

MACQUARIE UNIVERSITY
DEPARTMENT OF EARTH & PLANETARY SCIENCES

GEOS305: ENVIRONMENTAL AND GROUNDWATER GEOPHYSICS

2nd SEMESTER 2011

UNIT OUTLINE

INTRODUCTION

This unit will cover the geophysical techniques used for the study of the near surface environment, and discuss the application of these methods to environmental problems, to groundwater search and evaluation, and to geotechnical and engineering assessments. The theory, field procedures, interpretation and applications of the major methods in current use will be discussed with particular reference to Australian conditions. This will include high-resolution seismic reflection and refraction techniques and seismic tomography, gravity and magnetic methods, electrical and electromagnetic methods (including ground penetrating radar), and borehole techniques. Exercises involving data reduction and interpretation will be used to show the practical aspects of many of the techniques. The field excursion will provide experience in the collection of several types of data. The data collected will be reduced and interpreted with the aid of computer programs, and used as the data basis for a field report.

LECTURERS.

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Mark Lackie is the Unit Convenor for GEOS305. Queries regarding the unit and its operation should be directed to him.

UNIT ORGANISATION

Credit Points: 3

Please note that in 2009, this unit ran as a 4 cp unit, GEOS315.

Prerequisites: GEOS205 or GEOS268

Lectures are held on **Monday mornings from 10 am - Noon** and practicals will be held either on **Monday afternoon from 2 pm to 5 pm** or **Wednesday morning from 10 am - 1 pm**.

Invited experts from the geophysical consulting industry and government research institutions will contribute to specific topics. The majority of practical exercises will involve geophysical data reduction and interpretation, but it is planned to schedule some laboratory and on-campus field experiments during the semester.

FIELD EXCURSION

The five-day field excursion will take place during the mid-semester break at a location that has yet to be decided. The field site may be close to Sydney and thus we will be able to commute to the site daily or it may be away from Sydney and we will need to travel to the area and stay in the area, thus there may be accommodation costs. Please be prepared for both options. I will let the class know the field area as soon as possible. The **excursion is scheduled from Monday the 26th of September to Friday the 30th of September**, and attendance is compulsory, so you will need to keep these dates clear. During the field trip, geophysical equipment commonly used for groundwater, environmental and engineering surveys is deployed and real data will be collected. An individual comprehensive field report has to be written by each student and submitted for assessment. **The due date for submitting the field report is the 11th of November 2011.** No report will be accepted after the due date, except in extreme circumstances such as illness.

KEY LEARNING OUTCOMES

The key learning outcomes for this unit are:

1. understanding of the basic concepts of environmental and groundwater geophysics;
2. gaining experience in operating geophysical equipment;
3. understanding scientific methodology;
4. competence in accessing, using and synthesising appropriate information;
5. application of knowledge to solving problems and evaluating ideas and information; and
6. capacity to present ideas clearly with supporting evidence.

GRADUATE CAPABILITIES

Students will enter a globalizing world of major environmental change and resource constraints, of scientific and technological advance and ethical challenge, of continuing political instability and possible international conflicts, of unlimited creativity and increasing social surveillance. To prepare students for life after university, various graduate capabilities are developed through the curriculum. These capabilities are described below.

No.	Capability	Brief Description
1	<i>Discipline Specific Knowledge and Skills</i>	Graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession.
2	<i>Critical, Analytical and Integrative Thinking</i>	Graduates are to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments.
3	<i>Problem Solving and Research Capability</i>	Graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge.

4	<i>Creative and Innovative</i>	Graduates will be capable of creative thinking and of creating knowledge.
5	<i>Effective Communication</i>	Students develop the ability to communicate and convey their views in forms effective with different audiences.
6	<i>Engaged and Ethical Local and Global citizens</i>	Graduates will have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy.
7	<i>Socially and Environmentally Active and Responsible</i>	Graduates to be aware of and have respect for self and others.
8	<i>Capable of Professional and Personal Judgement and Initiative</i>	Graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement.
9	<i>Commitment to Continuous Learning</i>	Graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake.

UNIT ASSESSMENT

The final assessment will consist of four components:

- (1) **One assignment** will be given to you during the semester. It will consist of questions relating to the topics covered in the first part of the semester and will include questions on both the theoretical and practical aspects of the unit material. The **due date is the 12th of September 2011**.
- (2) Each student has to select a topic relevant to the unit on which a 10-15 minute long **oral presentation** must be given during the class hours. A selection of topics is given at the beginning of the unit.
- (3) A **field report** must be submitted.
- (4) There will be a **final two-hour examination** held during the examination period in November/December. It will consist of a choice of questions to be answered in essay style.

