

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

Course Overview

Expected Implementation in Academic Year (New format)	AY2026-2027
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Assoc Prof Wang Xianfeng
Course Author Email	xianfeng.wang@ntu.edu.sg
Course Title	Introduction to Geochemistry
Course Code	ES3003
Academic Units	3
Contact Hours	39
Research Experience Components	Research Defined Course (at least 50% of deliverables involve practical research activities: problem identification, hypothesis forming, data collection/analysis/interpretation, result communication)

Course Requisites (if applicable)

Pre-requisites	ES1003 (Solid Earth) or by permission;
Co-requisites	NA
Pre-requisite to	ES4904
Mutually exclusive to	NA
Replacement course to	ES3009
Remarks (if any)	

Course Aims

This course is designed to introduce you the principles of chemistry related to geology (therefore, geochemistry) and their applications to understand processes taking place on and within the Earth. The aim is to provide you with a powerful toolbox and the related skills, more than a static bank of knowledge. You will become familiar with the principles of geochemistry, including analytical chemistry, governing equations and typical applications in the Earth Systems Sciences (e.g., atmosphere, hydrosphere, biosphere, solid earth, anthroposphere). You will have experience to work with geochemistry analytical equipment, learn to collect, organize and present geochemical data, including presenting and writing a research report on a problem of your choice. With this set of tools and knowledge, you will have the mind skills and technical know-hows to answer a range of practical problems in geochemistry, including some that may not have been addressed in the class.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Become familiar with the basic principles and tools of geochemistry;
ILO 2	Practice problem solving with application of governing equations to investigate main geochemical processes;
ILO 3	Formulate questions about the dynamics within Earth System Sciences, from a geochemistry perspective.
ILO 4	Develop intellectual flexibility and critical thinking to identify the most useful geochemical tool to address some geological and environmental problems;
ILO 5	Perform geochemical research which involves hands-on acquisition, data analysis and interpretation;

Course Content

This course is divided into two parts:

In Part (i) lecture classes, you will be introduced to the basic principles and tools of geochemistry. You will learn about the large-scale processes occurring in the geosphere, hydrosphere, biosphere, atmosphere and anthroposphere on the Earth, using major and trace element geochemistry, and stable and radiogenic isotopes. You will also learn processes such as element and isotope fractionation, element transport and mixing as well as radiogenic isotopes and their application for geochronological purposes.

In Part (ii) tutorial classes and individual time, you will work closely with our researcher team and undertake hands-on data collection via geochemistry analytical instruments and data analysis.

Reading and References (if applicable)

Basic Reading:

Geochemistry, by William M. White, 2nd Edition, Wiley-Blackwell, 2020.

Environmental Chemistry: A Global Perspective, by Gary W. vanLoon & Stephen J. Duffy, 4th Edition, Oxford University Press, 2017.

Introduction to Atmospheric Chemistry, by Daniel J. Jacob, Princeton University Press, 1st Edition, 1999, (available as e-book for download through <https://acmg.seas.harvard.edu/education/introduction-atmospheric-chemistry>).

We will also make use of recent and primary sources in the literature, e.g., peer-reviewed articles in scientific journals.

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	Universe, element formation, Earth	1,2,3	In-person	Lecture	White: Chap. 10
2	Basic thermodynamics	1,2,3	In-person	Lecture	White: Chaps. 2, 4
3	Kinetics and fluxes	1, 2, 3	In-person	Lecture	White: Chap. 5;
4	Radiogenic isotopes and geochronology	1,2,3	In-person	Lecture	White: Chap. 8
5	Major stable isotopic systems	1, 2, 3	In-person	Lecture	White: Chap. 9
6	Isotope geochemistry applications	1,2,3	In-person	Lecture	White: Chaps. 8,9
7	Earth's differentiation, magmatic rocks	1, 2, 3	In-person	Lecture	White: Chap. 7
8	Aquatic geochemistry, element source and sinks	1,2,3	In-person	Lecture	White: Chap. 6; vanLoon & Duffy: Chap. 9
9	Carbonate equilibria	1, 2, 3	In-person	Lecture	White: Chaps. 6, 14; vanLoon & Duffy: Chap. 11
10	Atmospheric geochemistry: gas species and radiative balance of the Earth	1, 2, 3	In-person	Lecture	vanLoon & Duffy: Chaps. 3,8; Jacob: Chaps. 7
11	Photochemistry of atmospheric gas	1,2,3	In-person	Lecture	vanLoon & Duffy: Chaps. 3,8; Jacob: Chaps. 9, 10
12	Oxidation-reduction geochemistry	1, 2, 3	In-person	Lecture	White: Chap. 3
13	Research project presentations	1, 2, 3, 4, 5	In-person	Lecture, Student Presentation	N/A

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Lectures will pass on the theoretical knowledge required to understand the critical concepts in geochemistry and their applications.
Tutorial	Special lectures will be given on geochemistry analytical equipment, together with lab tour and experiment demo. You will get familiar with some basic knowledges of large analytical instruments and their application in geochemistry studies.
Group Research Project	The course adopts an active learning approach by encouraging you to work in a small team on a specific geochemistry project. You will have hands-on experience on analytical instruments and data interpretation. This task will help you to deepen your understanding of geochemical concepts learnt in the class, enhance your presentation and writing abilities, and develop responsibility for the project.
Research project presentation and writing report	You will present your research project in a small group, and then write an individual essay on your research finding. This task will help your to use basic knowledge learnt from the class to formulate convincing arguments and critically evaluate geochemical data.

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): Assignment(Weekly assignments)	1, 2	Creativity & Competence	30		Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Class Participation(Class and research project participation)	1,2,3,4	Creativity & Competence	10		Individual and Team	Analytic	Multistructural
3	Continuous Assessment (CA): Presentation(Research Project Presentation)	1,2,3,4,5	Creativity & Competence	20		Individual and Team	Analytic	Extended Abstract
4	Continuous Assessment (CA): Report/Case study(Research Project Report)	1,2,3,4,5	Creativity & Competence	40		Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

Weekly Assignment: There will be weekly homework that tests your knowledge on specific lectures in the semester.

Class and Research Project Participation: You are expected to attend the lectures/tutorials unless valid reasons for absence. You are also expected to actively participate the class projects, and contribute a fairly amount of time/efforts to the team.

Project Presentation: You are expected to give an oral presentation in a team, on your class project.

Research Report: You are expected to submit an individual research report on the findings of your class project, even though the project is done in a group effort.

Formative Feedback

You will receive written and/or verbal formal feedback from instructor/TA following each assessment criteria.

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
Building Inclusivity	Advanced
Care for Environment	Advanced
Care for Society	Advanced
Collaboration	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 pre-class readings and activities, attend all lectures punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for classes you have missed.

Policy (Absenteeism)

Absence from class will affect your overall course grade. It is important for you to attend the lectures even though they have been recorded on video. Absenteeism during Continuous Assessments is NOT ALLOWED without a valid reason. 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. The medical certificate has to be submitted to your school to be verified, before it reaches our school's student administration. 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 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 Christina Tee Siew Khiaw 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.

Last Updated Date: 26-03-2026 10:09:08

Last Updated By: Sze Chun Chau (Dr)