GMAT9205 FUNDAMENTALS OF GEO-POSITIONING

Semester 1, 2016

Never Stand Still | Faculty of Engineering | School of Civil and Environmental Engineering

COURSE DETAILS

Units of Credit	6
Contact hours	3 hours per week
Class	Wedneday: 10:00am - 12:00pm Mathews 307
Exercises	Wedneday: 12:00pm – 1:00pm CE 201
Course Coordinator and Lecturer	Associate Professor Jinling Wang email: jinling.wang@unsw.edu.au office: CE413, Civil Engineering Building phone: 9385 4203

INFORMATION ABOUT THE COURSE

This 6 UoC course is one of the core/compulsory subjects in the MEngSc specialisations: such as, Geospatial Engineering (e.g., 8338) and GeoInformation Technology (e.g., 8538/8539). This course introduces basic knowledge of geo-positioning to support your studies in other courses within these specialisations, such as GMAT9600, GMAT9211, GMAT9212, etc. This course will also provide a foundation for postgraduate research programs in the areas of surveying, satellite navigation, geodesy and geospatial technology.

HANDBOOK DESCRIPTION

Basic concept of geodesy, fundamentals of positioning, Cartesian and geodetic coordinate systems and datums for spatial information applications, including mathematical conversions between geodetic, Cartesian and topocentric coordinate systems, basic ellipsoid geometry, and transformations between national and international datums. Orthometric and ellipsoid height systems, and geoid models for height transformations. Principles and classifications of map projections and the Universal Transverse Mercator (UTM) projection in particular. Emphasis on Australian datums and projections: AGD/AMG, GDA/MGA and AHD. Fundamentals of Global Navigation Satellite Systems (GNSS) and their applications in geopositioning. Introduction to principles of geopositioning using GPS/GNSS techniques. Geo-referencing of space/airborne and land-based spatial information acquisition systems. Lectures complemented with class discussions, lab computations, and field exercises in the use of GPS/GNSS equipment.

See link to virtual handbook as

http://www.handbook.unsw.edu.au/postgraduate/courses/2016/GMAT9205.html

OBJECTIVES

The objectives of this course are

(a) to enhance your knowledge and skills in surveying and geospatial technology gained in previous studies and professional practices;
(b) to introduce you to the basic concepts of positioning and geodesy;
(c) to extend your knowledge base to the areas of ccoordinate reference systems, geospatial reference frames/datums, and map projections,
(d) to provide you with the concept and theory of satellite-based precise positioning and applications;
(e) to provide an environment that fosters in our students the following attributes:

Attributes	Related to this course
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	Minimal
an appreciation of and respect for, diversity	
a capacity to contribute to, and work within, the international community	Minimal
the skills required for collaborative and multidisciplinary work	Minimal
an appreciation of, and a responsiveness to, change	
a respect for ethical practice and social responsibility	
the skills of effective communication.	Significant

More details on how the teaching and learning activities in this course are linked to each of these attributes will be discussed in classes.

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) Exercises and computing tasks;
3) GPS/GNSS practical;
4) Regular quizzes, and discussions on the questions from the quizzes;
5) Essay writing;
6) Class discussions.

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 a higher education research expert 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"*.

Students are strongly encouraged to do sufficient preparation for class discussions on selected topics.

An example of the approaches to learning is:

Lectures	• Find out what you must learn • See methods that are not in the textbook • Follow worked examples
Visit Sydney Observatory	• Familiarise the history of the timing and navigation; • Ask questions on the invited talks • Reflect on the evolution of timing and reference frames
GPS/GNSS Practical	• Understand the concepts through hands-on work, • Set studies in context • Demonstrate data analysis and presentation skills
Exercises	• Practice solving set problems • Ask questions
Assessments (quizzes, hand-in exercises, reports etc.)	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Private Study	• Review lecture material and textbook • Do set problems and assignments • Reflect on class problems and assignments

EXPECTED LEARNING OUTCOMES

By the end of this Semester you should be able to

1) Describe the basic concepts of geo-positioning and geodesy;
2) Explain coordinate reference systems and datums for spatial information and mapping applications;
3) Master map projection concepts, and understand the Universal Transverse Mercator (UTM) projection in particular;
4) Explain the principles of GPS/GNSS positioning methods;
5) Appreciate the role of geo-positioning in spatial information collection.

At UNSW, the normal workload expectations of a student are 24-28 hours per semester for each unit of credit, including class contact hours, preparation and time spent on all assessable work.

For each hour of contact it is expected that you will put in at least 2.5 hours of self-centred and self-directed study: for example, reading the course related materials provided through the course website and reflect on the conceptual framework discussed in the classes.

