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Cooperative Training Program

SEWAGE ENGINEERING TECHNICIAN

trained in Việt Nam
Việt Nam
Được Đào Tạo Tại Việt Nam

Level: COLLEGE

Pilot location:

Vietnam, 2022

Cooperative Training Program

Occupation name:	**Sewage Engineering Technician**
Level:	**College level**
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INTRODUCTION

Cooperative Training Program, designed in modular form, following international standards

1. Introduction

The Vietnamese – German Cooperation Program “Reform of TVET in Viet Nam” is supporting eleven TVET colleges to become High-Quality TVET Institutes (HQTIs) that provide demand-oriented training. The Program “Reform of TVET in Viet Nam”, is financed by the German Ministry for Economic Cooperation and Development (BMZ) and implemented by Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) together with the Vietnamese Directorate of Vocational Education and Training (DVET).

The TVET Program has supported partner TVET Colleges to develop training Programs for technical occupations that are in line with Vietnamese regulations and requirements and international/German standards. These modular training Programs are flexibly used for the implementation of cooperative training at intermediary and college level TVET institutes and short-term “on the job” training in enterprises.

The pilot training Program of the "Sewage Engineering" profession has been developed and piloted by the " Program Reform of TVET in Vietnam " in the period 2015-2020. On the basis of a first pilot between 2016 and 2020, this training Program has been further revised to integrate a modularization, as well as new content (Greening, Industry 4.0, training for people with disabilities…).

2. Characteristics of the training Program

The training Program is demand oriented and highly permeable between different training levels. It also meets the requirements formulated in Circular No.03/2017/TT-BLDTBXH of the Ministry of Labor, Invalids and Social Affairs (MOLISA) laying out the procedures for the development, appraisal, and issuance of training curricula. The modules are practice-oriented from basic to advanced level with integrated elements of:

- Digitalization and I4.0
- Greening TVET, environmental protection
- Occupational safety and health

- Gender and Inclusion

3. Structure

Training Program is designed in a modular way at different levels as follows:

- Training Program for intermediate level (approx. 1.5 years)

Besides the general compulsory subjects specified by MOLISA, learners need to complete 6 technical modules to obtain competencies, knowledge and skills of the occupation at intermediate level.

- Training Program for college level (approx. 2.5 years)

Besides the general compulsory subjects specified by MOLISA, learners need to complete 10 technical modules to obtain competencies, knowledge and skills of the occupation at intermediate and college levels.

- Training Program for advanced college level (approx. 3 years)

Besides the general compulsory subjects specified by MOLISA, learners need to complete 12 technical modules to obtain competencies, knowledge, and skills of the occupation at intermediate, college and advanced college levels that is equivalent to international/German standards.

To enable pathways and lifelong learning, also separate training Programs for students that graduated from a lower level have been developed:

- ✓ Training Programs for intermediate level transfer to college level. After graduation from intermediate level, learners may transfer to college level and need to complete 4 additional modules (from module 7 to module 10)

- ✓ Training Programs for college level transfer to advanced college level. After graduation from college level, learners may transfer to advanced college level and need to complete 2 additional modules (module 11 and module 12).

With this training Program structure, TVET institutes can flexibly implement cooperative training at different levels at their own institutes and at partner companies according to needs and capabilities. In addition to long-term training at intermediate and college levels, TVET institutes can also apply/ modify training modules to implement short-term or advanced training for workers and job seekers according to specific requirements.

The Minutes of Results for the revised training curriculum were signed in September 2022 by:

- Directorate of Vocational Education and Training
- Vietnam Water Industry Training Center / Water Supply and Drainage Association
- Hue Industrial College
- Ho Chi Minh Vocational College of Technology
- Construction Technical College No. 1
- GOPA Worldwide Consultants (Germany)
- Gesellschaft für Internationale Zusammenarbeit (GIZ)

APPENDIX 01

TRAINING PROGRAM

Occupation name	**:** Sewage Engineering Technician
Occupation code	**:** 6520311
Level	**:** College
Training form	**:** Formal
Eligible enrollment applicants	**:** High school graduates or equivalent
Training duration	**: 2.5 years (**05 semesters)

1. Training objectives

1.1. General objectives

- The training Program for sewage engineering technician at college level shall ensure the minimum amount of knowledge and competency requirements that learners achieve after graduation for the college level. The list, duration, and sequence of courses, modules, theoretical studying time, practical studying time, and internship time shall be clearly determined. The evaluation method for studying results shall be particularly regulated to evaluate if the learners fulfill the competency requirements after finishing the courses and modules.
- In addition, college-level sewage engineering technicians can also work with English documents and communicate in English; have a professional working style; develop a habit of regular learning to improve professional capacities, expand social knowledge to meet the requirements of the Fourth Industrial Revolution and skills in the efficient and sustainable use of resources, fuel and energy, and materials in an environmentally friendly manner; can work individually or in groups to solve complicated tasks and challenges under changing working circumstances and settings; can monitor and assess the quality of finished work; instruct others to execute specified tasks; and share accountability for individual and team members' job outcomes.
- The training Program for sewage engineering technician at college level is established in accordance with the development needs of the industry, the locality and the country. It must also ensure modernity and be in line with advanced vocational training levels in the region and the world, as well as the transition procedure among training levels in the national education system.

1.2. Specific objectives

1.2.1. Knowledge

- Be able to describe the ecological cycle, the causes and consequences of environmental contamination, and pollution-reduction measures.
- Be able to explain the many types of microorganisms, their structure and living circumstances, as well as their role in wastewater treatment.
- Be able to demonstrate the fundamentals of chemistry and substance composition.
- Be able to demonstrate the chemical analysis methodologies and laboratory safety precautions.
- Be able to demonstrate the preparations for safety measures during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to demonstrate safety measures during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to demonstrate as-built drawings of drainage system, circuit diagrams and other technical documents.
- Be able to demonstrate energy and material conservation measures during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to examine the composition, physical, chemical, and biological aspects of wastewater.
- Be able to demonstrate the structure, characteristics, advantages and disadvantages of different types of drainage systems.
- Be able to describe the properties and applications of pipe and drain materials.
- Be able to demonstrate the functions, tasks and usual malfunctions of the works in the drainage system and in the wastewater treatment plant.
- Be able to present the causes, consequences and remedial measures of frequent damage to the drainage system and the wastewater treatment plant.
- Be able to describe the disease risks and potential hazards during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to describe the measurement, control, and adjustment procedures, as well as the structure and operation of the respective equipment.
- Be able to demonstrate the method for calculating sewer gradient, and the distance and depth of manholes.
- Be able to present the cleaning, repair and maintenance measures of sewers, manholes, connection points, and pumping stations.

- Be able to present the overview diagram of a wastewater treatment plant, treatment stages in a domestic wastewater treatment plant and a specific industrial wastewater treatment plant.
- Be able to present the decomposition processes of pollutants in each construction work and the methods to remove them.
- Be able to present the structure, function and operating principle of wastewater treatment facilities and equipment using mechanical, chemical, physical and biological methods, sterilization and deodorization structures.
- Be able to present the operation, repair and maintenance procedures for wastewater, sludge, waste and exhaust gas treatment works in a plant.
- Be able to list the sources, properties and impacts of sludge, emissions and waste in the wastewater treatment system.
- Be able to present the fundamental rights and obligations of employees and employers, national technical standards and regulations applicable to wastewater drainage and treatment, environmental protection, safety standards and regulations.
- Be able to present the names, characteristics, operating procedures, conditions of use and storage of laboratory equipment, tools, and chemicals.
- Be able to describe the techniques used to collect, transport, store, and preserve wastewater and sludge samples.
- Be able to present the criteria analysis methods in the field, factory, and laboratory for each parameter to be determined.
- Be able to present the general structure, functions, and duties of environmental protection of enterprises operating in the field of wastewater drainage and treatment.
- Be able to present the fundamental knowledge about politics, culture, society, law, national defense and security, and physical education as prescribed.

1.2.2. Skills

- Be able to use safety measures when working with microorganisms, chemicals, as well as analytical techniques in the laboratory.
- Be able to use safety measures during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to read as-built drawings of drainage system, technical diagrams and documents.

- Be able to cut, join and deform metal and plastic materials used in wastewater drainage and treatment systems.
- Be able to implement the techniques for measuring sludge, as well as the techniques for cleaning and dredging sludge in sewers, manholes, and troughs.
- Be able to perform the processes to inspect and evaluate joint tightness, condition of sewers, manholes, pressure capacity of manhole covers and discharge connection points.
- Be able to use energy and material conservation measures during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to identify and handle potential hazards during operation, repair and maintenance of drainage system and wastewater treatment plant.
- Be able to operate, control and adjust equipment and works on drainage system, at pumping stations and at wastewater treatment plants.
- Be able to evaluate the level of frequent damage, causes and consequences, and propose remedial measures for damage to sewers and works in the drainage system.
- Be able to undertake maintenance procedures for drainage system, pumping stations, and wastewater treatment plants.
- Be able to detect problems at works, equipment in factories and pumping stations, handling problems within the designated scope of duties.
- Be able to operate electrical equipment, automatic electrical systems, and backup generators in wastewater treatment plants.
- Be able to maintain operation log, record work procedures and outcomes, prepare corresponding reports, as well as implement data protection.
- Be able to collect, manage and treat all types of solid waste in accordance with regulations.
- Be able to apply national technical standards and regulations applicable to wastewater drainage and treatment, environmental protection, and safety standards and regulations.
- Be able to evaluate the quality of wastewater and sludge, identify the physical, chemical and microbiological parameters of wastewater and sludge according to technical regulations.
- Be able to select and appropriately use equipment, tools, supplies and chemicals in the field, factory and laboratory.

- Be able to collect, transport, store and preserve wastewater and sludge samples with suitable technique.
- Be able to monitor plant operations and indirect discharge points to ensure compliance with discharge regulations.
- Be able to use basic information technology as prescribed; exploit, process and apply information technology in professional roles within the industry and profession.
- Be able to use basic foreign languages, reaching level 2/6 in Foreign Language Proficiency Framework for Vietnam; use foreign languages in professional roles within the industry and profession.

1.2.3. Self-control ability and responsibility

- Maintain autonomy in environmental protection; respect the regulations on environmental protection and building a green and clean working environment; actively seek out relevant information.
- Actively save energy and resources.
- Actively improve and use environmentally friendly methods, tools and techniques.
- Actively comply with occupational safety principles and take appropriate response in case of incident.
- Comply with rules and regulations on occupational safety and health, as well as safety guidelines when working in electrically charged areas.
- Comply with regulations under the guidance of workshop assistants and instructors at the training institution.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.
- Comply with the privacy policies and occupational safety standards at the enterprise.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

1.3. Job positions after graduation

Graduating from the training Program of Sewage Engineering Technician, College level, the learners may work at the following positions:

- Operation of drainage system.
- Repair and maintenance of drainage system.
- Operation, repair and maintenance of drainage pumping station.
- Operation of wastewater treatment plant.
- Repair and maintenance of wastewater treatment plants.
- Supervise the quality of the wastewater treatment procedure.

2. Knowledge volume and course duration

- Number of subjects, modules: 10 modules (excluding compulsory general subjects).
- Total number of course credits: 152 (credits).
- Total course duration: 3795 hours.
- Duration of Compulsory general subjects: 435 hours.
- Duration of Specialized subjects and modules: 3360 hours. In which:

+ Theory: 901 hours.
+ Practice, intern, laboratory, home assignment, discussion: 2310 hours.
+ Examination: 149 hours.

