GEOS345

Exploring the Earth's Interior: An introduction to Solid Earth Geophysics

S2 Day 2018

Dept of Earth and Planetary Sciences

Contents

General Information

Unit convenor and teaching staff
Yingjie Yang
yingjie.yang@mq.edu.au

Juan Carlos Afonso
juan.afonso@mq.edu.au

Credit points
3

Prerequisites
GEOS385 and 3cp from PHYS or MATH units

Corequisites

Co-badged status

Unit description
The unit covers the fundamental physics of the solid Earth, including modelling and assessment of geophysical data to understand the working of the Earth's interior. The emphasis is on physical principles and their application to interpret surface observations. Major topics covered in this unit include the thermochemical state of the Earth, potential field methods, global seismology, the physics of plate tectonics, and inverse problems. Computational modelling and scientific programming will be used in practicals. Additional minor subjects include thermodynamics of the Earth, elastic and non-elastic processes in the Earth, rock mechanics, earthquake seismology, and mineral physics.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Understanding of the tools and methods that are used in Solid Earth Geophysics

Competence in applying physical principles to understanding the inner working of the Earth and other terrestrial planets

Capacity to employ appropriate geophysical tools and concepts to solve geoscientific problems and to interpret the results

Capacity to present concepts/ideas clearly with supporting evidence
Understanding of scientific methodology and mathematical modelling
Problem-solving skills relevant to geophysical studies
Competence in accessing, analysing and interpreting geophysical datasets
Capability of applying geophysical knowledge to solving geoscientific problems and evaluating ideas and information

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment	20%	No	Week 12
Weekly practical	25%	Yes	every week
Mid-Semester Examination	15%	No	Week 8
Final examination	40%	No	to be confirmed

Assignment

Due: **Week 12**
Weighting: **20%**

This is worth 20% and is divided in two components. You will hand in a *group* written report (accounts for 10%) and give a 25 min *group* presentation to the class (accounts for 10%). Attention will be given to the individual students' contributions to these group activities. You will be given specific details of what is expected for the report and presentation when you start the unit. The report must be written in a paper format similar to those requires by scientific journals (see below). More information about the assignment will be given to you during class.

On successful completion you will be able to:

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- Capacity to present concepts/ideas clearly with supporting evidence
- Understanding of scientific methodology and mathematical modelling
- Problem-solving skills relevant to geophysical studies
- Competence in accessing, analysing and interpreting geophysical datasets
- Capability of applying geophysical knowledge to solving geoscientific problems and

evaluating ideas and information

Weekly practical

Due: **every week**
Weighting: **25%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Each week you will have a set of problems to solve during the laboratories/practicals. These will involve a mixture of manual calculations, computer-aided simulations/computations, and hands-on laboratory exercises. Your tutor will carefully oversee your individual performance in each practical and take attendance. You need to participate of at least 8 practicals (hurdle = yes) and hand in all practicals (one per week). The convenors will randomly select 4 practicals at the end of the semester and mark them to obtain a final mark that will represent 25% of your final grade.

On successful completion you will be able to:

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Mid-Semester Examination

Due: **Week 8**
Weighting: **15%**

This test will be given to you at the beginning of the second part of the semester (after the mid-semester public holiday) and it will cover all the contents (mainly concepts) covered up until week 7. You will have 45 mins to answer some questions in writing + multiple choice questions.

On successful completion you will be able to:

- Understanding of the tools and methods that are used in Solid Earth Geophysics
- Capacity to present concepts/ideas clearly with supporting evidence
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- Competence in accessing, analysing and interpreting geophysical datasets

Final examination

Due: **to be confirmed**
Weighting: **40%**

The final exam will cover material from the lectures, text-book readings and class exercises. The exam will include questions that ask you to apply your knowledge to interpret and solve problems. Your tutor will discuss the details of the exam later in the semester.

On successful completion you will be able to:

- Understanding of the tools and methods that are used in Solid Earth Geophysics
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- Understanding of scientific methodology and mathematical modelling
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Delivery and Resources

Lab materials

We strongly suggest you bring a ruler, pencils and memory stick to the labs. A scientific calculator is recommended, but you can always use the computer in the lab.

Unit booklet

This contains diagrams that will be referred to in lectures and the laboratory exercises. It is available from the iLearn unit page. The completed worksheets are invaluable as an aid during revision for the examination. The booklet is essential for the laboratory exercises and it is not intended to serve as a formal guide to the lectures or study guide for the final exam. You will have to take your own explanatory notes and complement them with extra reading.