ASSESSMENT

Assessment for this course includes:

- Mini-quizzes/Exercises 25%
- Essay task 10% (due week 7)
- GPS/GNSS practical report 15% (group submissions, due week 11)
- Class discussion/participation 10%
- Final Exam 40% (during 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.

GPS/GNSS Practical Report
Each student will be a member of a group of 4-6 students to carry out the GPS/GNSS positioning exercises. The joint submission for the GPS/GNSS practical report requires considerable interaction between the students. Further information about the practical will be distributed during the lectures. All the practical reports are assessed in terms of: 1) Presentation; 2) Field Notes and Computations; 3) In-depth discussions on relevant issues.

***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 short presentation to the class workshop in Week 12. The attendance at the scheduled classes (including practicals) is necessary to achieve a satisfactory learning outcome from this course.

The Essay Task and **Exercises** will be documented separately and distributed to you during the lectures and laboratory exercises sessions. *Any changes to the above assessment arrangement will be notified in the class and will also be updated at the course website*. *All the marking schedules will be explained to the class.*

Final Exam will be of 2 hours duration, and will be held in the formal examination period, in 'closed book' format, but the 'complicated' formulae to be used in the exam will be provided in the examination paper. The formal exam scripts will not be returned.

Students who perform poorly in the mini-quizzes and exercises are recommended to discuss progress with the lecturer during the semester.

Note:

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. Otherwise, the marks for late submissions will be reduced: -10% (of the maximum mark) for each day late.

COURSE PROGRAM

(The time slots for **invited lecture/visiting Sydney Observatory/GPS Practical** as well as any other changes will be notified in the class and at the course website).

SEMESTER 1, 2016

Week	Date	Lecture Topics	Lab/Exercises Topics	Assignment Due
1	29 February	Positioning concept; Introduction to geodesy; Discussions	Web-resources on geodesy	
2	7 March	Coordinate reference systems	Geodesy and earth motion	
3	14 March	Reference frames and geodetic datums	Essay task	Quiz 1
4	21 March	Coordinate transformations	Coordinate transformations	
Break		***Mid-Semester Break***	***Mid-Semester Break***	
5	4 April	No class for PG students	No class for PG students	
6	11 April	Earth's gravity field; geoid and height systems	Gravity	Quiz 2
7	18 April	Principles and classifications of map projection; Basic theory of map projections; Universal Transverse Mercator (UTM) projection	Coordinate transformation between GDA and MGA	Essay Report
8	25 April	Introduction to GPS/GNSS; Single pint positioning/differential positioning methods	Least-squares and GPS/GNSS Positioning; GPS/GNSS Equipment Demonstration	
9	2 May	Precise GPS/GNSS positioning	Comparing GPS/GNSS pseudorange and carrier phases in geo-positioning	Quiz 3
10	9 May	GPS/GNSS Practical (time slots are to be rescheduled for individual groups)	GPS/GNSS Practical (time slots are to be rescheduled for individual groups)	
11	16 May	No class (this time slot re-scheduled for Visit to Sydney Observatory on one of the Fridays)	No class (this time slot re-scheduled for Visit to Sydney Observatory on one of the Fridays)	GPS/GNSS Practical Report
12	23 May	Geo-referencing spatial information acquisition systems; Demonstration.	Class Discussions	
13	30 May	Modern trends in geo-positioning and geospatial mapping; Class Discussions	Analysing GPS/GNSS Practical Results/ Revision	

RELEVANT RESOURCES

Lecture Materials

The course materials will be available through "Moodle": http://moodle.telt.unsw.edu.au/

The Power Point 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.

The class notes, latest journal articles and references related the course topics will be referred to and/or distributed during the lectures.

Text and Reference Books

Rizos C. (1997) *Principles and Practice of GPS Surveying*, Monograph No. 17, School of Surveying and Spatial Information Systems, UNSW. Online at: **http://www.gmat.unsw.edu.au/snap/gps/gps_survey/principles_gps.htm**

Bossler, J., Jenson, J., Mcmaster, R., & Rizos, C. (eds.) (2002). *Manual of Geospatial Science and Technology*. Taylor & Francis Inc., ISBN 0-7484-0924-6, 623pp.

Mather, R.S. (1972) *The Theory and Geodetic Use of Some Common Projections*, Monograph 1, School of Surveying & Spatial Information Systems, UNSW.

Stolz, A. (2001) *An Introduction to Geodesy*, Monograph 16, School of Surveying & Spatial Information Systems, UNSW.

Computational Aids

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

Computer software relevant to this course and available in the School's computer lab CE201, includes: Matlab or MicroSoft Excel, which will be used for exercises and GPS practical reports, see the practical instructions for details.

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 assignments and 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

(Formerly known as Common School Information)

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations,
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

Refer to Academic Advice on the School website available at:

http://www.engineering.unsw.edu.au/civil-engineering/resources/academic-advice