Solid Waste and Hazardous Waste Treatment Engineering – 3 credits

(Compulsory course)

Spring semester, 2020-2021

Cooordinator	**Nguyen Thi Van Ha**
Credits	4.5 ECTS (Compulsory course), 33.75 in-class hours
Lecturers	Nguyen Xuan Truong (HCMUNRE, Vietnam) Nguyen Thi Van Ha (HCMUNRE, Vietnam) Le Hoang Nghiem (HCMUNRE, Vietnam) Huynh Thi Ngoc Han (HCMUNRE, Vietnam)
Level	MSc and PhD courses
Host institution	Faculty of Environment, HCMUNRE, Vietnam
Course duration	15 weeks (Spring or Fall 2021)

Summary

This course provides specific and professional knowledge on municipal waste, industrial waste and hazardous waste such as: collection system, classification and transportation; Recycle and treatment technologies, sanitation disposal; legal responsibilities, regulations, policies and incentives in Viet Nam and in some countries on solid waste and hazardous waste management.

Students will be able to calculate technical specification and requirements for installing equipment, facilities, designing and operating the waste treatment system. Students have the vision toward zero emission and are able to apply the circular economic concept to waste management.

Target student audiences

Master or PhD students majoring in environmental engineering, environmental sciences, environmental management, etc.

Prerequisites

Required courses (or equivalents): Environmental Science Foundation

Aims and objectives

The course is aimed to introduce specific knowledge about solid waste and hazardous waste treatment engineering and orientate students' capacity to circular economic and zero waste emission.

Students will develop their professional skills to be able to design and operate the waste treatment system and to study on advanced technologies.

Course goals ***(CGs)***	***Course goal description***
CG1	Explain and analyze waste database such as composition, characteristics and sources of different types of wastes as well as their impacts on the environment and human health.
CG2	Analyze and select effective routes for collection of waste, classification as well as waste transportation facilities; Promote waste minimization and on-site classification
CG3	Able to propose technology, design and operate facilities for recycling and treating solid waste and hazardous waste for the specific cases
CG4	Proficiently apply the regulations of solid waste and hazardous waste management on different subjects such as: disposers, collectors and transfers, and treatment investors, managers, etc.
CG5	Develop innovation skills, logical thinking, problem-solving skills and leadership for working in group to develop and assess a waste treatment design or an integrated waste management system.

General learning outcomes:

By the end of the course, successful students will achieve the following course expected learning outcomes (CELO):

CELO	**CELO Description**
Knowledge and Understanding:	
CELO1	Compare the composition, characteristics and sources of different types of wastes.
CELO2	Analyze the adverse impacts of waste types on environment and health and requirement of integrated waste management.

CELO3	Analyze engineering specification and can select the waste sorting, collection, transfer systems which are suitable and efficiency for a specific case; Understand the smart waste management system.
CELO4	Assess and propose the suitable technology for recycling and treating municipal waste, industrial waste and hazardous waste.
CELO5	Institutional and stakeholder analysis on waste management.
CELO6	Compare legal legislations on solid waste and hazardous waste management versus disposers, collectors and transfers, and treatment investors, managers, etc.
Skills outcome	
CELO7	Capable to apply advanced waste treatment technology, able to calculate and degsin waste recycle and treatment facilities such as: composting, incinerator or sanitation landfill
CELO8	Work in group to design or operate a practical model of waste treatment facilities.
Responsibility skills	
CELO9	Develop innovation, logical thinking, problem-solving capacity and leadership for working in group on waste management

Overview of sessions and teaching methods

The course will make most of interactive and self-reflective methods of teaching and learning and, where possible, avoid standing lectures and presentations.

Learning methods

- Video presentations
- Fieldtrip
- Problem Based Learning
- Group Based Learning
- Project cased study
- Literature review
- Calculation assignments
- Case studies

Overview of learning sessions

Chapter	Description	Credit hours	Lectures	Practice and Discussion
Chapter 1	Course description Introduction on waste treatment and management	1.5 3	1.5 3	0 0
Chapter 2	Legal legislation and practical experience on municipal waste management	4.5	3	1.5
Chapter 3	Solid waste collection system	3	3	0
Chapter 4	Solid waste transferring and transportation system	3	1.5	1.5
Chapter 5	Solid waste recycling system	3	3	0
Chapter 6	Waste treatment principles and engineering	3	3	0
Chapter 7	Composting technology	3	2	1
Chapter 8	Sanitation Landfill	4.5	3.5	1
Chapter 9	Waste burning Technology	4.5	3.5	1
Chapter 10	Hazardous waste management	3	3	0
	Students' projects	9	0	9
	Total	**45**	**30**	**15**

