VIETNAM NATIONAL UNIVERSITY
**VIETNAM JAPAN UNIVERSITY**
**----------**

# MASTER TRAINING PROGRAM

## MAJOR: ENVIRONMENTAL ENGINEERING

## SUB-MAJOR: ENVIRONMENTAL ENGINEERING

## ORIENTATION: RESEARCH

**Hanoi, 2021**

VIETNAM NATIONAL UNIVERSITY
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## MAJOR: ENVIRONMENTAL ENGINEERING
## SUB-MAJOR: ENVIRONMENTAL ENGINEERING
## ORIENTATION: RESEARCH

## (After adjustment)

The adjusted Master's Program in Environmental Engineering, approved according to Decision No……/QĐ-ĐHVN, dated …..month…. 2021 by the Rector of Vietnam Japan University.

CONFIRMATION OF VIETNAM JAPAN UNIVERSITY
*Hanoi, date month year 2021*
**Rector of Vietnam Japan University**

**Furuta Motoo**

Hanoi, 2021

VIETNAM NATIONAL UNIVERSITY
**VIETNAM JAPAN UNIVERSITY**

**SOCIALIST REPUBLIC OF VIETNAM**
**Independence - Freedom - Happiness**

# MASTER TRAINING PROGRAM

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SUB-MAJOR: ENVIRONMENTAL ENGINEERING

ORIENTATION: RESEARCH

(After adjustment)

## PART I: GENERAL INTRODUCTION OF THE TRAINING PROGRAM

### I.1. General information about the training program

- Name of the training sub-major:

+ Vietnamese: Kĩ thuật môi trường

+ English: Environmental Engineering

- Name of major:

+ Vietnamese: Kĩ thuật môi trường

+ English: Environmental Engineering

- Code of the training sub-major: 8520320

- Training level: Master

- Training language: The training program is taught in English except for 2 follwing courses: Philosophy (in Vietnamese), Japanese (in Vietnamese and Japanese). The master thesis is written and defended in English.

- Training period: 02 years

- Name of master degree:

+ Vietnamese: Thạc sĩ chuyên ngành Kĩ thuật môi trường

+ English: The Degree of Master in Environmental Engineering

- The assigned training institution: Master's Program in Environmental Engineering (MEE), which belongs to the Faculty of Advanced Technologies and Engineering (FATE) – VNU Vietnam Japan University (VNU-VJU).

- Slogan of the training program: *Meet social requirements, toward sustainable environment.*

- Core values of the training program:

+ ***High quality*****:** MEE ensures the high quality education and the advanced research in the field of environmental engineering to meet the demands of learners and requirements of society toward a sustainable development.

+ ***Social responsibility:*** MEE commits to foster lecturers and students to contribute to solving both global and local environmental issues. Lecturers and students always respect the spirit of serving society to actively contribute to the sustainable development in Asia.

+ ***Internationality*****:** MEE provides international learning and working environment with the cooperation of well-experienced lecturers and experts from different nationalities. Innovations toward an international environment are created by all lecturers and students with understanding and respect for the cultural diversity.

+ ***Learning in practice:*** MEE provides practical learning environment, in addition to theoretical contents, through experience-based activities including internship and fieldwork. The program ensures abundant opportunities for students to enhance their research capacity.

## I.2. Objectives of the training program

### I.2.1. General objectives

The Master's Program in Environmental Engineering provides, enhances and updates learners with in-depth expertise knowledge in the field of environmental technology and engineering, and the ability to apply specialized knowledge in the practical activities. The program trains learners to become cadres with the ability to think independently and creatively working at environmental treatment stations/ plants; doing management work in ministries, branches and companies; working as lecturers or scientific researchers in universities and research institutes and as PhD

students at domestic and international universities, especially at Japanese universities.

### I.2.2. Specific training objectives

**** General objectives:***

- *Knowledge*: The research-oriented Master's Program in Environmental Engineering equips and updates for learners the advanced and in-depth knowledge on various aspects in the field of environmental technology and engineering, initially orients research for students through master thesis.

- *Skills:* The program provides learners with professional skills related to analysis, assessment, design, processing, environmental forecasting, as well as soft skills to support their research and work process.

- *Ethics*: The training program helps learners practice and promote personal, professional and social ethical qualities, including: Enthusiasm, sense of discipline, motivation, and high adaptability multicultural environment and new circumstances, respecting cultural diversity. Have high responsibility for work, be ready to cope with difficulties and pressure at work, be able to work independently and in groups, lead professional groups, be passionate, honest, creative in research research, adhere to research ethics, have a desire to apply what have learnt to solve practical environmental problems. Show the right awareness of environmental protection, have high responsibility towards society, and comply with the law.

**** Other specific objectives:***

The program provides society with high-quality human resources in environmental research, monitoring, management and treatment, meeting the entry requirements of doctoral training programs at prestigious universities in the world, especially Japanese universities; and meeting requirements of domestic and foreign agencies, organizations and enterprises, especially Japanese enterprises in Vietnam.

## I.3. Admission Information

### I.3.1. Admission methods

- Application reviewing

+ Appraisal of application documents

+ Interview by the admission committee including Vietnamese and Japanese members.

- Application documents: according to the regulations of VNU.

**I.3.2. Admission requirements**

- Degree: Having a university degree in the correct major, appropriate major and revelant major (after taking supplementary courses).

- Work experience:

+ Applicants are required to have GPA≥ 2.5/4.0.

+ One year of work experience is required for applicants graduated in the correct or appropriate majors with GPA < 2.5/4.0.

+ Two years of work experience is required for applicants graduated in relevant majors with GPA < 2.5/4.0.

- Foreign language proficiency: applicant must possess an English language proficiency that meets one of the following requirements:

+ Holding a valid English certificate within 2 years from the exam date to the date of submission and was issued by an institution recognized by VNU. The minimum English certificate must be level 3/6 (B1) or equivalent. After one year studying at VJU, student must submit English certificate of level 4/6 (B2) to be recognized as an official student of the university.

+ Holding a bachelor's degree or a master's degree, or a Ph.D. degree of an English-medium full-time study program in a country where English is used as the official language. The degree must be recognized by relevant agencies in accordance with current regulations.

+ Holding a bachelor's degree of an advanced training program under MoET's Project on advanced training in some Vietnamese universities; Graduated from talented, international, advanced, honor bachelor's program or master's program which have foreign language expected learning outcome equivalent to the level 4/6 onward of Vietnamese 6-level of foreign language ability framework within 2 years to the date of admission (expiry date does not apply to VNU's degree).

**I.3.3. List of correct major, appropriate majors and revelant majors of the proposed training program**

- The correct major: Environmental Engineering

- The appropriate majors: Chemical Technology (Công nghệ Kỹ thuật Hóa học), Environmental Science, Water Resource Engineering.

- The relevant majors: Candidates graduated from other majors belonging to the fields of engineering and technology (a group of majors in Architecture and Construction Technology, Chemical Technology, Materials, Metallurgy, and Environment), Engineering (Chemical, Materials, Metallurgy and Environment), engineering (a group of majors in Chemical Engineering, Materials, Metallurgy and Environment, Geological Engineering, Geophysics and Geodesy, Mining Engineering), Architecture and Construction, Natural Sciences; majors belonging to the fields of Life Sciences, Health (a group of majors in Pharmacy, Public Health, Agriculutre, Forestry, Fishery, Environment and Environmental Protection, Production and Processing, a group of majors in teachers' training (majors in Physic Pedagogy, Chemical Pedagogy, Biological Pedagogy, Industrial Engineering Pedagogy, Agricultural Engineering Pedagogy, Technological Pedogogy, Natural Science Pedagogy), highly interdisciplinary majors; majors provided by foreign countries will be reviewed and considered by the Admission Council based on the Application dossiers.

### I.3.4. List of supplementary courses needed for closely related majors

**Table 1.** List of supplementary courses required for relevant majors

| No | Name of course | Credit |
|---|---|---|
| 1 | Academic English in the field of environmental engineering | 3 |
| 2 | Environmental analysis methods | 3 |
| 3 | Fundamental environmental technology | 3 |
| 4 | Heat transfer & mass transfer | 3 |
| 5 | Environmental microbiology | 3 |
| **Total credits** | | **15** |

### I.3.5. Estimated enrollment quota:

- 15 students/batch

## PART II: PROGRAM LEARNING OUTCOMES (PLOs)

### II.1. Knowledge expceted learning outcomes

*a. General knowledge*

- **PLO1.** Apply basic knowledge and methodology of Marxist - Leninist philosophy to solve general and professional problems.

- **PLO2.** Have the minimum English proficiency certificate at 4/6 level according to the 6-level foreign language capacity framework for Vietnam or equivalent.

*b. Fundamental and specialized knowledge*

- **PLO3.** Analyze comprehensive knowledge of the law, environmental management, environmental protection, and sustainable development.

- **PLO4**. Develop research methods in the field of environment (assessment, control, management, handling of environmental problems) to solve practial environmental issues.

- **PLO5.** Apply the specialised knowledge of Chemistry, Physics, Biology, Sustainability Science, and Technology in environmental treatment processes including recovery and regeneration of waste resources; typical technologies in the treatment of supply water, wastewater, solid waste, and exhaust gases in environmental treatment systems.

- **PLO6.** Evaluate procedures for environmental assessment, analysis, monitoring, and prediction.

- **PLO7.** Evaluate environmental pollution and select appropriate technology and management solutions to solve the environmental problems.

### II.2. Skill expected learning outcomes

*a. Professional skills*

- **PLO8.** Apply laboratory skills, environmental analysis and monitoring procedures; operate advanced analytical equipment, environmental management and simulation softwares.

- **PLO9.** Design basic environmental treatment units.

- **PLO10.** Develop research plans to solve practial issues in the field of environmental engineering.

- **PLO11.** Evaluate the specialized documents on environmental engineering (both Vietnamese and English).

*b. Soft skills*

- **PLO12.** Have a ability of verbal and written communication, logic and critical thinking, self-study, planning, time management, independent and team work, group leading, mobilizing collective intelligence to solve environmental problems, making decision, starting up the business.

- **PLO13.** Have a crtical thinking in daily life and professional works.

- **PLO14**. Master office softwares and data analysis skills in professional careers.

- **PLO15.** Demonstrate ability to communicate in Japanese language.

**II.3. Ethics expceted learning outcomes**

*a. Personal ethics*

- **PLO16.** Have enthusiasm, discipline, motivation, high adapability to multicultural environments and new circumstances, respect the cultural diversity.