3. Program's content:

Subject/ module code	Subject/ module name	Number of course credit	Total	*Total training time (hours)*		
				Theory	Intern/Laboratory/ Home Assignment/ Discussion	Examination
I	**General subject**	**20**	**435**	**136**	**278**	**21**
MH1	Political Education	4	75	41	29	5
MH2	Law	2	30	18	10	2
MH3	Physical Education	2	60	5	51	4
MH4	National	3	75	15	58	2

Subject/ module code	Subject/ module name	Number of course credit	Total	*Total training time (hours)*		
				Theory	Intern/Laboratory/ Home Assignment/ Discussion	Examination
	Defense and Security Education					
MH5	Informatics	3	75	15	58	2
MH6	English Language	6	120	42	72	6
II	**Specialized modules**	**132**	**3360**	**901**	**2310**	**149**
II.1	**Fundamental modules**	**31**	**720**	**223**	**463**	**34**
MD 01	Introduction to Biochemistry and Environment	16	375	103	251	21
MD 02	Machine, Equipment Operation and Technical Processes	15	345	120	212	13
II.2	**Specialized modules**	**101**	**2640**	**678**	**1847**	**115**
MD 03	Operation of Wastewater Collection and Drainage System	15	345	129	198	18
MD 04	Repair and Maintenance of Drainage	10	330	45	270	15

Subject/ module code	Subject/ module name	Number of course credit	Total	*Total training time (hours)*		
				Theory	Intern/Laboratory/ Home Assignment/ Discussion	Examination
	System					
MD 05	Operation and Maintenance of Pumping Station	13	315	103	195	17
MD 06	Operation of Wastewater Treatment Plant	14	345	96	236	13
MD 07	Electrical Installation in Wastewater Treatment	14	330	86	223	21
MD 08	Repair and Maintenance of Wastewater Treatment Plants	10	300	56	238	6
MD 09	Quality Supervision of Wastewater Treatment Procedure	13	345	90	245	10
MD 10	Error Analysis and Troubleshooting	12	330	73	242	15
German standards						
II.3	**Specialized modules (optional)**	**22**	**600**	**118**	**457**	**25**

Subject/ module code	Subject/ module name	Number of course credit	Total	*Total training time (hours)*		
				Theory	Intern/Laboratory/ Home Assignment/ Discussion	Examination
MD 11	Automation and Digitization in Wastewater Drainage and Treatment	13	300	90	197	13
MD 12	Quality Supervision in Wastewater Drainage and Treatment	9	300	28	260	12

4. Manual instruction

According to the provisions of Circular No. 04/2022/TT-BLDTBXH dated March 30, 2022 of the Ministry of Labor, War Invalids and Social Affairs on organization of intermediate-level and college-level training by academic year or according to the method of accumulating modules or credits.

5. References

APPENDIX 03

MODULE PROGRAM

Module name: INTRODUCTION TO BIOCHEMISTRY AND ENVIRONMENT

Module code: MD 01

Training duration: 375 hours; (Theory: 103 hours; Practice, laboratory, discussion, assignment: 251 hours; Examination: 21 hours).

I. Position and features:

- Position: “Introduction to Biochemistry and Environment” module is taught along with other Fundamental modules, and before the Specialized modules.
- Features: This is a Fundamental module providing learners with basic knowledge about physics, chemistry, biology, and legal aspects related to environment. This module is also considered as one of the most fundamental modules in the training Programs for environment-related sectors.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to describe and explain ecological cycles in nature.
- Be able to present the origins, arising mechanisms and impacts of environmental pollution.
- Be able to present the roles, responsibilities, goals, and objectives of individuals and businesses in terms of environmental protection.
- Be able to present legal document system on the environment.
- Be able to present relevant regulations on prevention of environmental pollution.
- Be able to present all the required steps to formulate plans and activities for occupational safety and health administration.
- Be able to describe and explain the roles and impacts of energy and resources on sustainable development.
- Be able to describe how to carry out tasks efficiently to avoid wasting supplies or causing negative impacts on the environment.

- Be able to present the required steps to create profiles, and report on activities related to energy and supply conservation and environmental protection.
- Be able to present the chemical safety contents.
- Be able to present the safety principles when working within confined spaces.
- Be able to present and explain safety principles when working in laboratories.
- Be able to describe and explain information on equipment, machines and chemicals in the laboratory.
- Be able to present the troubleshooting principles when working in laboratories
- Be able to describe the composition, structure, development and metabolism processes in the cells of microbial species, particularly those used in wastewater treatment.
- Be able to explain the importance of microorganisms in wastewater treatment and Earth's ecosystems.
- Be able to describe the procedures of nutrient media preparation and microorganism inoculation.
- Be able to present the risks and safety principles when working with microorganisms.
- Be able to present hazards created by pathogenic bacteria during wastewater, sludge, and solid waste treatment operations.
- Be able to explain the purpose of personal protective equipment when working with microorganisms.
- Be able to present the applicable principles, procedures and sanitary foundations when working with microorganisms in wastewater treatment.
- Be able to present methods for preventing infection from pathogenic microorganisms.
- Be able to explain the basic composition and structure of substances, parameters, and compounds.
- Be able to understand and describe chemical processes using chemical equations.
- Be able to explain the structure and properties of water, as well as the solubility and insolubility of compounds in water and the changes in properties of water solution.
- Be able to predict the solubility and insolubility of substances in basic solvents.

- Be able to present the hazards and impacts of solvents on the environment and human health.
- Be able to explain osmosis, dialysis, and hydration.
- Be able to differentiate among true solutions, colloidal solutions, emulsions, suspensions and common dispersion systems in nature and in life.
- Be able to explain the metabolism, absorption and release of energy from chemical reactions, as well as the role of catalysts in chemical reactions.
- Be able to differentiate the actual reactions based on the amount of energy that they can absorb or release.
- Be able to explain the dependence of reaction speed on temperature conditions and chemical balance.
- Be able to explain and differentiate corrosion phenomena in nature and real-life production processes.
- Be able to present multiple types of solutions.
- Be able to present basic titration methods.
- Be able to present spectrometer-based methods for measuring concentration.

II.2. Skills

- Be able to apply ecological cycles to explain phenomena in relevant fields.
- Be able to search and update documents in the national environmental legal systems.
- Be able to develop a strategy for implementing actions to safeguard the environment, minimize pollution, and promote green workplaces.
- Be able to apply 3R principles within the scope of work.
- Be able to collect, classify and control waste hazards within the scope of work.
- Be able to implement measures for reducing/avoiding environmental contamination.
- Be able to implement measures to use environmentally friendly materials and energy.
- Be able to apply relevant regulations on prevention of environmental pollution.
- Be able to identify environmental risks and the efficiency of resources consumption.
- Be able to implement policies on occupational safety, hygiene and health.
- Be able to apply safety principles when working in laboratories.
- Be able to implement first aid measures when working on site.

- Be able to develop plans to use and maintain equipment, machines and chemicals in the laboratory.
- Be able to troubleshoot when working in laboratories.
- Be able to use microscopes and determine the morphology of the microorganisms.
- Be able to implement nutrient media preparation and microorganism inoculation.
- Be able to identify risks, apply appropriate procedures, and use occupational protective equipment.
- Be able to evaluate hazards created by pathogenic bacteria during wastewater, sludge, and solid waste treatment operations.
- Be able to evaluate infectious microorganism in wastewater, sludge and solid waste.
- Be able to use personal protective equipment when working with microorganisms.
- Be able to apply principles, procedures and sanitary foundations when working with microorganisms in wastewater treatment.
- Be able to implement methods for preventing infection from pathogenic microorganisms.
- Be able to analyze the composition of a material using information from the periodic table of elements.
- Be able to use chemical reaction equations in calculating the quantity of substances.
- Be able to use solubility charts and calculate the concentration of solutions, density, and solubility.
- Be able to identify and use dielectric constants in predicting the solubility and insolubility of substances.
- Be able to use H and P phrases in the safety data sheet when working with solvents.
- Be able to calculate pH, pOH, and identify acidic and base solutions based on calculations. Be able to predict the pH level of some basic chemicals solutions.
- Be able to propose anti-corrosion solutions in real cases.
- Be able to prepare chemical solutions in accordance with the required concentration and volume.
- Be able to determine the concentration of substances by basic titration methods, including acid-base, reduction-oxidation, precipitation and complexity creation.

- Be able to determine the concentration of substances by a spectrometer.

II.3. Self-control ability and responsibility

- Maintain autonomy in environmental protection; respect the regulations on environmental protection and building a green and clean working environment; actively seek out relevant information.
- Actively save energy and resources.
- Actively improve and use environmentally friendly methods, tools and techniques.
- Actively comply with occupational safety principles when working in laboratories, and take appropriate response in case of incident.
- Be honest, careful, meticulous, and responsible for the working results.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Module contents

1. General contents and time allocation

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Environmental education***	***60***	***30***	***27***	***3***
	Intro lesson: Content introduction	**1**	**1**		
	Lesson 1: Environmental protection and environmental regulation 1. Objectives and goals of environmental protection 2. Introduction to the environmental legal system	**3**	**3**		

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	3. Introduction to publications, professional organizations, and informal assessment methods				
	Lesson 2: Environmental pollution 1. Soil pollution 2. Water pollution 3. Air pollution 4. Radiation pollution 5. Environmental pollution due to human activities	**10**	**10**		
	Lesson 3: Impacts of environmental pollution 1. Impacts of environmental pollution on human and environment 2. Climate change	**4**	**4**		
	Lesson 4: Efficient use of energy and resources 1. Resources 2. Energy 3. Efficient use of energy 4. Project assignment	**13**	**4**	**9**	
	Lesson 5: Waste management 1. Classification of waste and their impacts on the environment 2. Project assignment	**13**	**4**	**9**	
	Lesson 6: Proper handling of hazardous substances in an environmental friendly manner 1. Concepts and classification of	**13**	**4**	**9**	

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	hazardous substances 2. Effects of hazardous substances on the environment 3. Safe storage and use of hazardous substances 4. Project assignment				
	Examination	**3**			**3**
2	***Part 2: Laboratory techniques***	***45***	***15***	***27***	***3***
	Lesson 1: Common laboratory instruments and equipment 1. Laboratory instruments 2. Common laboratory equipment	**6**	**6**		
	Lesson 2: Basic laboratory techniques 1. Instrument cleaning technique 2. Instrument sterilizing technique 3. Instrument drying technique	**9**	**9**		
	Lesson 3: Practice 1. Working with laboratory instruments and equipment 2. Washing and drying instruments	**27**		**27**	
	Examination	**3**			**3**
3	***Part 3: Microorganisms and biological safety***	***45***	***15***	***27***	***3***
	Intro lesson: Content introduction	**1**	**1**		
	Lesson 1: Introduction to life 1. Characteristics and conditions of life 2. Structures and functions of cells	**2**	**2**		

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	3. Metabolism processes in cells				
	Lesson 2: Microorganisms 1. Overview and structure of the microbial system 2. Bacteria 3. Unicellular animal (Protozoen) 4. Multicellular animal (Metazoen)	**6**	**6**		
	Lesson 3: Ecology and meaning of microorganisms 1. Definitions and concepts of ecology 2. Factors influencing the ecosystem 3. Role of microorganisms for life on Earth	**6**	**6**		
	Lesson 4: Practical working with microorganisms in laboratories 1. Safety and hygiene principles when working with microorganisms 2. Introduction to microscope 3. Cell solution preparation technique 4. Nutrient medium preparation 5. Inoculation techniques for aerobic bacteria, yeasts, molds	**27**		**27**	
	Examination	**3**			**3**
4	***Part 4: General Chemistry***	***90***	***28***	***60***	***2***

