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

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	Asst Prof Euan Mutch/ Asst Prof Aron Meltzner
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Course Title	Structural Geology and Tectonics
Course Code	ES3002
Academic Units	3
Contact Hours	65
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	ES1003 Solid Earth
Co-requisites	NIL
Pre-requisite to	ES3005 Advanced Field Course in Geology
Mutually exclusive to	NIL
Replacement course to	NIL
Remarks (if any)	

Course Aims

The course aims to introduce students to the deformation of Earth materials and the fundamental principles of structural geology and tectonics. It teaches how rocks respond to stress and strain under different conditions, covering topics such as mountain building, plate tectonics, faulting, folding, fractures, ductile deformation, and regional tectonic histories. Students will learn to analyze geological structures using tools like geologic maps, cross-sections, seismic data, stereonets, microscopic rock fabrics, and field observations. The course also aims to build practical skills through labs and a field trip, developing the ability to interpret structural features in both academic and applied settings.

This course is intended for:

- Undergraduate or graduate students in Earth Sciences, Geology, Geophysics, or related fields.
- Students needing a foundational or intermediate course in structural geology and tectonics.
- Learners who will benefit from hands-on experience with mapping, seismic interpretation, field methods, and geological analysis tools.

Students should take this course because it provides:

- Foundational knowledge essential for careers in geology, geophysics, geotechnical engineering, natural resources (oil, gas, geothermal), environmental consulting, and earthquake hazard assessment.
- Skills needed for advanced courses in tectonics, structural analysis, geomechanics, and geological field methods.
- Training in practical industry-relevant tools such as balanced cross sections, seismic reflection data, satellite imagery, and analog experiments.
- Field experience that strengthens a student's ability to collect, record, and interpret real-world geological data.
- A strong understanding of Earth structure and deformation processes, which is crucial for understanding earthquakes, mountain formation, and crustal evolution.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Describe and draw the major types of fractures and folds, and explain what stresses are required to produce them.
ILO 2	Use a Mohr circle to analyze fault stresses and failure
ILO 3	Use a stereonet to plot different types of geological data and to solve problems by hand and on a computer, and explain why this is useful.
ILO 4	Interpret a geological map, generate structure contours and draw a realistic cross-sections of subsurface geology.
ILO 5	Plan, perform, and analyse an experiment to create an analog fold-and-thrust belt.
ILO 6	Observe structural and rock data in the field and take notes in a field notebook. Then use these observations to assess timing, style and magnitude of deformation.

Course Content

- Stress, strain, and rock strength
- Fractures & faults
- Fault-related folding
- Ductile deformation
- Tectonic regimes: compressional mountain belts, rift basins, strike-slip margins, passive margins

Reading and References (if applicable)

- Fossen, H. (2016). *Structural geology* (2nd ed.). Cambridge University Press.
- Van der Pluijm, B. A., & Marshak, S. (2004). *Earth structure: An introduction to structural geology and tectonics* (2nd ed.). W. W. Norton

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	Introduction to Structural Geology Geological maps and measurements	4	In-person	Guest lecture, Lab – geological maps	vARIES
2	Stress	1, 2	In-person	Guest lecture, Lab – cross sections	Varies
3	Strain	1, 3	In-person	Guest lecture, Lab - Stereonets	Varies
4	Rock strength	1	In-person	Guest lecture, Lab – compass measurements	Varies
5	Fractures (joints)	1, 2	In-person	Guest lecture, Lab stress measurement estimates	Varies
6	Fractures (faults)	1, 2	In-person	Guest lecture	Varies
7	Field Trip	1, 3, 4, 6	In-person	Field trip to St Johns and Lazarus	Varies
8	Ductile Deformation	1, 4	In-person	Guest lecture, Lab Structure contours 1	Varies
9	Folds	1, 4	In-person	Guest lecture, Lab Structure contours 2	Varies
10	Convergent Margins, mountain belts and subduction zones	1, 5	In-person	Guest lecture, Lab sandbox experiments	Varies
11	Extensional margins and transform margins	1, 5	In-person	Guest lecture, sandbox experiment videos	Varies
12	Practical Test	1, 2, 3, 4, 5, 6	In-person	Practical Test	Varies
13	Theory Test	1, 2, 3, 4, 5, 6	In-person	Theory Test	Varies

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Lectures will cover the various concepts in structural geology, and teach both ideas and techniques. Lectures will be primarily powerpoint or equivalent, with images, diagrams, and maps. During lectures you will also work on specific assignments to practice techniques explored in class. You will also evaluate specific rock samples.
Lab Sessions	In laboratories, you will use maps, cross sections, rock samples, analog models, and subsurface data to understand rock deformation. Most labs will take place in the classroom and use analog modeling tools. You will perform calculations and interpret data to understand the stresses, strains, and rock deformation that have occurred in various places. Some of the laboratory work will take place during the three weekly hours of laboratory time with teaching staff available, but much will be done independently.
Field trips	During the field trip, you will visit various outcrops and sites of interest on St Johns and Lazarus. You will observe the geology independently and in groups. You will record your observations (qualitative and qualitative) in your field notebook. You will then construct a geological map and cross section and interpret how these observations fit into the tectonic context.
Active learning and discussion	Group discussions and activities will facilitate content assimilation and ensure learn in an active way. Some assignments will also be given for hands on application of the content covered during lectures.

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): Others(Labs and assignments)	1, 2, 3, 4, 5		40		Individual	Analytic	Extended Abstract
2	Continuous Assessment (CA): Others(Field trip)	1, 3, 4, 6		10		Individual	Holistic	Extended Abstract
3	Continuous Assessment (CA): Test/Quiz(Final theory test)	1, 2, 3, 4, 5, 6		25		Individual	Analytic	Extended Abstract
4	Continuous Assessment (CA): Test/Quiz(Final practical test)	1, 2, 3, 4, 5, 6		25		Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

- Continuous Assessment 1 (CA1): You will complete weekly lab assignments and turn them in. The topics and methods of the assignments will vary: some will involve computer analysis using specialized software, while others will involve the interpretation of paper maps, rock samples, and other forms of geological data. This will also include a project presentation on sandbox analog experiments.

- Continuous Assessment 2 (CA2): A field trip to St Johns and Lazarus will examine structural features in the field using the tools of structural field geology. All students must also keep a clear, well-organized field notebook which will be turned in and graded at the end of the trip.

- Single Assessment 1 (SA1): A 3h test during the last week of classes assessing all the theoretical knowledge covered during lectures.

- Single Assessment 2 (SA2): A 3h test during the last week of classes assessing all the practical skills covered during lectures.

Formative Feedback

Throughout the class, each lab will be returned to you 1-2 weeks after being turned in, with each component marked as correct or incorrect. The correct answers will be given. Cross sections and maps will have notes to indicate which parts are good and which parts could have been improved.

Your field notebook will be assessed holistically; overall suggestions and comments will be provided about good aspects of your notebook, and ways to improve, referring to specific pages in your field notebook as evidence. You will also receive verbal feedback after your field presentation.

Your video presentation of your research project (labs 9&10) will be discussed in class with feedback from both the professor and the students. You will receive advice during the course of the research project as well.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Adaptability	Advanced
Care for Environment	Advanced
Curiosity	Advanced
Critical Thinking	Advanced
Embrace Challenge	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)

Diversity and inclusion policy
Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal at ASE 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, a peer or senior, Janelle or Michel (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 an ASE faculty member.

Last Updated Date: 26-03-2026 10:32:51

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