School of Civil and Environmental Engineering

Term 3, 2021

# GMAT 9600 PRINCIPLES OF REMOTE SENSING

## COURSE DETAILS

| | | |
|---|---|---|
| **Units of Credit** | 6 | |
| **Contact hours** | 3 hours per week | |
| **Lecture** | Wed 4:00PM - 7:00PM | Online |
| **Course Coordinator and Lecturer** | Professor Linlin Ge<br>Email: L.GE@UNSW.EDU.AU<br>Office: Civil Engineering 414<br>Phone: 9385 4177 | |
| **Guest Lecturer** | Dr Patrick (Zheyuan) Du<br>Email: zheyuan.du@geos.org.au | |

## INFORMATION ABOUT THE COURSE

This course will focus on the theory and physics of remote sensing. Various remote sensing techniques such as optical and radar are discussed throughout the course.

Remote sensing is one of the most important spatial information systems which can efficiently gather information essential for decision making. This course is included to enable students to develop particular communications skills that will enhance their practice as a geo-spatial specialist and surveyor. It reflects my position that their practice within the field will require advanced levels of communication to enable ongoing development of cost-effective mapping and planning for a sustainable environment.

On the other hand, GPS and other ground survey techniques play very important roles in georeferencing remote sensing imagery and validating remote sensing results. Therefore, GMAT9600 has close relationship to courses such as

- GMAT3500 Remote Sensing and Photogrammetry,
- GMAT3200 Geospatial Information Techniques and Applications, and
- GMAT4900 Principles of GNSS Positioning.

## HANDBOOK DESCRIPTION

See link to virtual handbook*:*

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/GMAT9600/

## OBJECTIVES

This course will enable students to explore and gain further understanding of remote sensing for earth

observation through the investigation of satellite remote sensing data with a direct emphasis of their application to real world situations in the field of mapping and environmental monitoring.

The course will address the following programme attributes:

- An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context
- Capacity for analytical and critical thinking and for creative problem solving
- Ability to engage independent and reflective learning
- Information literacy
- Skills for collaborative and multi-disciplinary work
- A respect for ethical practice and social responsibility
- Skills for effective communication

## TEACHING STRATEGIES

A variety of teaching activities will be conducted to maximize teaching and learning outcomes, including:

- lectures are delivered as interactively as possible using PPT slides and animations.
- **quizzes are scheduled almost weekly to enhance learning.**
- workshops are used to supplement lectures with further details and to assist students from non spatial information background.
- lab exercises are used to give students the opportunity to apply remote sensing theory to real data.
- assignments are included to reinforce learning.

Students are strongly encouraged to attend all lectures and prepare for class discussions on selected topics.

Below are some suggested approaches to learning in the course.

| | |
|---|---|
| **Private Study** | • Preview lecture material and textbook<br>• Review lecture material and textbook<br>• Do set problems and assignments<br>• Join Moodle discussions of problems<br>• Reflect on class problems and assignments<br>• Download materials from Moodle<br>• Keep up with notices and find out marks via Moodle |
| **Lectures** | • Find out what you must learn<br>• See methods that are not in the textbook<br>• Follow worked examples<br>• Hear announcements on course changes |
| **Workshops** | • Be guided by Demonstrators<br>• Practice solving set problems<br>• Ask questions |
| **Assessments** | • Demonstrate your knowledge and skills<br>• Demonstrate higher understanding and problem solving |

| | |
|---|---|
| **Laboratory Work** | • Hands-on work, to set studies in context |

## EXPECTED LEARNING OUTCOMES

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

| | Learning Outcome | EA Stage 1 Competencies |
|---|---|---|
| 1. | Investigate remote sensing options for identified applications, | *PE1.1, PE1.2, PE1.3, PE1.4, PE3.4* |
| 2. | Apply theory to the implementation of the chosen option, | *PE1.5, PE2.1, PE2.3, PE3.3, PE3.5* |
| 3. | Appreciate the complementary nature between remote sensing, GIS and surveying, | *PE1.3, PE1.4, PE1.5* |
| 4. | Undertake basic data analysis, and | *PE1.2, PE2.2* |
| 5. | Create digital maps. | *PE2.2, PE3.2, PE3.4* |

