



## Course Syllabus (Academic Year 2022)

School of Interdisciplinary Studies, Kanchanaburi Campus, Mahidol University

- Course No. and Title** : KAED 352 Hazardous Waste Management  
**Credit (study hours)** : 3 (3-0-6)
- Program Name** : Bachelor of Engineering Program in Environmental Engineering and Disaster Management
- Course Module** : Major Required Courses  
**Pre/co-requisite** : KAED 225 (Solid Waste Engineering)
- Class Semester** :  1<sup>st</sup> Semester  2<sup>nd</sup> Semester Academic Year 2022
- Class Schedule & Venue** : Friday 13:00 – 16:00 Room R-L218
- Class Coordinator** : Dr. Pensiri Prachakittikul Contact No: 086-024-0919  
Email: pensiri.prc@mahidol.edu

### 7. Course Description

Definition, laws and environmental legislations, classification of hazardous wastes, physicochemical properties, toxicology, types and characteristics of hazardous waste, risk assessment and management, handling and transportation, fundamentals of treatment and disposal processes, stabilization, solidification, land disposal, site remediation.

### 8. Course Learning Outcomes (CLOs)

No.	CLOs	Expected Skills / Knowledge			PLOs
		Specific	Generic	Knowledge	
8.1	Understand different types of hazardous waste or industrial waste, their handling, storage, disposal requirements, remediation, and their potential effect on the environment, worker health, and safety.	SS3-SS6	GS1-Gs5	K1-K3	1, 2
8.2	Identify the national and international regulations and laws related to the management of hazardous waste and industrial waste.	SS3-SS6	GS1-GS6	K3	1, 2

No.	CLOs	Expected Skills / Knowledge			PLOs
		Specific	Generic	Knowledge	
8.3	Define the issues of hazardous waste and industrial waste contamination in simulated scenarios.				
8.4	Apply appropriate principles of hazardous waste and industrial waste management and treatment for solving the problems according to Professional Standards.	SS1-SS6	GS1-GS6	K1-K3	1, 2

## 9. Class Instructor List

9.1 Dr. Pensiri Prachakittikul (PP) Contact No.: 086-024-0919 Email: pensiri.prc@mahidol.edu

9.2 Dr. Narongsak Chaiyasit (NC) Contact No.: 094-597-9654 Email: [eshmanagement10@gmail.com](mailto:eshmanagement10@gmail.com)

Special Lecture from Synergy Plus Co., Ltd.

## 1. Course Outline

Week	Date	Contents	CLOs	Teaching & Learning Method	Instructor's name
1-2	13/01/2023 9.00-16.00	<ul style="list-style-type: none"> <li>Course Introduction</li> <li>Ch1: Hazardous and industrial waste and their impact               <ul style="list-style-type: none"> <li>- Definition, types, sources</li> <li>- Properties</li> </ul> </li> </ul>	1, 2	- Lecture	PP
3	20/01/2023	<ul style="list-style-type: none"> <li>Ch1: Hazardous and industrial waste and their impact               <ul style="list-style-type: none"> <li>- Impacts/ Toxicology</li> </ul> </li> <li>Ch2: Hazardous and industrial waste laws and regulations I</li> </ul>	1, 2	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Case study-based learning</li> <li>- Activity-based learning</li> </ul>	
4	27/01/2023*	<ul style="list-style-type: none"> <li>Ch3: Hazardous and Industrial waste storage and Transportation I</li> <li>Ch4: Guidelines for managing industrial waste management I               <ul style="list-style-type: none"> <li>- Lean management for the environment</li> </ul> </li> </ul>	1, 2, 3	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Activity-based learning</li> </ul>	

Week	Date	Contents	CLOs	Teaching & Learning Method	Instructor's name
		- Clean Technology			
5-6	10/02/2023 9.00-16.00	<ul style="list-style-type: none"> <li>• Ch4: Guidelines for managing industrial waste management II               <ul style="list-style-type: none"> <li>- Life cycle assessment</li> <li>- Waste minimization</li> </ul> </li> <li>• Ch5: Pathways, fate, and transport of hazardous Waste I (contaminants in the water and subsurface)</li> </ul>	1, 3	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Activity-based learning</li> </ul>	
7-8	24/02/2023 9.00-16.00	<ul style="list-style-type: none"> <li>• Ch5: Pathways, fate, and transport of hazardous Waste II (contaminants in the water and subsurface)</li> <li>• Ch6: Technology for utilizing industrial waste               <ul style="list-style-type: none"> <li>- Evaporation</li> <li>- Metal recovery</li> <li>- Solvent recovery</li> <li>- Solvent extraction</li> </ul> </li> </ul>	1, 3, 4	- Lecture	
7-10 Mar 2023 Mid-term Examination					
9	17/03/2023	<ul style="list-style-type: none"> <li>• Ch7: Industrial and Hazardous Wastes Treatment (Physico-chemical and biological treatment) I               <ul style="list-style-type: none"> <li>- Neutralization</li> <li>- Adsorption</li> <li>- Oxidation -Reduction, Advanced oxidation processes</li> <li>- Air and vapor stripping</li> <li>- Soil vapor extraction</li> <li>- Land treatment</li> </ul> </li> </ul>	1, 3, 4	- Lecture	
10	24/03/2023	<ul style="list-style-type: none"> <li>- Ch8: Industrial and Hazardous Wastes Treatment (Thermal treatment)               <ul style="list-style-type: none"> <li>- Combustion</li> </ul> </li> </ul>	1, 3, 4	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Case study-based learning</li> </ul>	PP