*b. Professional ethics*

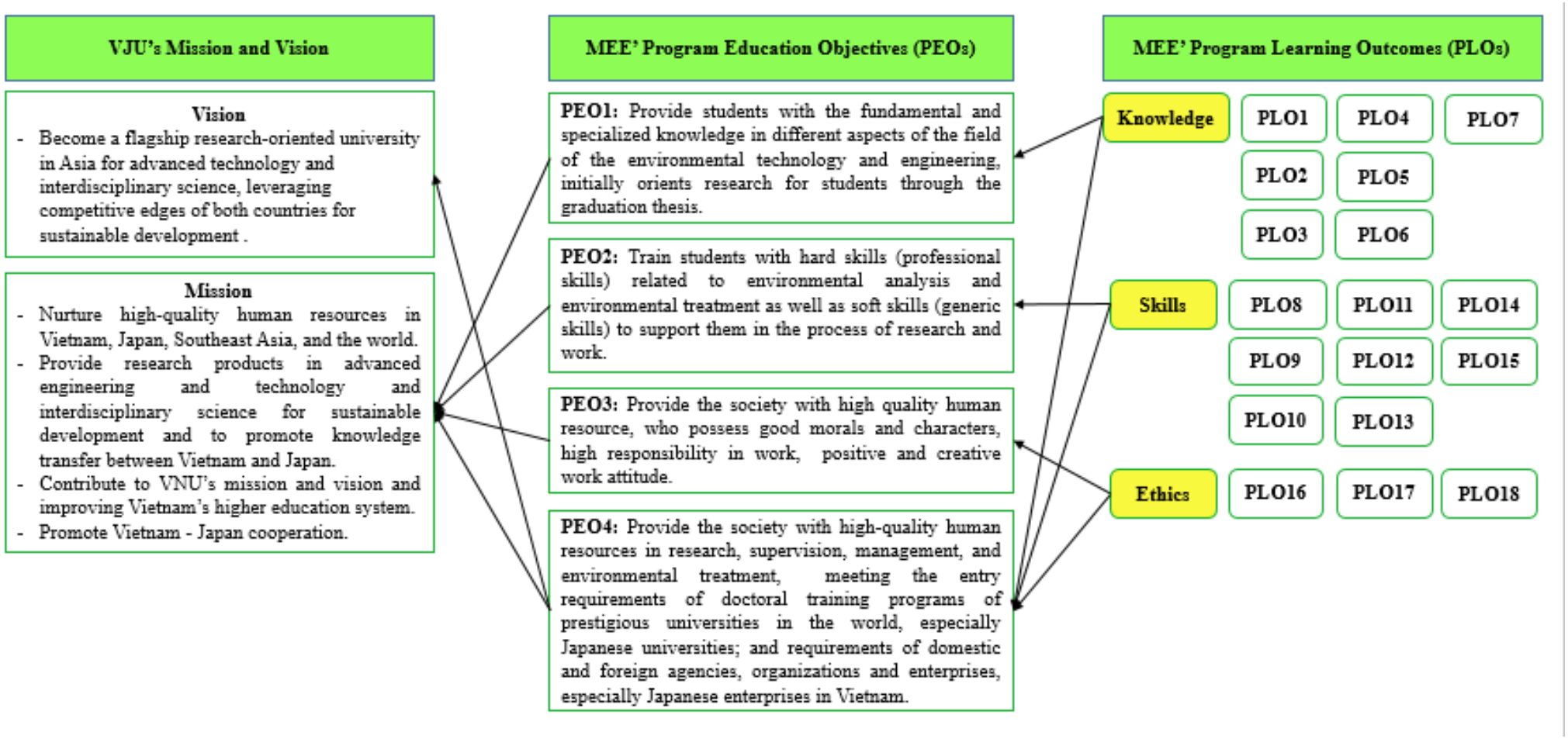
- **PLO17.** Demostrate high responsibility for work, be ready to cope with difficulties and pressure at work, be able to work independently and in groups, lead professional groups, show passion, honesty, creativity in research, abide research ethics, have a desire to apply what have learnt to solve practical environmental problems, and contribute to developing work conducts.

*c. Social ethics*

- **PLO18.** Demonstrate the right awareness of environmental protection, have high responsibility towards society, and strictly comply with the law.

## II.4. Contribution of PLOs and PEOs of MEE to the mission and vision of VJU

**Table 2.** Contribution of PLOs and PEOs of MEE to the mission and vision of VJU



## II.5. Matrix between program education objectives (PEOs) and the program learning outcomes (PLOs)

**Table 3.** Matrix between PEOs and PLOs of the MEE

| **PEOs** | **PLOs** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **KNOWLEDGE** | | | | | | | **SKILLS** | | | | | | | | **ETHICS** | | |
| | General | | Fundamental and specialized | | | | | Hard | | | | Soft | | | | Personal | Professional | Social |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| PEO1 | x | x | x | x | x | x | x | | | | | | | | | | | |
| PEO2 | | | | | | | | x | x | x | x | x | x | x | x | | | |
| PEO3 | | | | | | | | | | | | | | | | x | x | x |
| PEO4 | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |

## II.6. Contribution of courses to PLOs of the MEE

**Table 4.** Contribution of courses to PLOs of the MEE

| Course title | Credits | Knowledge PLOs | | | | | | | Skills PLOs | | | | | | | | Ethics PLOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| **General knowledge** | **7** | | | | | | | | | | | | | | | | | | |
| Philosophy | 3 | 4 | 3 | | | | | | | | | | 4 | 3 | | | 4 | | 5 |
| Basic English | 4 | | 5 | | | | | | | | | 4 | 5 | 4 | | | 5 | | |
| **Fundamental and specialized knowledge** | **43** | | | | | | | | | | | | | | | | | | |
| ***Fundamental knowledge*** | ***8*** | | | | | | | | | | | | | | | | | | |
| Basis sustainability science | 3 | | 4 | 3 | 3 | | | | | | 5 | 5 | 4 | 5 | | | 4 | 5 | 5 |
| Methodology and informatics for sustainable science | 3 | | 4 | 3 | 3 | | | | | | 5 | 5 | 4 | 5 | | | 4 | 5 | 5 |
| Japanese language | 2 | 3 | | | | | | | | | | | 4 | 3 | | 3 | 4 | | 5 |
| ***Specialized knowledge*** | ***35*** | | | | | | | | | | | | | | | | | | |
| *Compulsory courses* | *14* | | | | | | | | | | | | | | | | | | |
| Environmental management systems | 2 | | 4 | 3 | 5 | 4 | 4 | 6 | | | 5 | 5 | 5 | 4 | | | 4 | 5 | 5 |
| Environmental analysis and measurement | 3 | | 4 | | 4 | 4 | 6 | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | | 5 | 5 | |
| Environmental assessment and modeling | 2 | | 4 | 5 | 4 | 5 | 5 | 6 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | | 5 | 5 | 5 |
| Water and wastewater engineering | 3 | | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 | | 5 | 5 | 4 |
| Internship | 4 | | 5 | 3 | 3 | 3 | 5 | 3 | 5 | 3 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 5 | 5 |
| *Elective courses* | *21/38* | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Japanese language | 4 | 3 | | | | | | | | | | | 4 | 3 | | 3 | 4 | | 5 |
| Material cycles and solid waste management | 3 | | 4 | 5 | 4 | 5 | 3 | 5 | | 4 | 5 | 5 | 4 | 4 | | | 4 | 5 | 4 |
| Environmental health | 2 | | 4 | 5 | 5 | 4 | 4 | 4 | | | 5 | 5 | 5 | 4 | | | 4 | 5 | 5 |
| Chemical reaction engineering | 2 | | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 4 | 4 | | 4 | 5 | 4 |
| Air emission and quality control | 3 | | 4 | 4 | 4 | 5 | 5 | 6 | 5 | 4 | 5 | 5 | 4 | 4 | 5 | | 4 | 4 | 3 |
| Environmental biotechnology | 3 | | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 | | 5 | 5 | 4 |
| Environmental engineering laboratory | 3 | | 4 | 4 | 5 | 6 | 6 | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 4 | 4 |
| Environmental management in Vietnam and Japan | 2 | | 4 | 3 | 5 | 4 | 4 | 6 | | | 5 | 5 | 5 | 4 | | | 4 | 5 | 5 |
| Advanced computer applications in environment | 3 | | 4 | | 3 | 4 | 3 | 4 | 3 | 5 | 4 | 4 | 5 | 4 | 5 | | 4 | 5 | 5 |
| Global environmental issues | 2 | | 4 | 3 | 5 | 4 | 4 | 6 | | | 5 | 5 | 5 | 4 | | | 4 | 5 | 5 |
| Waste to energy | 2 | | 4 | 5 | 4 | 5 | 3 | 5 | | 4 | 5 | 5 | 4 | 4 | | | 4 | 5 | 4 |
| Data analysis in environmental engineering | 3 | | 4 | | 3 | 4 | 3 | 4 | 3 | 5 | 4 | 4 | 5 | 4 | 5 | | 4 | 5 | 5 |
| Seminar 1 | 2 | | 4 | 4 | 5 | 3 | 4 | 4 | 4 | 4 | 5 | 4 | 3 | 3 | 3 | | 4 | 4 | 4 |
| Seminar 2 | 2 | | 5 | 4 | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 4 | 3 | | 4 | 5 | 4 |
| Seminar 3 | 2 | | 5 | 4 | 5 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | | 5 | 5 | 5 |
| **Master thesis** | **14** | | | 5 | 5 | 5 | 4 | 6 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| **TOTAL** | **64** | | | | | | | | | | | | | | | | | | |

**Note:**

Bloom's Taxonomy of knowledge: 1 - Remember, 2 - Understand, 3 - Apply, 4 - Analyze, 5 - Evaluate, 6 - Create.

Bloom's Taxonomy of skills: 1- Imitation, 2 - Manipulation, 3 - Precision, 4 - Articulation, 5 - Naturalization.

Bloom's Taxonomy of attitudes: 1 - Receiving, 2 - Responding, 3 - Valuing, 4 - Organization, 5 - Characterization by a value complex.

