**Ecological Engineering – 2 credits**

(Selective course)

**Spring semester**

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| Cooordinator | **Nguyen Thị 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* providesthe 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:

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| --- | --- |
| **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. |

### General learning outcomes:

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

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| --- | --- |
| **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.

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| --- | --- |
| **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.
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***Overview of learning sessions***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Chapter** | **Description** | **Credit hours** | **Lectures** | **Practice and Discussion** |
| **Chapter 1** | Course descriptionIntroduction on Ecological Engineering | 12 | 12 | 0 |
| **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:

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| --- | --- | --- | --- |
| **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 bioengineering, solid waste management, and exotic species control | Class participation | 10.5 |
| 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 presentationsQuality of essay | 25 |
| Course group assignment | Look up, collect information and documents, synthesize, write an essay skills.Develop group work skillsDetermine 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:

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| --- | --- |
| 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:

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| --- | --- | --- | --- |
| **Week** | **Chapter** | **Topic** | **Lecturer** |
| Week 1 | 1  | - Guide to the course – purpose, objectives, learning outcomes, teaching and learning method, assignment and grading, reference materials.**Chapter 1 – Introduction of Ecological engineering** 1.1. Concepts and definition on ecological engineering1.2. Benefits of ecological engineering application1.3. Main principles and methods of ecological engineering | Huynh Thi Ngoc Han |
| Week 2-4 | 2 | **Chapter 2 – Treatment wetlands**2.1. Natural wetlands2.2. Constructed wetlands2.3. Case study: constructed wetlands in the leachate treatment system2.4 Assignment #1 2.5 Assignment #2 | Huynh Thi Ngoc HanLe Hoang Nghiem |
| Week 5-7 | 3 | **Chapter 3 –** Restoration ecology3.1. Restoration ecology basic concepts3.2. The main methods in restoration ecology3.3. Coastal zone restoration3.4. Lake restoration3.5 Estuary restoration3.6 Stream restoration3.7 Case study: stream restoration in Ho Chi Minh city (Nhieu Loc canal) and Korea (Cheonggye-cheon stream).Group presentation3.8 Assignment #3Mid-term exam | Huynh Thi Ngoc HanLe Hoang Nghiem |
| Week 8 | 4 | **Chapter 4 – Soil bioengineering**4.1. Concepts of soil bioengineering4.2. Erosion control 4.3. Organic farming4.4. Biological control and biopesticidesGroup presentation | Huynh Thi Ngoc Han |
| Week9 | 5 | **Chapter 5 – Ecological engineering for solid waste management**5.1. The basic concepts 5.2. Current status of solid waste generation in Vietnam5.3. Solid waste management methods using ecological engineering 5.4. Case study: how to make a new ecology at landfillGroup presentation | Huynh Thi Ngoc Han |
| Week10 | 6 | **Chapter 6 – Exotic species control**6.1. The basic Concepts6.2. Exotic plants control6.3. Exotic animals control6.4 Case study: research on production of bioenergy by the hyacinth biodegradationGroup presentation | 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, Kyounghak; 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*](http://libgen.rs/scimag/10.1080/19443994.2014.997991). Desalination and water treatment, 2015. DOI: 10.1080/19443994.2014.997991

Lismore city council. *The use of Reed Beds for the treatment sewage and wastewater from Domestic Households*. 2005

Manuel C. Molles Jr.. *Ecology: Concepts and Applications.* McGraw-Hill. New York. 2008.

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](http://libgen.rs/scimag/journals/11109) (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.; Bécares, E. [*Design parameters affecting metals removal in horizontal constructed wetlands for domestic wastewater treatment*](http://libgen.rs/scimag/10.1016/j.ecoleng.2014.10.035). [Ecological Engineering](http://libgen.rs/scimag/journals/6197), 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](http://libgen.rs/scimag/journals/13330), (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*](http://libgen.rs/scimag/10.1016/j.foreco.2020.118734). [Forest Ecology and Management](http://libgen.rs/scimag/journals/7748), 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.