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities (33.75 hours)			
Lectures	Understanding theories, concepts, methodology and tools	Class participation	6
Moderated in-class discussions	Understanding various policy and management contexts and common problems in integrated solid waste management.	Class participation and preparedness	10

		for discussions	
In-class assignments, field assignment	Understanding various technology and facilities (principles, design, operation and maintenance) of waste treatment. Applying calculation for designing the waste treatment facilities.	Class participation and preparedness for assignments	10
Reading and discussion of assigned papers for seminars and preparation for lectures	Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature	Class participation, creative and active contribution to discussion	2.5
Group presentation	Ability to interpret data, to analyze audience, and to use the concepts, tools, and methods for communicating and defending the ideas presented in report	Quality of group assignments and individual presentations	5
Independent work (75 hours)			
Group work: - Contribution to the group case-study projects - Contribution to the preparation and delivery of individual presentation - Contribution to the web-application	Ability to interpret data, to analyze audience, and to use the concepts, tools, and methods for communicating information to all participants Select one kind of waste and one facility to treat this waste; check the technology diagram, engineering design calculation and efficiency	Quality of group assignments and individual presentations Quality of essay	40
Course group assignment	Ability to conceptualize and frame an integrated waste management, find related literature and data, interpret data, use the concepts, tools and methods covered in the course, and draw the policy/management relevant to achieve circular economic in the integrated waste management proposed for the selected waste above.	Quality of developed essay	30

	Select one kind of wastes and apply circular economic to design the integrated waste management		
Group presentation	Ability to interpret data, to analyze audience, and to use the concepts, tools, and methods for communicating and defending the ideas presented in report	Quality of group assignments and individual presentations	10
Total			***113.75***

Grading

The students' performance will be based on the following:

Assessment

- Progress assessment (40%):
  Assignments in class and Homework
- Final assessment (60%):

- Group report (30%): The students will be divided into groups of 2 - 3 students and choose one case study to analyze the success and failures of the waste management and proposed the integrated waste management for this case and then withdrawn the learnt lessons which could be transferred to Viet Nam or developing countries.
- Final examination (30%)

Evaluation

A (8.5 – 10)
B (7.0 – 8.4)
C (5.5 – 6.9)
D (4.0 – 5.4)

Course schedule

The overall schedule is provided below:

Course schedule

Week	Chapter	Topic	Lecturer
Week 1 - 2	1	- Guide to the course – purpose, objectives, learning outcomes, teaching and learning method, assignment and grading.	Nguyen Thi Van Ha

		Chapter 1 – Introduction of solid waste and Waste management 1.1. Composition, characteristics and sources of different types of wastes 1.2. Impacts of waste disposal on environment and human health. 1.3. Development history of solid waste management 1.4. Solid waste emission in industrial society 1.5. Urban waste management system 1.6. Solid waste management of HCM City	
Week 2 -3	1	**Chapter 2 – Legislation and experience of urban municipal waste management** 2.1. Current urban municipal waste management in Vietnam 2.2. Legislation base for solid waste management in Vietnam 2.3. Difficulties and barriers of municipal waste management in Vietnam 2.4. The Practical experience of municipal waste management in other countries 2.5. The integrated waste management system Assignment #1	Nguyen Thi Van Ha;
Week 4	2	**Chapter 3 – Solid waste collection system** 3.1. Municipal waste emission trends in Vietnam 3.2. Solid waste collection system 3.3. Smart collection system for solid waste 3.4. Identify the solid waste collection routes Assignment #2	Nguyen Xuan Truong
Week 5	3	**Chapter 4 – Solid waste transfer and transportation system** 4.1. Needs of solid waste transfer station 4.2. Classification of SW transfer station 4.3. Waste transportation facilities 4.4. Important issues for designing the transfer station 4.5. Select the preferable locations of transfer stations	Nguyen Xuan Truong

Week 6	7	**Chapter 5 – Solid waste recycling** 5.1. Recycling technologies for normal recycled wastes 5.2. Recycling industrial inorganic wastes 5.3. Recycling industrial organic wastes 5.4. Market and recycled materials/products	Nguyen Xuan Truong
Week 7	5	**Chapter 6 –Solid waste treatment principles** 6.1 Mechanic treatment process 6.2 Thermal treatment process 6.3 Biological and chemical treatment	Huynh Thi Ngoc Han
Week 8	6	**Chapter 7 – Composting** 7.1. Composting process and their control factors 7.2. Anaerobic composting 7.3. Aerobic composting Assignment	Huynh Thi Ngoc Han
Week 9-10	7	**Chapter 8 – Sanitation landfill** 8.1. Landfill design and operation regulations in Vietnam 8.2. Landfill classification 8.3. Location selection 8.4. Waste degradable process 8.5. Air emission and control 8.6. Leachate control 8.7. Operation, monitoring and closure of landfill Assignment	Nguyen Thi Van Ha
Week 10 - 11		**Chapter 9 –Incinerator** 9.1 Incinerator design and operation regulations in Vietnam 9.2. Incinerator classification 8.3. Advantage and disadvantage of i Location selection 8.4. Burning process 8.5. Air emission and control 8.6. Heat balance and control 8.7. Advanced technologies (gasification, plasma incinerator) Assignment	Huynh Thi Ngoc Han

