



Course Syllabus (Academic Year 2021)

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 2021
5. **Class Schedule & Venue** : Tuesday and Wednesday: 09:00 – 12:00
The online classroom (Cisco Webex Meeting)
Google classroom:
<https://classroom.google.com/c/MzQ3ODMyNzAyMzEx?cjc=7p2ebar>
6. **Class Coordinator** : Dr. Pensiri Prachakittikul
Contact No: 086-0240919
: Email: pensiri.prc@mahidol.edu

7. 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.

8. Course Objectives / Course Learning Outcomes (CLOs)

No.	Objectives / CLOs	Expected Skills / Knowledge			PLOs
		Specific (SS)	Generic (GS)	Knowledge (K)	
1.	Demonstrate knowledge and understanding of equilibrium equations, material balances, kinetic equations, and stoichiometric relationships to calculate conditions in environmental systems	SS1, SS2	GS1-GS5	K1-K6	1
2.	Define important terminology for physical-chemical processes involved in environmental engineering	SS1, SS2	GS1-GS5	K1-K6	1
3.	Describe the basic knowledge of physical-chemical processes involved in environmental engineering	SS1, SS2	GS1-GS5	K1-K6	1
4.	Describe the physical-chemical characteristics of water and wastewater and the measurements of them	SS1, SS2	GS1-GS5	K1, K2	1
5.	Describe the fundamental physical-chemical processes applicable to water and wastewater treatment	SS1, SS2	GS1-GS5	K1-K6	1, 2

9. Class Instructor List

9.1 Dr. Pensiri Prachakittikul (PP)

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

10. Course Outline

Week	Date	Contents	CLOs	Teaching & Learning method	Instructor's Names
1	Tue 29/06/2021	<ul style="list-style-type: none"> • Fundamentals of Chemistry for Environmental Engineering I - Units of measurement - Significant figures and rounding the results 	1, 4	<ul style="list-style-type: none"> • Lecture • Assignment in Class 	PP

Week	Date	Contents	CLOs	Teaching & Learning method	Instructor's Names
2	Wed 30/06/2021	<ul style="list-style-type: none"> • Fundamentals of Chemistry for Environmental Engineering I - Matter - Concentrations of solutions - Units of concentration 	1, 4	<ul style="list-style-type: none"> • Lecture • Assignment in Class 	PP
3	Tue 6/07/2021	<ul style="list-style-type: none"> • Fundamentals of Chemistry for Environmental Engineering II -Stoichiometry and Balanced Equations -Chemical Kinetics 	1, 4	<ul style="list-style-type: none"> • Lecture • Assignment in Class • Homework 	PP
4	Wed 7/07/2021	<ul style="list-style-type: none"> • Fundamentals of Chemistry for Environmental Engineering II - Chemical Equilibrium - Acids, Bases, and Salts 	1-3	<ul style="list-style-type: none"> • Lecture • Homework • Quiz I 	PP
5	Tue 13/07/2020	<ul style="list-style-type: none"> • Fundamentals of Chemistry for Environmental Engineering III - Solubility Product 	1-3	<ul style="list-style-type: none"> • Lecture • Assignment in Class • Homework 	PP
6	Wed 14/07/2021	<ul style="list-style-type: none"> • Fundamental of water chemistry (I) - Buffering and Carbonate system 	1-3	<ul style="list-style-type: none"> • Lecture • Assignment in Class 	PP
7	Tue 20/07/2021	<ul style="list-style-type: none"> • Major Water Quality Parameters and Applications - pH, Alkalinity, Acidity 	1-3	<ul style="list-style-type: none"> • Lecture • Homework • Quiz II 	PP
8	Tue 21/07/2021	<ul style="list-style-type: none"> • Major Water Quality Parameters and Applications - Water hardness 	1-3	<ul style="list-style-type: none"> • Lecture • Homework 	PP
9	Tue. 3/08/2021 Mid-term Examination				
10	Wed 4/08/2021	<ul style="list-style-type: none"> • Introduction to Water Quality and Pollution - Conductivity 	1-3	<ul style="list-style-type: none"> • Lecture/ Discussion • Assignment in Class 	PP
11	Tue 10/08/2021	<ul style="list-style-type: none"> • Water Quality and Pollution - Color - Turbidity - Solids 	1-3	<ul style="list-style-type: none"> • Lecture/ Discussion • Assignment in Class 	PP
12	Wed 11/08/2021	<ul style="list-style-type: none"> • Water quality and pollution - Dissolved Oxygen and Oxygen Demand, TOC 	1-3	<ul style="list-style-type: none"> • Lecture/ Discussion • Assignment in Class 	PP

