

SEE4203: ADVANCED TREATMENT AND MANAGEMENT OF SOLID AND MUNICIPAL WASTE

Effective Term

Semester B 2023/24

Part I Course Overview

Course Title

Advanced Treatment and Management of Solid and Municipal Waste

Subject Code

SEE - School of Energy and Environment

Course Number

4203

Academic Unit

School of Energy and Environment (E2)

College/School

School of Energy and Environment (E2)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

SEE4217 Waste and Wastewater Treatment Engineering

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course aims to provide students with up-to-date knowledge regarding ever-growing and intricate problems of managing and processing waste due to urban development. It covers issues concerning economic, legislative and regulatory development involved in the management of solid waste and technology, including solid waste classification, characterisation and generation, waste treatment facilities, resource recovery and recycling, waste collection and disposal. Students will be able to design an integrated waste management system for source reduction and disposal by combining the available options. Life-cycle assessment (LCA) in making engineering decisions of municipal solid waste treatment and resource circulation will be discussed.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain solid waste generation and management in a technological society and generalize the Integrated Solid Waste Management framework; and evaluate the economics, legislation, as well as the costs and benefits of recycling different types of MSW materials	20	x		
2	Characterise the physical, chemical, and biological properties of municipal solid waste; and evaluate available biological and thermal treatment technologies	25		x	
3	Design and facilitate implementation of MSW charging scheme, collection and recycling of food waste; reduction in the use of single-use plastics; and promotion of waste-to-energy	25		x	
4	Apply LCA and green chemistry principles into the design of an integrated solid and municipal waste management system; and identify opportunities for improvement, propose innovative solutions, and assess the potential benefits and limitations	30	x	x	

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Lectures on (1) Classification and Characterisation of Solid Waste; (2) Waste Management Facilities in Hong Kong; (3) Recycling Municipal Waste; (4) Healthcare Waste Management; (5) Plastic Waste Management; (6) E-waste Management; (7) Food and Yard Waste Management; (8) Textile Waste and Solid Hazardous Waste Management; (9) Techno-economic analyses and Life Cycle Assessment; (10) Solid Waste, Circular Economy and Sustainable Development Goals	2.5 hrs/wk
2	In-class exercises	In-class exercises will be handed out to students to assess students' concepts and grasp of knowledge taught in class	0.5 hrs/wk
3	Readings	Reading materials including reference books, journal papers and related online articles/ reports will be provided to students to facilitate self-directed learning.	
4	Mid-term	Mid-term will be arranged to assess students' understanding and ability to apply subject-related knowledge learned in class, textbooks and required reading materials.	
5	Examination	Examination will be arranged to assess students' understanding and ability to apply subject-related knowledge learned in class, textbooks and required reading materials.	

Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1 In class exercises Students need to complete in-class exercises and participate actively in discussing these exercises to facilitate their understanding of knowledge taught in class.	1, 2, 3	8	
2 Case study and oral presentation Students will work in groups, prepare and deliver oral presentation on a selected case study. Students are required to propose projects that can enhance efficiency of waste reduction and recycling as well as resources circulation.	1, 2, 3	20	
3 Assignments There will be several assignments throughout the semester. Students will complete the assignments to demonstrate their ability to apply their knowledge on advanced treatment and management of solid and municipal waste, and to analyses problems related to energy and environmental applications.	1, 2, 3, 4	20	
4 Field Trip Report Students will write a summary of a field trip visit to see one of the waste management facilities in Hong Kong. Students will report their learning during the visit, and describe the importance of proper waste management on the social and economic development in terms of Sustainable Energy and Environment in Hong Kong.	1, 3	2	

5	Mid-term Students will be assessed via the examination of their understanding of concepts learned in classes, textbooks, reading materials, and their ability to apply subject-related knowledge.	1, 2, 3, 4	25	Duration: 2 hours, if applicable
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Continuous Assessment (%)

75

Examination (%)

25

Examination Duration (Hours)

2

Additional Information for ATs

Examination (CILOs 1, 2, 3 and 4)

Students will be assessed via the examination of their understanding of concepts learned in classes, textbooks, reading materials, and their ability to apply subject-related knowledge.

