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	AY2019-2020
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Environmental Chemistry
Course Code	EN1001
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

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

Course Aims

This course aims to:

i) Equip you with a firm foundation in basic chemistry;
ii) Introduce chemistry concepts relevant to environmental engineering and science.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Explain Basic chemistry concepts.
ILO 2	Solve problems related to Thermodynamics and reaction kinetics.
ILO 3	Apply the equilibrium relation into Acids & Bases, Alkalinity & Acidity and Hardness equation.
ILO 4	Use formula to solve Metal Complexation.
ILO 5	Explain the reactions of organic compounds.
ILO 6	Explain electrochemistry and solve REDOX reactions problems.
ILO 7	Discuss the importance of Oxygen and Electron Equivalents.
ILO 8	Explain the basic biochemistry and radio-activity.

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1	Basic concepts: chemical bonds, intermolecular forces, polarity of molecules, structure of water.	1	-
2	Expressing concentrations, activities, equilibrium relationships.	1	1
3	Thermodynamics: laws of thermodynamics, enthalpy, entropy, Gibbs free energy.	3	1
4	Reaction kinetics.	2	1
5	Acid-base equilibria. Moles, mass, charge and proton balances. Algebraic and graphical solutions to water chemistry problems.	3	2
6	The carbonate system. Alkalinity, acidity, and methods of determination. Buffers.	2	1
7	Hardness. Metal complexes. Solubility of salts.	2	1
8	Organic chemistry. Reactions of organic compounds. Introduction to persistent organics.	6	3
9	Electrochemistry and redox reactions. Oxygen and electron equivalents.	2	1
10	Introduction to biochemistry	3	1
11	Introduction to nuclear chemistry and radioactivity	1	1
	Total:	26	13

Reading and References (if applicable)

Textbooks:

1. Sawyer, C.N., McCarty, P.L. and Parkin, G.F. 2003. Chemistry for Environmental Engineering and Science. 5th ed., McGraw-Hill.

References:

1. Gonick, L. and Criddle, C.S. 2005. The Cartoon Guide to Chemistry. Collins.

2. Snoeyink, V.L. and Jenkins, D. 1980. Water Chemistry. Wiley.

3. Benjamin, M.M. 2002. Water Chemistry. McGraw-Hill.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Basic concepts: chemical bonds, intermolecular forces, polarity of molecules, structure of water.	1		In-person	Lectures & Tutorial
2	Expressing concentrations, activities, equilibrium relationships.	1		In-person	Lectures & Tutorial
3	Thermodynamics: laws of thermodynamics, enthalpy, entropy, Gibbs free energy and Reaction kinetics.	1, 2		In-person	Lectures & Tutorial
4	Acid-base equilibria. Moles, mass, charge and proton balances. Algebraic and graphical solutions to water chemistry problems.	3		In-person	Lectures & Tutorial
5	The carbonate system. Alkalinity, acidity, and methods of determination. Buffers.	3		In-person	Lectures & Tutorial

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
6	Hardness. Metal complexes. Solubility of salts.	3, 4		In-person	Lectures & Tutorial
7	Quiz 1	1, 2, 3, 4		In-person	
8	Organic chemistry. Reactions of organic compounds. Introduction to persistent organics.	5		In-person	Lectures & Tutorial
9	Electrochemistry and redox reactions. Oxygen and electron equivalents.	6, 7		In-person	Lectures & Tutorial
10	Electrochemistry and redox reactions. Oxygen and electron equivalents.	6, 7		In-person	Lectures & Tutorial
11	Introduction to biochemistry	8		In-person	Lectures & Tutorial
12	Introduction to nuclear chemistry and radioactivity	8		In-person	Lectures & Tutorial
13	Quiz 2	5, 6, 7, 8		In-person	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Weekly lectures to provide you with the specific knowledge and techniques to achieve the learning outcome stated above.
Tutorials	Weekly tutorials to enable you to apply the knowledge to solve structured problems. We encourage you to explore alternative approaches and techniques.

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	Summative Assessment (EXAM): Final exam(Final Examination)	1 to 8	ENE SLOs (2018) a,b,c	60	Individual	Holistic	Relational
2	Continuous Assessment (CA): Test/Quiz(Quiz 1)	1 to 3	ENE SLOs (2018) a,b,c	20	Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(Quiz 2)	3 to 7	ENE SLOs (2018) a,b,c	20	Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

Related Programme LO or Graduate Attributes

a) Engineering Knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and environmental engineering specialisation to the solution of complex environmental engineering problems.

b) Problem Analysis: Identify, formulate, research literature, and analyse complex environmental engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) Design/development of Solutions: Design solutions for complex environmental engineering problems and design system components or processes with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) Investigation: Conduct investigations of complex problems using research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex environmental engineering activities with an understanding of the limitations.

f) The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and the need for the sustainable development.

h) Ethics: Apply ethical principles and commit to professional and moral responsibilities in the environmental

engineering practice.

i) Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) Communication: Communicate effectively on complex environmental engineering activities with the engineering community and with society at large, be able to comprehend and write effective reports and design documentation and make effective presentations.

k) Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to work, as a member and leader in a multidisciplinary team.

l) Life-long Learning: Recognise the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological evolution.

Formative Feedback

1. Feedback will be gathered through the dissemination of your performance in quizzes as well as review of the quiz questions in class.
2. You are encouraged to initiate an Individual consultation session on their learning needs.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Care for Environment	Advanced
Collaboration	Intermediate
Creative Thinking	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)

Policy (Absenteeism)

Policy (Others, if applicable)

The standing university policy governing student responsibilities shall apply.
No special policy for this course.

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