GEOS701

Geophysics: Special Topics 1

S1 Day 2015

Dept of Earth and Planetary Sciences

Contents

General Information	2
Learning Outcomes	2
Assessment Tasks	3
Delivery and Resources	4
Unit Schedule	5
Learning and Teaching Activities	6
Policies and Procedures	7
Graduate Capabilities	8

General Information

Unit convenor and teaching staff
Unit Convenor
Juan Carlos Afonso
juan.afonso@mq.edu.au
Contact via juan.afonso@mq.edu.au
E7A523
Send email to book time

Credit points
4

Prerequisites
Admission to MRes

Corequisites

Co-badged status

Unit description
This unit will focus on special topics in geophysics. Topics can range from shallow geophysical, to deep geophysical to global geophysics. Topics will be chosen to give students the basic tools of analysis that are required to undertake more advanced research.

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:

Acquire a basic, coherent knowledge of the fundamental principles and concepts of continuum mechanics, gravity potential and numerical methods.
Acquire a basic understanding of computer programming (MATLAB) for solving differential equations, linear systems, and tensorial algebra relevant to Geophysics problems
Application of knowledge to solving problems and evaluating ideas and information.
Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

Assessment Tasks

Name	Weighting	Due
Exam	25%	June
Assignments I	25%	end of March
Assignments II	25%	End of April
Assignments III	25%	end of May

Exam

Due: **June**
Weighting: **25%**

FInal exam on theory

On successful completion you will be able to:

- Acquire a basic, coherent knowledge of the fundamental principles and concepts of continuum mechanics, gravity potential and numerical methods.
- Application of knowledge to solving problems and evaluating ideas and information.
- Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

Assignments I

Due: **end of March**
Weighting: **25%**

Problems in Continuum Mechanics and Crystallography. This assignment will consist of 2 or 3 individual parts that will be evaluated separately. All three parts must be completed to approve the assignment.

On successful completion you will be able to:

- Acquire a basic, coherent knowledge of the fundamental principles and concepts of continuum mechanics, gravity potential and numerical methods.
- Acquire a basic understanding of computer programming (MATLAB) for solving differential equations, linear systems, and tensorial algebra relevant to Geophysics problems
- Application of knowledge to solving problems and evaluating ideas and information.
- Capacity to summarising relevant information for specific problems and formulating

adequate solutions for them.

Assignments II

Due: **End of April**
Weighting: **25%**

Probems in Mantle convection. Use of matlab and convection codes to simulate convection in the Earth's mantle. This assignment will consist of 2 or 3 individual parts that will be evaluated separately. All three parts must be completed to approve the assignment.

On successful completion you will be able to:

- Acquire a basic, coherent knowledge of the fundamental principles and concepts of continuum mechanics, gravity potential and numerical methods.
- Acquire a basic understanding of computer programming (MATLAB) for solving differential equations, linear systems, and tensorial algebra relevant to Geophysics problems
- Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

Assignments III

Due: **end of May**
Weighting: **25%**

Matlab excercises about numerical methods used in scientific research. This assignment will consist of 3 or 4 individual parts that will be evaluated separately. All three parts must be completed to approve the assignment.

On successful completion you will be able to:

- Acquire a basic, coherent knowledge of the fundamental principles and concepts of continuum mechanics, gravity potential and numerical methods.
- Acquire a basic understanding of computer programming (MATLAB) for solving differential equations, linear systems, and tensorial algebra relevant to Geophysics problems
- Application of knowledge to solving problems and evaluating ideas and information.
- Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

Delivery and Resources

Video lectures + practicals or Lectures/practical, depending on the number of studentes enrolled.

One laptop/desktop per student will be provided by the Department of Earth and Planetary Sciences

Unit Schedule

1. **Continuum mechanics 1**: Vectors, vector equations, Cartesian tensors, tensorial equations, differentiation, gradient, divergence, curl ***(S. Clark)***

2. **Continuum mechanics 2**: Forces, Stress, Cauchy's formula, equations of equilibrium, principal stresses and principal axes, plane stress, deviatoric stress tensor, pressure, Lame's stress ellipsoid ***(S. Clark)***

3. **Continuum mechanics 3**: Deformation and strain, strain tensor and strain components, infinitesimal strain, finite strain, Eulerian and Lagrangian descriptions, vector fields, compatibility condition ***(S. Clark)***

