



Course Syllabus (Academic Year 2022)

School of Interdisciplinary Studies, Kanchanaburi Campus, Mahidol University

1. **Course No. and Title** : KAED 225 Chemistry for Environmental Engineering
Credit (study hours) : 3 (3-0-6)
2. **Program Name** : Bachelor of Engineering Program in Environmental Engineering and
Disaster Management
3. **Course Module** : Major Required Courses
Pre/co-requisite : SCCH 113 (General Chemistry)
4. **Class Semester** : 1st Semester 2nd Semester Academic Year 2022
5. **Class Schedule & Venue** : Tuesday 09:00 – 12:00
Class Coordinator : Dr. Pensiri Prachakittikul
Contact No: 086-0240919
: Email: pensiri.prc@mahidol.edu

6. Course Description

Fundamental principles of environmental engineering calculations, mass, and energy balance, chemical kinetics, chemical thermodynamics, basic reactor models, chemical equilibrium, acid-base chemistry, precipitation, dissolution, complex ion equilibria oxidation-reduction reactions, carbonate system, aquatic chemistry, colloid chemistry, chemical and physical characteristics of water and wastewater, water quality parameters, sample collections and preservations, water and wastewater analyses in laboratory e.g. pH, hardness, alkalinity, acidity, solids, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrogen, phosphorus, etc., application of water quality data in environmental engineering practices, basic of chemical treatment processes e.g. coagulation-flocculation and disinfection, etc.

7. Course Learning Outcomes (CLOs)

No.	CLOs	Expected Skills / Knowledge			PLOs
		Specific (SS)	Generic (GS)	Knowledge (K)	
1	Explain terminologies related to water quality and the importance of water quality parameters	<ul style="list-style-type: none"> Professionalism SS2 	-	Water and Wastewater K2	1 (Introductory)
2.	Perform basic unit calculations and conversions used in environmental engineering	<ul style="list-style-type: none"> Mathematic solving SS1 	--	-	1, 2 (Introductory)
3	Illustrate the chemical concept and their application in environmental engineering fields	<ul style="list-style-type: none"> Ability to analyze Problem solving Systematic thinking SS2, SS3 	GS1-GS4	Water and Wastewater K1-K5	1 (Introductory)
4.	Apply the equilibrium equations, kinetic equations, and stoichiometric relationships to solve environmental problems	<ul style="list-style-type: none"> Mathematic solving Ability to analyze Problem solving Data interpretation SS1-SS5 	GS1-GS4	Water and Wastewater K1, K2, K5	1, 2 (Introductory)
5.	Apply knowledge of basic water chemistry to solve problems associated with waste and wastewater treatment	<ul style="list-style-type: none"> Ability to analyze Problem solving SS1-SS5 	GS1-GS4	Water and Wastewater K1-K6	1, 2 (Introductory)

8. Class Instructor List

Dr. Pensiri Prachakittikul (PP)

Contact No. : 086-024-0919 Email: pensiri.prc@mahidol.edu

9. Course Outline

Week	Date	Contents	CLOs	Teaching & Learning method	Instructor's Names
Review fundamentals of chemistry for environmental engineering I					
1	9/08/2022	<ul style="list-style-type: none"> Unit of measurement <ul style="list-style-type: none"> Significant figure and rounding the results Matter and properties of matter States of matter Concentrations of solutions Units of concentration 	1, 2	<ul style="list-style-type: none"> Lecture with learning materials In class assignment Out of class assignment Asking and answering questions 	PP
2	16/08/2022	<ul style="list-style-type: none"> Stoichiometry <ul style="list-style-type: none"> Balance the equation Chemical equilibria I 	1, 2, 4		PP

Week	Date	Contents	CLOs	Teaching & Learning method	Instructor's Names
		<ul style="list-style-type: none"> - Homogeneous equilibria - Heterogeneous equilibria (solubility product) 			
3	23/08/2022	<ul style="list-style-type: none"> • Chemical equilibria I - Shifting of chemical equilibria (precipitation reaction, oxidation-reduction reaction) 	1, 2, 4		PP
4	30/08/2022	<ul style="list-style-type: none"> • Chemical equilibria II - Shifting of chemical equilibria (acid-base reaction (neutralization), gas-producing reaction) 	1-5		PP
5	6/09/2022	<ul style="list-style-type: none"> • Chemical kinetic - Zero, first, second-order reactions - Gas solubility 	1-5		PP
Basic water chemistry					
6	13/09/2022	<ul style="list-style-type: none"> • Alkalinity • Buffering Carbonate system 	1-5	• Lecture with learning materials	PP
7	20/09/2022	<ul style="list-style-type: none"> • Carbonate system • Acidity 	1-5	<ul style="list-style-type: none"> • In class assignment • Out of class assignment • Asking and answering questions 	PP
Measure of water quality/ assessing water quality/ water quality standards					
8	27/09/2022	<ul style="list-style-type: none"> • pH, ORP, Conductivity • Hardness 	1-5	<ul style="list-style-type: none"> • Lecture with learning materials • In class assignment • Out of class assignment • Asking and answering questions 	PP
9	4/10/2022 Midterm Examination				
10	11/10/2022	<ul style="list-style-type: none"> • Dissolved oxygen • Oxygen Demand (BOD) 	1-5	<ul style="list-style-type: none"> • Lecture with learning materials • In class assignment 	PP