## II.7. Matrix between PLOs and teaching methods

**Table 5.** Matrix between PLOs and teaching methods of the MEE

| Strategies and Methods of Teaching | PLOs | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** |
| **I. Theoretical Class** | | | | | | | | | | | | | | | | | | |
| 1. Direct Instruction | | | | | | | | | | | | | | | | | | |
| Explicit Teaching | x | x | x | x | x | x | x | x | x | | | | | x | x | x | x | x |
| Lecture | x | x | x | x | x | x | x | | x | x | | | | x | x | x | | x |
| Guest Lecture | x | | x | x | x | x | x | | x | x | | | | x | | x | | x |
| 2. Indirect Instruction | | | | | | | | | | | | | | | | | | |
| 4. Inquiry | x | x | x | x | x | x | x | | | x | | x | | | | x | | x |
| 5. Problem Solving | | | x | x | x | x | x | x | x | x | x | x | | | | x | | |
| 6. Case Study | | | x | x | x | x | x | | x | x | x | | | x | | x | | x |
| **II. Practical Class** | | | | | | | | | | | | | | | | | | |
| 1. Models | | | | x | x | x | x | | | | | | | x | | | | |
| 2. Field Trip | | | | | x | x | x | | | | | x | x | | | x | | x |
| 3. Experiment | | | | | x | x | x | x | x | x | | | | x | | | x | |
| 4. Research Project | | | | x | x | x | x | x | x | x | x | x | | x | | x | x | |
| **III. Interactive Instruction** | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Debates | | x | x | x | | | | | | | | x | x | | x | x | | x |
| 2. Discussions | x | | x | x | x | x | x | | x | x | | x | x | | | x | | x |
| 3. Peer Learning | | | x | x | x | x | x | x | | x | x | x | x | | x | x | | x |
| **IV. Independent Study** | | x | | | | | | | | | | | | | | | | |
| 1. Work Assignment | | x | x | x | x | x | x | | | | x | | x | x | | x | | |

## II.8. Carrer opportunities after graduation

Graduates of the Master' Program in Environmental Engineering can take up the following positions:

- Learners can work as specialists, experts or managers and operators at environmental treatment stations/plants, foreign-invested companies or environmental protection funds, non-governmental organizations ... with professional work relevant to the the environment.

- Researchers or lecturers at research centers, institutes, universities, colleges or other educational institutions with the training program of the environmental science;

- Become an environmental manager in state agencies and enterprises.

## II.9. Possibility to study at higher level aftergraduation

- After completing the Master's Program in Environmental Engineering, learners will be able to explore and solve problems arising in the process of personal practice or the practice of agencies, organizations and businesses where they work, Learners also be able to conduct self-study and self-research on theoretical and practical issues related to environmental technology and engineering;

- Learners will be able to continue studying PhD in sub-majors relevant to the environmental science at domestic and foreign universities.

## II.10. Reference training programs and documents for development of the MEE training program

- Ministry of Education and Training: Consolidated document No. 15/VBHN-BGDĐT dated May 8, 2014 on promulgating the List of education and training level IV at college and university level;

- Circular No. 07/2015/TT-BGDĐT of the Ministry of Education and Training: Promulgating regulations on the minimum amount of knowledge, the requirements on the competence that learners can achieve after graduation for each level training of higher education and the process of formulating, appraising and promulgating training programs at university, master and doctoral levels;

- Official Letter No. 1885/ĐHQGHN-KHTC dated June 24, 2010 on the draft of a pilot plan on funding for postgraduate training at Vietnam National University, Hanoi;

- Regulation on Master's Training at VNU, issued together with Decision No. 4668/QD-ĐHQGHN, dated December 10, 2014 of the President of Vietnam National University, Hanoi;

- Decision No. 1366/QD-ĐHQGHN dated April 25, 2012 of the President of Vietnam National University, Hanoi on promulgating Regulations on opening new and adjusting training programs at Vietnam National University, Hanoi;

- Decision No. 1230/QD-ĐHQGHN dated April 8, 2015 of the President of Vietnam National University, Hanoi on the establishment of expert groups to develop master's training programs of VNU Vietnam Japan University (including Master's Program in Environmental Engineering).

- Decision No. 3525/QD-ĐHQGHN dated September 25, 2015 of the President of Vietnam National University, Hanoi on the establishment of the Council for Appraisal of Master's Programs of VNU Vietnam Japan University;

- Decision No. 4294/QD-ĐHQGHN dated October 30, 2015 of the President of President of Vietnam National University, Hanoi on promulgating the research-oriented Master's Program in Environmental Engineering at VNU Vietnam Japan University;

- Guidance No. 808/HD-ĐHQGHN issued on March 9, 2015 on the adjustment, update or transformation, supplement of the master training program according to the Regulation on training masters at Vietnam National University, Hanoi;

- Dispatch No. 852/DT-ĐHQGHN dated March 14, 2017 on adjusting the English language entry requirements for master's programs of VNU Vietnam Japan University;

- Dispatch No. 4551/DT-ĐHQGHN dated December 28, 2018 on adjusting the admission requirements for master's programs of VNU Vietnam Japan University;

- Conclusions at the Workshop on Evaluation of pilot master's training programs of VNU Vietnam Japan University on December 4, 2020;

- Official Letter No. 333/ĐHVN-DT dated May 28, 2021 on the plan to adjust the master's training programs of VNU Vietnam Japan University;

- The guideline No. 385/HD-DHVN of the VNU Vietnam Japan University on developing and adjusting course syllabus;

- Announcement No. 489/ĐHVN-TB dated July 1, 2021 of VNU Vietnam Japan University on adjusting admission requirements of master's programs;

- Master of Urban Environmental Engineering, The University of Tokyo, Japan;

- Master Environmental Systems Engineering, Ritsumekan University, Japan;

- Master of Environmental Engineering, New Jersey Institute of Technology, U.S.A.;

- Master of Environmental Engineering, National University of Singapore;

- Master of Environmental Science and Technology, Lancaster University, United Kingdom.

## PART III: CONTENTS OF TRAINING PROGRAM

### III.1. Summary of training program

#### III.1.1. Distribution of knowledge clusters in curriculum

| | |
|---|---|
| **Total credits of the training program** | **64 credits** |
| - ***General knowledge*** | ***07 credits*** |
| - ***Fundamental and specialized knowledge*** | ***43 credits*** |
| + *Fundamental knowledge* | *08 credits* |
| + *Specialized knowledge* | *35 credits* |
| * Compulsory | 14 credits |
| * Selective | 21/38 credits |
| - ***Master thesis*** | ***14 credits*** |

### III.1.2. Contribution of knowledge clusters to PLOs

**Table 6.** Contribution of knowledge clusters to PLOs of the MEE

| Knowledge cluster | | Credit number | Weight (%) | Knowledge PLOs | | | | | | | Skill PLOs | | | | | | | | Ethic PLOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| **I** | **General knowledge** | **7** | **10.94** | H | H | L | L | L | L | L | L | L | L | L | L | L | L | H | L | L | H |
| **II** | **Fundamental and specialized knowledge** | **43** | **67.19** | | | | | | | | | | | | | | | | | | |
| ***II.1*** | ***Fundamental knowledge*** | ***8*** | ***12.50*** | L | M | H | H | M | M | M | L | L | H | H | H | H | H | H | H | H | H |
| ***II.2*** | ***Specialized knowledge*** | ***35*** | ***54.69*** | | | | | | | | | | | | | | | | | | |
| | Compulsory courses | 14 | 21.88 | L | M | H | H | H | H | H | H | H | M | H | H | H | M | M | H | M | M |
| | Elective courses | 21 | 32.81 | L | H | M | M | H | H | H | H | H | M | H | H | L | H | L | H | M | M |
| **III** | **Master thesis** | **14** | **21.87** | M | H | M | M | H | H | H | H | H | H | H | H | H | M | L | H | H | H |
| | **TOTAL** | **64** | **100** | | | | | | | | | | | | | | | | | | |

## III.2. Program curriculum

MEE training program is designed on the basis of the training program of the University of Tokyo with modification to promote the strengths of VNU and overcome the disadvantages of existing training programs in Vietnam. The program aims to provide a background on basis of processes in the environment including chemical reactions, microbial and physicochemical processes. Thus, students have the capacity to work on management, monitoring, process design and system operation. In particular, the program arranges many practical courses and internship to equip students the practical working skills.

**Table 7.** The curriculum of the MEE training program

| No | Course code | Course name | Number of credits | Total credit hours | | | Prerequisite course |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practice/ Exercises | Self-study | |
| **I** | **GENERAL KNOWLEDGE** | | **7** | | | | |
| 1 | PHI5001 | Philosophy | 3 | 45 | 5 | 10 | |
| 2 | ENG5001 | Basic English | 4 | 30 | 30 | 0 | |
| **II** | **FUNDAMENTAL AND SPECIALIZED KNOWLEDGE** | | **43** | | | | |
| **II.1** | **Fundamental knowledge** | | **8** | | | | |
| 3 | VJU6001 | Basic of sustainability science | 3 | 40 | 5 | 0 | |
| 4 | VJU6002 | Methodology and informatics for sustainable | 3 | 40 | 5 | 0 | |

| No | Course code | Course name | Number of credits | Total credit hours | | | Prerequisite course |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practice/ Exercises | Self-study | |
| | | science | | | | | |
| 5 | VJU6003 | Japanese language | 2 | 5 | 25 | 0 | |
| **II.2** | **Specialized knowledge** | | **35** | | | | |
| ***II.2.1*** | ***Compulsory courses*** | | ***14*** | | | | |
| 6 | MEE6010 | Environmental management systems | 2 | 25 | 5 | 0 | |
| 7 | MEE6011 | Environmental analysis and measurement | 3 | 40 | 5 | 0 | |
| 8 | MEE6012 | Environmental assessment and modeling | 2 | 25 | 5 | 0 | |
| 9 | MEE6013 | Water and wastewater engineering | 3 | 40 | 5 | 0 | |
| 10 | MEE6014 | Internship | 4 | 10 | 50 | 0 | MEE6010<br>MEE6011<br>MEE6012<br>MEE6013 |
| ***II.2.2*** | ***Elective courses*** | | ***21/38*** | | | | |
| 11 | VJU6004 | Japanese language | 4 | 10 | 50 | 0 | |
| 12 | MEE6015 | Environmental engineering laboratory | 3 | 5 | 40 | 0 | MEE6013 |
| 13 | MEE6016 | Material cycles and solid waste management | 3 | 40 | 5 | 0 | |

| No | Course code | Course name | Number of credits | Total credit hours | | | Prerequisite course |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practice/ Exercises | Self-study | |
| 14 | MEE6017 | Environmental management in Vietnam and Japan | 2 | 26 | 4 | 0 | |
| 15 | MEE6018 | Environmental health | 2 | 26 | 4 | 0 | |
| 16 | MEE6019 | Air emission and quality control | 3 | 40 | 5 | 0 | |
| 17 | MEE6020 | Environmental biotechnology | 3 | 40 | 5 | 0 | |
| 18 | MEE6021 | Chemical reaction engineering | 2 | 26 | 4 | 0 | MEE6011<br>MEE6012 |
| 19 | MEE6022 | Advanced computer application in environment | 3 | 40 | 5 | 0 | VJU6001<br>MEE6010<br>MEE6013 |
| 20 | MEE6023 | Global environmental issues | 2 | 26 | 4 | 0 | |
| 21 | MEE6024 | Waste to energy | 2 | 26 | 4 | 0 | |
| 22 | MEE6025 | Data analysis in environmental engineering | 3 | 40 | 5 | 0 | |
| 23 | MEE6026 | Seminar 1 | 2 | 26 | 4 | 0 | MEE6010<br>MEE6011<br>MEE6012 |

| No | Course code | Course name | Number of credits | Total credit hours | | | Prerequisite course |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practice/ Exercises | Self-study | |
| | | | | | | | MEE6013 |
| 24 | MEE6027 | Seminar 2 | 2 | 26 | 4 | 0 | MEE6010<br>MEE6011<br>MEE6012<br>MEE6013<br>MEE6026 |
| 25 | MEE6028 | Seminar 3 | 2 | 26 | 4 | 0 | MEE6010<br>MEE6011<br>MEE6012<br>MEE6013<br>MEE6026<br>MEE6027 |
| **III** | **MEE7001** | **MASTER THESIS** | **14** | | | | |
| **TOTAL** | | | **64** | | | | |

