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

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	
Semester/Trimester/Others (specify approx. Start/End date)	
Course Author * Faculty proposing/revising the course	Prof Simon Redfern
Course Author Email	simon.redfern@ntu.edu.sg
Course Title	EARTH MATERIALS
Course Code	ES2002
Academic Units	0
Contact Hours	39
Research Experience Components	

Course Requisites (if applicable)

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

Course Aims

This course aims to introduce the principles of magmatic, sedimentary and metamorphicpetrology and the use of the optical microscope in Geosciences. You will learn how to identify thedifferent types of rocks and minerals under the microscope (and SEM) and make connectionswith the hand specimen. You will discover the main processes that lead to the formation of thedifferent rock types and rock associations in different tectonic environments. You will gain handson experience with the different analytical techniques used to study rocks (microscope and SEM)and make connections with the theoretical content. You will discover implications for the societyand practical applications by discussing the importance of rocks and minerals for the industry,and problems related to human health and environmental pollution.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Identify magmatic, sedimentary, and metamorphic minerals and components under the optical microscope.
ILO 2	Recognize the geologic processes that produced a specific rock specimen.
ILO 3	Build connections between large scale tectonic processes, local scale chemical reactions and physical processes, and the characteristics of a rock.
ILO 4	Use phase diagrams and rock classifications to understand and infer rock formation processes.
ILO 5	Describe rocks, their constituents, texture, and geologic interpretation.

Course Content

Know the minerals and components that make magmatic, sedimentary and metamorphic rocks. Know the environmental conditions of formation of magmatic, sedimentary and metamorphicrocks. Know the physical and chemical processes that lead to the formation of these rocks and their expression in rocks.Know how to use the optical microscope to study rocks and their origin. Know how to use phase diagrams and rock classifications to study rocks and their origin.Know how to describe rocks and communicate the related implications of your findings.

Reading and References (if applicable)

The textbook chosen for this class is: Klein C., and Philpotts, A. (2012) Earth Materials Introduction to Mineralogy and Petrology. Cambridge University Press. I encourage you to read it between lectures to help you discover more of the content, while shorter lectures and hands-on practice will be done in class.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to Earth Materials.	3	Introduction to crystal structures and mineral classification.	In-person	
2	Introduction to the optical microscope.	1,3	Mineral identification criteria in plain and cross polarized light.	In-person	
3	Magmatic Rocks 1 - Classification of magmatic rocks	1,2,3,4,5	Components of magmatic rocks.	In-person	
4	Magmatic Rocks 2 - Magma generation	1, 2, 3, 4,5	Mafic plutonic and volcanic rocks.	In-person	
5	Magmatic Rocks 3 - Magma differentiation	1, 2, 3, 4,5	Felsic plutonic and volcanic rocks.	In-person	
6	Sedimentary Rocks 1 - Components of sedimentary rocks	1,2,3,4,5	Components of sedimentary rocks.	In-person	
7	Sedimentary Rocks 2 - Sedimentary processes	1,2,3,4,5	Sedimentary processes.	In-person	
8	Metamorphic Rocks 1 - Classification of metamorphic rocks	1, 2, 3, 4,5	Components of metamorphic rocks.	In-person	
9	Metamorphic Rocks 2 - Metamorphic processes	1,2,3,4.5	Regional metamorphism	In-person	
10	Analytical Techniques - SEM	1,2,3,4,5	Thin Section project	In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
11	Course review - Magmatic, sedimentary and metamorphic rocks	1,2,3,4,5	Magmatic, sedimentary and metamorphic rock descriptions	In-person	
12	Mineral Resources and Human Health	1,2,3,4,5	Mineral Resources - Opaque minerals	In-person	
13	Final practical and theory tests	1,2,3,4,5		In-person	Final practical and theory tests

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures (39 hours)	There will be lectures at the beginning of each week covering the topics of all Learning Outcomes (LO 1-5). These will be done in an interactive way, involving your participation in the form of discussions and contributions to the whiteboard. These lectures will also be punctuated with demonstrations using the microscope and analog models of crystals. Short MCQs at the beginning of each lecture, on the topic of the previous lecture, will facilitate content assimilation and ensure that you can discuss about a topic and learn in an active way. Some assignments will also be given for hands on application of the content covered during lectures (LO 4).
Laboratories (39 hours)	During labs, you will individually have access to microscopes and be encouraged to share your findings and observations with your classmates in order to discover rocks in thin section and describe them adequately (LO 1-3, 5). You will also be doing exercises and asked questions that help you build connections between theoretical processes and their expression in rocks (LO 3-4). You will have the opportunity to go to the SEM and acquire data in pairs for a thin section of your choice (LO 2). This will be part of a 6-week long project aiming at going in depth on one sample to fully discover how to recognize the expression of specific phenomenon in rocks (LO2-3) and how to present this in a professional way (LO 5).

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Others([quiz/test] Short Answer Questions)	1, 2, 3, 5	1. a 2. a 3. a, c 4. a, b 5. c 8. a, b 9. b, c 10. a	25	Individual		
2	Summative Assessment (EXAM): Others([final examination] Final Theory Test 1)	3,4	1. a 2. a 3. a, c 4. b 8. a 9. b	25	Individual		
3	Continuous Assessment (CA): Others([class participation] Activities)	1,2,3,4	1. a, b 2. a 3. a, c 4. b 5. c 8. a, b 9. b, c 10. a	25	Individual		
4	Continuous Assessment (CA): Others([assignments (e.g. term paper, essay)])	1,2,3,4,5	1. a, b 2. a 3. a, c 4. a, b 5. c 8. a, b 9. b, c 10. a	25	Team		

Description of Assessment Components (if applicable)

Formative Feedback

Your weekly activities (thin section descriptions, quizzes, assignments) will be graded and handed back the following week, with feedback in the form of a grade and comments on how to improve. These activities will help you build knowledge and understanding for the final theory and practical tests, which will be in a similar form. The weekly activities and feedback relate to learning outcomes 1-5. You will work on a project in pairs, and qualitative feedback will be provided on the report at the end of the semester (i.e. shortly after the report is due).

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level

Course Policy

Policy (Academic Integrity)

Policy (General)

(1) General
You are expected to complete all assigned pre-class readings and activities, attend all lecture classes punctually and take all scheduled tests by due dates. You are expected to take responsibility to follow up with course notes and course related announcements for seminar sessions they have missed. You are expected to participate in all seminar discussions and activities.

Policy (Absenteeism)

(2) Missed Assessments
When you are absent from an assessment due to illness, you must submit a medical certificate within 7 working days. A student who is absent from assessment without valid Leave of Absence will be given zero mark for the missed assessment. Course lecturers may, however, use his/her own discretion for extenuating circumstances. Policy on medical leave for student may be found from http://www.ntu.edu.sg/Students/Undergraduate/AdminServices/Pages/Applyforshortleave.aspx.

Policy (Others, if applicable)

(3) Special Accommodations
All courses will have some form of assessment and if you envision that you will have difficulty satisfying an assessment component due to your disability then you are advised to contact the Course Coordinator within the first 2 weeks of the course.Students requiring assistance in the learning environment should contact and notify the Associate Chair (Academic) in their School within the first 2 weeks of their first semester so that you and School can work together to optimise your learning experience. Examples of services that may be provided or supported in individual courses include an editor service to help those with reading and writing difficulties, and access to a personal mentor within the School. Please access the NTU Office of Academic Services' website http://www.ntu.edu.sg/sasd/oas/Pages/default.aspx for more information about the arrangementsfor candidates during examinations.
(4) 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 isinvolved 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 anyof these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

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