4. **Continuum mechanics 4**: Constitutive equations, isotropic and anisotropic materials, elasticity, viscosity, plasticity ***(C. O'Neill)***

5. **Continuum mechanics 5**: conservation of mass, momentum, and energy, mantle convection ***(C. O'Neill)***

6. **Continuum mechanics 6**: conservation of mass, momentum, and energy, mantle convection (cont.) ***(C. O'Neill)***

7. **Gravitation and gravity 1**: gravitational potential, Laplace and Poisson equations, Moments of inertia, MacCullagh's formula, ellipticity of the Earth, the geopotential, normal gravity and potential, the geoid, isostatic geoid anomalies, spherical harmonic functions, Legendre polynomials, regional gravity and geoid anomalies, modelling, Talwani equations ***(J. C. Afonso)***

7. **Gravitation and gravity 2**: isostatic geoid anomalies, spherical harmonic functions, Legendre polynomials, regional gravity and geoid anomalies, modelling, Talwani equations ***(J. C. Afonso)***

8**. Numerical methods I**: Linear algebraic equations, Direct methods (Gauss elimination, factorisation, Cholesky method, Pivoting), Iterative methods (Jacobi, Gauss-Seidel, gradient methods) ***(J. C. Afonso)***

9. **Numerical methods II**: Numerical integration, Numerical solution of ordinary differential equations, Introduction to the FD and FE methods ***(J. C. Afonso)***

10. **Numerical methods III**: Partial differential equations, FD and FE methods ***(J. C. Afonso)***

Learning and Teaching Activities

Continuum mechanics I

Vectors, vector equations, Cartesian tensors, tensorial equations, differentiation, gradient, divergence, curl

Continuum mechanics 2

Forces, Stress, Cauchy's formula, equations of equilibrium, principal stresses and principal axes, plane stress, deviatoric stress tensor, pressure, Lame's stress ellipsoid

Continuum mechanics 3

Deformation and strain, strain tensor and strain components, infinitesimal strain, finite strain, Eulerian and Lagrangian descriptions, vector fields, compatibility condition

Continuum mechanics 4

Constitutive equations, isotropic and anisotropic materials, elasticity, viscosity, plasticity

. Continuum mechanics 5

Gauss's theorem, Stokes theorem, first and second laws of thermodynamics, conservation of mass, momentum, and energy

Gravitation and gravity 1

gravitational potential, Laplace and Poisson equations, Moments of inertia, MacCullagh's formula, ellipticity of the Earth, the geopotential, normal gravity and potential, the geoid

Gravitation and gravity 2

isostatic geoid anomalies, spherical harmonic functions, Legendre polynomials, regional gravity and geoid anomalies, modelling, Talwani equations

Numerical methods I

: Linear algebraic equations, Direct methods (Gauss elimination, factorisation, Cholesky method, Pivoting), Iterative methods (Jacobi, Gauss-Seidel, gradient methods)

Numerical methods II

Numerical integration, Numerical solution of ordinary differential equations, Introduction to the FD and FE methods

Numerical methods III

Partial differential equations, FD and FE methods

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/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.

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://informatics.mq.edu.au/help/.

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

Graduate Capabilities

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

- Application of knowledge to solving problems and evaluating ideas and information.
- Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- Acquire a basic, coherent knowledge of the fundamental principles and concepts of continuum mechanics, gravity potential and numerical methods.
- Acquire a basic understanding of computer programming (MATLAB) for solving differential equations, linear systems, and tensorial algebra relevant to Geophysics problems

Assessment tasks

- Exam
- Assignments I
- Assignments II
- Assignments III

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

- Application of knowledge to solving problems and evaluating ideas and information.
- Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

Assessment tasks

- Exam
- Assignments I
- Assignments II
- Assignments III

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- Acquire a basic understanding of computer programming (MATLAB) for solving differential equations, linear systems, and tensorial algebra relevant to Geophysics problems
- Application of knowledge to solving problems and evaluating ideas and information.
- Capacity to summarising relevant information for specific problems and formulating

adequate solutions for them.

Assessment tasks

- Assignments I
- Assignments II
- Assignments III

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcome

- Capacity to summarising relevant information for specific problems and formulating adequate solutions for them.

Assessment tasks

- Exam
- Assignments I
- Assignments II
- Assignments III

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Assessment task

- Assignments II