



Ecological Engineering – 2 credits (Selective course)

Spring semester

Coordinator	Nguyen Thi Van Ha
Credits	3 ECTS (selective course), 22.5 in-class hours
Lecturers	Huynh Thi Ngoc Han (HCMUNRE, Vietnam) Le Hoang Nghiem (HCMUNRE, Vietnam)
Level	MSc and PhD courses
Host institution	Faculty of Environment, HCMUNRE, Vietnam
Course duration	10 weeks (Spring semester)

Summary

This course provides the integrated knowledge of ecology and environmental engineering, the ecological engineering methods used to solve the environmental problems, includes wastewater treatment by wetlands, exotic species control, restoration ecology, soil bioengineering and ecological engineering for solid waste management, etc.

Target student audiences

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

Prerequisites

None required course (or equivalent)

Aims and objectives

This course goals as follows:

Course goals (CGs)	Course goal description
CG1	Understand the integrated knowledge of ecology and environmental engineering in the ecological engineering.
CG2	Analysis and choose the suitable ecological engineering method to solve the environmental problems.
CG3	Apply the ecological engineering knowledge into the design of waste treatment and ecology restoration



CG4	Develop logical thinking, analytical and problem-solving skills, and presentation skills required in the independent and group works.
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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	Gain the basic ecological engineering knowledge in treatment wetlands, ecology restoration, soil bioengineering, solid waste management, and exotic species control.
CELO2	Determine exactly the environmental problems and suggest the suitable ecological methods to solve the namely environmental problems
CELO3	Apply the ecological engineering methods to solve the namely environmental problems.
CELO4	Design basically the constructed wetlands, ecological landfill, lake restoration.
Skills outcome	
CELO5	Look up, collect information and documents, synthesize, write an essay skills.
CELO6	Develop independent and group work skills, presentation skills, and critical thinking skills.

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, group work, presentation
- Project Based Learning
- Literature review
- Case studies such as: constructed wetland, stream restoration, new ecology system at a landfill, invasive plants control.

Overview of learning sessions

Chapter	Description	Credit hours	Lectures	Practice and Discussion
Chapter 1	Course description	1	1	0
	Introduction on Ecological Engineering	2	2	
Chapter 2	Treatment Wetlands (natural and constructed wetlands)	9	6	3
Chapter 3	Restoration ecology	9	6	3
	Mid-term exams	1		1
Chapter 4	Soil bioengineering	3	2	1
Chapter 5	Ecological engineering for solid waste management	3	2	1
Chapter 6	Exotic species control	2	1.5	0.5
	Total	30	20.5	9.5

1 credit hours = 45 minutes

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities (22.5 hours)			
Lectures	Understanding the basic ecological engineering knowledge in treatment wetlands, ecology restoration, soil	Class participation	10.5





	bioengineering, solid waste management, and exotic species control		
Moderated in-class discussions (group work)	Understanding the wastewater treatment mechanism in natural wetlands and constructed wetlands; the solutions used in lake restoration (Eutrophication, acidification), etc.	Class participation and preparedness for discussions	7
In-class assignments,	Understanding how to calculate the constructed wetland in wastewater treatment	Class participation and preparedness for assignments	1.0
Group presentation	Develop group work skills, presentation skills, critical thinking skills. Apply the basic knowledge ecological engineering to solve the namely environmental problems such as: biological control and biopesticides, Sustainable marine aquaculture, Mine area remediation, etc.	Quality of group assignments and individual presentations, answer the question from teacher and other groups.	3
mid-term exam	Understanding and apply the basic ecological engineering knowledge in treatment wetlands, ecology restoration.	Complete of the quiz or Mid-term report.	1
Independent work (45 hours)			
Group work: - Contribution to the group case-study projects - Contribution to the preparation and delivery of individual presentation	Apply the basic knowledge ecological engineering to solve the namely environmental problems such as: biological control and biopesticides, Sustainable marine aquaculture, Mine area remediation, etc. Look up, collect information and documents, synthesize, write an essay skills. Develop group work skills	Quality of group assignments and individual presentations Quality of essay	25



Course group assignment	Look up, collect information and documents, synthesize, write an essay skills. Develop group work skills Determine exactly the environmental problems, suggest, and apply the suitable ecological methods to solve the namely environmental problems	Quality of developed essay	10
Group presentation	Develop group work skills, presentation skills, critical thinking skills.	Quality of group assignments and individual presentations	10
Total			67.5

Grading

The students' performance will be based on the following:

- Assessment
- Progress assessment (40%):
 - Quiz/Midterm examination (10%): students have to complete the quiz or Mid-term report.
 - Assignment (20%): 02 assignments at chapter 2; 01 assignment at chapter 3.
 - Final assessment (60%):
 - Group report (30%): The students will be divided into groups of 3-5 students and choose one case study for applying ecological engineering into solving the environmental problems.
 - 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:

Week	Chapter	Topic	Lecturer
Week 1	1	- Guide to the course – purpose, objectives, learning outcomes, teaching and learning	Huynh Thi Ngoc Han



