COURSE CONTENT

Date	September 2016
Academic Year	2016/2017
Study Year(if applicable)	Year 3 and 4
Course Code & Title	ES3004 Introduction to Geophysics
Academic Unit	4AUs
Pre-requisite	ES1003 Solid Earth
Co-requisite	
Mutually exclusive with	

Course Description

The class will cover concepts in both global geophysics and applied geophysics, with an emphasis on research done at NTU. The main goal of this class is to provide students with general understanding of some techniques that are used to probe the Earth's surface. The techniques that will be presented during this class are used in both private sectors as well as in Earth science in general.

ES3004 Introduction to Geophysics
[Lectures: 26 hours; Tutorials: 26 hours; Academic Unit: 4.0]

Learning Objective

The aim of this course is to demonstrate the physical principles behind various geophysical techniques, the methods by which they are applied and review the results that they give using a mixture of lectures and practical examples that students will complete online.

There is number-handling, application of supplied formulae, and quantitative discussion- but it is not a theoretical course: its physics and mathematics content should be accessible by anyone qualified to join the department.

Specific objectives are to introduce the most important methods of geophysics that include active and passive source seismology, infrasound, gravity, magnetics, geoelectrics, electromagnetic, ground-penetrating radar and geophysics on volcanoes.

The course will emphasize how to deliver results with topics such as what is a justifiable precision in your quoted results and what is the difference between results and interpretations.

Content

This course will serve as an introduction to the study of Earth phenomena such as gravity, earthquakes, plate movements and magnetism as well as what they tell us about the deep Earth. In addition, we will study the response of the Earth to various signals (e.g. reflection seismic, GPR, resistivity, etc.) and how we can use this to better understand the subsurface. The class will have a theoretical part as well as complimentary tutorials where we will acquire (when possible) and process data.

Week	Content		Tutorials	
1	- Introduction, Basic seismology: wave types, ray paths, etc	2 hours	Basic concepts	2 hours
2	- Seismic exploration I, seismic refraction - Seismic exploration II, seismic reflection	2 hours	Seismic exploration	2 hours
3	- Global seismology 1: Plate tectonics, earthquake basics & mechanisms - Global Seismology II: Seismometers & networks, Magnitude, rays through the Earth, tomography, anisotropy	2 hours	Global seismology	2 hours
4	- Gravity methods 1: Principles, satellite measurements, geodesy and isostasy - Gravity methods II: Gravity surveying in exploration; data reduction, field separation, interpretation example	2 hours	Gravity	2 hours
5	- Magnetics methods I & II: Principles, dipole field, the geodynamo, rock magnetism, paleomagnetism, space weather	2 hours	Magnetics, general principles	2 hours

6	- Magnetics methods III: Magnetics Surveys - Magnetics methods IV: Magnetics Surveys; applied magnetics methods	2 hours	Magnetics surveys	2 hours
7	- Recap on previous weeks	2 hours	In-class assessment	2 hours
8	- Geoelectrical methods I: Electromagnetic, ground-penetrating radar - Geoelectrical methods II: SP, IP and DC resistivity	2 hours	Geoelectrical methods	2 hours
9	- Geophysics on volcanoes I	2 hours	The 3 pillars: seismicity, deformation and degassing	2 hours
10	- Geophysics on volcanoes II	2 hours	Real time simulation of crisis	2 hours
11	-Geophysics in your backyard 1: Probing Singapore's underground	2 hours	Interpretation of local geophysical data	2 hours
12	- Geophysics in your backyard II: Singapore's Geophysical network	2 hours	On-site visit	2 hours (potentially half-day)
13	- Infrasound and their implications	2 hours	In-class assessment	2 hours

Learning Outcomes

By the end of the course students should be able to do the following:

I) Identify which technique should be used depending on the question they have to answer,

2) Evaluate the quality of the data that they collect/analyse,

3) And finally, they should be able to interpret those data.

Wherever possible, we will engage in data collection on the field, within Singapore, to give the students direct, hands-on experience. When it is not possible or applicable we will use real-world data for classes and labs.

Student Assessment

Students will be assessed by:

50% marking of practical exercises
20% short online quizzes
30% two in-class assessment

The practical exercise will be a combination of online evaluations and paper based evaluations (e.g. interpretation of gravity profile, locating seismicity). These will take place during the tutorial session with immediate feedback. They will be design to test understanding of concepts directly link with the associated lecture.

Quizzes will be completed online using the NTULearn platform on regular basis to assess students' progress and understanding on concept learn since the beginning of the class.

The two mid-term in-class assessment will be based on short answer questions and a written report associated to in-class presentations.

Textbooks

Recommended reading for this class: ''Introduction to Applied geophysics'', H. Robert Burger {Author, Smith College), Craig H. Jones (Author, University of Colorado at Boulder), Anne F. Sheehan (Author, University of Colorado at Boulder), W. W. Norton & Company, ISBN: 978-0-393-92637-8