<u>Annexe A: New/Revised Course Content in OBTL+ Format</u>

Course Overview

Expected Implementation in Academic Year (New format)	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Luca Dal Zilio
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Course Title	INTRODUCTION TO GEOPHYSICS
Course Code	ES3004
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	ES1003
Co-requisites	NIL
Pre-requisite to	NIL
Mutually exclusive to	NIL
Replacement course to	NIL
Remarks (if any)	

Course Aims

The aim of this course is to introduce the fundamental concepts of the solid Earth, providing students with a theoretical foundation and exercises that incorporate basic computational methods to quantitatively explore subsurface Earth structures. Building on this background, the course will then focus on near-surface geophysical imaging, covering a range of techniques including active and passive source seismology, gravity, magnetic, geoelectric, and electromagnetic surveys. Students will learn the physical principles behind these techniques, practice how they are applied, and review and interpret results through a mixture of lectures, computational exercises, and practical examples. Whenever possible, field-based data collection within Singapore will be included to offer direct, hands-on experience; where this is not feasible, real-world datasets will be used for classroom exercises and labs. Throughout the course, students will develop an understanding of the complementary perspectives each method offers and how, when combined, they provide a coherent view of the subsurface, with an emphasis on precision, interpretation, and the distinction between results and their implications.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Select appropriate geophysical techniques based on the scientific question and geological context.
ILO 2	Assess the quality and suitability of geophysical data collected from fieldwork or provided datasets.
ILO 3	Interpret geophysical data using physical principles and computational tools.
ILO 4	Communicate geophysical results effectively through written reports, visualisations, and presentations.

Course Content

The course introduces the fundamental concepts of the solid Earth, providing students with a theoretical foundation and exercises that incorporate basic computational methods to quantitatively explore subsurface Earth structures. With this background, the course transitions to an introduction to near-surface geophysical imaging, presenting a range of techniques including seismology, gravity, magnetic, and electrical surveys. As an introductory course in geophysics, it familiarizes students with the fundamental principles and applications of each method that offer complementary perspectives and, when used together, provide a coherent view of the subsurface. Whenever possible, the course will include field-based data collection within Singapore, offering direct, hands-on experience. When fieldwork is not feasible, real-world datasets will be used for classroom exercises and labs. Students will be exposed to realistic examples and approaches aligned with current research and industrial practice.

Reading and References (if applicable)

Recommended reading for this class:

“Introduction to Applied Geophysics”, H. Robert Burger (Author, Smith College), Craig H. Jones, Anne F. Sheehan, ISBN: 978-0-393-92637-8

Turcotte, D. L., & Schubert, G. (2002). "Geodynamics". Cambridge university press. ISBN: 9780521186230

Lowrie, William. Fundamentals of Geophysics. Cambridge, UK: Cambridge University Press, September 1997. ISBN: 9780521467285.

NOTE: The above listing comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they become available

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	Class introduction, Essentials of Solid Earth Geophysics: Gravity	1,2,3,4	In-person	Hands-on computational exercises	Varies
2	Essentials of Solid Earth Geophysics: Gravity	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
3	Essentials of Solid Earth Geophysics: Seismology	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
4	Essentials of Solid Earth Geophysics: Seismology	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
5	Essentials of Solid Earth Geophysics: Geodynamics	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
6	Essentials of Solid Earth Geophysics: Geodynamics	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
7	Near-Surface Geophysical Imaging: Resistivity	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
8	Near-Surface Geophysical Imaging: Resistivity	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
9	Near-Surface Geophysical Imaging: Magnetism	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
10	Near-Surface Geophysical Imaging: Gravity	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
11	Near-Surface Geophysical Imaging: Seismic	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
12	Near-Surface Geophysical Imaging: Seismic	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies
13	Near-Surface Geophysical Imaging: Seismic	1,2,3,4	In-person	Hands-on computational exercises and Quiz	Varies

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures with embedded computational examples.	Provides the theoretical background and conceptual understanding needed to identify geophysical techniques and interpret data. Integrated Python-based exercises enhance quantitative skills and reinforce learning through application.
Field-based data collection / labs	Hands-on fieldwork (or real-world datasets when fieldwork is not feasible) enables students to evaluate data quality and make sound interpretations grounded in real geophysical contexts.
Problem-based learning (PBL)	Encourages critical thinking by challenging students to solve realistic geophysical problems, supporting outcome-oriented analysis and the ability to select the appropriate method for a given geoscientific question.
In-class discussions and short presentations	Enhances scientific communication skills and fosters peer learning, helping students articulate their findings effectively in both oral and written forms.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Report/Case study(Field Data Report / Lab Analysis)	1, 2, 3	A1, A2, A3	30		Individual	Holistic	Relational
2	Continuous Assessment (CA): Others(In-Class Computational Exercises)	1, 2	A1, A2	20		Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Final exam(Final Examination (Written))	Final Examination (Written)	A1, A2, A3, A4	50		Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

Students will participate in individual in-class computational exercises that reinforce theoretical concepts from lectures. These exercises focus on building fluency with basic quantitative methods in geophysics, such as data analysis, potential field modelling, and inverse problem setups. They serve as formative assessments and introduce students to computational workflows used in real-world geophysical problem-solving. Emphasis is placed on data quality, methodological rigor, and clarity in scientific communication. When fieldwork is not feasible, students will analyse open-access datasets reflecting current research or industrial practice.

Formative Feedback

Students will receive formative feedback throughout the course in both written and verbal formats. During practical exercises and lab sessions, feedback will be provided on common issues and conceptual misunderstandings to help guide students toward more accurate interpretations and analyses. In-class discussions will also serve as a platform for immediate verbal feedback, encouraging active participation and iterative improvement. Written feedback will be provided on submitted assignments and assessments, with a focus on clarity of analysis, justification of results, and the use of appropriate methods. Students are encouraged to proactively seek feedback from the instructor during office hours or via email, particularly when reviewing exercise results or preparing for assessments. Group feedback may also be provided after major course components, such as field exercises or the final exam, to reinforce key learning points and foster shared learning.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Learning Agility	Advanced
Project Management	Advanced
Value Creation	Advanced
Critical Thinking	Advanced

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

Integrating a diverse set of experiences is important for a more comprehensive understanding of science.
It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.
To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
- If you feel like your performance in the class is being impacted by your experiences outside of class;
- If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, our school pastoral officer, Ms Christina Tee, or a peer or senior (either in-person or via email) about how we can help facilitate your learning experience.
As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.
All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

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