**Note:** Total credit hours (theory/ practice/ self-study credit hours)

### III.3. List of references

**Table 8.** List of references for courses of the MEE

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| **I** | **GENERAL KNOWLEDGE** | | **7** | |
| | PHI5001 | Philosophy | 3 | Following the guideline of VNU |
| | ENG5001 | Basic English | 4 | Following the guideline of VNU |
| **II** | **FUNDAMENTAL AND SPECIALIZED KNOWLEDGE** | | **43** | |
| ***II.1*** | ***Fundamental knowledge*** | | ***8*** | |
| | VJU6001 | Basic of sustainability science | 3 | ***Required materials***<br>Lecturer note is provided by each lecturer.<br>***References***<br>1. Many authors (2011), Sustainability Science Series, Vol. 1-5, United Nations University Press.<br>2. AR Edwards (2010), Thriving beyond Sustainability: Pathways to a resilient society, New Society Publishers.<br>3. J Diamond (2005), Collapse: How societies choose to fail or succeed, Penguin.<br>4. B Walker, D Salt (2006), Resilience Thinking: Sustaining Ecosystems and People in a Changing World, Island Press.<br>5. Bell Simon, Stephen Morse (2008), Sustainability Indicators; Measuring the Immeasurable, Earthscan.<br>6. Jurgen Scheffran (2007), Advanced Methods for Decision |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | Making and Risk Management in Sustainability Science, Nova Science Publishers. |
| | VJU6002 | Methodology and informatics for sustainable science | 3 | ***Required materials***<br>Lecturer note is provided by each lecturer.<br>***References***<br>1. Shoichiro Hara (2010), "Area Informatics – Concept and status. Culture and Computing", Lecture Notes in Computer Science, Volume 6259, pp 214 – 228.<br>2. Ishikawa, M., Kaneko, K. (2009), "Design of a Map Annotation System Using a Digital Pen for Field Work". In: Proceeding of Society for Information Technology & Teacher Education (SITE 2009), CD-ROM.<br>3. Hara, S., Yasunaga, H. (2002), "Resource Sharing System for Humanity Researches". In: Proceedings of the Third International Conference on Language Resources and Evaluation, pp. 51–58.<br>4. The Electronic Cultural Atlas Initiative (ECAI), http://www.ecai.org/ |
| | VJU6003 | Japanese language | 2 | ***Required materials***<br>Lecturer note is provided by each lecturer.<br>***References***<br>1. 東京: 冬至書房 (2001), 本語教科書. 第 1,2,3 巻 .<br>2. 東京: ベレ出版 (2009), 日本語の教科書<br>3. 東京: 東京大学出版会 (2008), 中・上級日本語教科書日本への招待. テキスト . |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | 4. 東京: 東京大学出版会 (2008) 中・上級日本語教科書日本への招待. 予習シート・語彙・文型 .<br>5. 東京: 早稲田大学日本語研究教育センター (1996)日本語教科書分野別用語集 : 外国学生用<br>6. 東京: ゆまに書房 (1995), An English‐Japan dictionary of the spoken English.<br>7. ラテックス・インターナショナル訳 (2014) TRY! 日本語能力試験 N5 : 文法から伸ばす日本語. ベトナム語版 / ABK [著], アスク出版.<br>8. ラテックス・インターナショナル訳 (2014) TRY!日本語能力試験 N4 : 文法から伸ばす日本語 (2014) / ABK [著], アスク出版. |
| ***II.2*** | ***Specialized knowledge*** | | ***35*** | |
| *II.2.1* | *Compulsory courses* | | *14* | |
| | MEE6010 | Environmental management systems | 2 | ***Required materials***<br>Handouts/ lecture notes will be provided before class by each lecturer.<br>***References***<br>1. Enger Eldon, Bradley Smith, Environmental Science: A study of inter-relationships (14th edition), McGraw-Hill Education, 2015.<br>2. William P. Cunningham & Mary Ann Cunningham, Environmental Science: A Global Concern (14th edition), McGraw-Hill Education, 2018. |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | 3. Dibyendu Sarkar et al., An Integrated Approach to Environmental Management, Wiley 2015.<br>4. Christopher Sheldon & Mark Yoxon, Environmental Management Systems: A step-by-step Guide to Implementation and Maintenance (3rd edition), Routledge, 2012. |
| | MEE6011 | Environmental analysis and measurement | 3 | ***Required materials***<br>1. Lecturer note is provided by each lecturer.<br>2. Comprehensive Analytical Chemistry, Vol. 32, D. Perez-Bendito & S. Rubio, 1999, Elsevier.<br>***References***<br>1. Chemical Analysis: Modern Instrumentation Methods and Techniques – 2nd Edition, F. Rouessac & A. Rouessac, 2007, Wiley.<br>2. Fundamentals of Analytical Chemistry- 8$^{th}$ Edition, D.A. Skoog, D.M.West, F.J. Holler and S.R.Crouch, 2004, Thomson.<br>3. Modern Instrumental analysis, Vol. 47 (Comprehensive Analytical chemistry), S. Ahuja, N. Jespersen, 2006, Amazon.<br>4. Principles of Instrumental Analysis, Skoog D. A., 1993, Saunders College Publishing.<br>5. Analytical Chemistry. Principles - 2nd Edition., Kennedy J.H., 1990, Saunders College Publishing. |
| | MEE6012 | Environmental assessment and modeling | 2 | ***Required materials***<br>Lecturer note is provided by each lecturer.<br>***References***<br>1. Environmental Assessment (Second Edition), Ravi K. Jain, L. V. Urban, Gary S. Stacey, Harold E. Balbach, McGraw-Hill |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | Professional, 2001<br>2. Octave Levenspiel, Chemical Reaction Engineering, 3rd Edition, Wiley, 1998 Chapters 1-6, 11-14<br>3. Water Quality Engineering, Mark M. Benjamin, Desmond F. Lawler, Wiley, 2012 |
| | MEE6013 | Water and wastewater engineering | 3 | ***Required materials***<br>Lecture notes will be provided by each instructor; additional references may be given.<br>***References***<br>1. Handbook of Environmental Engineering Calculations, 2nd edition by C. C. Lee, Shun Dar Lin, Publisher: McGraw-Hill Companies 2007<br>2. MWH's Water Treatment: Principles and Design, Third Edition, John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe and George Tchobanoglous, 2012 John Wiley & Sons, Inc. (Main Phys.Chem. Units & Drinking Water Treatment)<br>3. Metcalf & Eddy/AECOM. Wastewater Engineering: Treatment and Resource Recovery,<br>5th Edition (2 Volumes) International Edition, McGraw-Hill 2014 |
| | MEE6014 | Internship | 4 | ***Required materials***<br>Materials will be provided by lecturer/internship sites during the period of internship.<br>***References***<br>Reference information will be provided by lecturer/internship sites during the period of internship. |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | ***Elective courses*** | | ***21/38*** | |
| | VJU6004 | Japanese language | 4 | ***Required materials***<br>Lecturer note is provided by each lecturer.<br>***References***<br>1. 東京: 冬至書房 (2001),日本語教科書. 第 1,2,3 巻 .<br>2. 東京: ベレ出版 (2009), 日本語の教科書<br>3. 東京: 東京大学出版会 (2008), 中・上級日本語教科書日本への招待. テキスト .<br>4. 東京: 東京大学出版会(2008) 中・上級日本語教科書日本への招待. 予習シート・語彙・文型 .<br>5. 東京: 早稲田大学日本語研究教育センター(1996)日本語教科書分野別用語集 : 外国学生用<br>6. 東京: ゆまに書房 (1995), An English‐Japan dictionary of the spoken English.<br>7. ラテックス・インターナショナル訳 (2014) TRY!日本語能力試験 N5 : 文法から伸ばす日本語. ベトナム語版 / ABK [著], アスク出版.<br>8. ラテックス・インターナショナル訳 (2014) TRY!日本語能力試験 N4 : 文法から伸ばす日本語 (2014) / ABK [著], アスク出版. |
| | MEE6015 | Environmental engineering laboratory | 3 | ***Required materials***<br>1. Handouts/ lecture notes will be provided before class by each lecturer. |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | 2. Nguyen Thi An Hang, Vu Ngoc Duy, Cao The Ha, Textbook of Environmental Engineering Laboratory, 2019.<br>***References***<br>1. AEESP, Environmental Engineering Processes Laboratory Manual, Association of Environmental Engineering and Science Professors, 2001.<br>2. Metcalf and Eddy/Aecom, Wastewater Engineering: Treatment and Resource Recovery (5th edition), Tata McGraw-Hill Education, 2018. |
| | MEE6016 | Material cycles and solid waste management | 3 | ***Required materials***<br>1. Handouts/ lecture notes will be provided before class by each lecturer.<br>2. Christensen, Thomas H. (Edi.), Solid waste technology and management, John Wiley & Sons Ltd, 2011.<br>***References***<br>1. Nicholas P. Cheremisinoff, Handbook of solid waste management and waste minimization technologies, Elsevier Science (USA), 2003.<br>2. Lawrence K. Wang, Yung-Tse Hung, Howard H. Lo, Constantine Yapijakis, Handbook of Industrial and Hazardous Waste Treatment, CRC Press, 2004. |
| | MEE6017 | Environmental management in Vietnam and Japan | 2 | ***Required materials***<br>Lecture note will be provided by each instructor.<br>***References***<br>1. Mitsumasa Okada, Spencer A. Peterson, Water Pollution |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | Control Policy and Management: The Japanese Experience, Gyosei, 2000.<br>2. Ministry of the Environment, Annual Report 2020, http://www.env.go.jp/ en/wpaper/2020/index.html |
| | MEE6018 | Environmental health | 2 | ***Required materials***<br>1. Dade W. Moeller. Environmental Health. 3rd Edition. Harvard University Press, USA, 2005<br>2. Sigmund F. Zakrzewski. Environmental Toxicology, Third Edition Published by Oxford University Press, Inc. 2002<br>***References***<br>1. Casarett and Doull's. Toxicology, 7th Ed, Klaassen CD, McGraw-Hill 2008<br>2. Ernest Hodgson. A textbook of Modern Toxicology. 3rd edition. A John Wiley & Sons, Inc., Publication.<br>3. Lecture notes provided by lecturers<br>4. Scientific articles |
| | MEE6019 | Air emission and quality control | 3 | ***Required materials***<br>Lecturer note is provided by each lecturer.<br>***References***<br>1. Air Pollution Control Engineering: Second Edition, Noel de Nevers, McGraw-Hill Inc., 1994<br>2. Air Pollution Control Technology Handbook, Karl B. Schnelle, Charles A. Brown, CRS Press, 2000<br>3. Sustainable Air Pollution Management (Theory and Practice), Ramesha Chandrappa, Umesh Chandra Kulshrestha, Springer, 2016 |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | MEE6020 | Environmental biotechnology | 3 | ***Required materials***<br>Lecture notes will be provided by each lecturer prior to the class.<br>***References***<br>1. Bruce E. Rittmann & Perry L. McCarty, Environmental Biotechnology: Principles and Applications, Tata McGraw-Hill Education, 2012.<br>2. Hans-Joachim Jordening and Josef Winter, eds. Environmental Biotechnology: Concepts and Applications, John Wiley & Sons, lnc., New York, 2005.<br>3. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery (5th Edition), McGraw-Hill Education, 2013. |
| | MEE6021 | Chemical reaction engineering | 2 | ***Required materials***<br>Handouts/ Lecture notes will be provided before class by each lecturer, additional literature may be given.<br>***References***<br>1. John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe and George Tchobanoglous (2012) MWH's Water Treatment: Principles and Design, Third Edition, John Wiley & Sons, Inc. (Chapter 6 Principles of Reactor Analysis and Mixing, pp.287-390)<br>2. Octave Levenspiel (1999) Chemical Reaction Engineering, Third Edition, John Wiley & Sons (Chapter 1, pp.1-9; Part V, Chapters 27-30, pp.609-654) |
| | MEE6022 | Advanced computer application in | 3 | ***Required materials***<br>1. Installing and licensing the latest ArcGIS, InVEST tool, R, python and some general applications (Google Earth Pro, MS office, |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | environment | | PDF, Unzip)<br>2. Original Manuals and datasets for GIS exercises will be provided<br>3. William Bajjali, ArcGIS for Environmental and Water Issues, Springer (2018), https://link.springer.com/book/10.1007/978-3-319-61158-7<br>***References***<br>1. The ArcGIS Book: Instructional Guide for The ArcGIS Imagery Book, Instructional Guide for The ArcGIS Book Second edition, ESRI Press (2015), downloadable from "http://learn.arcgis.com/ja/arcgis-book/"<br>2. Kennedy, M., Introducing Geographic Information Systems with ArcGIS®: A Workbook Approach to Learning GIS. Third Edition. John Wiley and Sons, Inc., Hoboken, New Jersey (2013)<br>3. Harder, C., Ormsby, T., Balstrom, T., Understanding GIS: An ArcGIS Project Workbook, Second Edition, ESRI Press (2013)<br>4. Parece, T., Campbell J.B., McGee, J., Remote Sensing Analysis in an ArcMap Environment (English Edition), Kindle version, Amazon Services International, Inc |
| | MEE6023 | Global environmental issues | 2 | ***Required materials***<br>1. Lecture notes will be provided by each lecturers.<br>***Reference materials***<br>1. William P. Cunningham and Mary Ann Cunningham (2015), |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | Environmental Science: A Global Concern (14th Edition). McGraw Hill Education. This book is available from the VNU-VJU's Library.<br>2. Frances Hariss (2012). Global Environmental Issue (2nd Edition). Wiley- Blackwell.<br>3. G. Tyler Miller and Scott E. Spoolman (2009). Living in the Environment: Principles, Connections and Solutions (16th Edition). Brooks/Cole, Cengage Learning. |
| | MEE6024 | Waste to energy | 2 | ***Required materials***<br>1. Lecture notes will be provided by each lecturers.<br>***Reference materials***<br>1. Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", 3rd Edition, Elsevier Store, 2019.<br>2. Young G.C., "Municipal Solid Waste to Energy Conversion Processes", John Wiley and Sons, 2010<br>3. Christensen, Thomas H. (Edi.), Solid waste technology and management, John Wiley & Sons Ltd, 2011 |
| | MEE6025 | Data analysis in environmental engineering | 3 | ***Required materials***<br>1. Jürgen W. Einax, Heinz W. Zwanziger, Sabine Geiß. Chemometrics in Environmental Analysis. Wiley - VCH Verlag GmbH,1997.<br>2. Zhihua Zhang. Environmental Data Analysis: Methods and Applications, De Gruyter, 2016.<br>***References***<br>1. Grady Hanrahan. Environmental Chemometrics Principles and |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | Modern Applications. CRC Press, 2019<br>2. Bruce Kendall and Chris Costello. Data Analysis for Environmental Science and Management. Wiley, 2006.<br>3. Giovanni Visco. Multivariate Analysis and Chemometrics Applied to Environment and Cultural Heritage. Current Analytical Chemistry. Volume 6, Issue 1 , 2010 |
| | MEE6026 | Seminar 1 | 2 | ***Required materials***<br>Lecture materials will be provided by each lecturer.<br>***References***<br>Recommended references and information will be provided by each lecturer. |
| | MEE6027 | Seminar 2 | 2 | ***Required materials***<br>Handouts/ lecture notes will be provided before class by each lecturer.<br>***References***<br>1. Paul Gruba and Justin Zobel, How to write your first thesis, Springer, 2017.<br>2. Qais Faryadi, PhD Thesis Writing Process: A Systematic Approach - How to Write Your Literature Review, Creative Education, 2018, 9, 2912-2919.<br>3. Sarah Cuschieri, Victor Grech, Charles Savona-Ventura, WASP (Write a Scientific Paper): How to Write a Scientific Thesis, Early Human Development 127, December 2018, 101-105. |
| | MEE6028 | Seminar 3 | 2 | ***Required materials***<br>Handouts/ lecture notes will be provided before class by each |