Week	Date	Contents	CLOs	Teaching & Learning method	Instructor's Names
11	18/10/2022	<ul style="list-style-type: none"> Oxygen Demand (NBOD, COD) Oxygen Profile in Stream 	1-5	<ul style="list-style-type: none"> Out of class assignment Asking and answering questions 	PP
12	25/10/2022	<ul style="list-style-type: none"> Color, Turbidity, Solids 	1-5		PP
13	1/11/2022	<ul style="list-style-type: none"> Nitrogen, Phosphorus Iron, Manganese TOC 	1-5		PP
14	8/11/2022	<ul style="list-style-type: none"> Oil and grease Bacteria Assessing water quality water quality standards 	1-5		PP
Introduction to basic chemical treatment processes					
15	15/11/2022	<ul style="list-style-type: none"> Coagulation/Flocculation/Jar test Neutralization Chemical Precipitation/ Water softening 	1-5	<ul style="list-style-type: none"> Lecture with learning materials In class assignment Out of class assignment Asking and answering questions 	PP
16	22/11/2022	<ul style="list-style-type: none"> Disinfection Chlorination and Chlorine Demand 	1-5		PP
17	Final exam				

10. Course Assessment

No.	Assessment Methods	Regulations	CLOs	Week	Weight Distribution (%)
11.1	Mid-term exam	The midterm examinations will each cover approximately 1/2 of the course material.	1-5	9	30
11.2	Final exam	- The final exam will review the entire course as well as more intensively cover the last 1/2 of the course material.	1-5	17	30

No.	Assessment Methods	Regulations	CLOs	Week	Weight Distribution (%)
11.3	Quizzes	- Quizzes will be given in class and cover the content from the previous weeks.	1-5	3, 7, 12, 15	15
11.4	Individual or group Assignment	Class assignment rubric	1-5	1-7, 16	15
11.5	Active Participation, Class Attendance	Class participation rubric	1-5	1-16	10
				Total	100

- **Quizzes, midterm, and final exams**

Students should understand the following examination rules. The exam will be mixtures short answer questions and short essay questions. Very few multiple choice and true/ false questions will be used.

- **Make-up exams**

Make-up examinations will be given only if the student has an excused or authorized absence. Students must contact the instructor no later than one week after the missed exam, or after return to campus, to indicate why they were absent and to request to take a make-up. It is the responsibility of the student to inquire as to the procedure for making up an exam. There are no make-ups, other class assignments.

- **Requirements:**

Bring to every class scientific or engineering calculator; phones must be turned off or switched to vibration mode; if you receive an urgent call, step out of the classroom while using the phone.

11. Grading System

Criterion-referenced evaluation

Grade	Score	Grade	Score	Grade	Score	Grade	Score
A	$\geq 80\%$	B	70 – 74.99%	C	60 – 64.99%	D	50 – 54.99%
B+	75 – 79.99%	C+	65 – 69.99%	D+	55 – 59.99%	F	< 50 %

12. References

12.1 Susan M. Morgan, Lauren G. Heine, P. Arne Vesilind, Introduction to Environmental Engineering, SI Version, 3rd edition, CL-Engineering, 2010.

12.2 Mackenzie L. Davis, David A. Cornwell, Introduction to Environmental Engineering, 5th Edition, McGraw-Hill Education, 2013.

12.3 Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin, Chemistry for Environmental Engineering, 4th edition, McGraw-Hill, Inc, 1994.

12.4 Stanley E. Manahan, Fundamentals of Environmental Chemistry, 1st edition, Lewis publishers, 1993.

Note:

PLO	
PLO 1 (Introduced)	Apply environmental engineering principles and knowledge to systematic solutions according to professional standards.
PLO 2 (Introduced)	Apply practical skills in environmental engineering and disaster management to real situations based on academic principles and professional ethics
Specific Skill (SS)	
SS1	Apply the knowledge of mathematics, science, engineering fundamentals
SS2	Assess quantity and quality of wastewater
SS3	Predict chemical reactions that occur in contaminated and natural environments
SS4	Analyze complex problems in the field of environmental engineering
SS5	Apply knowledge and theory to analyze and solve problems
Generic Skill (GS)	
GS1	Perform the systematic thinking, problem solving, and analytical skills
GS2	Demonstrates awareness of environmental issues
GS3	Demonstrate a sense of responsibility and a concern for ethical practice in environmental engineering
Knowledge (K)	
K1	Chemical principles of water and wastewater
K2	Water and wastewater chemistry
K3	Physical, chemical, and biological water and wastewater characteristics
K4	Physical-chemical water and wastewater treatment processes
K5	In-depth knowledge of theory and chemical principles used for evaluation of water quality in water and wastewater treatment
K6	Water quality parameters and measurements