The assessment proportions are as follows:

oral presentation	10%
one assignment	15%
field report	30%
final examination	<u>45%</u>
	100%

To achieve a passing grade in the course you must satisfy the following requirements:

- (i) Attendance and satisfactory performance at the field excursion and attendance at the final examination.
- (ii) Give an oral presentation.
- (iii) Submit a field report.

The unit will be assessed as follows:

Task	Weight	Due Date	Linked Learning Outcomes	Linked Graduate Capabilities
Oral Presentation	10%	See schedule	3,4,6	1,3,5,9
Assignment 1	15%	12/9/11	1,4,5,6	1,2,3,5,9
Field Report	30%	11/11/11	1,2,3,4,5,6	2,3,4,5,8,9
Final Examination	45%	November	1,3,4,5,6	1,2,3,5

DESIRED STANDARDS

Grade	Standard Required
High Distinction	Demonstrates an extensive knowledge and understanding of the concepts of the course. Analysis skills are very sophisticated with a balance of individual components and larger ideas. Capable of generalising from examples and evaluating ideas.
Distinction	Demonstrates a thorough knowledge and understanding of the concepts of the course. Analysis skills are sophisticated with a balance of individual components and larger ideas. Capable of generalising from examples and evaluating ideas.
Credit	Demonstrates a sound knowledge and understanding of the concepts of the course. Can break down complex problems into components and synthesise multiple factors into a larger idea. Can evaluate the importance and limitations of data.
Pass	Demonstrates a basic knowledge and understanding of the concepts of the course. Analysis is mainly descriptive. Demonstrates limited capacity to identify complex factors within an idea or to combine multiple factors.
Conceded Pass (sorry in 2011 this means you failed)	Demonstrates a limited knowledge and understanding of the concepts of the course. Analysis is mainly descriptive. Demonstrates very limited capacity to identify complex factors within an idea or to combine multiple factors
Fail	Demonstrates a poor knowledge and understanding of the concepts of the course. Analysis skills are very limited.

TEXTBOOK AND TECHNOLOGY USED

The textbooks to consider for the unit are SHARMA (Environmental and Engineering Geophysics, 1997) and REYNOLDS (An Introduction to Applied and Environmental Geophysics, 1997), because they cover all the major geophysical topics with an emphasis on environmental geophysics. As well, you will also need a copy of the unit CD, which I will hand out during class. The CD contains all of the iLectures and associated lecture notes used during lectures in GEOS315 from when the unit was taught in 2009, with modified and updated sections. Some additional material, i.e. for case histories, will be handed out during classes.

All additional material will be placed on the unit's WEB page, which can be found through the Online Learning @ MQ WEBSITE at <http://learn.mq.edu.au/>. Students are advised the monitor it for any extra material. It is recommended that you acquire a geophysical text to supplement and expand the information within the booklet and WEB pages. At the start of the year you should be issued with a username and password to access all your unit WEB pages, this will get you into the front page of the GEOS315 WEB page. Please note that some sections within the WEB page require an internal username and password; the username is **geos315** and please see, or call me to obtain the password.

Information for students about access to online units is available at <https://learn.mq.edu.au/webct/RelativeResourceManager/25994001/Public%20Files/uw/software.html>

A list of other texts and references is attached.

EXTENSIONS AND PENALTIES:

Whenever possible requests for an extension should be submitted prior to an assignment's due date. Late assignments will be date stamped and a penalty of initially 10% and then 5% per day (Monday to Friday) will be deducted from the total mark.

ACADEMIC HONESTY AND PLAGIARISM.

Plagiarism involves using the work of another person and presenting it as one's own. If you use the work of another person without clearly stating or acknowledging the source, you are falsely claiming that material as your own work and committing an act of **PLAGIARISM**. This is a very serious violation of good practice and an offence for which you will be penalised. You should read the University's policies and procedures on plagiarism. These can be found at: http://www.mq.edu.au/policy/docs/academic_honesty/policy.html

The policies and procedures explain what plagiarism is, how to avoid it, the procedures taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

As such, all assignments must have a signed "Faculty of Science" (FoS) assignment cover sheet attached. These sheets are available from the Science centre or from the FoS WEB page.