Week	Date	Contents	CLOs	Teaching & Learning Method	Instructor's name
		<ul style="list-style-type: none"> <li>- Pyrolysis</li> <li>- Gasification</li> <li>- Incineration and Co-incineration</li> </ul>			
11	31/03/2023	<ul style="list-style-type: none"> <li>• Ch9: Land disposal</li> <li>- Industrial waste landfills</li> <li>- Stabilization and solidification</li> <li>- Deep well injection</li> <li>- Surface impoundment</li> </ul>	1, 2, 3, 4	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Case study-based learning</li> </ul>	PP
12	7/04/2023	<ul style="list-style-type: none"> <li>• Ch10: Remediation Technologies for Cleaning Up Contaminated Sites I (Physico-chemical remediation technologies)</li> <li>- Barrier wall</li> <li>- Pump and treat</li> <li>- Air sparging and soil vapor extraction</li> <li>- In situ chemical oxidation</li> <li>- In situ stabilization and solidification</li> </ul>	1, 3, 4	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Case study-based learning</li> </ul>	
13	14/04/2023 National holiday: Songkran Festival **	<ul style="list-style-type: none"> <li>• Ch11: Remediation Technologies for Cleaning Up Contaminated Sites II (Biological remediation technologies)</li> <li>- Phytoremediation</li> <li>- In situ bioremediation</li> <li>- Bioventing and biosparging</li> <li>- Natural attenuation</li> </ul>	1, 3, 4	<ul style="list-style-type: none"> <li>- Lecture</li> <li>- Case study-based learning</li> </ul>	
14	21/04/2023	<ul style="list-style-type: none"> <li>• Special topics for hazardous waste management</li> </ul>	1, 3, 4	Case study-based / Experience-based learning Project-based learning	Narongsak Chaiyasit

Week	Date	Contents	CLOs	Teaching & Learning Method	Instructor's name
15	28/04/2023	<ul style="list-style-type: none"> <li>Special topics for hazardous waste management</li> </ul>	1, 3, 4	Case study-based / Experience-based learning	Narongsak Chaiyasit
1-12 May 2023: Final examination					

\* The class may be canceled if an instructor's absence is unavoidable; a make-up class will be announced later.

\*\* The class affected by the national holiday; a make-up class will be announced later.

## 2. Course Assessment

No.	Methods / Activities	Regulations	CLOs	Week	Weight Distribution (%)
11.1	Mid-term exam	<ul style="list-style-type: none"> <li>Contents (week 1-7)</li> <li>Closed book</li> </ul>	1-4	9	30
11.2	Final exam	<ul style="list-style-type: none"> <li>Contents (week 9-15)</li> <li>Closed book</li> </ul>	1-4	19	30
11.3	Quiz	<ul style="list-style-type: none"> <li>Pretest or post test</li> <li>Closed book</li> </ul>	1-4	To be announcement	10
11.4	Assignments/Homework	Homework must be turned in during the class hour in the classroom on the due date.	1-4		5
11.5	Group project and presentation	Projects–Rubric scoring	1-4		15
11.6	Class participation	Learners must be engaged in asking - answering questions and discussions.	1-4		All
				<b>Total</b>	<b>100</b>

On time attendance at class sessions is mandatory. Three late arrivals or missing more than half a class session is considered an absence. If attendance is less than 80%, students may not take the final exam and will receive an “F” for the course.

### 3. Grading System

Criterion-referenced evaluation

Grade	Score	Grade	Score	Grade	Score	Grade	Score
A	≥ 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 %

Norm-referenced evaluation

\*If use both criterion and norm-referenced evaluation, please tick two boxes.

### 4. References

13.1 เกียรติศักดิ์ อุดมสินโรจน์, ขงเสี่ยอันตราย, พิมพ์ครั้งที่ ๑. มหาวิทยาลัยรังสิต , กรุงเทพมหานคร.๒๕๕๓.

13.2 Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans: Hazardous Waste Management McGraw-Hill, Inc., Singapore, International Editions, 1994

13.3 Richard J. Watts, Hazardous Wastes: Sources, Pathways, Receptors, John Wiley & Sons, Inc., New York; January 1998, ISBN: 0-471-00238-0.

#### Note

Specific Skill (SS)	
SS1	Mathematical problem solving
SS2	Systematic planning
SS3	Assess quantity and quality of hazardous wastes
SS4	Specify important criteria for suitable and reliable of hazardous waste management
SS5	Identify and safely handle hazardous chemicals
SS6	Evaluate the toxicity of a substance for the purpose of health risk assessment
Generic Skill (GS)	
GS1	Self-discipline
GS2	Professional ethics and Responsibility
GS3	Systematic Thinking, Problem Solving and Analytical Skills
GS2	Environmental and Disaster Risk Awareness
GS4	A knowledge of contemporary issues
GS5	A recognition of the need for, and an ability to engage in life-long learning
Knowledge (K)	
K1	Solid waste and Hazardous waste engineering
K2	Pollution prevention and control
K3	Environmental Laws and regulations of hazardous waste management
PLOs	
PLO1 (Reinforced)	Apply environmental engineering principles and knowledge to systematic solutions according to professional standards
PLO2 (Reinforced)	Apply practical skills in environmental engineering and disaster management to real situations based on academic principles and professional ethics