| No. | Course code | Course name | Number of credits | List of references |
|---|---|---|---|---|
| | | | | lecturer.<br>***References***<br>Reference materials will be recommended by lecturers based on the contents and quality of students' presentation. |

### III.4. Lecturers

**Table 9.** List of lecturers of the MEE

| No. | Course code | Course name | Number of credits | Lecturers | | | |
|---|---|---|---|---|---|---|---|
| | | | | **Name** | **Academic title** | **Major** | **Working place** |
| **I** | **GENERAL KNOWLEDGE** | | **7** | | | | |

| | | | | |
|---|---|---|---|---|
| | PHI5001 | Philosophy | 3 | Lecturers from VNU University of Social Sciences and Humanities |
| | ENG5001 | Basic English | 4 | Lecturers from University of Languages & International Studies (ULIS) |
| **II** | **FUNDAMENTAL AND SPECIALIZED KNOWLEDGE** | | **43** | |
| ***II.1*** | ***Fundamental knowledge*** | | ***8*** | |
| | VJU6001 | Basic of sustainability science | 3 | Lecturers from all programs of VJU and invited lecturers from outside |
| | VJU6002 | Methodology and informatics for sustainable science | 3 | Lecturers from all programs of VJU and invited lecturers from outside |
| | VJU6003 | Japanese language | 2 | Lecturers of Japanese Education Program of VJU |
| ***II.2*** | ***Specialized knowledge*** | | ***35*** | |
| *II.2.1* | *Compulsory courses* | | *14* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | MEE6010 | Environmental management systems | 2 | 1. Nguyen Thi An Hang<br>2. Kensuke Fukushi<br>3. Monte Cassim | 1. Dr.<br>2. Prof. Dr.<br>3. Prof. Dr. | 1. Environmental Engineering<br>2. Civil Engineering<br>3. Urban Engineering | 1. Vietnam Japan University (VJU)<br>2. The University of Tokyo (UoT)<br>3. xxx |
| | MEE6011 | Environmental analysis and measurement | 3 | 1. Tran Thi Viet Ha<br>2. Tu Binh Minh<br>3. Nakajima Fumiyuki | 1. Dr.<br>2. Assoc. Prof. Dr.<br>3. Prof. Dr. | 1. Environmental Engineering<br>2. Environmental Chemistry<br>3. Environmental Engineering | 1. VJU<br>2. VNU Hanoi University of Science (HUS)<br>3. UoT |
| | MEE6012 | Environmental assessment and modeling | 2 | 1. Kasuga Ikuro<br>2. Furumai Hiroaki<br>3. Tran Thi Viet Ha | 1. Assoc. Prof. Dr.<br>2. Prof. Dr.<br>3. Dr. | 1. Environmental Engineering<br>2. Environmental Engineering<br>3. Environmental Engineering | 1. UoT<br>2. UoT<br>3. VJU |