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 1. Basic concepts of Chemistry 1. Atomic structure 2. Chemical bonds 3. Reactions of inorganic substances	**14**	**4**	**10**	
	Lesson 2. Water solution 1. Water properties 2. Water solvent 3. Concentration of solutions	**14**	**4**	**10**	
	Lesson 3. Organic solvent 1. Solubility 2. Classification of organic solvent 3. Important organic solvents	**15**	**5**	**10**	
	Lesson 4. Disperse system 1. Basic concepts of disperse system 2. Colloidal solution 3. Specific features of colloidal solution	**15**	**5**	**10**	
	Lesson 5. Chemical reactions 1. Heat and energy of reaction 2. Reaction speed 3. Chemical balance 4. Calculation of ion volume in water, pH	**16**	**6**	**10**	
	Lesson 6. Corrosion 1. Chemical corrosion 2. Electrochemical corrosion 3. Microbiological corrosion	**14**	**4**	**10**	

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	4. Protection from corrosion				
	Examination	**2**			**2**
5	***Part 5: Chemical analysis techniques***	***135***	***15***	***110***	***10***
	Lesson 1: Introduction to chemical laboratory and working procedure for hazardous chemical substances 1. Task organization in laboratories 2. First aids in case of laboratory accident 3. Characteristic of toxic substances GHS Manuals for using small laboratory equipment	**30**	**4**	**26**	
	Lesson 2: Determination of substance properties and solution preparation 1. Determination of physical parameters and properties of substance 2. Solution preparation	**20**	**3**	**17**	
	Lesson 3: Determination of quality and quantity 1. Identification of anions and cations 2. Identification by volume 3. Identification by weight	**75**	**8**	**67**	
	Practical examination	**10**			**10**

2. Detailed contents

PART I: ENVIRONMENTAL EDUCATION

Intro lesson: Content introduction

Time: 1 hour

Lesson 1: Environmental protection and environmental regulation

Time: 3 hours

1. Lesson objectives:

- Be able to present the objectives and goals of environmental protection.
- Be able to present the environmental legal system.
- Be able to search and update documents in the national environmental legal systems.
- Uphold autonomous compliance with the principles and regulations on environmental protection.
- Be able to present the roles, responsibilities, goals, and objectives of individuals and businesses in terms of environmental protection.
- Be able to develop a strategy for implementing actions to safeguard the environment, minimize pollution, and promote green environment.
- Maintain autonomy in environmental protection; respect the regulations on environmental protection and building a green and clean working environment; actively seek out relevant information.

2. Lesson contents

2.1. Objectives and goals of environmental protection

2.2. Introduction to environmental legal system

2.2.1. General regulations

2.2.2. Regulations and responsibilities in penalties for environmental violation

2.2.3. Factory divisions/departments in charge of environment

2.2.4. State agencies involved in environmental protection

2.3. Introduction to publications, professional organizations, and informal assessment methods

Lesson 2: Environmental pollution

Time: 10 hours

1. Lesson objectives:

- Be able to describe and explain ecological cycles in nature.

- Be able to apply ecological cycles to explain phenomena in relevant fields.
- Be able to present air, water, and soil pollution: causes and consequences
- Uphold autonomy, diligence, and passion.

2. Lesson contents

2.1. Soil pollution

2.1.1. Soil environmental quality degradation

2.1.2. Urbanization

2.2. Water pollution

2.2.1. Water pollution causes

2.2.2. Self-cleaning capacity of surface water and groundwater

2.2.3. Eutrophication

2.3. Air pollution

2.3.1. Processes of discharging pollutants into the air

2.3.2. Consequences of emissions

2.3.3. Agglomeration

2.4. Radiation pollution

2.4.1. Radioactive radiation

2.4.2. UV radiation

2.5. Environmental pollution due to human activities

2.5.1. Domestic wastes

2.5.2. Environmental pollution due to industry and handicrafts

2.5.2.1. Wastewater, solid and hazardous waste

2.5.2.2. Emission of gas pollutants

2.5.2.3. Noise pollution

2.5.3. Pollution due to agriculture activities

2.5.3.1. Use of plant protection products

2.5.3.2. Monoculture

2.5.3.3. Agricultural land improvement

2.5.3.4. Use of fertilizers

Lesson 3: Impacts of environmental pollution

Time: 4 hours

1. Lesson objectives

- Be able to present the impacts of environmental pollution on human and surrounding environment.

- Be able to recognize impacts of climate change and present responding methods.

2. Lesson contents:

2.1. Impacts of environmental pollution on human and environment

2.1.1. Health risk

2.1.2. Ozone hole

2.1.3. Greenhouse effect

2.1.4. Climate change

2.1.5. Soil erosion and toxicity

2.2. Climate change

2.2.1. General mechanism and impacts of climate change

2.2.2. Impacts of climate change on wastewater drainage and treatment

2.2.3. Responses to climate change in the wastewater drainage and treatment industry.

Lesson 4: Efficient use of energy and resources

Time: 13 hours

1. Lesson objectives

- Be able to present the concepts and differentiate multiple forms of energy and resources.
- Be able to describe and explain the roles and impacts of energy and resources on sustainable development.
- Be able to use energy and resources efficiently within the individual scope and professional tasks.
- Actively save energy and resources.

2. Lesson contents

2.1. Resources

2.1.1. Overview of resources

2.1.1.1. Definition of resources

2.1.1.2. Categorization of resources

2.1.2. Impacts of exploiting and using natural resources on the environment

2.1.3. Efficient use of resources

2.2. Energy

2.2.1. Overview of energy

2.2.1.1. Definition

2.2.1.2. Categorization of energy

2.2.1.3. Overview of energy in Vietnam

2.2.2. Impacts of producing and consuming energy on the environment

2.3. Efficient use of energy

2.3.1. Definition

2.3.2. Solutions for efficient use of energy

2.4. Project assignment

Lesson 5: Waste management

Time: 13 hours

1. Lesson objectives

- Be able to identify, classify waste and explaining its impacts on the environment.
- Be able to present the origin and classification of hazardous factors to the environment.
- Be able to collect, classify and control waste hazards within the scope of work.
- Be able to collect, store and dispose of waste in the workplace in an environmentally friendly and proper manner.
- Be able to apply 3R principles (reduce, reuse, recycle) at workplace.
- Actively improve and use environmentally friendly methods, tools and techniques.

2. Lesson contents

2.1. Classification of waste and their impacts on the environment

2.1.1. Type of waste

2.1.1.1. Definition of waste

2.1.1.2. Impacts of waste on the environment

2.1.2. Classification of waste

2.2. Project assignment

2.2.1. Survey objective and plan

2.2.2. On-site survey

2.2.3. Waste collection and classification

2.2.4. Report results

Lesson 6: Proper handling of hazardous substances in an environmental friendly manner

Time: 13 hours

1. Lesson objectives

- Be able to explain the concepts of hazardous chemicals and meanings of labels.
- Be able to explain the effects of hazardous substances on human and the environment.
- Be able to use and store hazardous substances safely.

2. Lesson contents

2.1. Concepts and classification of hazardous substances

2.1.1. Concepts

2.1.2. Type

2.1.3. Chemical labeling regulations

2.2. Effects of hazardous substances on the environment

2.2.1. Effects of hazardous substances on soil environment

2.2.2. Effects of hazardous substances on water environment

2.2.3. Effects of hazardous substances on air environment

2.2.4. Effects of hazardous substances on human health

2.3. Safe storage and use of hazardous substances

2.3.1. Storage

2.3.2. Safely use hazardous substances

2.4. Project assignment

Examination: 3 hours

PART II: LABORATORIES TECHNIQUES

Lesson 1: Common laboratory instruments and equipment

Time: 6 hours

1. Lesson objectives:

- Be able to describe and explain information on equipment, machines and chemicals in the laboratory.
- Be able to develop plans to use and maintain equipment, machines and chemicals in the laboratory.
- Be honest, careful, meticulous, and responsible for the working results.

2. Lesson contents

2.1. Laboratory instruments

2.1.1. Glass instruments

2.1.2. Glass instruments

2.1.3. Plastic instruments

2.1.4. Stainless-steel instruments

2.2. Common laboratory equipment

2.2.1. pH, DO meters

2.2.2. Lab oven

2.2.3. Dehumidifier cabinet

2.2.4. Autoclave cabinet

2.2.5. Electrical scale

Lesson 2: Basic laboratory techniques

Time: 9 hours

1. Lesson objectives:

- Be able to present and explain safety principles when working in laboratories.
- Be able to apply safety principles when working in laboratories.
- Actively comply with occupational safety principles when working in laboratories, work carefully and meticulously.
- Be able to present the troubleshooting principles when working in laboratories
- Be able to troubleshoot when working in laboratories.
- Be honest, forthright, and able to take appropriate response in case of incidents.
- Be able to present glass instrument cleaning techniques.
- Be able to present glass instrument sterilizing techniques.

- Be able to present glass instrument drying techniques.

2. Lesson contents

2.1. Instrument cleaning technique

2.2. Instrument sterilizing technique

2.3. Instrument drying technique

Lesson 3: Practice

Time: 27 hours

1. Lesson objectives:

- Be able to use laboratory instruments and equipment.
- Be able to perform laboratory instrument cleaning and drying techniques.
- Actively comply with occupational safety principles when working in laboratories, work carefully and meticulously.

2. Lesson contents

2.1. Working with laboratory instruments and equipment

2.2. Washing and drying instruments

Examination: 3 hours

PART III: MICROORGANISMS AND BIOLOGICAL SAFETY

Intro lesson: Content introduction

Time: 1 hours

Lesson 1: Introduction to life

Time: 2 hours

1. Lesson objectives:

- Be able to describe the composition, structure, development and metabolism processes in the cells of microbial species, particularly those used in wastewater treatment.

2. Lesson contents

2.1. Characteristics and conditions of life

2.1.1. Signs of life

2.1.2. Components of life

2.2. Structures and functions of cells

2.3. Metabolism processes in cells

Lesson 2: Microorganisms

Time: 6 hours

1. Lesson objectives:

- Be able to describe the structure of the microbial system in nature.
- Be able to present the characteristics, structure and morphology of bacterial unicellular and multicellular animals in nature.
- Be able to present the growth and influence of microorganisms on life.
- Be able to evaluate the important roles of microorganisms in wastewater treatment.
- Be able to present the sterilization and disinfection methods for bacteria.

2. Lesson contents

2.1. Overview and structure of the system

2.2. Bacteria

2.2.1. Bacterial formation

2.2.2. Metabolism processes of aerobic bacteria

2.2.3. Metabolism processes of anaerobic bacteria

2.2.4. Bacterial living conditions

2.2.4.1. Bacterial multiplication

2.2.4.2. Bacterial reduction

2.2.4.3. Bacterial growth diagram in continuous and intermittent culture conditions

2.2.5. Bacteria sterilization and disinfection methods

2.3. Unicellular animal (Protozoen)

2.3.1. Amoeba

2.3.2. Rotatoria

2.4. Multicellular animal (Metazoen)

2.4.1. Flatworms

2.4.2. Tapeworms

2.4.3. Roundworms

Lesson 3: Ecology and meaning of microorganisms

Time: 6 hours

1. Lesson objectives

- Be able to present definitions and concepts of ecology and life forms in nature.
- Be able to present the factors impacting the natural ecosystem.
- Be able to explain the significant roles of micro organizations for life on Earth.
- Be able to evaluate the important roles of microorganisms in human life and in water purification.
- Be able to explain the importance of microorganisms in wastewater treatment and Earth's ecosystems.
- Be careful, honest, responsible for the results of assigned tasks.

