CHEM4023A: BIOLOGICAL TREATMENT OF WASTES

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Biological Treatment of Wastes

Subject Code
CHEM - Chemistry
Course Number
4023A

Academic Unit
Chemistry (CHEM)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
BCH4023A Biological Treatment of Wastes

Exclusive Courses
CHEM4034/BCH4034 Environmental Control and Waste Treatment

Additional Information
Note: CHEM4023A does not contain any practical component, and has a credit unit value of three (3).

Part II Course Details

Abstract

In this course, students will:

- examine the problems of wastewater and solid waste in industrialized and urbanized societies;
- explain various biological wastewater treatment methods, discuss the advantages, disadvantages and problems associated with each of the treatment processes;
- identify the options available for handling solid waste, explain the biological principles and processes involved, discuss the pros and cons of each option;
- critically evaluate present knowledge in treatment of wastewater and solid waste, and provide practical experience in the analysis of waste and wastewater characteristics, treatment processes and efficiency.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe and analyze the causes and problems of wastewater and solid waste in industrialized and urban societies, with reference to situation in Hong Kong SAR and our neighbours.	10	x		
2	List various wastewater treatment techniques with emphasis on the principles and biochemical reactions in biological processes, critically evaluate the pros and cons of each treatment process, and suggest a recommended approach.	35	x	x	x
3	Critically evaluate the options for treatment and disposal of municipal and hazardous solid waste including reuse and recycling, explain the biological principles and processes involved, discuss the pros and cons of each option, and advise a preferred option.	30		x	x
4	Design the wastewater/waste treatment processes based on data obtained from laboratory studies and field visits to various treatment facilities in Hong Kong SAR, and communicate results, knowledge and application both orally and in writing.	25	x	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	Group activities	In large and small group activities students will analyze the causes and problems of wastewater and solid waste in industrialized and urban societies, with reference to situation in Hong Kong SAR and our neighbours.	1, 2, 3, 4	
2	Group activities, field visits, discussions, debates, and practical classes	Students in large and small group sessions, field visits, discussions, debates, and practical classes to explain the principles and biochemical reactions in various biological treatment processes, compare different treatment processes, and suggest a recommended approach.	2, 4	
3	Group activities, field visits, written assignments, debates and presentations	Teaching and learning will be primarily large and small group activities, field visits, written assignments, debates and presentations to evaluate the options for reduce, reuse, recycle, treatment and disposal of municipal and hazardous solid waste, the biological principles and processes involved.	3, 4	
4	Practical classes, field visits, discussion and presentations	Through a number of practical classes, field visits, discussion and presentations, students will collect, record, analyze and interpret data on waste and wastewater treatment efficiency, relate results to principles, and critically evaluate the limitations of the design presented.	2, 3, 4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Short Quizzes	1, 2, 3	10	
2	Tutorial Assignment and Presentation	2, 3, 4	25	
3	Problem-based Learning		5	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

Additional Information for ATs

Starting from Semester A, 2015-16, students must satisfy the following minimum passing requirement for courses offered by CHEM:
"A minimum of 40% in both coursework and examination components."

Assessment Rubrics (AR)

Assessment Task

Short Quizzes

Criterion

understanding of the topics and reading materials; correctness of interpretation of data

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Tutorial Assignment and Presentation

Criterion

understanding of key issues related to the topics and reading materials; ability to explain the concepts and materials; application of knowledge in solving real life problems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Problem- based Learning

Criterion
developing insightful / innovative ideas; application of knowledge in solving real life problems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Laboratory Performance, Report and Presentation

Criterion
conducting laboratory work; correctness of interpretation and analysis of experimental data; ability to explain and discuss the results

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Field Visit Reports

Criterion
attending field visit; raise relevant questions; correctness of interpretation and explanation of the knowledge learned during the visit

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
completeness and correctness of answers; correctness of interpretation and analysis of experimental data; application of knowledge in solving real life problems; logic of argumentation and intelligent use of course content / original thinking

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Wastewater Treatment Options
Brief description of various options of wastewater treatment, including wetland and agricultural land systems. Reference to the Hong Kong situation.

Biological Aspects of Wastewater Treatment
Principles and efficiency of biological systems in reducing pollutants from wastewater in particular, organic matter, nitrogen, phosphorus compounds, heavy metals and other organic substances. Brief introduction to importance of application of biotechnology in wastewater treatment.

Anaerobic Digestion of Sewage Sludges
Biochemical reactions and microorganisms involved. Environmental requirements. Biogas production and re-uses of digested sludge.

Conventional Waste Disposal Options
Sanitary landfills, composting, incineration, ocean dumping, waste reuse, recycle and minimization. Reference to the situation in Hong Kong. Hazardous waste and its disposal.

Reutilization of Waste as Feed and Food
Bioconversion of waste to single cell and plant protein. Nutritive value and digestability of waste as animal food and feed. Problems of toxic compounds. Public health and public acceptance. Contribution of biotechnology on waste re-utilization.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	EPD (Environmental Protection Department) Environment Hong Kong. Hong Kong Government Printer.
2	Hong Kong Government (2014) Food waste and yard waste: A plan for Hong Kong 2014-2022. Environment Bureau.
3	Hong Kong Government (2013) Blue print for sustainable use of resources 2013-2022. Environment Bureau.
4	Buddolla Viswanath (2017) Environmental Biotechnology: Basic Concepts and Applications. Oxford: Alpha Science International Ltd.
5	Jain Monika (2014) Environmental Biotechnology. Oxford: Alpha Science International Ltd.
6	Hopcroft Francis J (2015) Wastewater Treatment Concepts and Practice. New York, NY: Momentum Press.
7	Das Surajit (2014) Microbial Biodegradation and Bioremediation. London, Waltham, MA: Elsevier.
8	Rada Elena Cristina (Editor, 2016) Biological Treatment of Solid Waste: Enhancing Sustainability. Toronto: Apple Academic Press.
9	Prasad M N V (2016) Environmental Materials and Waste: Resource Recovery and Pollution Prevention. London: Academic Press.
10	Ismail Ahmad Fauzi and Matsuura Takeshie (Editors) (2016) Membrane Technology for Water and Wastewater Treatment, Energy and Environment. Boca Raton: CRC Press.
11	Mastellone, Maria Laura (2015) Waste Management and Clean Energy Production from Municipal Solid Waste. New York : Nova Publishers.
12	Hammer M.J. and Hammer M.J.Jr. (2012) Water and Wastewater Treatment Technology (7th edition). Prentice-Hall Inc.
13	Gabriel B. (2010) Wastewater Microbiology (4th edition). John Wiley, New York.

14	Tchobanoglous G. et al. (2014). Wastewater Engineering: Treatment and Resource Recovery (5th edition). McGraw-Hill Education, New York.
15	Relevant websites