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|---|---|---|---|---|---|---|---|
| | MEE6013 | Water and wastewater engineering | 3 | 1. Cao The Ha<br>2. Nguyen Thi An Hang<br>3. Hiroyasu Satoh | 1. Assoc. Prof. Dr.<br>2. Dr.<br>3. Prof. Dr. | 1. Theoretical Chemistry and Physic Chemistry<br>2. Environmental Engineering<br>3. xx | 1. VJU<br>2. VJU<br>3. UoT |
| | MEE6014 | Internship | 4 | Lecturers from VJU and Lecturers from organization received the students for internship | | | |
| *II.2.2* | *Elective courses* | | *21/38* | | | | |
| | VJU6004 | Japanese language | 4 | Lecturers of Japanese Education Program of VJU | | | |
| | MEE6015 | Environmental engineering laboratory | 3 | 1. Vu Ngoc Duy<br>2. Nguyen Thi An Hang | 1. Dr.<br>2. Dr. | 1. Theoretical Chemistry and Physic Chemistry<br>2. Environmental Engineering | 1. HUS<br>2. VJU |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | MEE6016 | Material cycles and solid waste management | 3 | 1. Do Quang Trung<br>2. Seiji Hashimoto<br>3. Masaki Takaoka<br>4. Phuong Thao | 1. Assoc. Prof. Dr.<br>2. Prof. Dr.<br>3. Prof. Dr.<br>4. Dr. | 1. Analytical Chemistry<br>2. Environmental Engineering<br>3. Environmental Engineering<br>4. Environmental engineering technology | 1. HUS<br>2. Ritsumeikan University<br>3. Kyoto University<br>4. HUS |
| | MEE6017 | Environmental management in Vietnam and Japan | 2 | 1. Nakajima Jun<br>2. Le Van Chieu<br>3. Naoki Yoshikawa<br>4. Yazawa Taishi | 1. Prof. Dr.<br>2. Assoc. Prof. Dr.<br>3. Dr.<br>4. Dr. | 1. Engineering<br>2. Analytical Chemistry<br>3.Environmental Engineering<br>4. Environmental Engineering | 1. Ritsumeikan University, VJU<br>2. VNU<br>3. Ritsumeikan University<br>4. VJU, Ritsumeikan University |
| | MEE6018 | Environmental health | 2 | 1. Nguyen Thi Ha<br>2. Naoyuki Kamiko<br>3. Hiroyuki Katayama | 1. Dr.<br>2. Prof. Dr.<br>3. Prof. Dr. | 1. Organic chemistry<br>2. Environmental Engineering<br>3. Environmental Engineering | 1. HUS<br>2. Ritsumeikan University<br>3. UoT |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | MEE6019 | Air emission and quality control | 3 | 1. Tran Thi Viet Ha<br>2. Higuchi Takashi<br>3. Nguyen Minh Viet | 1. Dr.<br>2. Prof. Dr.<br>3. Dr. | 1. Environmental Engineering<br>2. Environmental Engineering<br>3. Environmental Engineering | 1. VJU<br>2. Ritsumeikan University<br>3. HUS |
| | MEE6020 | Environmental biotechnology | 3 | 1. Nguyen Thi An Hang<br>2. Nakajima Jun<br>3. Futoshi Kurisu<br>4. Le Van Chieu | 1. Dr.<br>2. Prof. Dr.<br>3. Assoc. Prof. Dr.<br>4. Assoc. Prof. Dr. | 1. Environmental Engineering<br>2. Engineering<br>3. Environmental Engineering<br>4. Analytical Chemistry | 1. VJU<br>2. Ritsumeikan University, VJU<br>3. UoT<br>4. VNU |
| | MEE6021 | Chemical reaction engineering | 2 | 1. Cao The Ha<br>2. Vu Ngoc Duy<br>3. Kensuke Fukushi | 1. Assoc. Prof. Dr.<br>2. Dr<br>3. Prof. Dr. | 1. Theoretical Chemistry and Physic chemistry<br>2. Theoretical Chemistry and Physic chemistry<br>3. Civil Engineering | 1. VJU<br>2. HUS<br>3. UoT |

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|---|---|---|---|---|---|---|---|
| | MEE6022 | Advanced computer application in environment | 3 | 1. Sato Keisuke<br>2. Dang Kinh Bac<br>3. Yazawa Taishi | 1. Assoc. Prof. Dr.<br>2. Dr.<br>3. Dr. | 1. Environmental Engineering<br>2. Agricultural Sciences/Ecology<br>3. Environmental Engineering | 1. Ritsumeikan University<br>2. HUS<br>3. VJU, Ritsumeikan University |
| | MEE6023 | Global environmental issues | 2 | 1. Nguyen Thi An Hang<br>2. Tran Thi Viet Ha<br>3. Yazawa Taishi | 1. Dr.<br>2. Dr.<br>3. Assist. Prof. Dr. | 1. Environmental Engineering<br>2. Environmental Engineering<br>3. Environmental Engineering | 1. VJU<br>2. VJU<br>3. VJU, Ritsumeikan University |
| | MEE6024 | Waste to energy | 2 | 1. Do Quang Trung<br>2. Nguyen Minh Viet | 1. Assoc. Prof. Dr.<br>2. Dr. | 1. Analytical Chemistry<br>2. Environmental Engineering | 1. HUS<br>2. HUS |
| | MEE6025 | Data analysis in environmental engineering | 3 | 1. Ta Thi Thao<br>2. Bui Van Hoi | 1. Assoc. Prof. Dr.<br>2. Dr. | 1. Analytical Chemistry<br>2. Chemistry | 1. VNU University of Science<br>2. University of Science and Technology of Hanoi |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | MEE6026 | Seminar 1 | 2 | 1. Yazawa Taishi<br>2. Nguyen Thi An Hang<br>3. Tran Thi Viet Ha<br>4. Nakajima Jun<br>5. Cao The Ha | 1. Dr.<br>2. Dr.<br>3. Dr.<br>4. Prof. Dr.<br>5. Assoc. Prof. Dr. | 1. Environmental Engineering<br>2. Environmental Engineering<br>3. Environmental Engineering<br>4. Engineering<br>5. Theoretical Chemistry and Physic Chemistry | 1. VJU, Ritsumeikan University<br>2. VJU<br>3. VJU<br>4. VJU, Ritsumeikan University<br>5. VJU |
| | MEE6027 | Seminar 2 | 2 | 1. Nguyen Thi An Hang<br>2. Yazawa Taishi<br>3. Tran Thi Viet Ha<br>4. Nakajima Jun<br>5. Cao The Ha | 1. Dr.<br>2. Dr.<br>3. Dr.<br>4. Prof. Dr.<br>5. Assoc. Prof. Dr. | 1. Environmental Engineering<br>2. Environmental Engineering<br>3. Environmental Engineering<br>4. Engineering<br>5. Theoretical Chemistry and Physic Chemistry | 1. VJU<br>2. VJU, Ritsumeikan University<br>3. VJU<br>4. VJU, Ritsumeikan University<br>5. VJU |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | MEE6028 | Seminar 3 | 2 | 1. Tran Thi Viet Ha<br>2. Nguyen Thi An Hang<br>3. Yazawa Taishi<br>4. Nakajima Jun<br>5. Cao The Ha | 1. Dr.<br>2. Dr.<br>3. Dr.<br>4. Prof. Dr.<br>5. Assoc. Prof. Dr. | 1. Environmental Engineering<br>2. Environmental Engineering<br>3. Environmental Engineering<br>4. Engineering<br>5. Theoretical Chemistry and Physic Chemistry | 1. VJU<br>2. VJU<br>3. VJU, Ritsumeikan University<br>4. VJU, Ritsumeikan University<br>5. VJU |

## III. 5. Guidelines on implementation of the training program

### III.5.1. Training plan

**Table 10.** The training plan of the MEE

| No. | Course code | Course name | Number of credits | Number of credit hours | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1st semester | 2nd semester | 3rd semester | 4th semester |
| **I** | **GENERAL KNOWLEDGE** | | **7** | | | | |
| | PHI5001 | Philosophy | 3 | 60 (45/5/10) | | | |
| | ENG5001 | Basic English | 4 | 60 (30/30/0) | | | |
| **II** | **FUNDAMENTAL AND SPECIALIZED KNOWLEDGE** | | **43** | | | | |
| ***II.1*** | ***Fundamental knowledge*** | | ***8*** | | | | |

| No. | Course code | Course name | Number of credits | Number of credit hours | | | |
|---|---|---|---|---|---|---|---|
| | | | | **1st semester** | **2nd semester** | **3rd semester** | **4th semester** |
| | VJU6001 | Basic of sustainability science | 3 | 45 (40/5/0) | | | |
| | VJU6002 | Methodology and informatics for sustainable science | 3 | | 45 (40/5/0) | | |
| | VJU6003 | Japanese language | 2 | 30 (5/25/0) | | | |
| ***II.2*** | ***Specialized knowledge*** | | ***35*** | | | | |
| *II.2.1* | *Compulsory courses* | | *14* | | | | |
| | MEE6010 | Environmental management systems | 2 | 30 (25/5/0) | | | |
| | MEE6011 | Environmental analysis and measurement | 3 | 45 (40/5/0) | | | |
| | MEE6012 | Environmental assessment and modeling | 2 | 30 (25/5/0) | | | |
| | MEE6013 | Water and wastewater engineering | 3 | 45 (40/5/0) | | | |
| | MEE6014 | Internship | 4 | | | 60 (10/50/0) | |
| *II.2.2* | *Elective courses* | | *21/38* | | | | |
| | VJU6004 | Japanese language | 4 | | 60 (10/50/0) | | |

| No. | Course code | Course name | Number of credits | Number of credit hours | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1st semester | 2nd semester | 3rd semester | 4th semester |
| | MEE6015 | Environmental engineering laboratory | 3 | | 45 (5/40/0) | | |
| | MEE6016 | Material cycles and solid waste management | 3 | | 45 (40/5/0) | | |
| | MEE6017 | Environmental management in Vietnam and Japan | 2 | | 30 (26/4/0) | | |
| | MEE6018 | Environmental health | 2 | | 30 (26/4/0) | | |
| | MEE6019 | Air emission and quality control | 3 | | 45 (40/5/0) | | |
| | MEE6020 | Environmental biotechnology | 3 | | 45 (40/5/0) | | |
| | MEE6021 | Chemical reaction engineering | 2 | | 30 (26/4/0) | | |
| | MEE6022 | Advanced computer application in environment | 3 | | 45 (40/5/0) | | |
| | MEE6023 | Global environmental issues | 2 | | 30 (26/4/0) | | |
| | MEE6024 | Waste to energy | 2 | | 30 (26/4/0) | | |
| | MEE6025 | Data analysis in environmental engineering | 3 | | 45 (40/5/0) | | |

| No. | Course code | Course name | Number of credits | Number of credit hours | | | |
|---|---|---|---|---|---|---|---|
| | | | | **1st semester** | **2nd semester** | **3rd semester** | **4th semester** |
| | MEE6026 | Seminar 1 | 2 | | 30 (26/4/0) | | |
| | MEE6027 | Seminar 2 | 2 | | | 30 (26/4/0) | |
| | MEE6028 | Seminar 3 | 2 | | | | 30 (26/4/0) |
| **III** | **MEE7001** | **MASTER THESIS** | **64** | | | | |