2. Lesson contents:

2.1. Definitions and concepts of ecology

2.1.1. Ecology

2.1.2. Ecosystem

2.1.3. Living environment

2.1.4. Populations of organisms

2.2. Factors influencing the ecosystem

2.2.1. Abiotic factors

2.2.2. Biotic factors

2.3. Role of microorganisms for life on Earth

2.3.1. For human being

2.3.2. Pathogen

2.3.3. Food spoilage

2.3.4. Biological corrosion

Lesson 4: Practical working with microorganisms in laboratories

Time: 27 hours

1. Lesson objectives

- Be able to present the risks and safety principles when working with microorganisms.
- Be able to identify risks, apply appropriate procedures, and use occupational protective equipment
- Be able to present the sterilization methods for individuals and equipment, and sterilization methods for equipment in microbiological laboratories.
- Be able to present the structure and proficient use of microscopes.
- Be able to use microscopes and determine the morphology of the microorganisms.
- Be able to perform the preparation of nutrient medium.
- Be able to implement nutrient media preparation and microorganism inoculation.
- Be able to implement proficiently microbial inoculating techniques in laboratories.
- Be careful, honest, responsible for the results of assigned tasks, strictly follow laboratory rules and regulations.

2. Lesson contents:

2.1. Safety and hygiene principles when working with microorganisms

2.1.1. Regulations on working with microorganisms

2.1.2. Personal hygiene principles

2.1.3. Equipment disinfection and sterilization

2.2. Introduction to microscope

2.2.1. Structures and using instructions of microscope

2.2.2. Microscopic monitoring

2.2.2.1. Bioproducts

2.2.2.2. Marine creatures

2.2.2.3. Sludge sample observation

2.3. Cell solution preparation technique

2.3.1. Preparation of cell inoculation solutions

2.3.2. Preparation of diluted solutions

2.4. Nutrient medium preparation

2.4.1. Equipment sterilization

2.4.2. Nutrient medium preparation

2.4.3. Pouring nutrient medium into Petri dishes

2.5. Inoculation techniques for aerobic bacteria, yeasts, molds

2.5.1. Transplant

2.5.2. Determining shape, color and number of cell clusters

Examination: 3 hours

PART IV: GENERAL CHEMISTRY

Lesson 1: Basic concepts of Chemistry

Time: 14 hours

1. Lesson objectives

- Be able to explain the basic composition and structure of substances, parameters, and compounds.
- Be able to analyze the composition of a material using information from the periodic table of elements.
- Be able to understand and describe chemical processes using chemical equations.
- Be able to use chemical reaction equations in calculating the quantity of substances.
- Autonomously abide by the rules of the classroom, actively participate in lessons and work in groups.
- Be careful, honest, responsible for the results of assigned tasks.

2. Lesson contents:

2.1. Atomic structure

2.1.1. Atomic structure

2.1.2. Periodic table of chemical elements

2.2. Chemical bonds

2.3.1. Ionic bond

2.3.2. Covalent bond

2.3.3. Polar covalent bond

2.3.4. Hydrogen bond

2.3.5. Metallic bond

2.3. Reactions in solutions of organic substances

2.3.1. Ion-exchange reactions

2.3.2. Proton-exchange reaction (acid-base)

Lesson 2: Water solution

Time: 14 hours

1. Lesson objectives

- Be able to explain the relation between the structure and properties of water, as well as the solubility and insolubility of compounds in water and the changes in properties of water solution.
- Be able to use solubility charts and calculate the concentration of solutions, density, and solubility.
- Be careful, honest, responsible for the results of assigned tasks, strictly follow laboratory rules and regulations.

2. Lesson contents:

2.1. Water properties

2.1.1. Water physical properties

2.1.2. Structure and bipolar

2.1.3. Temperature-related changes in properties

2.2. Water solvent

2.2.1. Solubility of soluble substances in water

2.2.2. Constitution diagram

2.3. Concentration of solutions

2.3.1. Concentration concept

2.3.2. Mole, molar mass

2.3.3. Quantities of solution composition

2.3.4. Concentration and density

2.3.5. Solubility

Lesson 3: Organic solvent

Time: 15 hours

1. Lesson objectives

- Be able to present the solubility and insolubility of substances in basic solvents.
- Be able to identify and use dielectric constants in predicting the solubility and insolubility of substances.
- Be able to present the hazards and impacts of solvents on the environment and human health.
- Be able to use H and P phrases in the safety data sheet when working with solvents.
- Be able to present safety principles when exposing to or working with solvents.
- Actively participate in discussions and work in groups.

- Be mindful of safeguarding the health of yourself and the community, as well as keeping the environment safe.

2. Lesson contents:

2.1. Solubility process

2.2. Classification of organic solvent

2.2.1. Classification by structure

2.2.2. Classification by hazardous group

2.3. Important organic solvents

Lesson 4: Disperse system

Time: 15 hours

1. Lesson objectives

- Be able to differentiate among true solutions, colloidal solutions, emulsions, suspensions and common dispersion systems in nature and in life.
- Be able to explain the dispersion of substances.
- Be able to distinguish and explain the features of colloidal solutions.
- Actively participate in discussions and work in groups.

2. Lesson contents:

2.1. Basic concepts of disperse system

2.2. Colloidal solution

2.3. Specific features of colloidal solution

2.3.1. Hydrophobic and hydrophilic properties of colloidal solution system

2.3.2. Electrical properties

2.3.3. Optical properties

Lesson 5: Chemical reactions

Time: 16 hours

1. Lesson objectives:

- Be able to explain the metabolism, absorption and release of energy from chemical reactions, as well as the role of catalysts in chemical reactions.
- Be able to differentiate the actual reactions based on the amount of energy that they can absorb or release.
- Be able to calculate pH, pOH, and identify acidic and base solutions Be able to predict the pH level of some basic chemicals solutions.

- Actively participate in discussions and work in groups.
- Be careful, honest, responsible for the results of assigned tasks.

2. Lesson contents:

2.1. Heat and energy of reaction

2.1.1. Reaction heat

2.1.2. Activation energy

2.2. Reaction speed

2.2.1. Temperature-reliant reaction speed

2.2.2. Concentration-reliant reaction speed

2.3. Chemical balance

2.3.1. Equilibrium

2.3.2. Law of mass action

2.4. Calculation of ion volume in water, pH

2.4.1. Calculation of ion volume in water

2.4.2. pH of solutions

Lesson 6: Corrosion

Time: 14 hours

1. Lesson objectives:

- Be able to explain and differentiate corrosion phenomena in nature and real-life production processes.
- Be able to propose anti-corrosion solutions in real cases.
- Be careful, honest, responsible for the results of assigned tasks, strictly follow laboratory rules and regulations.

2. Lesson contents:

2.1. Chemical corrosion

2.2. Electrochemical corrosion

2.2.1. Electrochemical range

2.2.2. Electrochemical corrosion

2.2.3. Corrosion due to scattered current

2.3. Microbiological corrosion

2.3.1. Biofilm

2.3.2. Microbial corrosion on material

2.4. Protection from corrosion

2.4.1. Protective design

2.4.2. Surface protection

2.4.3. Protective electrode

Examination: 2 hours

PART V: CHEMICAL ANALYSIS TECHNIQUES

Lesson 1: Introduction to chemical laboratory and working procedure for hazardous chemical substances

Time: 30 hours

1. Lesson objectives

- Be able to present and implement general laboratory rules; measures to prevent accidents; protect health and conduct reports.
- Be able to implement first aid in case of laboratory accident.
- Be able to present and implement chemical hazard warnings, safety instructions and measures to handle hazardous substances.
- Be able to use laboratory equipment proficiently, clean and store them properly.

2. Lesson contents:

2.1. Task organization in laboratories

2.1.1. General working rules in laboratories

2.1.2. Preventing accidents in laboratories

2.2. First aids in case of laboratory accident

2.2.1. Chemical burns

2.2.2. Injury due to mechanical impacts

2.2.3. Heat injury

2.2.4. Intoxication

2.2.5. Electrical accident

2.3. Characteristic of toxic substances GHS

2.3.1. Dangerous signs

2.3.2. Hazardous guidelines

2.3.3. Safety instructions

2.3.4. Warning terms

2.4. Manuals for using small laboratory equipment

2.4.1. Using laboratory equipment

2.4.2. Cleaning laboratory equipment

Lesson 2: Determination of substance properties and solution preparation

Time: 30 hours

1. Lesson objectives

- Be able to present multiple types of solutions.

- Be able to prepare chemical solutions in accordance with the required concentration and volume.
- Be careful, honest, responsible for the results of assigned tasks, strictly follow laboratory rules and regulations.

2. Lesson contents:

2.1. Determination of physical parameters and properties of substance

2.1.1. Mass of solid objects and solid substances

2.1.2. Volume of solid objects and liquid substances

2.1.3. Density of liquid and solid substances

2.2. Solution preparation

2.2.1. Solution preparation with required concentrations

2.2.2. Required mixing ratio

Lesson 3: Determination of quality and quantity

Time: 75 hours

1. Lesson objectives

- Be able to present basic titration methods.
- Be able to determine the concentration of substances by basic titration methods, including acid-base, reduction-oxidation, precipitation and complexity creation.
- Be able to present spectrometer-based methods for measuring concentration.
- Be able to determine the concentration of substances by a spectrometer.
- Be careful, honest, responsible for the results of assigned tasks, strictly follow laboratory rules and regulations.

2. Lesson contents:

2.1. Identification of anions and cations

2.2. Identification by volume

2.2.1. Acid-base neutral titration

2.2.2. Complexity titration

2.3. Identification by weight

Practical examination: 10 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Practice workshops.
- Laboratories with full instruments, chemicals and equipment for learners to practice.

2. Machine and equipment

- Computers, calculators.
- Overhead projector.
- Laboratory equipment: analytical balance, technical balance, sample storage cabinet, drying cabinet, autoclave sterilizer, electric oven, water distiller, pH meter, DO meter, sample filter centrifuge, microscope, erythrocyte counting chamber, machine spectrophotometer, etc.

3. Learning materials, tools and consumables

Learning materials:

- Technical course books.
- Handouts, practice guidelines.
- References

Tools:

- Sample material: Oil, lubricants, common wastes, etc.
- Pictures, videos, colored papers, pin boards, etc.;
- Pipettes, burettes, glass beakers, glass flashes, test tubes, Durham tubes, funnels, Erlenmeyer flasks, measuring tubes, jet flasks, etc.;
- Spreaders, alcohol burners, droppers, micropipettes, test tube racks, etc.

Consumables:

- Filter papers, immersion oil, wrapping papers, waterproof cotton wool;
- Chemicals, litmus paper, solutions for cleaning glassware.
- Nutrient medium.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Environmental education

- Be able to describe and explain ecological cycles in nature.
- Be able to present the roles, responsibilities, goals, and objectives of individuals and businesses in terms of environmental protection.
- Be able to present legal document system on the environment.
- Be able to describe and explain the roles and impacts of energy and natural resources on sustainable development.
- Be able to present the origin and classification of hazardous factors to the environment.