Textbooks

We have not been able to identify a single textbook that will cover all the topics in the unit. Therefore, we will compile a set of chapters from different sources for you to read after each lecture and use as a study material for final the exam. However, *the textbook that contains most of the material covered in this unit at an appropriate level is* "**Fundamentals of Geophysics**" by W. Lowrie. Below we list a number of textbooks you may find useful while studying the different topics covered in this unit (all available in the library).

1. Lowrie, W., **Fundamentals of Geophysics**, Cambridge University Press
2. Stacey, F. and Davis, P., **Physics of the Earth** (4^{th} ed.), Cambridge University Press
3. Brown, G. and Mussett, A., **The Inaccessible Earth** (2^{nd} ed.), Chapman & Hall
4. Turcotte, D. and Schubert, G., **Geodynamics**, Cambridge University Press
5. Menke, W., **Geophysical Data Analysis**, Academic Press.
6. Fowler, C.M.R., **The Solid Earth: An introduction to Global Geophysics**, Cambridge University press

7. Davis, G., **Dynamic Earth: Plates, Plumes and Mantle Convection**, Cambridge University press
8. Stein, S. and Wysession, M., **An Introduction to Seismology**, **Earthquakes, and Earth Structure**, Blackwell Publishing
9. Shearer, P., **Introduction to Seismology**, Cambridge University press
10. Ranalli, G., **Rheology of the Earth**, Chapman & Hall
11. Karato, S-I, **Deformation of Earth Materials: An Introduction to the Rheology of Solid Earth**, Cambridge University press.

Library Loans

The Library at Macquarie will have provided you with information on library loans. The procedures differ for metropolitan and country students. Please familiarise yourself with the procedures appropriate in your case.

Unit Schedule

Days	Week	Lecture **Weds 10 am – 12 pm**	Laboratory **Weds 12 pm – 4 pm**
1 August	**1**	The Earth and terrestrial planets [JCA]	Practical 1: Physical aspects of terrestrial planets
8 August	**2**	The Earth's gravity field [JCA]	Practical 2: Gravitation and gravity anomalies
15 August	**3**	Gravity potential, Geoid and Isostasy [JCA]	Practical 3: Gravity potential and isostasy
22 August	**4**	Heat transfer and geothermics I [JCA]	Practical 4: Heat transfer I (steady-state)
29 August	**5**	Heat transfer and geothermics II [JCA]	Practical 5: Heat transfer II (non steady-state)
5 September	**6**	Mechanical properties of Earth materials [JCA]	Practical 6: Stress and strain
12 September	**7**	Seismology 1: wave propagation [YY]	Practical 7: Wave propagation

		Mid-semester Break	
3 October	**8**	Seismology 2: Ray theory [YY]	Practical 8: mid-term test + ray theory and travel times
10 October	**9**	Seismology 3: Seismograms as signals [YY]	Practical 9: Seismograms as signals
17 October	**10**	Seismology 4: Seismic tomography [YY]	Practical 10: Seismic tomography
24 October	**11**	Probability and inverse problem theory I [JCA]	Practical 11: inversion of geophysical data I
31 October	**12**	Probability and inverse problem theory II [JCA]	Practical 12: Inversion of geophysical data II
7 November	**13**	Group Presentations	Exam Revision

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (http

s://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Supplementary exam

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Capacity to employ appropriate geophysical tools and concepts to solve geoscientific problems and to interpret the results
- Understanding of scientific methodology and mathematical modelling

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Competence in applying physical principles to understanding the inner working of the Earth and other terrestrial planets
- Competence in accessing, analysing and interpreting geophysical datasets

Assessment tasks

- Weekly practical
- Final examination

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships

with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in Solid Earth Geophysics
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Assessment task

- Mid-Semester Examination

Discipline Specific Knowledge and Skills

Our 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. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

- Assignment
- Weekly practical

- Mid-Semester Examination
- Final examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

- Assignment
- Weekly practical
- Final examination

Problem Solving and Research Capability

Our 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; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

- Assignment
- Weekly practical

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Capacity to employ appropriate geophysical tools and concepts to solve geoscientific problems and to interpret the results
- Capacity to present concepts/ideas clearly with supporting evidence
- Understanding of scientific methodology and mathematical modelling

Assessment tasks

- Assignment
- Weekly practical
- Mid-Semester Examination
- Final examination