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

## COURSE PROGRAM

**Term 3 2021**

| Date | Lecture Content (by Linlin Ge unless specified) | Demonstration/ lab Content |
|---|---|---|
| 13/09/2021 (Week 1) | Introduction to Course; Introduction to Earth Observation/Remote Sensing | |
| 20/09/2021 (Week 2) | Electromagnetic Radiation – Definition & Physics | Lab demonstration: DInSAR data analysis |
| 27/09/2021 (Week 3) | Spectral Reflectance and Atmospheric Attenuation | |
| 04/10/2021 (Week 4) | Radar Background and Surface Interaction; Interferometric Synthetic Aperture Radar | |
| 11/10/2021 (Week 5) | Electro-optical Sensors (1) (by Dr Patrick Du) | Assignment / lab 1 – radar application |
| 18/10/2021 (Week 6) | ***Flexibility week for all courses (non-teaching)*** | |
| 25/10/2021 (Week 7) | Electro-optical Sensors (2) (by Dr Patrick Du) | |
| 01/11/2021 (Week 8) | Thermal Infrared Sensing | Assignment / lab 2 – optical application |
| 08/11/2021 (Week 9) | Laser Scanning, Remote Sensing & GIS | |

| | | | |
|---|---|---|---|
| 15/11/2021<br>(Week 10) | | Revision, course summary | |

## ASSESSMENT

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below.

| Assessment task | Length | Weight | Due date |
|---|---|---|---|
| Quizzes | Various | 20% | As instructed |
| Lab exercise | 2 hours | 10% | 5pm Monday Week 4 |
| Assignment 1 – radar application | 2 weeks | 20% | 5pm Monday Week 7 |
| Assignment 2 – optical application | 2 weeks | 20% | 5pm Monday Week 10 |
| Final Exam | 2 hours | 30% | In the formal exam period |

**Assessment Criteria:** *The course learning outcomes include a significant level of technical learning, calculations, and engineering understanding of problems. These outcomes can be effectively and ideally assessed in an exam environment that can reflect the students' understanding of concepts, and the students' abilities to make decisions and solve problems within limited time. You need to score at least 40% in the final exam to be able to pass the course.*

*Students who perform poorly in the quizzes and lab assignments are recommended to discuss progress with the lecturer during the term. Note: The lecturer reserves the right to adjust the final scores by scaling if agreed by the Head of School.*

Supplementary Examinations for Term 3 2021 will be held on Monday 10 January – Friday 14 January 2022 (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

## PENALTIES

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 workshops 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.**

## RELEVANT RESOURCES

The course will be mainly based on PDF files of Powerpoint lecture slides available at the course Moodle site.

The material will be uploaded week by week.

The following are recommended reading materials:

1. CCRS website: https://www.nrcan.gc.ca/maps-tools-and-publications/satellite-imagery-and-air-photos/tutorial-fundamentals-remote-sensing/9309
2. “Principles of Remote Sensing”, Paul J. Curran. London; New York : Longman, 1985.
3. “Physical Principles of Remote Sensing”, William.G. Rees. Cambridge, U.K.; New York, NY : Cambridge University Press, 2001.
4. The UNSW Library website: http://info.library.unsw.edu.au/web/services/services.html

## 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

## ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Academic Advice on the School website available at:

https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw

**Appendix A: Engineers Australia (EA) Competencies**

*Stage 1 Competencies for Professional Engineers*

| | **Program Intended Learning Outcomes** |
|---|---|
| **PE1: Knowledge and Skill Base** | PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals |
| | PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing |
| | PE1.3 In-depth understanding of specialist bodies of knowledge |
| | PE1.4 Discernment of knowledge development and research directions |
| | PE1.5 Knowledge of engineering design practice |
| | PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice |
| **PE2: Engineering Application Ability** | PE2.1 Application of established engineering methods to complex problem solving |
| | PE2.2 Fluent application of engineering techniques, tools and resources |
| | PE2.3 Application of systematic engineering synthesis and design processes |
| | PE2.4 Application of systematic approaches to the conduct and management of engineering projects |
| **PE3: Professional and Personal Attributes** | PE3.1 Ethical conduct and professional accountability |
| | PE3.2 Effective oral and written communication (professional and lay domains) |
| | PE3.3 Creative, innovative and pro-active demeanour |
| | PE3.4 Professional use and management of information |
| | PE3.5 Orderly management of self, and professional conduct |
| | PE3.6 Effective team membership and team leadership |