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Examination duration: 2 hrs

Percentage of coursework, examination, etc.: 75% by coursework; 25% by exam

To pass a course, a student must do ALL of the following:

- 1) obtain at least 30% of the total marks allocated towards coursework (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
- 2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
- 3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. In-class exercises

Criterion

Ability to evaluate and analyse different thermal and biological processes for the treatment of solid and municipal waste, and to discuss their calculations/findings to others.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of treatment of solid and municipal waste

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of treatment of solid and municipal waste

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of treatment of solid and municipal waste

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of treatment of solid and municipal waste

Failure (F)

Poor analysis and is barely able to demonstrate an understanding of treatment of solid and municipal waste

Assessment Task

2. Assignments

Criterion

Ability to apply LCA and green chemistry principles on decision making of solid and municipal management strategies; ability to analyse and provide solutions to practical problems in treatment and management of solid and municipal waste.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate the LCA and green chemistry principles on decision making of solid and municipal management strategies; excellent ability to analyse and provide solutions to practical problems in treatment and management of solid and municipal waste.

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate the LCA and green chemistry principles on decision making of solid and municipal management strategies; good ability to analyse and provide solutions to practical problems in treatment and management of solid and municipal waste.

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate the LCA and green chemistry principles on decision making of solid and municipal management strategies; acceptable ability to analyse and provide solutions to practical problems in treatment and management of solid and municipal waste.

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate the LCA and green chemistry principles on decision making of solid and municipal management strategies; marginally acceptable ability to analyse and provide solutions to practical problems in treatment and management of solid and municipal waste.

Failure (F)

Poor analysis and problem solving skills to demonstrate the LCA and green chemistry principles on decision making of solid and municipal management strategies; poor ability to analyse and provide solutions to practical problems in treatment and management of solid and municipal waste.

Assessment Task

3. Case study and oral presentation

Criterion

Ability to design and propose innovative solutions to enhance efficiency of waste reduction and recycling, as well as resources circulation; and assess the potential benefits and limitations.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of design and propose innovative solutions to enhance efficiency of waste reduction and recycling, as well as resources circulation; and assess the potential benefits and limitations.

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of design and propose innovative solutions to enhance efficiency of waste reduction and recycling, as well as resources circulation; and assess the potential benefits and limitations.

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of design and propose innovative solutions to enhance efficiency of waste reduction and recycling, as well as resources circulation; and assess the potential benefits and limitations.

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of design and propose innovative solutions to enhance efficiency of waste reduction and recycling, as well as resources circulation; and assess the potential benefits and limitations.

Failure (F)

Poor analysis and is barely able to demonstrate an understanding of design and propose innovative solutions to enhance efficiency of waste reduction and recycling, as well as resources circulation; and assess the potential benefits and limitations.

Assessment Task

4. Mid-term

Criterion

Ability to apply waste treatment and management knowledge to solve problems related to solid and municipal waste management.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of solid and municipal waste management

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of solid and municipal waste management

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of solid and municipal waste management

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of solid and municipal waste management

Failure (F)

Poor analysis and problem solving skills and is barely able to demonstrate an understanding of solid and municipal waste management

Assessment Task

5. Final exam

Criterion

Ability to apply waste treatment and management knowledge to solve problems related to solid and municipal waste management.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of solid and municipal waste management

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of solid and municipal waste management

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of solid and municipal waste management

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of solid and municipal waste management

Failure (F)

Poor analysis and problem solving skills and is barely able to demonstrate an understanding of solid and municipal waste management

Part III Other Information

Keyword Syllabus

- Waste Management Facilities and Infrastructure
- Municipal Waste Classification, Characterisation and Generation
- Legislation and Regulations: Waste Disposal Ordinance; Producer Responsibility Schemes; Basel Convention on Transboundary Movement of Waste
- Resource Recovery and Recycling
- Biowaste Treatment Technologies
- Landfills
- Hazardous Solid Waste
- Sustainability Issues in Solid Waste Management: Life Cycle Assessment; Circular Economy and Sustainable Development Goals; Ethics and Role of the Engineers

Reading List

Compulsory Readings

Title	
1	WORRELL W.A., VESILIND P.A. and LUDWIG, C. (2017) Solid Waste Engineering: A Global Perspective, 3rd ed. Connecticut: Cengage Learning.
2	TCHOBANOGLIOUS, G. and KREITH, F. (2002) Handbook of Solid Waste Management. New York: McGraw-Hill, Ltd.

Additional Readings

Title	
1	NZIHOU, A. (2020) Handbook on Characterization of Biomass, Biowaste and Related By-products. Volume 1 & 2. Switzerland: Springer Nature.
2	MANAHAN, S. (2022) Environmental Chemistry, 11th ed. Boca Raton: Taylor & Francis.
3	CHRISTENSEN, T. (ed.) (2010) Solid Waste Technology & Management. New Jersey: John Wiley & Sons, Ltd.

4	http://www.epd.gov.hk/epd/english/environmentinhk/waste/waste_maincontent.html
5	WASTE BLUEPRINT for Hong Kong 2035 http://www.eeb.gov.hk/sites/default/files/pdf/waste_blueprint_2035_eng.pdf