Week 12		**Chapter 10 –Hazardous waste management** 10.1. Characteristics and classification 10.2. Government management for hazardous waste 10.3.Hazardous waste management 10.4.Advanced treatment methods Assignment	Nguyen Xuan Truong
Week 13		**Group presentation** Assignment: Present the composting project	Nguyen Thi Van Ha, Huynh Thi Ngoc Han
Week 14		**Group presentation** Assignment: Present the sanitation landfill project for municipal waste	Nguyen Thi Van Ha, Huynh Thi Ngoc Han
Week 15		**Group presentation** Assignment: Present the incinerator project for municipal waste; or hospital waste	Huynh Thi Ngoc Han, Nguyen Xuan Truong

Course assignments

Course assignments will constitute a multi-part project:

- Assignment #1 (mostly in-class and a part of home reading) – Policy and stakeholder analysis for managing one kind of waste.
- Assignment #2 (mostly in-class) – Calculate the facilities for the sorted- waste collection from the district.
- Assignment #3 (home assignment) – Select one kind of wastes and select the technology, check the engineering design calculation for the proposed facilities for treatment (composting, burning, dumping, etc.) Calculate cost benefit ratio, net present value, etc.
- Assignment #4 (mostly in-class) – Prepare the report and presentation and defend for the proposed integrated waste management system.

Literature

Schmidt, Michael; Glasson, John; Emmelin, Lars and Hendrike Helbron, 2008. Standards and Thresholds for Impact Assessment. Environmental Protection in the European Union ISSN 1613-8694. 487pp.

- Literature in English:

1. John N.Hahladakis**,** Plastic waste in a circular economy Plastic Waste and Recycling, 2020.
2. Annelise, M. de Jong, 2021. The Potential of Plastic Reuse for Manufacturing: A Case Study into Circular Business Models for an On-Line Marketplace, Sustainability.
3. Ruohomaa, H., Ivanova, N., 2019. From solid waste management towards the circular economy and digital driven symbiosis, IOP Conference Series: Earth and Environmental Science.
4. Obiora, B. Ezeudu, Tochukwu, S. Ezeudu, 2019. Implementation of Circular Economy Principles in Industrial Solid Waste Management: Case Studies from a Developing Economy (Nigeria), Recycling.
5. Malinauskaite, J, et.al. 2017, Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe, Energy.
6. Elisabetta, Allevi, et. al., 2021. Municipal solid waste management in circular economy: A sequential optimization model, Energy Economics.
7. Shikha, Dahiya et.al., 2017. Food waste biorefinery: Sustainable strategy for circular bioeconomy. Bioresource Technology 248(Pt A). DOI:10.1016/j.biortech.2017.07.176
8. Malinauskaite, J., 2017. Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe, Energy.

- Literature in Vietnamese:

1. Nguyễn Đình Hòe, 2008. Môi trường và phát triển bền vững. Nhà xuất bản Giáo dục. Hà Nội .
2. Nguyễn Đình Hương, 2007. Giáo trình kinh tế chất thải. Nhà xuất bản Giáo dục. Hà Nội. 2007.
3. Nguyễn Văn Phước, 2008. Giáo trình Quản lý và Xử lý Chất thải rắn, NXB XD, 357 trang.
4. Đinh Xuân Thắng, 2011, Kỹ thuật lò đốt chất thải rắn nguy hại, NXB ĐHQG – HCM, 276 trang.
5. Nguyễn Văn Phước, Nguyễn Thị Thanh Phượng, 2006. Giáo trình kỹ thuật xử lý chất thải công nghiệp, NXBXD, 360 trang.
6. Nguyễn Đức Khiển, 2003. Quản lý Chất thải nguy hại, NXB XD HN.
7. Lâm Minh Triết và CTV, 2015. Kỹ thuật Môi trường, NXB ĐHQG – HCM.
8. Nguyễn Xuân Nguyên, Trần Quang Huy, 2004. Công nghệ xử lý rác và chất thải rắn, NXB KHKT –HN, 240 trang.
9. Nguyễn Đức Lượng, Nguyễn Thị Thùy Dương, 2003. Tập 2. Xử lý chất thải hữu cơ NXB ĐHQG – HCM, 276 trang.
10. Video

11.

Revised Date: 08/04/2020 **Revised contents:** Update and increase the contents 40% on waste recycling and hazardous waste management; Change the asisgnments.	Revised by Assoc. Prof. Nguyen Thi Van Ha Reviewed by the Head of Division Dr. Huynh Thi Ngoc Han
Approval: **The syllabus is approved by the Course Reviewing Committee on: 25 August 2020** **Chairman: Assoc. Prof. Le Hoang Nghiem**	Approved by the University Rector: Assoc. Prof. Huynh Quyen