk)	60hr
Total	158hr

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. 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.

All assignments or practical reports are compulsory parts of the course and must be handed in by the due date. A mark of zero will be given for any submission which violates this rule. **OR 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/assignment 4 days late has his/her mark reduced by 4 if the maximum mark of the submission is 10.). Any late submission must be made before solutions are issued to the class.

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

Plagiarism is the presentation of the thoughts or work of another as one's own.*

Examples include:

- direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University online resource for staff and student information on plagiarism and academic honesty. It can be located at:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

† Adapted with kind permission from the University of Melbourne.

The School's Plagiarism Statement can be found at:

<http://www.gmat.unsw.edu.au/currentstudents/general/plagiarism.htm>

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

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, however the calculations and reports require individual work. 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 at the briefings. 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.

ISSUING OF EQUIPMENT

During the issue of equipment, a large crowd around the store causes difficulties for everyone, so one group collects their equipment and the remaining groups should stand well back. A group is responsible for all equipment issued to it, with the student signing for the equipment as the representative.

1. *You should first inspect all equipment and make sure that it is in working order, otherwise you will be held responsible.* When returning equipment at the end of the field class, it should be handed back to the Stores Officer, piece by piece, so that he can check it off. Not until all your equipment has been returned and signed off, does your responsibility end.
2. ***It is not sufficient to leave the equipment near the store and depart.***
3. ***Any equipment lost or damaged will have to be paid for by the group.*** In the field, there is less danger of losing items if everything is laid close to an instrument box or in a group where pedestrians can safely bypass it.

INSTRUMENTS

The equipment used in surveying is sometimes delicate and often valuable (> \$10,000). Please make sure that you take due care of the equipment and give some thought to the way in which you handle it. The staff member in charge of your class will give detailed instructions about its use. *Theodolites and electronic tacheometers*, have fragile optical mechanical and electronic components and are delicately adjusted. ***Shut instrument boxes immediately after removing/replacing the instrument.*** Carrying theodolites (on tripods) over the shoulder will not

be tolerated in this School. Do not force any parts to move, check whether clamps are set, and do not over tighten clamps.

IN THE PUBLIC EYE

It is hoped that students taking part in surveying practicals on the campus will create a favourable impression on passers-by, **so behave like professionals**. The field classes give you an opportunity to handle interesting equipment and should be a welcome break from lectures. It is hoped you find them enjoyable as well as instructive.

Students should not normally leave the field work location during the practical sessions. However students leaving the field for short periods must ask another student to look after their equipment and must inform the student (and the supervisor, if present) of their time of return. No equipment is to be left unattended in the field at any time.

SUBMISSION OF REPORTS ON PRACTICAL WORK

Time: Reports may be submitted at any time prior to the due date. **Late submissions may not be marked**, unless accompanied by an appropriate reason. Reports should be submitted to your practical supervisor.

Contents of Reports: Your report should have a front/title page, then a summary of results page, then the rest of the report including computations and plans. Reports may consist of original field notes or a photocopy of the originals, but not rewritten field notes. The requirements for each practical will be discussed at the briefings before the practicals, if in doubt ask the supervisor. The front cover of all submissions should include: Course No. and Name, Group number and names of students in the group, Title of Exercise

Field Notes: All field notes must be recorded on proper field sheets available from the Store except for exercises where forms are supplied. On the first page of your notes for a particular exercise the following information should be given: Title of Exercise, Date, Names of students present in the group, Instrument number and Make of instruments used

Field notes should be written in neatly, not overcrowded and pencils are recommended. Use tabular form where possible and draw neat sketches or diagrams where applicable. You should include a locality sketch plan. Overwriting is not permissible in the field sheets and wrong figures or words should be crossed and the true one written above it and initialled by the booker whose name must appear at the top of each page. At the end of the exercise **original field notes** should be presented to a supervisor for signature.

Computations: Computations must be done individually by every member of the group. The Group No., Name of a student, Date of exercise and Title of exercise should be shown. There is no need to show in the computation sheet all observed quantities as they are in the field notes. Tabular form must be used as much as possible. Formulae used must be shown, and symbols or letters used explained.