**Table 11.** The curriculum map of the MEE

| 1st semester | | 2nd semester | | 3rd semester | | 4th semester | |
|---|---|---|---|---|---|---|---|
| **Course** | **Credit** | **Course** | **Credit** | **Course** | **Credit** | **Course** | **Credit** |
| Philosophy | 3 | Basic English | 2 | Internship | 4 | Master thesis | 14 |
| Basic English | 2 | Methodology & informatics for sustainable science | 3 | Seminar 2 | 2 | Seminar 3 | 2 |
| Basic of sustainability science | 3 | Japanese language | 4 | | | | |
| Japanese language | 2 | Environmental engineering laboratory | 3 | | | | |
| Environmental management systems | 2 | Material cycles and solid waste management | 3 | | | | |
| Environmental analysis and measurement | 3 | Environmental management in Vietnam and Japan | 2 | | | | |
| Environmental assessment and modeling | 2 | Environmental health | 2 | | | | |
| Water and wastewater engineering | 3 | Air emission and quality control | 3 | | | | |
| | | Environmental biotechnology | 3 | | | | |
| | | Chemical reaction engineering | 2 | | | | |
| | | Advanced computer application in environment | 3 | | | | |
| | | Global environmental issues | 2 | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Waste to energy | 2 | | | | |
| | | Data analysis in environmental engineering | 3 | | | | |
| | | Seminar 1 | 2 | | | | |
| **TOTAL** | **20**<br>**1st semester** | | **22**<br>**2nd semester** | | **6**<br>**3rd semester** | | **16**<br>**4th semester** |

*** Note:**

| **General knowledge** | **Fundamental and specialized knowledge** | | | **Master thesis** |
|---|---|---|---|---|
| | **Fundamental knowledge** | **Specialized knowledge** (compulsory courses) | **Specialized knowledge** (elective courses) (21/38) | |

### III.5.2. Course selection

Students will fully learn the General knowledge cluster (I), in which the Philosophy course will be taught in Vietnamese for Vietnamese students and in English for students who are foreigners. Next, students will study the required courses in Fundamental and Specialized knowledge cluster (II). Fundamental courses (II.1) include the courses which are taught to all students of VJU to give them the background on sustainability science and methods, informatics for sustainable science as well as Japanese language. Specialized courses (II.2) include Compulsory courses and Elective courses. While compulsory courses are mandatory to all students, elective course can be selected by students based on the advices and guidances of lecturers and academic advisors to ensure that the content of elective courses is consistent with the student's research direction.

After accumulating 50 credits of the above courses, students will carry out the master thesis for graduation. Students can choose a research topic and complete their master thesis in the diversified research orientations.

### III.5.3. Assignment of research topics and supervisors, implementation of graduation thesis

The process of assigning the research topics and scientific supervisors is conducted since the Semeser II of the Year I to the Semester I of the Year II based on the students' expectations. The thesis implementation is performed at adanved laboratories at VNU or Japanese coordinating unviverisities. Learns write and defense their graduation theses in English.

## III.6. Comparision of the developed training program with the foreign advanced training programs (used to develop the program)

- Name of program (name of major / sub-major), name of degree after graduation: Urban Environmental Engineering, Master of Urban Environmental Engineering

- Name of training institution, training country: The University of Tokyo, Japan

- Ranking of the training institutions, major/ sub-major: The University of Tokyo is in the top 30 in the world and number 1 in Asia.

- Based on the expected learning outcomes of the tentative Master of Environmental Technology (MET, which later became MEE), the task forse has

built the training program based on the curriculum of the Urban Environmental Engineering Master Program of The University of Tokyo, Japan – one of the leading prestigious training institutions in Asia. Based on the curriculum of the University of Tokyo, the task force has added a number of coures suitable to the current environmental conditions of Vietnam.

**III.6.1. Introduction to the refence training program used to build the MEE**

- Name of program (name of major/ sub-major), name of degree after graduation: Urban Environmental Engineering, Master of Urban Environmental Engineering

- Name of training institution, training country: The University of Tokyo, Japan

- Ranking of the training institutions, major/ sub-major: The University of Tokyo is in the top 30 in the world and number 1 in Asia.

- Based on the expected learning outcomes of the Master of Environmental Technology (MET), the task forse has built the training program based on the curriculum of the Urban Environmental Engineering Master Program of The University of Tokyo, Japan - one of the leading prestigious training institutions in Asia. Based on the curriculum of the University of Tokyo, the task force has added a number of coures suitable to the current environmental conditions of Vietnam.

### III.6.2. Training program in comparison with other training program

**Table 12.** Comparison of the training program between MEE and Master of Urban Environmental Engineering (UoT)

| No | Master of Urban Environmental Engineering (University of Tokyo) | MEE | Similarities and differences between the two training programs |
|---|---|---|---|
| **Compulsory courses** | | | |
| | Management of global and urban environmental | Environmental management systems | Similar |
| | Advanced course of environmental water quality engineering | Environmental analysis and measurment | Similar |
| | | Environmental assessment and modeling | The course enhances the ability to assess and predict environmental pollution |
| | Water environment technology | Water and wastewater engineering | Similar |
| **Elective courses** | | | |
| | Solid waste management | Material cycles and solid waste management | Similar |
| | Management of global and urban environmental | Global environmental issues<br>Environmental management in Vietnam and Japan | The course introduces effective environmental management policies and techniques as well as scientific and technological applications in the environment management of Vietnam and Japan. |
| | Asian urban environmental health | Environmental health | Similar |

| No | Master of Urban Environmental Engineering (University of Tokyo) | MEE | Similarities and differences between the two training programs |
|---|---|---|---|
| | csiences<br>Environmental risk management<br>Urban flood disaster and risk management | | |
| | Advanced course of environmental water quality engineering | | Some of the contents are combined in *Water and wastewater engineering* course |
| | Management of hazardous pollutants | | Some of the contents are combined in *Material cycles and solid waste management* course |
| | | Air emission and quality control | The course aims to provide knowledge about air pollution and emission pollution control |
| | Advanced course on environmental microbiology | Environmental biotechnology | Similar |
| | Advanced course in environmental engineering laboratory | Environmental engineering laboratory | Similar |
| | Water treatment by membrane technology<br>Advanced course of environmental water quality engeneering<br>Water environment technology | Chemical reaction engineering | The course *Chemical reaction engineering* presents the same reaction kinetics as the course of the University of Tokyo program but apply to treatment technology |
| | Environmental system analysis | Advanced computer applications in environment | Similar |

| No | Master of Urban Environmental Engineering (University of Tokyo) | MEE | Similarities and differences between the two training programs |
|---|---|---|---|
| | Fundamentals of water pollution control | | The contents of this course are combined in *Water and wastewater engineering* |
| | Urban water systems | | This course is not choosen because it is taught in bachelor level |
| | Systems and tools toward the recycle-based society | Waste to energy | Similar<br>The course aims to provide knowledge about conversion of waste to energy toward circular economy |
| | | Data analysis in environmental engineering | These courses are designed to provide learners with the knowledge on the latest research directions in environmental engineering, methods and skills to conduct a scientific research, and to improve the quality of master thesis. |
| | | Seminar 1 | |
| | | Seminar 2 | |
| | | Seminar 3 | |

### III.7. Course brief description

**1. PHI5001, Philosophy, 03 credits**

According to the common training program of VNU.

**2. ENG5001, Basic English, 04 credits**

According to the common training program of VNU.

**3. VJU6001, Basic of sustainability science, 03 credits**

Sustainability science is an interdisciplinary/multidisciplinary science that uses a holistic approach to address complex, long-term global issues facing humanity such as climate change. climate change, loss of biodiversity and reduced function of ecosystems, etc. This course deals with factors related to sustainability science such as: economy, society, culture, education, life, environment and resources. A holistic perspective and the interrelationship between these factors will be taught, with an emphasis on correlation and significance with sustainable development. By the end of the course, students will have a fundamental understanding of sustainability science and how each factor contributes to local and global sustainable development.

**4. VJU6002, Methodology and informatics for sustainable science, 03 credits**

By understanding the process of forming data sets from specific knowledge, the course helps students to accumulate knowledge about possible error ranges, large-scale data mining, data integration, data visualization,... From there, students can understand the characteristics of each data set to process information accurately and thoroughly. Through case studies, interdisciplinary approaches and contexts of sustainability science (from local to global) will be discussed. The course also helps students understand that the nature of the process of knowledge integration is not a fixed and deterministic information processing process, but always need to ensure a balance between information processing and interpretation of the human.

**5. VJU6003, Japanese language, 02 credits**

The Japanese language course uses active teaching and learning methods to develop the 4 basic language skills (listening, speaking, reading, and writing), and comprehensively nurtures learners' Japanese ability. The purpose of this course is to practice Japanese language skills and introduce Japanese culture/language to students for communication during their internship in Japan as well as in work after graduation. After completing the course, students have basic communication ability in Japanese.

**6. MEE6010, Environmental management systems, 02 credits**

This course deals with the inter-relationships of environmental elements including both natural and built environment as well as the interactions between human and nature. The concepts, tools and techniques for environmental management, such as eco management and audit scheme, life cycle assessment, eco labeling, environmental performance evaluation, environmental impact assessment, strategic environmental assessment, clean development mechanism, environmental tax/fee/charge, etc. are introduced. The management of resources is examined. Methods to assess human impacts, environmental and human risks, and environmental sustainability (e.g. lifecycle assessment, economical assessments, ecological services, inclusive wealth index, and other environmental indices, etc.) are covered. Design exercises relevant to the water, energy recovery, greenhouse gas emission, future and solution design are studied as well.

**7. MEE6011, Environmental analysis and measurment, 03 credits**

Chapter 1 to 4 discuss about the fundamental of environmental chemistry and environmental sampling as well as the basic skills in laboratory to students. Chapter 5 introduced the chemical analysis for examination of water. Chapter 6 and 7 provided the knowledge in spectrometry and chromatography in environmental analysis. In chapter 8, local and international standard guidelines values and procedure for inorganic and organic parameters and analysis will be introduced.

In practice classes, different analytical methods will be carried out to apply for the determination of concentration of inorganic and organic substances in the environmental samples.

**8. MEE6012, Environmental assessment and modeling, 02 credits**

Environmental assessment and forecasting is very important when conducting any activities related to environment and sustainable development. After studying and understanding the basic concepts of environmental assessment and system dynamics modeling, through case studies, students can understand the meaning of many environmental assessment methods, such as life cycle analysis, material flow analysis, ecological footprint, input-output analysis, environmental audit, systems analysis, etc. The exercises at the end of the course on estimation and analysis of life cycle and utilization of dynamic models of environmental systems will help students gain practical skills in environmental modeling and assessment.

**9. MEE6013, Water and wastewater engineering, 03 credits**

This course is an overview of engineering approaches to protecting water quality with an emphasis on fundamental principals. Theory and conceptual design of systems for treating drinking water and municipal wastewater are discussed. But, reactor theory, process kinetics, and models are described in a separate subjects. Main physical, chemical, and biological processes are presented, including pretreatment, coagulation, sedimentation, filtration, biological treatment, and disinfection. Along with this course there is a separate subject of biological treatment, therefore, herein focus is made in process principles, on material balance, and designing is relied on F/M concept only. Finally, there is discussion of engineered and natural processes for wastewater treatment.

