GEOS701

Geophysics: Special Topics 1

S1 Day 2014

Earth and Planetary Sciences

Contents

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
No Co-badged

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). 3. Competence in assessing and obtaining quantitative information on a variety of solid-Earth 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.
- Acquire a basic understanding of computer programming (MATLAB). 3. Competence in assessing and obtaining quantitative information on a variety of solid-Earth 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 I

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

Problems in Continuum Mechanics and Crystallography

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). 3. Competence in assessing and obtaining quantitative information on a variety of solid-Earth 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.

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). 3. Competence in assessing and obtaining quantitative information on a variety of solid-Earth 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 III

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

Matlab excercises about numerical methods used in scientific research.

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). 3. Competence in assessing and obtaining quantitative information on a variety of solid-Earth 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/

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.