1.1.2. Part 2: Laboratory techniques

- Be able to present and explain principles and regulations when working in laboratories.
- Be able to describe and explain information on equipment, machines and chemicals in laboratories.
- Be able to present troubleshooting principles when working in laboratories
- Be able to present principles and regulations when working in laboratories.
- Be able to present equipment cleaning methods when working in laboratories.
- Be able to present equipment sterilization methods when working in laboratories.

1.1.3. Part 3: Microorganisms and biological safety

- Be able to describe the composition, structure, development and metabolism processes in the cells of microbial species, particularly those used in wastewater treatment.
- Be able to explain the importance of microorganisms in wastewater treatment and Earth's ecosystems.
- Be able to describe the procedures of nutrient media preparation and microorganism inoculation.
- Be able to present the risks and safety principles when working with microorganisms.

- Be able to present the microbiological safety and hygiene principles, as well as theoretical basis of sterilization methods.
- Be able to present the structure of a microscope and the equipment in a microbiology laboratory.

1.1.4. Part 4: General Chemistry

- Be able to explain the basic composition and structure of substances, parameters, and compounds.
- Be able to understand and describe chemical processes using chemical equations.
- Be able to explain the relation between the structure and properties of water, as well as the solubility and insolubility of compounds in water and the changes in properties of water solution.
- Be able to explain the solubility and insolubility of basic solvents.
- Be able to present the hazards and impacts of basic solvents on the environment and human health.
- Be able to explain osmosis, dialysis, and hydration.
- Be able to differentiate among true solutions, colloidal solutions, emulsions, suspensions and common dispersion systems in nature and in life.
- Be able to explain the metabolism, absorption and release of energy from chemical reactions, as well as the role of catalysts in chemical reactions.
- Be able to differentiate the actual reactions based on the amount of energy that they can absorb or release.
- Be able to explain the dependence of reaction speed on temperature conditions and chemical balance.
- Be able to explain and differentiate corrosion phenomena in nature and real-life production processes.

1.1.5. Part 5: Chemical analysis techniques

- Be able to present multiple types of solutions and chemical processes occurring in solution: dissolution of solids, electrolysis of substances, hydrolysis, coagulation, etc.
- Be able to present the chemical equations, the conditions under which they occur, and classify the many types of chemical reactions.

- Be able to present basic titration methods.
- Safety methods in laboratories.
- Be able to present spectrometer-based methods for measuring concentration.

1.2. Skills

1.2.1. Part 1: Environmental education

- Be able to apply ecological cycles to explain phenomena in relevant fields.
- Be able to develop a strategy for implementing actions to safeguard the environment, minimize pollution, and promote green workplaces.
- Be able to search and update documents in the national environmental legal systems.
- Be able to apply 3R principles within the scope of work.
- Be able to collect, classify and control waste hazards within the scope of work.

1.2.2. Part 2: Laboratory techniques

- Be able to apply safety principles when working in laboratories.
- Be able to develop plans to use and maintain equipment, machines and chemicals in the laboratory.
- Be able to troubleshoot when working in laboratories.
- Be able to use laboratory instruments and equipment as per technical requirements.
- Be able to perform equipment cleaning methods when working in laboratories.
- Be able to perform equipment sterilization methods when working in laboratories.

1.2.3. Part 3: Microorganisms and biological safety

- Be able to implement the preparation steps of medium for microbial culture.
- Be able to implement microbiological culture and isolation techniques.
- Be able to identify risks, apply appropriate procedures, and use occupational protective equipment.
- Be able to utilize microscopes to monitor and evaluate the state of biological treatment processes using the observation results of activated sludge.

1.2.4. Part 4: General Chemistry

- Be able to analyze the composition of a material using information from the periodic table of elements.
- Be able to use chemical reaction equations in calculating the quantity of substances.
- Be able to use solubility charts and calculate the concentration of solutions, density, and solubility.
- Be able to identify and use dielectric constants in predicting the solubility and insolubility of substances.
- Be able to use H and P phrases in the safety data sheet when working with solvents.
- Be able to calculate and quantify necessary chemicals as required.
- Be able to implement practical operations in laboratories.
- Be able to follow laboratory rules.

1.2.5. Part 5: Chemical analysis techniques

- Be able to apply preventive measures and first aids in case of laboratory accident.
- Be able to comply with chemical safety regulations.
- Be able to use equipment in laboratories proficiently and safely, and apply in specific cases.
- Be able to prepare chemical solutions in accordance with the required concentration and volume.
- Be able to determine the concentration of substances by basic titration methods, including acid-base, reduction-oxidation, precipitation and complexity creation.
- Be able to determine the concentration of substances by a spectrometer.
- Be able to prepare report forms and implement task organization in laboratories.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Uphold autonomy in protecting the environment, using energy and resources efficiently.

- Promote communication in protecting the environment, using energy and resources efficiently.
- Comply with rules and regulations when working with laboratory tools and equipment.
- Comply with principles of occupational hygiene.
- Be aware of hazards when working with tools and equipment, and think of implementation principles for self-protection.
- Be meticulous and precise in work.
- Be responsible for the results of assigned tasks.

2. Method

- Oral examination, multiple choice test, writing essay, assigned, report.
- Partake in group discussions and presentations on topics.
- Observe and assess based on practical ability:
  + Observe the implementation process of laboratory tools and equipment using, cleaning and drying techniques.
  + Observe the implementation process of sterilization by heat, moist heat, membrane filtration, radiation; preparation of all kinds of nutrition media; use microscope to observe the characteristics of microorganisms.
  + Observe performances of learners: experiments such as titration, determination of physical parameters, solution preparation, etc.

VI. Module implementation instructions

1. Scope of application

The “Introduction to biochemistry and environment” module can be used to teach learners at the intermediate, college and advanced German standards college levels for “Sewage engineering technicians”.

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.
- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.

- Teachers need to prepare all necessary laboratory equipment, instruments and chemicals when teaching.
- Teachers need to demonstrate all practical steps, then observe and evaluate the practice performance of learners.
- Teachers need to prepare learning materials with complete instructions for conducting experiments.

2.2. For learners

- Actively participate in classroom sessions.
- Complete all assigned assignments.
- Complete all assignments of the self-studying hours.
- Comply with the rules and instructions of teachers.
- Attend class on schedule with sufficient learning hours as required, and follow all safety guidelines.
- Perform experiments under the guidance of teachers or laboratory managers.
- Refer to relative documents and actively participate in lessons

3. Key points requiring attention

3.1. Part 1: Environmental education

- Environment-related regulations and legal instruments;
- Causes of pollution and remedial measures;
- Impacts of environmental pollution on human and ecological environment.
- Efficient use of energy and resources.
- Effects of hazardous substances and waste on the environment.
- On-site survey and suggestion of measures for improvement.

3.2. Part 2: Laboratory techniques

- Work with laboratory instruments and equipment.
- Laboratory instrument cleaning and drying techniques.

3.3. Part 3: Microorganisms and biological safety

- Structures of virus, multicellular and unicellular organisms and their effects on human being;
- Safety rules in microbiological experiments;
- Prepare nutrient medium and observe microorganism via a microscope.

3.4. Part 4: General Chemistry

- Differentiate between natural substances and compounds, chemical reactions, and conditions for chemical reactions to occur, etc.

3.5. Part 5: Chemical analysis techniques

- Key points: Chemical quantification, substance determination by mass, volume, etc.; laboratory safety requirements, report forms, etc.

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5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: MACHINE, EQUIPMENT OPERATION AND TECHNICAL PROCESSES

Module code: MD 02

Training duration: 345 hours; (Theory: 120 hours; Practice, laboratory, discussion, assignment: 212 hours; Examination: 13 hours).

I. Position and features:

- Position: “Machine, Equipment Operation and Technical Processes” module is taught along with other Fundamental modules, and before the Specialized modules.
- Features: This is one of the fundamental modules providing learners basic specialized knowledge about the operation principles of equipment in wastewater collection and treatment systems; the principles to ensure occupational and electrical safety when working with machines and equipment, etc. This module provides additional knowledge and skills for other specialized modules.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to explain the basic contents of the Labor Code and the Law on Occupational Safety and Health.
- Be able to present the principles of occupational health.
- Be able to analyze the impacts of electrical current on human body, and the potential causes of electrical accident at work sites.
- Be able to present safety principles when exposing with power sources.
- Be able to present the structures, functions, and usage of electrical safety devices.
- Be able to explain the concepts of safety power grid, protective devices on the power grid, abbreviations and symbols of electrical devices.
- Be able to list, identify, and categorize cables and electrical lines.
- Be able to list basic electrical accessories.

- Be able to present the principles in connecting and clamping electrical lines
- Be able to present the operational principles of motors and explain star-delta connection and switch.
- Be able to present the structure and operational methods of anti-overload protection devices.
- Be able to analyze the structures, operational methods, and application scopes of switch equipment and tools.
- Be able to present and list fluid transport equipment and machines.
- Be able to describe the structures, classification, functions and tasks of all types of machines and equipment at a wastewater treatment facility.
- Be able to describe the operating process of machines and equipment at a wastewater treatment facility.
- Be able to present and list the incidents, causes, and remedies during machine and equipment operation at a wastewater treatment facility.
- Be able to demonstrate the methods for storing and conserving supplies, equipment, and machines in compliance with technical requirements.
- Be able to present the fundamental principles and definitions of measuring techniques.
- Be able to present measuring methods for mass, volume, temperature, pressure, water level, flow, concentration, etc.
- Be able to present the structures and functions of measuring equipment for each parameter.
- Be able to identify the organizational structure, business concept, training field, basic activities of the company, and internal and public information channels.
- Be able to identify the regimes, policies and benefits for employees participating in training activities when changing technology or for capacity improvement.
- Be able to list the general and specific hazards at workplace, environmentally harmful factors from factories, and preventive methods.
- Be able to list and describe the properties and application scope of materials, additives, hazardous and toxic substances.

II.2. Skills

- Be able to search and update information from legal documents in the Labor Code and the Law on Occupational Safety and Health.
- Be able to apply the principles of occupational health.
- Be able to develop the operating principles for each specific structure.

- Be able to use the necessary equipment when working at different locations in factories, manholes, sewers, as well as public transport areas.
- Be able to formulate and strictly follow safe work plans.
- Be able to apply troubleshooting and safety procedures in wastewater treatment.
- Be able to apply electrical safety measures and rescue procedures in cases of electrical accidents.
- Be able to identify the areas with safe use of electrical equipment and evaluate the installation technique.
- Be able to check the functional status and use electrical safety equipment.
- Be able to select suitable electrical cables and lines for each application.
- Be able to use some basic electrical accessories.
- Be able to connect and clamp different types of electrical lines using the right techniques.
- Be able to maintain motors and connect them as per requirements.
- Be able to select and install anti-overload protection devices using the right techniques.
- Be able to read and install basic dynamic circuit diagrams.
- Be able to inspect and identify basic errors in circuits.
- Be able to start and stop the fluid transport equipment and machines.
- Be able to select appropriate machines and equipment for a wastewater treatment facility.
- Be able to operate machines and equipment at a wastewater treatment facility.
- Be able to troubleshoot common errors in machines and equipment operation at a wastewater treatment facility.
- Be able to maintain equipment and machines at a wastewater treatment work within the scope of work.
- Be able to formulate the methods for sorting, storing and conserving supplies, equipment, and machines in compliance with technical requirements.
- Be able to sort chemicals and equipment in warehouse.
- Be able to proficiently convert measurement units for: mass, volume, temperature, pressure, water level, flow and concentration.
- Be able to measure, record, and calculate the standard deviations of parameters measuring water level, flow, and concentration.
- Be able to maintain and preserve measuring instruments properly.