		<p>method, assignment and grading, reference materials.</p> <p>Chapter 1 – Introduction of Ecological engineering 1.1. Concepts and definition on ecological engineering 1.2. Benefits of ecological engineering application 1.3. Main principles and methods of ecological engineering</p>	
Week 2-4	2	<p>Chapter 2 – Treatment wetlands 2.1. Natural wetlands 2.2. Constructed wetlands 2.3. Case study: constructed wetlands in the leachate treatment system 2.4 Assignment #1 2.5 Assignment #2</p>	Huynh Thi Ngoc Han Le Hoang Nghiem
Week 5-7	3	<p>Chapter 3 – Restoration ecology 3.1. Restoration ecology basic concepts 3.2. The main methods in restoration ecology Coastal zone restoration Lake restoration 3.5 Estuary restoration 3.6 Stream restoration 3.7 Case study: stream restoration in Ho Chi Minh city (Nhieu Loc canal) and Korea (Cheonggye-cheon stream). Group presentation 3.8 Assignment #3 Mid-term exam</p>	Huynh Thi Ngoc Han Le Hoang Nghiem
Week 8	4	<p>Chapter 4 – Soil bioengineering 4.1. Concepts of soil bioengineering 4.2. Erosion control 4.3. Organic farming 4.4. Biological control and biopesticides Group presentation</p>	Huynh Thi Ngoc Han



Week 9	5	<p>Chapter 5 – Ecological engineering for solid waste management</p> <p>5.1. The basic concepts</p> <p>5.2. Current status of solid waste generation in Vietnam</p> <p>5.3. Solid waste management methods using ecological engineering</p> <p>5.4. Case study: how to make a new ecology at landfill</p> <p>Group presentation</p>	Huynh Thi Ngoc Han
Week 10	6	<p>Chapter 6 – Exotic species control</p> <p>6.1. The basic Concepts</p> <p>6.2. Exotic plants control</p> <p>6.3. Exotic animals control</p> <p>6.4 Case study: research on production of bioenergy by the hyacinth biodegradation</p> <p>Group presentation</p>	Huynh Thi Ngoc Han

Course assignments

Course assignments will constitute a multi-part project:

- Assignment #1 (mostly at home) –Write an essay about the characteristics of natural wetlands in Viet Nam and suggest the natural wetlands management methods for sustainable development.
- Assignment #2 (mostly in-class) – Brief design of constructed wetland, etc.
- Assignment #3 (mostly at home) – Analysis and Suggest the restoration methods to restore Xuan Huong Lake in Da Lat city.

Literature

- Literature in English:

Hyun, Kyounggak; Choi, Joungjoo; Ki, Dongwon; Park, Joonhong; Ahn, Soojeung; Oh, Hyunje; Choung, Youn-Kyoo. *Bathroom wastewater treatment in constructed wetlands with planting, non-planting and aeration, non-aeration conditions*. Desalination and water treatment, 2015. DOI: 10.1080/19443994.2014.997991





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- Pan, Baozhu; Yuan, Jianping; Zhang, Xinhua; Wang, Zhaoyin; Lu, Jinyou; Yang, Wenjun; Chen, Jiao; Li, Zhiwei; Zhao, Na; Xu, Mengzhen. *A review of ecological restoration techniques in fluvial rivers*. International Journal of Sediment Research (2016). DOI: 10.1016/j.ijsrc.2016.03.001
- Patrick C. Kangas. *Ecological Engineering: Principles and Practice*. Lewis Publisher. New York. 2004.
- Pedescoll, A.; Sidrach-Cardona, R.; Hijosa-Valsero, M.; Bécáres, E. *Design parameters affecting metals removal in horizontal constructed wetlands for domestic wastewater treatment*. Ecological Engineering, Vol. 80, 2015. DOI: 10.1016/j.ecoleng.2014.10.035
- Peter Stiling. *Ecology: Theories and applications. Fourth Edition*. New Delhi. Prentice-Hall of India Private Limited. 2002.
- Sven Erik Jorgensen. *Applications in Ecological Engineering*. Elsevier. Netherlands. 2009.
- Wang, Mo; Zhang, Dong Qing; Dong, Jian Wen; Tan, Soon Keat. *Constructed wetlands for wastewater treatment in cold climate — A review*. Journal of Environmental Sciences, (2017). DOI: 10.1016/j.jes.2016.12.019
- Zanini, Anani Morilha; Mayrinck, Rafaella Carvalho; Vieira, Simone Aparecida; de Camargo, Plinio Barbosa; Rodrigues, Ricardo Ribeiro. *The effect of ecological restoration methods on carbon stocks in the Brazilian Atlantic Forest*. Forest Ecology and Management, volume 481 (2021). DOI: 10.1016/j.foreco.2020.118734

- Literature in Vietnamese:

- Lê Hoàng Nghiêm. Vận hành và Bảo trì Công trình Đất ngập nước kiến tạo dòng chảy ngầm theo phương ngang trong xử lý nước thải. NXB ĐHQG, 2019.
- Lều Thọ Bách và cộng sự. Xử lý nước thải chi phí thấp. NXB Xây Dựng, 2010.