



THE UNIVERSITY OF  
NEW SOUTH WALES  
SYDNEY · 2052 · AUSTRALIA

**SCHOOL OF SURVEYING & SPATIAL INFORMATION SYSTEMS**

## **GMAT 9211**

# **MODERN GEODESY AND APPLICATIONS**

### **Course Outline – Session 2, 2009**

Version: 10/07/2009

*This document, and other material, is available at the Course Website:  
<http://www.gmat.unsw.edu.au/wang/gmat9211/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 Convener: Dr. Jinling Wang (JLW)

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

### 1.2 Guest Lecturers:

Prof Chris Rizos (CR) and other invited speakers from industry/government/academia.

### 1.3 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 period of 22-24/9/2009. 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 elective courses for the postgraduate coursework programs within the School of Surveying and Spatial Information Systems. This course is also an advanced elective subject in the undergraduate program. It is based on the concepts learned and the skills gained in other courses in the undergraduate program. Major topics of this course have close connections with the subjects GMAT2700, GMAT3700 and GMAT9205. This course will focus more on the modern geodetic techniques as well as the three pillars of geodesy.

### 2.2 Aim of the Course

This course aims to introduce you to (1) the fundamentals and modern concerns of geodesy, (2) the concepts and computations in gravimetry and geoid determination, (3) recent developments in, and applications of, global and satellite geodesy.

### 2.3 Learning Outcomes

By the end of this session you should be able to

- a) Understand the basic concepts and classification of geodesy;
- b) Explain the basic steps for gravity survey and geoid determination;
- c) Describe the principles of major modern geodetic techniques: satellite altimetry, airborne and satellite gravimetry, SLR/VLBI/DORRIS, Galileo/Glonass/Compass;
- d) Apply the practical procedures of GPS heighting;
- e) Appreciate the advantages and limitations of the various global/satellite geodetic techniques;
- f) Explain the trends in modern geodesy (such as GGOS);
- g) Locate and use web-based resources for selected topics in geodesy.

### 2.4 Teaching Strategies

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

- 1) Regular lectures
- 2) Tutorials and computing tasks

- 3) Invited lectures given by professionals from industry/government agencies
- 4) Class discussions
- 5) Regular quizzes and discussions on the questions from the quizzes
- 6) Essay writing

This course will provide students with significant reading materials from a range of topics in modern geodesy.

## 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.

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

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 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	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	Some
a capacity to contribute to, and work within, the international community	
the skills required for collaborative and multidisciplinary work	Some
an appreciation of, and a responsiveness to, change	
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) Increase some hands-on lab work, including some data analysis; 2) Restructure the assessment tasks to reduce the number of the summary reports from the tutorials.

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)	Thursday 2:00pm – 4:00pm ChemScM17, Lectures	Thursday 4:00pm - 5:00pm EE401A, Tutorials
1 (20 July)	Course Outline; Modern geodesy: an overview	Web-based resources on geodesy
2 (27 July)	Fundamentals of physical geodesy	Characteristics of surface spherical harmonics in geopotential model
3 (3 August)	Geoid Determination	Practicing geoid computations with software packages
4 (10 August)	GPS heighting	Error analysis for GPS heighting
5 (17 August)	Airborne and satellite gravimetry	Web-based resources on geoid determination
6 (24 August)	Satellite orbit determination	Classifications and applications of GNSS based satellite orbit determination;
7 (31 August)	Satellite altimetry	Web-based resources on satellite altimetry
Break (7-11 September)	<b>Mid-Session Break</b>	<b>Mid-Session Break</b>
8 (14 September)	SLR/DORIS and VLBI	Web-based resources on VLBI/SLR/DORIS
9 (21 September)	Preparation on Class Discussions (No lecture)	Essay Report Due.
10 (5 October)	<i>New Global Navigation Satellite Systems (GNSS): Galileo/Glonass/Compass</i>	Applications of modern IGS products
11 (12 October)	International GNSS Services (IGS)/Modern geodetic infrastructure/Global Geodetic Observing System -GGOS (CR)	Web-based resources on GGOS
12 (19 October)	<i>Class Discussions (presentations)</i>	Revision
13 (26 October)	Tut: Reviewing the GPS heighting results	Revision

**\*During the tutorials, students will use the internet to search for electronic resources and discuss on the lecture topics; will prepare a summary of their findings/understanding on the assigned topics in small groups.**

#### 4. Assessment in the Course

Assessment for the course includes:

- Essay task 15% (due week 9)
- Class discussion/participation 10%
- Tutorial submissions 20%
- Mini-quizzes during lectures 10%
- Assignment on GPS heighting 10% (due week 7)
- Final exam 35% (during the formal exam period)

##### **Mini-Quizzes:**

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

##### **Class Discussions/participation:**

Students should regularly attend the lectures and participate actively in class discussions during the lectures. In addition, students are invited to give a presentation to the class during the session and the scheduled class discussions in week 12. The scheduled class discussions aim (a) to extend the scope of the contents provided in the lectures; (b) to advance your ability for independent learning and critical analysis; (c) to provide an opportunity for developing your presentation skills. At least 80% attendance at the scheduled classes is necessary to achieve a satisfactory learning outcome from this course. Both attendance and class discussion are equally assessed.

**The Essay Task, Tutorials and GPS heighting assignments** will be documented separately and distributed to you during the lectures/tutorial sessions. *The Essay and tutorial reports will be evaluated in terms of: a) Presentation; b) Clarity; c) In-depth discussions on relevant issues.*

**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:</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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## 5. Course Resources

### 5.1 Lecture Material (check the course website):

<http://www.gmat.unsw.edu.au/wang/gmat9211/home.htm>

The Powerpoint lecture slides are available for download as PDF files at the course website. The lecture material will be **supplemented** by electronic resources on the web, such as:

What is Geodesy? [http://www.geod.nrcan.gc.ca/geodesy/index\\_e.php](http://www.geod.nrcan.gc.ca/geodesy/index_e.php)

IAG Geoid Resources [http://op.gfz-potsdam.de/iagwg/WG\\_links.html](http://op.gfz-potsdam.de/iagwg/WG_links.html)

International Earth Rotation Service (IERS) : <http://www.iers.org/>

The International Terrestrial Reference Frame ITRF: <http://lareg.ensg.ign.fr/ITRF/>

International VLBI Service for Geodesy and Astrometry: <http://ivscc.gsfc.nasa.gov/>

International Laser Ranging Service: <http://ilrs.gsfc.nasa.gov/>

International DORIS Service (IDS): <http://ids.cls.fr/welcome.html>

International GNSS Service: <http://igscb.jpl.nasa.gov/>

Russian Official GLONASS website: <http://www.glonass-ianc.rsa.ru>

Technical Materials on GPS/Glonass:

<http://www.topcon.com.au/gps/GPSGLONASS.htm>

<http://www.oso.chalmers.se/~geo/glonass.html>

History of Com. on Int. Coordination of Space Techniques for Geodesy and Geodynamics:

<http://www.gfy.ku.dk/~iag/cstg.html>

United Nations Office for Outer Space Affairs <http://www.oosa.unvienna.org/index.html>

More web-based resources are listed at the course website:

<http://www.gmat.unsw.edu.au/wang/gmat9211/home.htm>

Additional materials will be provided during the lectures.

### 5.2 Text and Reference Books

Torge W. (2001) Geodesy, Walter de Gruyter, Berlin (3rd Edition), 416pp.

Kearsley W. (1997) Gravimetric Geoid Heights and GPS Heighting, Lecture Notes, UNSW.

Seeber, G. (1993). Satellite Geodesy, Walter de Gruyter, Berlin, 531pp.

Stolz, A. (1994). An Introduction to Geodesy, Monograph 16, School of Geomatic Engineering, The University of New South Wales, Sydney, Australia, 122pp.

Lambeck K. (1988). Geophysical Geodesy: The Slow Deformations of the Earth, Clarendon Press, Oxford, 718pp.

Mueller, I. I. and S. Zerbini (1989). The Interdisciplinary Role of Space Geodesy. Springer-Verlag, Berlin Heidelberg, New York, London, Paris, Tokyo, Hong Kong, 300pp.

Sanso, F. and Rummel, R. (1989). Theory of Satellite Geodesy and Gravity Field Determination, Springer-Verlag, Berlin Heidelberg, 491pp.

**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>

### 5.3 Computational Aids

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

Computer software relevant to this course and available in the School's computer lab EE401a, includes: Grav (for geoid determination). The instructions for the use of this software will be available at the course website

## 6. Administrative Matters

### 6.1 Expected work load

*At UNSW, the normal workload expectations of a student are 24-26 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/tutorials (11 x 3hr)	33hr
Class discussions (week 12, 3hr + preparation, 12hr)	15hr
GPS heighting Assignment	10hr
Essay Task	26hr
Revision of Lectures, preparation of tutorial reports, background reading (approximately 6hr x 12wk)	72hr
Total	156hr

### 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](http://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.