- Be able to collect, process and evaluate the information and data provided by companies. Be able to use information channels to communicate with customers.
- Be able to sort and store scientific records; proficiently use instruments, machines, and equipment at factories under the supervision official employees, or within permission scope.
- Be able to respond appropriately to hazards in specific working situations.
- Be able to store and preserve equipment and chemicals in line with the principles of factories. Be able to use and maintain material transporting equipment.

II.3. Self-control ability and responsibility

- Comply with the rules and regulations on occupational safety and health.
- Comply with the safety principles when working in area with power sources.
- Comply with and apply all electrical safety regulations.
- Maintain a serious and forward-thinking approach to learning.
- Comply with privacy policies of companies.
- Comply with occupational safety regulations of companies.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Work independently or in a team, solve complicated issues and work in changing working conditions;
- Guide and supervise others to perform defined tasks; accept individual and collective accountability;
- Evaluate the quality of work outcomes and performance results of team members.

III. Description

1. General contents and time allocation

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Occupational safety in wastewater treatment***	***60***	***30***	***28***	***2***
	Intro lesson	**1**	**1**		
	Lesson 1: Overview of occupational safety 1. Legal basis 2. Dangers when working in and on wastewater facilities	**3**	**3**		
	Lesson 2: Safety measures and working principles 1. Personal protective equipment 2. Rescue equipment 3. Protection against hazardous gases and oxygen deficiency 4. Protection against infections and pathogens	**8**	**3**	**5**	
	Lesson 3: Safety procedures for construction entry point in public traffic areas 1. Warning sign for traffic 2. Warning devices 3. Workplace safety	**8**	**3**	**5**	
	Lesson 4: Working in and on wastewater facilities 1. Organizational measures 2. Safety measures 3. Exercises on entering or isolating sewers	**13**	**3**	**10**	

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 5: The Law on Occupational Safety in electricity and the effect of electric current on human body 1. Occupational safety and Labor Code 2. Effect of electric current on human body	**10**	**10**		
	Lesson 6: Electrical safety 1. Labor protection equipment and instrument - Electrical safety 2. Concepts of electrical safety	**15**	**7**	**8**	
	Examination	**2**			**2**
2	***Part 2: Electrical Engineering in Wastewater Treatment***	***90***	***30***	***56***	***4***
	Lesson 1: Electrical Engineering 1. Electrical cables and lines 2. Motor and inversion technology 3. Anti-overload protection devices	**10**	**10**		
	Lesson 2: Electrical circuit diagrams and instruments 1. Electrical circuit diagrams in electrical engineering 2. Switching instrument 3. Inspection of electrical circuits	**13**	**13**		

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 3: Lighting instruments and ex-zone 1. Luminaries 2. Basics of fire and explosion safety	**7**	**7**		
	Lesson 4: Practice of electrical engineering 1. Introduction to electrical engineering 2. Fundamentals of electrical engineering 3. Standards 4. Introduction to electrical instrument	**56**		**56**	
	Examination	**4**			**4**
3	***Part 3: Machine, Equipment and Facility Operation***	***90***	***30***	***56***	***4***
	Lesson 1: Machine components of a facility 1. Overview of machine in transportation of liquids and gases 2. Pump and agitator 3. Compressor and blower 4. Cooling equipment	**68**	**28**	**40**	
	Lesson 2: Storage and sorting 1. Storage of solids, liquids, and gases 2. Safety devices	**18**	**2**	**16**	

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Examination	**4**			**4**
4	***Part 4: Efficient measurement, control and adjustment of equipment***	***60***	***30***	***28***	***2***
	Intro lesson	**1**	**1**		
	Lesson 1: Basis theory of measurement techniques and equipment 1. Basic concepts and definitions 2. Measuring samples and standards 3. Structures and functions of measuring equipment	**14**	**14**		
	Lesson 2: Functional elements of measuring equipment 1. Basic properties of measuring circuits and converting measuring quantity 2. Controlling and adjusting equipment	**15**	**15**		
	Lesson 3: Practice of measuring techniques 1. Mass 2. Length and volume 3. Density, example of using the measuring range on a hydrostatic balance to determine 4. Average figures, volume,	**28**		**28**	

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	density and standard deviation 5. Temperature, example of collecting and comparing temperature rise between different temperature measuring equipment 6. Water level, flow and concentration				
	Examination	**2**			**2**
5	***Part 5: Internship at training institution***	***45***		***44***	***1***
	Lesson 1: Structure and operational areas of the company 1. Organizational structure of the company 2. Operational areas of the company	**4**		**4**	
	Lesson 2: Occupational safety and environmental protection 1. Hazards at workplace 2. Occupational safety at factories 3. Occupational safety at work site with wastewater treatment 4. Environmental protection	**15**		**15**	
	Lesson 3: Information, profile and quality control 1. Factory information, customer information and customer	**10**		**10**	

No.	Module lesson	*Time (hour)*			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	profiles 2. Quality control				
	Lesson 4: Use of materials and warehouse management 1. Use of materials and additives 2. Hazardous substances 3. Tools, machines, and equipment 4. Warehouse management 5. Use of labor and transport equipment	**15**		**15**	
	Examination	**1**			**1**

2. Detailed contents

PART I: OCCUPATIONAL SAFETY IN WASTEWATER TREATMENT

Intro lesson

Time: 1 hours

Lesson 1: Overview of occupational safety

Time: 3 hours

1. Lesson objectives

- Be able to explain the basic contents of the Labor Code and the Law on Occupational Safety and Health.
- Be able to search and update information from legal documents in the Labor Code and the Law on Occupational Safety and Health.
- Comply with the rules and regulations on occupational safety and health.

2. Lesson contents:

2.1. Legal basis

2.1.1. Labor Code

2.1.2. Law on occupational safety and environmental hygiene

2.2. Dangers when working in and on wastewater facilities

2.2.1. Health risks

2.2.1.1. Risk of infection by pathogens

2.2.1.2. Oxygen deficiency

2.2.1.3. Harmful gases (CO_2 and H_2S) from digestion processes

2.2.1.4. Working when harmful/hazardous substances are released

2.2.2. Explosion hazards

2.2.2.1. Gases

2.2.2.2. Flammable gases and vapors

2.2.3. Mechanical hazards

2.2.3.1. Stopping in public traffic areas

2.2.3.2. Lifting and lowering manhole covers

2.2.3.3. Falling

2.2.3.4. Strong water flow

2.2.4. Other hazards

2.2.4.1. Slipping, bumping

2.2.4.2. Electricity

2.2.4.3. Lack of safety technology

Lesson 2: Safety measures and working principles

Time: 8 hours

1. Lesson objectives:

- Be able to present the principles of occupational health.
- Be able to present and differentiate personal protective and rescue equipment.
- Be able to apply the principles of occupational health.
- Be able to develop the operating principles for each specific structure.
- Be able to use equipment proficient for each specific case.
- Be able to present protection measures against infection and pathogens.
- Be diligent, optimistic, hard-working, and self-responsible for assigned work results.

2. Lesson contents:

2.1. Personal protective equipment

2.1.1. General personal protective equipment

2.1.1.1. Warning and protective clothing

2.1.1.2. Protective gloves on each task

2.1.1.3. Protective shoes

2.1.1.4. Protective helmet (protective cap if necessary)

2.1.1.5. Pants for sewer worker

2.1.1.6. Hearing protection

2.1.1.7. Eye and face protection

2.1.2. Specific personal protective equipment

2.1.2.1. Safety belt

2.1.2.2. Faint-proof buoyancy aids

2.2. Rescue equipment

2.2.1. Self-rescuers

2.2.2. Tripod

2.2.3. Safety ropes

2.2.4. Flashlight

2.2.5. First-aid kit

2.2.6. Portable fire extinguisher

2.3. Protection against hazardous gases and oxygen deficiency

2.3.1. Gas detector

2.3.2. Properties, hazards, and limits of measured gases

2.3.2.1. Methane, CH_4

2.3.2.2. Hydrogen sulfide, H_2S

2.3.2.3. Carbon dioxide, CO_2

2.3.2.4. Carbon monoxide, CO

2.3.2.5. Ammonia, NH_3 if applicable

2.3.2.6. Oxygen, O_2

2.3.3. Natural and technical ventilation

2.4. Protection against infections and pathogens

2.4.1. Route of infection

2.4.2. Hand and foot protection

2.4.3. Body protection

2.4.4. Skin protection (skin protection plan)

2.4.5. Laundry cleaning

2.4.6. Black/white chamber

Lesson 3: Safety procedures for construction entry point in public traffic areas

Time: 8 hours

1. Lesson objectives

- Be able to present and use the necessary equipment when working at different locations in factories, manholes, sewers, as well as public transport areas.
- Be able to develop the operating principles for each specific structure.
- Be positive, proactive and responsible for the assigned duties.

2. Lesson contents:

2.1. Warning sign for traffic

2.1.1. Workplace safety barrier

2.1.2. Installation distance and height of warning sign

2.2. Warning devices

2.2.1. Danger/construction site sign

2.2.2. Warning lights

2.2.3. High-visibility clothing

2.3. Workplace safety

2.3.1. Principles for long-term working sites

2.3.2. Principles for short-term working sites

2.3.3. Construction sites in pedestrian and bicycle areas

Lesson 4: Working in and on wastewater facilities

Time: 13 hours

1. Lesson objectives

- Be able to present the risks when working at wastewater drainage and treatment facilities.
- Be able to present and comply with factory regulations.
- Be able to use the necessary equipment when working at different locations in factories, manholes, sewers, as well as public transport areas.
- Be able to formulate and strictly follow safe work plans.
- Be able to perform safety operations proficiently when entering manholes and walking in sewers.
- Be able to apply troubleshooting and safety procedures in wastewater treatment.
- Be positive, proactive and responsible for the assigned duties.

2. Lesson contents:

2.1. Organizational measures

2.1.1. Factory regulations

2.1.2. License

2.2. Safety measures

2.2.1. Safety assurance when entering manholes and walking in sewers

2.2.2. Rescue and first aid

2.3. Exercises on entering or isolating sewers

Lesson 5: The Law on Occupational Safety in electricity and the effect of electric current on human body

Time: 10 hours

1. Lesson objectives

- Be able to present the law on occupational safety in electricity.
- Be able to present safety principles when exposing with power sources.
- Be able to present the impacts of electrical current on human body, and the potential causes of electrical accident at work sites.
- Comply with the safety principles when working in area with power sources.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents

2.1. Occupational safety and Labor Code

2.1.1. Law on occupational safety, and occupational safety when working with electricity

2.1.2. Occupational safety principles

2.1.2.1. Five electrical safety principles

2.1.2.2. Triple-safety principle

2.2. Effect of electric current on human body

2.2.1. Calculate electrical resistance of human body

2.2.2. Active zones of alternative current and circuit break diagram

2.2.3. Electricity current hazards in fixed and variable working positions

Lesson 6: Electrical safety

Time: 15 hours

1. Lesson objectives

- Be able to analyze the impacts of electrical current on human body, and the potential causes of electrical accident at work sites.
- Be able to present safety principles when exposing with power sources.
- Be able to present the structures, functions, and usage of electrical safety devices.
- Be able to explain the concepts of safety power grid, protective devices on the power grid, abbreviations and symbols of electrical devices.
- Be able to apply electrical safety measures and rescue procedures in cases of electrical accidents.
- Be able to identify the areas with safe use of electrical equipment and evaluate the installation technique.
- Be able to check the functional status and use electrical safety equipment.
- Work carefully and comply with electrical safety principles.
- Be serious about learning and research.