Week	Date	Contents	CLOs	Teaching & Learning method	Instructor's Names
13	Tue 17/08/2021	<ul style="list-style-type: none"> • Water quality and pollution - Oxygen Profile in Stream 	1-3	<ul style="list-style-type: none"> • Lecture/ Discussion • Assignment in Class • Quiz III 	PP
14	Wed 18/08/2021	<ul style="list-style-type: none"> • Basic chemical treatment processes (I) - Coagulation - Neutralization - Precipitation - Oxidation and reduction - Ion exchange - Disinfection 	1-3	<ul style="list-style-type: none"> • Lecture/ Discussion 	PP
15	Tue 24/08/2021	<ul style="list-style-type: none"> • Basic chemical treatment processes (II) - Chlorination and Chlorine Demand 	1-3	<ul style="list-style-type: none"> • Lecture • Assignment in Class 	PP
16	Wed 25/08/2021	<ul style="list-style-type: none"> • Basic Mass Balance for Environmental Engineering 	1, 4	<ul style="list-style-type: none"> • Lecture Assignment in Class • Quiz IV 	PP
17	Tue 31/08/2021	Final exam			

11. Course Assessment

No.	Methods / Activities	Regulations	CLOs	Week	Weight Distribution (%)
11.1	Mid-term exam	<ul style="list-style-type: none"> - Content week 1-7 - Closed book - Faculty-approved calculator 	1-3	8	30
11.2	Final exam	<ul style="list-style-type: none"> - Content week 11-16 - Closed book - Faculty-approved calculator 	1-4	16	35
11.3	Quizzes	<ul style="list-style-type: none"> - Quizzes will be given in class and cover the content from the previous weeks. There will be no make-up quizzes. 	1-4	4, 7,12,15	20

No.	Methods / Activities	Regulations	CLOs	Week	Weight Distribution (%)
11.4	Homework	-Turn in homework or assignments on the google classroom	1-4	1-4, 7, 11, 13	5
11.5	Report/Assignment	To be announced	1-4	1-15	10
				Total	100

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 (this is a privilege, do not overuse it).

12. 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 %

13. References

- 13.1) Susan M. Morgan, Lauren G. Heine, P. Aarne Vesilind, Introduction to Environmental Engineering, SI Version, 3rd edition, CL-Engineering, 2010.
- 13.2) Mackenzie L. Davis, David A. Cornwell, Introduction to Environmental Engineering, 5th Edition, McGraw-Hill Education, 2013.
- 13.3) Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin, Chemistry for Environmental Engineering, 4th edition, McGraw-Hill, Inc, 1994.
- 13.4) Stanley E. Manahan, Fundamentals of Environmental Chemistry, 1st edition, Lewis publishers, 1993.

Note:

PLO	
PLO 1 PLO 2	Apply environmental engineering principles and knowledge to systematic solutions according to professional standards. Apply practical skills in environmental engineering and disaster management to real situations based on academic principles and professional ethics
Specific Skill (SS)	
SS1 SS2	Assess quantity and quality of wastewater. Predict chemical processes that occur in contaminated and natural environments
Generic Skill (GS)	
GS1 GS2 GS3 GS4 GS5	Systematic Thinking, Problem Solving, and Analytical Skills Basic Computer Skills Environmental and Disaster Risk Awareness A broad education is necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. A knowledge of contemporary issues
Knowledge (K)	
K1 K2 K3 K4 K5 K6	Basic chemistry Basic principles of chemical processes Chemical principles of water and wastewater Water and wastewater chemistry Physical, chemical, and biological water and wastewater characteristics Physical-chemical water and wastewater treatment processes