UNIVERSITY POLICIES

Macquarie is developing a number of policies in the area of learning and teaching. Approved policies and associated guidelines and procedures can be found at Policy Central: <http://www.mq.edu.au/policy/> . There you will find the University's policy and associated procedures on assessment, Special Consideration and grade appeal.

July 2011

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RECOMMENDED TEXTBOOKS

There is no compulsory textbook for this unit. The compiled lecture material is available as a study booklet, which I will give a copy to each student and is updated to the WEB page. You are strongly encouraged to purchase one of the two books by *Reynolds* and *Sharma*. The following books are on seven day loan in the library for you to read up on relevant subjects:

Burger, H.R., *Exploration Geophysics of the Shallow Subsurface*, Prentice-Hall, 1992.
[TN269.B86]

Kearey, P., Brooks, M., and Hill, I., *An Introduction to Geophysical Exploration*, 3rd Edition, Blackwell Scientific Publications, 2002. [TN269.K36/2002]

Mussett A.E. and Khan M.A., *Looking into the Earth*, Cambridge, 2000. [QE501.M87/2000]

Parasnis, D.S., *Principles of Applied Geophysics*, 5th Edition, Chapman and Hall, 1997.
[TN269.P32]

Reynolds, J.M., *An Introduction to Applied and Environmental Geophysics*, John Wiley & Sons, 1997. [QC808.5.R49]

Sharma, P.V., *Environmental and Engineering Geophysics*, Cambridge University Press, 1997.
[TA705.S515]

Telford, W.N., Geldart, L.P., and Sheriff, R.E., *Applied Geophysics*, 2nd Edition, Cambridge University Press, 1990. [TN269.T44]

Ward, S.H. (editor), *Geotechnical and Environmental Geophysics*, Vol. I-III, Society of Exploration Geophysicists, Tulsa, 1990. [TA705.G426]

In addition you will find some useful material in *Geophysical Methods in Geology* by P.V. Sharma (it is out of print but still available in the library).

e-Reserve (<http://www.lib.mq.edu.au/reserve/index.php>)

The following article is in the e-Readings section of the library WEB page. Please search by author.

McNeill J.D., 1990, Use of electromagnetic methods for groundwater studies, 191-218. In *Geotechnical and Environmental Geophysics (Ed S.H. Ward) Volume I*.

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GEOS305 ENVIRONMENTAL AND GROUNDWATER GEOPHYSICS**

SCHEDULE OF LECTURE AND PRACTICAL TOPICS, 2nd SEMESTER 2011

DATE	LECTURER	TOPIC	PRACTICAL
Week 1 1 Aug	Mark Lackie	Introduction to the unit	Physical Properties
	Mark Lackie	Physical Properties	
Week 2 8 Aug	Craig O'Neill	Data Sampling and Spectral Analysis	Filtering
	Craig O'Neill	Filtering of Potential Field Data	
Week 3 15 Aug	Mark Lackie	Refraction: GRM, Ray Tracing etc	Refraction Interpretation
	Mark Lackie	MASW	
Week 4 22 Aug	Mark Lackie	EM Basics / EM Acquisition	Something Evil
	Mark Lackie	EM Interpretation	
Week 5 29 Aug	Bob Whiteley	Seismic Case Histories (10 - 12)	Something More Evil
Week 6 5 Sept	Craig O'Neill	GPR	GPR Acquisition
	Mark Lackie	Applications of Resistivity Surveys	
Week 7 12 Sept	Mark Lackie	Magnetics and Gravity	GPR Processing
			<i>Assignment 1 Due</i>
		Mid Semester Recess Field Excursion (26 Sept – 30 Sept)	
Week 8 3 Oct		<i>Labour Day Holiday</i>	Enjoy the break
Week 9 10 Oct	Phil McClelland	Case Histories: Magnetics (10 - 12)	Field data Compilation
Week 10 17 Oct	Simon Williams	Engineering Geophysics (10 – 12)	Field data Compilation
Week 11 24 Oct	Steve Webster	Groundwater Geophysics	Field data Compilation
	Mark Lackie	Case Histories	
Week 12 31 Oct	Tim Pippett	Environmental Geophysics (10 - 12)	Field data Compilation
Week 13 7 Nov	Mark Lackie	Case Histories	Field data Compilation
	Mark Lackie	Case Histories	

Any resemblance between this schedule and what actually happens is entirely coincidental.