2. Lesson contents

2.1. Labor protection equipment and instrument - Electrical safety

2.1.1. Electrical equipment and components with fixed positions

2.1.2. Electrical components with variable positions

2.1.3. Protection and support tools

2.1.4. Identify and evaluate improper installation

2.1.5. Scope of responsibility when working in electrical environment

2.1.6. Organizational methods when working in electrical environment

2.2. Concepts of electrical safety

2.2.1. Safety grid and its protection elements

2.2.1.1. Grid type

2.2.1.1.1. TN system

2.2.1.1.2. TT system

2.2.1.1.3. IT system

2.2.1.2. Insulated equipment

2.2.1.3. Protection class

2.2.1.3.1. Equipment with class 1 protection

2.2.1.3.2. Equipment with class 2 protection

2.2.1.3.3. Equipment with class 3 protection

2.2.1.4. Safety extra low voltage

2.2.2. Symbols on electrical components

Examination: 2 hours

PART II: ELECTRICAL ENGINEERING IN WASTEWATER TREATMENT

Lesson 1: Electrical Engineering

Time: 10 hours

1. Lesson objectives

- Be able to present types of electrical cables and lines, identification, classification and methods of connecting and clamping them.
- Be able to present the technical principles of motors and inversion.
- Be able to present the structure and operational methods of anti-overload protection devices.
- Comply with the safety principles when working in area with power sources.
- Be serious about learning and research.

2. Lesson contents

2.1. Electrical cables and lines

2.1.1. Marking of harmonized/non-harmonized lines

2.1.2. Categorization of electrical cables and lines by color code

2.1.3. Installation procedures of cables and lines

2.1.3.1. Line connection

2.1.3.2. Line connection, clamps and other connections

2.2. Motor and inversion technology

2.2.1. Rotary field

2.2.2. Basic principles of asynchronous motor

2.2.2.1. Squirrel-cage motor

2.2.2.2. Star-delta connection/Soft start

2.2.2.3. Connection designations of electric motors

2.2.3. Specification plate

2.2.4. Operating modes

2.2.4.1. Motors for single-phase alternating current

2.2.4.2. Motors for three-phase alternating current

2.2.5. Finding faults on control circuit of motors

2.3. Anti-overload protection devices

2.3.1. Overview

2.3.2. Fuses

2.3.3. NH fuses (NH system)

2.3.4. Device protection fuses or glass fuses or fine-wire

2.3.5. Line circuit-breaker (LS switch)

2.3.6. Motor protection circuit-breaker

2.3.7. Motor protection circuit-breaker

Lesson 2: Electrical circuit diagrams and instruments

Time: 13 hours

1. Lesson objectives

- Be able to present and recognize symbols, names and orders of electrical devices on technical drawings.
- Be able to present various types of diagrams in the electrical engineering field.
- Be able to present devices, and switching tools with their structure, operation and application scope.
- Be able to present checking methods for electrical circuits, measuring devices and quantities that are necessary to be tested on the electrical circuits.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents

2.1. Electrical circuit diagrams in electrical engineering

2.1.1. Wiring diagram

2.1.2. Block diagrams and their special features

2.2. Switching instrument

2.2.1. Contactor

2.2.2. Relay

2.2.3. Impulse switch

2.2.4. Impulse relay

2.2.5. Commanding and signaling devices

2.2.6. Compensation capacitors

2.3. Inspection of electrical circuits

2.3.1. Measuring equipment

2.3.2. Instruction on measuring electrical elements

2.3.3. Instruction on measuring insulation

Lesson 3: Lighting instruments and ex-zone

Time: 7 hours

1. Lesson objectives

- Be able to present luminaries, safety issues when operating lamps with high voltage discharge;
- Be able to present causes of fire and explosion by electricity and fire prevention methods.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents

2.1. Luminaries

2.1.1. Emergency luminaries

2.1.2. Lights

2.1.2.1. Filament lights

2.1.2.2. Fluorescent light

2.1.2.3. Light base

2.1.2.4. Low-pressure sodium vapor lamp

2.1.2.5. High-pressure discharge lamp

2.1.2.6. High-pressure sodium vapor lamp

2.1.2.7. High-pressure mercury vapor lamp (HQL)

2.1.2.8. Metal halide lamp

2.1.3. Safety during high-pressure discharge lamp operation

2.1.4. Provisions for luminaries and lighting installations

2.1.5. LEDs

2.2. Basics of fire and explosion safety

2.2.1. Ignition sources

2.2.2. Flash point

2.2.3. Primary and secondary fire and explosion protection

2.2.4. Areas at risk of fire and explosion

2.2.5. EC EX directives.

Lesson 4: Practice of electrical engineering

Time: 50 hours

1. Lesson objectives

- Comply with and apply all electrical safety measures.
- Be able to draw and read some basic circuit diagrams.
- Be able to detect faults in electrical circuits.
- Be able to read symbols in the field of engineering.

- Be able to use electrical tools proficiently.
- Be diligent, positive, hard-working, careful and studious.

2. Lesson contents

2.1. Introduction to electrical engineering

2.1.1. Occupational safety

2.1.2. Introduction to training/working area

2.2. Fundamentals of electrical engineering

2.2.1. Draw and read a circuit diagram

2.2.2. Work and wire according to a circuit diagram

2.2.3. Troubleshoot a circuit diagram

2.3. Standards

2.3.1. TCVN, QCVN, ISO, EN, DIN

2.3.2. Symbols in technical field

2.4. Introduction to electrical instrument

2.4.1. Voltage testers/instruments

2.4.2. Handling techniques for wires and cables

2.4.2.1. Cable stripping

2.4.2.2. Stripping electrical conductors

2.4.2.3. Crimping of wire end ferrules

2.4.2.4. Eyelet bending

2.4.2.5. Crimping cable lugs

2.4.2.6. Solderless cable lugs and connectors

2.4.2.7. Handling Grip crimping pliers

2.4.3. Connection techniques

Examination: 2 hours

PART III: MACHINE, EQUIPMENT AND FACILITY OPERATION

Lesson 1: Machine components of a facility

Time: 68 hours

1. Lesson objectives:

- Be able to describe the operating process of machines and equipment at a wastewater treatment facility.
- Be able to start and stop the fluid transport equipment and machines.
- Be able to operate machines and equipment at a wastewater treatment facility.
- Be able to present and list the incidents, causes, and remedies during machine and equipment operation at a wastewater treatment facility.
- Be able to present and list fluid transport equipment and machines.
- Be able to describe the structures, classification, functions and tasks of all types of machines and equipment at a wastewater treatment facility.
- Be able to select appropriate machines and equipment for a wastewater treatment facility.
- Be able to describe the maintenance processes for equipment and machines at a wastewater treatment facility.
- Be able to maintain equipment and machines at a wastewater treatment work within the scope of work.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents:

2.1. Overview of machine in transportation of liquids and gases

2.2. Pump and agitator

2.2.1. Design and function of pump

2.2.2. Design and function of agitator

2.2.3. Transformer

2.2.4. Use and selection of suitable pumps and agitators

2.3. Compressor and blower

2.3.1. Design and function of compressor

2.3.2. Design and function of blower

2.4. Cooling equipment

2.4.1. Energy transfer equipment

2.4.2. Heat transfer methods

2.4.3. Cooling equipment

Lesson 2: Storage and sorting

Time: 18 hours

1. Lesson objectives:

- Be able to demonstrate the methods for storing and conserving supplies, equipment, and machines in compliance with technical requirements.
- Be able to formulate the methods for sorting, storing and conserving supplies, equipment, and machines in compliance with technical requirements.
- Be able to sort chemicals and equipment in warehouse.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents:

2.1. Storage of solids, liquids, and gases

2.1.1. Packaged goods

2.1.2. Liquid storage tank

2.1.3. Air cylinder

2.2. Safety devices

Examination: 4 hours

PART IV: EFFICIENT MEASUREMENT, CONTROL AND ADJUSTMENT OF EQUIPMENT

Intro lesson

Time: 1 hours

Lesson 1: Basis theory of measurement techniques and equipment

Time: 14 hours

1. Lesson objectives

- Be able to present the fundamental principles and definitions of measuring techniques.
- Be able to present measuring methods for mass, volume, temperature, pressure, water level, flow, concentration, etc.
- Be able to present the structures and functions of measuring equipment for each parameter.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents

2.1. Basic concepts and definitions

2.1.1. Measuring techniques

2.1.2. Measurement

2.1.3. Measurement classification

2.1.4. Measurement equipment classification

2.2. Measuring samples and standards

2.2.1. Measurement unit system

2.2.2. Standard equipment

2.2.3. Sample equipment

2.2.4. Structural diagram of measuring equipment

2.3. Structures and functions of measuring equipment

2.3.1. Mass and volume

2.3.2. Density

2.3.3. Temperature

2.3.4. Pressure

2.3.5. Water level

2.3.6. Flow

2.3.7. Concentration

Lesson 2: Functional elements of measuring equipment

Time: 15 hours

1. Lesson objectives

- Be able to present types of measuring circuits and their basic properties.
- Be able to proficiently convert measurement units for: mass, volume, temperature, pressure, water level, flow and concentration.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents

2.1. Measuring circuit, basic characteristics of measuring circuits and measurement conversion

2.1.1. Resistance conversion

2.1.2. Electromagnetic conversion

2.1.3. Static electrical conversion

2.1.4. Electro thermal conversion

2.1.5. Quantum conversion

2.1.6. Humidity conversion

2.2. Controlling and adjusting equipment

2.2.1. Introduction to controlling and adjusting equipment

2.2.2. Structure and functions

Lesson 3: Practice of measuring techniques

Time: 28 hours

1. Lesson objectives

- Be able to use equipment proficiently to measure quantities in machine operation.
- Be able to measure, record, and calculate the standard deviations of parameters measuring water level, flow, and concentration.
- Be able to maintain and preserve measuring instruments properly.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

2. Lesson contents

2. 1. Volume

2.2. Length and volume

2.3. Density, example of using the measuring range on a hydrostatic balance to determine

2.4. Average figures, volume, density and standard deviation

2.5. Temperature, example of collecting and comparing temperature rise between different temperature measuring

2.6. Water level, flow and concentration

Examination: 2 hours

PART V: INTERNSHIP AT TRAINING INSTITUTION

Lesson 1: Structure and operational areas of the company

Time: 4 hours

1. Lesson objectives

- Be able to identify the organizational structure, business concept, training field, basic activities of the company.
- Be able to identify the regimes, policies and benefits for employees participating in training activities when changing technology or for capacity improvement.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. Organizational structure of the company

2.1.1. Type

2.1.2. Organization

2.1.3. Training center

2.1.4. Description of basic functions, such as procurement, manufacturing, sales, and administration

2.1.5. Personnel structure, qualifications and capacity requirements of job positions

2.1.6. Further education and training opportunities for employees

2.2. Operational areas of the company

2.2.1. Training fields

2.2.2. Fields of activity of the professions

Lesson 2: Occupational safety and environmental protection

Time: 15 hours

1. Lesson objectives

- Be able to list the general and specific hazards at workplace, environmentally harmful factors from factories, and preventive methods.
- Be able to respond appropriately to threats in particular situation, and comply with occupational safety regulations of companies.
- Be able to identify the environmental hazards at factory and prevention methods.
- Comply with occupational safety regulations of companies.

