COURSE CONTENT

Academic Year	2019-2020	**Semester**	2
Course Coordinator	A/P DARREN SUN DELAI		
Course Code	EN1001		
Course Title	Environmental Chemistry		
Pre-requisites	NIL		
No of AUs	3		
Contact Hours	Total: 39 Hours (Lecture: 26 hours; Tutorial: 13 hours)		
Proposal Date	30 Apr 2019		

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 Learning Outcomes (Course LO)

By the end of this course, you should be able to:

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

Components	**Course LO tested**	**Related Programme LO or Graduate Attributes**	**Weight -ing**	**Team/ Individual**	**Assessment rubrics**
1. Final Examination	1 - 8	ENE SLOs (2018) a,b,c	60%	Individual	
2. Continuous Assessment 1: Quiz 1	1 - 3	ENE SLOs (2018) a,b,c	20%	Individual	
3. Continuous Assessment 2: Quiz 2	3 - 7	ENE SLOs (2018) a,b,c	20%	Individual	
Total			100%		

*ENE SLOs = Student Learning Outcome for Environmental Engineer Programme

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.

Learning and Teaching approach

Approach	**How does this approach support students 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.

Textbooks/References:

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.

Course Policies and Student Responsibilities

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

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. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors AY2019/20

Instructor	Office Location	Phone	Email
A/P Darren Sun Delai	N1-01C-89	67906273	ddsun@ntu.edu.sg
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Planned Weekly Schedule

Week	Topics	Course LO	Activities
1	Basic concepts: chemical bonds, intermolecular forces, polarity of molecules, structure of water.	1	Lectures & Tutorial
2	Expressing concentrations, activities, equilibrium relationships.	1	Lectures & Tutorial
3	Thermodynamics: laws of thermodynamics, enthalpy, entropy, Gibbs free energy and Reaction kinetics.	1,2	Lectures & Tutorial
4	Acid-base equilibria. Moles, mass, charge and proton balances. Algebraic and graphical solutions to water chemistry problems.	3	Lectures & Tutorial
5	The carbonate system. Alkalinity, acidity, and methods of determination. Buffers.	3	Lectures & Tutorial
6	Hardness. Metal complexes. Solubility of salts.	3,4	Lectures & Tutorial
7	**Quiz 1**	1,2,3,4	
	Recess Week		
8	Organic chemistry. Reactions of organic compounds. Introduction to persistent organics.	5	Lectures & Tutorial

9	Electrochemistry and redox reactions. Oxygen and electron equivalents.	6,7	Lectures & Tutorial
10	Electrochemistry and redox reactions. Oxygen and electron equivalents.	6,7	Lectures & Tutorial
11	Introduction to biochemistry	8	Lectures & Tutorial
12	Introduction to nuclear chemistry and radioactivity	8	Lectures & Tutorial
13	**Quiz 2**	5,6,7,8	