**10. MEE6014, Internship, 04 credits**

In the course of Environmental Engineering Internship, students will participate in internships, research and field trips at the laboratories of the coordinating universities, environmental treatment plants/stations in Japan for 2 months. In addition, students can visit and participate in the operation of environmental treatment stations/factories in industrial parks in Vietnam. During the internship, students have the opportunity to learn practical knowledge as well as work skills. After the course, each student will prepare report and make presentation in English on what they had learnt, and at the same time participate in a group discussion.

**11. VJU6004, Japanese language, 4 credits**

**12. MEE6015, Environmental engineering laboratory, 3 credits**

This course deals with lab rules and safety, statistical analysis methods, lab apparatus and equipment, and lab classes. It consists of 10 laboratories, which belong to 3 parts as follows:

(i) Introduction to the environmental engineering laboratory

(ii) Physico-chemical methods for water and wastewater treatment (e.g. adsorption, ion-exchange, coagulation – flocculation).

(iii) Transport and partitioning processes (e.g. hydraulic, mixing, and flow characteristics).

Each laboratory will be studied in 2 classes. Each lab class contains 4 parts, such as objectives, principles of the investigated method, experimental procedure, and report instruction.

**13. MEE6016, Material cycles and solid waste management, 3 credits**

In the first part, various kinds of engineering issues, related to material cycles, solid and hazardous wastes recycling and treatment are discussed. Chapter 1, introduce to different types of waste, legal and economical means of control for waste prevention, minimization. Chapter 2, discuss about principle, method and application Life Cycle Analysis in waste management. Chapter 3, discuss about waste collection, segregation and transportation system. Chapter 4, provides the best available technology for recycling of materials. And chapter 5, general waste treatment technologies are introduced with case studies in Vietnam and the World. The second part is practical studies in which six typical experiments will organize to ascertain the fundamental knowledge, technologies and application of the integrated solid waste management.

**14. MEE6017, Environmental management in Vietnam and Japan, 2 credits**

Cased by the industrialization and economic development, Japan had faced to serious environmental pollution called "kogai (destruction of the public domain)". The big efforts and practices for environmental management with success and failure had started at 1970s. Through learning typical examples tried in Japanese environmental management history, some obtained teachings will be explained. Next, the contemporary activities for environmental management in Vietnam will be learned. The deeper understanding of environmental management activities in Vietnam will be obtained by comparing to the Japanese experiences. Finally, new concepts and methods for environmental management such as LCA and IWRM modeling will be shown using some case studies. By learning these subjects, the attitude for aiming new approach for environmental management should be obtained.

**15. MEE6018, Environmental health, 2 credits**

Subject content includes knowledge related to toxicity and epidemiology, environmental toxicity, origin and characteristics of the main compositions and toxic factors in the environment, contents related to the exposure and absorption of toxins, mechanisms of bio-metabolism and impact on exposed organisms. At the same time, it also provides knowledge about risk assessment, risks of environmental factors / toxins to public health. Some case studies of specific subjects and effects such as carcinogenic toxins, genetic modification, and toxicity of some common pollutants. Group exercises and case studies will equip students

with reading skills and reference materials related to toxicity and environmental health and students will use this skill throughout their work.

**16. MEE6019, Air emission and quality control, 3 credits**

Chapter 1 discussed about the fundamental of air emission and air pollution. Chapter 2 involved measurement of pollutant emission. Chapter 3, 4, 5, 6 introduced the control of different pollutants including particulate matter, VOCs, SOx, NOx, respectively. Chapter 7 provided knowledge in indoor air pollution control and chapter 8 discuss about motor vehicle problem. In the last chapter – chapter 9, actual situation of air pollution and air pollution control in Vietnam will be introduced.

Air samples in different areas will be collected. After that, the samples will be treated, observed and analyzed by different methods (including SEM, XRD, FT-IR, XRF).

**17. MEE6020, Environmental biotechnology, 3 credits**

This course mainly focuses on environmental biotechnologies, which are closely relevant to biology and ecology and can be applied in environmental engineering. Basic microbiologial and ecological concepts are introduced. Fundamental principles of environmental biotechnologies and their actual applications in environmental engineering are studied. The basics and applications of molecular biological methods in environmental engineering will be overviewed. Fundamental principles of biological treatment will be learned. Different types of the biological wastewater treatment processes are summarized. Water, wastewater and soil purification using plants and microorganisms in constructed wetlands, phytoremediation and bioremediation are studied. Practical studies such as field trip, laboratory experiment, and/or solving problem will be added to the lectures to enable students to understand the course contents.

**18. MEE6021, Chemical reaction engineering, 2 credits**

In the environment, many of the contaminants in water are removed gradually by naturally occuring physical, chemical, and biological processes. In water and wastewater treatment, the same processes that occur in nature are carried out in vessels or tanks, commonly known as reactors. Through the use of engineered reactors, the processes used to treat water and wastewater can be accelerated under controlled conditions. The rate at which such processes occur

depends on the constituents involved and conditions in the reactor, including temperature and hydraulic (mixing) characteristics.

The topics presented in this chapter include (1) the types of reactors used in water treatment processes; (2) the mass balance analysis, which is the fundamental basis for the analysis of the physical, chemical, and biological processes used for water treatment; (3) ideal reactors used in modeling; (4) the modeling of reactions occurring in completely mixed batch reactors;(5) the modeling of reactions occurring in ideal continuous-flow reactors; (6) the use of tracer curves to characterize nonideal flow patterns; (7) the modeling of nonideal flow through reactors; (8) modeling the performance of nonideal reactors; (9) using tracer curves to model reactor performance; (10) mixing; and (11) biological reaction systems

**19. MEE6022, Advanced computer application in environment, 3 credits**

This course specifically examines the uses of GIS and remote sensing, and their applications to the analysis of scientific and environmental data. Through these studies and exercises, students will learn exactly what spatial information is available for environmental analysis and how it can be processed to achieve effective results. In addition, ideas of how spatial information is employed in practical environmental assessment/management will be provided in this course using some functions of GIS and reviewing actual application cases.

**20. MEE6023, Global environmental issues, 2 credits**

The course provides fundamental knowledge and latest trends on types of natural resources and associated problems, sources and effects of different kinds of pollution as well as analysis and assessment tools for environment, resource and disaster management. The course comprises of six main content areas starting with the introduction to global and environmental science, then moving on to land resource and environment, water resource and environment, atmospheric science and quality, global environmental issues, and finally concluding with the environmental management.

**21. MEE6024, Waste to energy, 2 credits**

This course is designed to provide an understanding of the various aspects of Waste to Energy. The effect of waste generation and climate change and its potential for energy production is discussed in chapter 1. The various technologies used to generate energy from waste are introduced in chapter 2, 3, 4, including thermochemical energy processes (combustion, gasification, pyrolysis, reforming,

hydrothermal conversion), biochemical processes (fermentation and anaerobic digestion, microbial fuel cell), finally mechanical and chemical processes (oil extraction and trans esterification, refuse-derived fuel, landfill gas capture), Emphasis is given to thermochemical processes and anaerobic digestion to highest amount of generated waste. Chapter 5 provided the knowledge about environmental implications of the waste to energy. Case studies will be discussed to provide a better understanding of the concepts of "Waste to Energy".

**22. MEE6025, Data analysis in environmental engineering, 3 credits**

The content of Statistics and chemometrics applied in Environmental Study Covered the probabilistic, statistical methods and multivariate analysis to analyze environmental data including:

1. Descriptive statistics: Mean, Standard Deviation, COV, Kurtosis, Skewness Bias, Accuracy, Random and systematic errors, population vs. sample

2. Distributions - Normal, Log-normal, t

3. Smoothing Techniques for visualization

4. Correlation and Regression analysis

5. Comparisons of numbers: Confidence intervals, percentiles, tolerance limits t-test: independent and paired t-tests ANOVA, F-test, Factorial design

6. Design of experiment and optimization based on factorial model and response surface methodology

7. Multivariate analysis including unsupervised and supervise leaning with principal component analysis (PCA), cluster analysis (CA), discriminant analysis (FA), multiple linear regression coupled with DA and artificial neural network.

This course emphasizes both theoretical and applied aspects of data analysis methods. Weekly lab exercises are from environmental applications. Topics include: distribution, hypothesis test, linear regression, multiple regression, uncertainty analysis, outlier detection, sample design, and spatial and temporal data analysis, classification of objects in environmental study.

**23. MEE6026, Seminar 1, 2 credits**

This course provides learners with knowledge on the latest research topics in environmental engineering covering environmental modeling, water treatment, material science, water and waste management, sustainable science, etc. Students will also learn how environmental technologies are applied in up-to-date research. Through a series of lectures, discussions, and exercises with experts, students will

be able to design their research plan with proper problem identification and critical thinking. In addition, the course will provide students with basic ideas of research rules and ethics, such as FFP (fabrication, falsification, and plagiarism), to develop the responsibility of meeting social requirements by research activities.

**24. MEE6027, Seminar 2, 2 credits**

This course equips students with knowledge and skills for writing literature review, thesis and scientific papers. Students will learn how to search for reference materials; archive references in a systematic and scientific manner using specialized software; summarize their main contents; compare, analyze and evaluate findings from previous studies; identify research gaps and formulate new research questions. Additionally, students will study how to write research questions, objectives, methods; present and discuss research results; draw conclusions. Key requirements for writing a good scientific paper will be introduced. The way to use relevant tools (e.g. for checking spelling and grammar mistakes, avoiding plagiarism, automatic citation, etc.) is covered as well. This course provides step-by-step instructions and practice exercises on students' actual thesis research.

**25. MEE6028, Seminar 3, 2 credits**

This course will be held for total 30 h in class. Each student will present about their progress achieved data and research schedule of master thesis for 4 times. The last presentation will be about the summarize all the achieved data for the thesis.

**List of abbreviations**

| | |
|---|---|
| CLOs | Course Learning Outcomes |
| FATE | Falcuty of Advanced Technologies and Engineering |
| GPA | Grade Point Average |
| HUS | University of Science |
| MEE | Master's Program in Environmental Engineering |
| MET | Master of Environmental Technology |
| MoET | Ministry of Education and Training |
| PEOs | Program Education Objectives |
| PLOs | Expected Learning Outcomes |
| RITs | Ritsumeikan University |
| UoT | The University of Tokyo |
| VJU | Vietnam Japan University |
| VNU | Vietnam National University, Hanoi |

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