2. Lesson contents

2.1. Hazards at workplace

2.1.1. Recognize hazards

2.1.2. Special hazards

2.1.3. Prevention measures

2.2. Occupational safety at factories

2.2.1. Factory regulations

2.2.2. Occupational safety when working at company

2.2.3. Select and use personal protective equipment

2.2.4. Emergency response in case of incident

2.2.5. Fire and explosion prevention

2.3. Occupational safety at work site with wastewater treatment

2.3.1. Describe explosion hazards and take measures for explosion protection (formation of gases in wastewater)

2.3.2. Hazards due to pathogens in wastewater and rules for occupational hygiene

2.3.3. Rules of conduct when working in enclosed spaces

2.4. Environmental protection

2.4.1. Describe possible environmental impacts of a company

2.4.2. Ability to use economical and environmentally friendly materials and energy

2.4.3. Reduce waste from substances and materials that can be disposed of in an environmentally friendly manner

Lesson 3: Information, profile and quality control

Time: 10 hours

1. Lesson objectives

- Be able to identify information channels inside and outside of the company.
- Be able to identify the regimes, policies and benefits for employees participating in training activities when changing technology or for capacity improvement.
- Be able to sort and store scientific records; proficiently use instruments, machines, and equipment at factories under the supervision official employees, or within permission scope.
- Comply with privacy policies of companies.

2. Lesson contents

2.1. Factory information, customer information and customer profiles

2.1.1. Obtain, process, and evaluate information

2.1.2. Use information and communication systems

2.1.3. Read technical documents, minutes, and work reports

2.1.4. Data privacy

2.2. Quality control

2.2.1. Implement quality assurance measures

2.2.2. Documenting and checking

Lesson 4: Use of materials and warehouse management

Time: 15 hours

1. Lesson objectives

- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be able to list and describe the properties and application scope of materials, additives, hazardous and toxic substances.
- Be able to store and preserve equipment and chemicals in line with the principles of factories. Be able to use and maintain material transporting equipment.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.

2. Lesson contents

2.1. Use of materials and additives

2.1.1. Selection of materials and additives

2.1.2. Use of materials and additives

2.2. Hazardous substances

2.2.1. Identify hazardous substances

2.2.2. Safety regulations and application of protective measures

2.3. Tools, machines, and equipment

2.3.1. Introduction to tools, machines, and equipment

2.3.2. Use of tools, machines, and equipment

2.4. Warehouse management

2.4.1. Proper storage and transportation of substances and materials

2.4.2. Evaluate and inspect the condition of substances and materials

2.5. Use of labor and transport equipment

2.5.1. Operation of hoists and transport equipment

2.5.2. Using, inspecting, maintaining and cleaning labor equipment

2.5.3. Identify malfunctions of labor equipment and remedies

Examination: 1 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Practical rooms of treatment models.
- Practical rooms of water and waste water treatment system.
- Practical rooms of engines and electrical system equipment.
- Studying at factories or companies.

2. Machine and equipment

- Model of wastewater treatment system.
- Thermometers, scales, water level, flow and concentration measuring devices, electrical measuring devices.
- Computers, calculators, overhead projectors.
- Safety equipment such as tripods and winches, toxic gas detectors, barriers in public places, warning lights, explosion-proof flashlights, personal protective equipment, etc.
- Wastewater drainage and treatment works such as manholes, models, wastewater treatment tanks, etc.
- Electrical equipment training models.
- Electrical toolkit, cabin with electrical installation, motor, engine, etc.

3. Learning materials, tools and consumables

Learning materials:

- Occupational safety training material
- Handouts, practice guidelines.
- Diagrams, drawings;
- Factory diagram, operation manual.
- Course books, reference materials.

Tools:

- Personal protective set: protective clothing, reflective vest, S3 shoes, boots, gloves, hats, first aid box, etc.

Consumables:

- Personal bandages, etc.
- Soft electrical cable, tapes, etc.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Occupational Safety in Wastewater Treatment

- Be able to explain the basic contents of the Labor Code and the Law on Occupational Safety and Health.
- Be able to present the principles of occupational health.
- Be able to present the hazards in labor and when working with technical equipment in the field of water wastewater drainage and treatment.
- Be able to analyze the impacts of electrical current on human body, and the potential causes of electrical accident at work sites.
- Be able to present safety principles when exposing with power sources.
- Be able to present the structures, functions, and usage of electrical safety devices.
- Be able to explain the concepts of safety power grid, protective devices on the power grid, abbreviations and symbols of electrical devices.

1.1.2. Part 2: Electrical Engineering in Wastewater Treatment

- Be able to list, identify, and categorize cables and electrical lines.
- Be able to list basic electrical accessories.
- Be able to present the principles in connecting and clamping electrical lines
- Be able to present the operational principles of motors and explain star-delta connection and switch.
- Be able to present the structure and operational methods of anti-overload protection devices.
- Be able to analyze the structures, operational methods, and application scopes of switch equipment and tools.

1.1.3. Part 3: Machine, Equipment and Facility Operation

- Be able to present and list fluid transport equipment and machines.

- Be able to describe the structures, classification, functions and tasks of all types of machines and equipment at a wastewater treatment facility.
- Be able to describe the operating process of machines and equipment at a wastewater treatment facility.
- Be able to present and list the incidents, causes, and remedies during machine and equipment operation at a wastewater treatment facility.
- Be able to describe the maintenance processes for equipment and machines at a wastewater treatment facility.
- Be able to demonstrate the methods for storing and conserving supplies, equipment, and machines in compliance with technical requirements.

1.1.4. Part 4: Efficient measurement, control and adjustment of equipment

- Be able to present the fundamental principles and definitions of measuring techniques.
- Be able to present measuring methods for mass, volume, temperature, pressure, water level, flow, concentration, etc.
- Be able to present the structures and functions of measuring equipment for each parameter.

1.1.5. Part 5: Internship at training institution

- Be able to identify the organizational structure, business concept, training field, basic activities of the company, and internal and public information channels.
- Be able to identify the regimes, policies and benefits for employees participating in training activities when changing technology or for capacity improvement.
- Be able to list the general and specific hazards at workplace, environmentally harmful factors from factories, and preventive methods.
- Be able to list and describe the properties and application scope of materials, additives, hazardous and toxic substances.

1.2. Skills

1.2.1. Part 1: Occupational Safety in Wastewater Treatment

- Be able to search and update information from legal documents in the Labor Code and the Law on Occupational Safety and Health.
- Be able to apply the principles of occupational health.
- Be able to develop the operating principles for each specific structure.

- Be able to use the necessary equipment when working at different locations in factories, manholes, sewers, as well as public transport areas.
- Be able to formulate and strictly follow safe work plans.
- Be able to apply troubleshooting and safety procedures in wastewater treatment.
- Be able to apply electrical safety measures and rescue procedures in cases of electrical accidents.
- Be able to identify the areas with safe use of electrical equipment and evaluate the installation technique.
- Be able to check the functional status and use electrical safety equipment.

1.2.2. Part 2: Electrical Engineering in Wastewater Treatment

- Be able to select suitable electrical cables and lines for each application.
- Be able to use some basic electrical accessories.
- Be able to connect and clamp different types of electrical lines using the right techniques.
- Be able to maintain motors. Be able to connect motors as per techniques.
- Be able to select and install anti-overload protection devices using the right techniques.
- Be able to read and install basic dynamic circuit diagrams. Be able to inspect and identify basic errors in circuits.

1.2.3. Part 3: Machine, Equipment and Facility Operation

- Be able to start and stop the fluid transport equipment and machines.
- Be able to select appropriate machines and equipment for a wastewater treatment facility.
- Be able to operate machines and equipment at a wastewater treatment facility.
- Be able to troubleshoot common errors in machines and equipment operation at a wastewater treatment facility.
- Be able to maintain equipment and machines at a wastewater treatment work within the scope of work.
- Be able to formulate the methods for sorting, storing and conserving supplies, equipment, and machines in compliance with technical requirements.
- Be able to sort chemicals and equipment in warehouse.

1.2.4. Part 4: Efficient measurement, control and adjustment of equipment

- Be able to proficiently convert measurement units for: mass, volume, temperature, pressure, water level, flow and concentration.
- Be able to measure, record, and calculate the standard deviations of parameters measuring water level, flow, and concentration.
- Be able to maintain and preserve measuring instruments properly.
- Be able to explain the methods of collecting, converting, and processing measured values.
- Be able to proficiently use measuring equipment.
- Be able to measure and evaluate value and results.
- Be able to identify and solve inaccurate values.

1.2.5. Part 5: Internship at training institution

- Be able to collect, process and evaluate the information and data provided by companies. Be able to use information channels to communicate with customers.
- Be able to sort and store scientific records; proficiently use instruments, machines, and equipment at factories under the supervision official employees, or within permission scope.
- Be able to respond appropriately to hazards in specific working situations.
- Be able to store and preserve equipment and chemicals in line with the principles of factories. Be able to use and maintain material transporting equipment.

1.3. Self-control ability and responsibility

- Be diligent, industrious, careful, precise.
- Be responsible for completing assigned tasks.
- Be aware of career development
- Work independently and solve occupational problems.
- Ensure occupational safety while working.
- Comply with the rules of practice workshop.
- Handle equipment meticulously and safely.
- Comply with the commitments on health protection, occupational safety, environmental protection and occupational hygiene.
- Comply with the rules and regulations on electrical safety;
- Implement safety measures while working with electrical equipment.
- Comply with company and unit regulations.

2. Method

- Evaluate through examination: Oral examination, multiple choice, essay, observing practical activities in:
  + Carrying out the personal protective measures, work safety measures such as manhole barriers, etc.
  + Using rescue equipment, manhole cover opening and sewer exploration, etc.
  + Implementing electrical equipment.
  + Implementing equipment and machines.
- Evaluate through performance at company, or examination at school or company.

VI. Module implementation instructions

1. Scope of application

The “Machine, Equipment Operation and Technical Processes” module can be used to teach learners at the intermediate, college and advanced German standards college levels for “Sewage engineering technicians”.

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers at school:

- Teaching methods include presentation, integration, conservation, group discussion.
- Use equipment and images to visually illustrate the lessons.
- Teachers can use computers, projectors, and electronic lesson materials when teaching.
- The practice of sub-module is carried out in the form of practices at workshop and outside the treatment system.
- Improve skills in using measuring, controlling and adjusting devices.
- Teachers need to organize practice sessions at workshop or construction site.
- Teachers need to prepare learning materials with complete instructions for conducting experiments.
- Practice skills in using electrician's tools and circuit assembly skills.
- Guide learners before their internship course at company.
- Set up goals for learners after completing their internship course at company.

For teachers/lecturers at enterprise

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at the company.
- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.
- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required;
- Complete all assignments of the self-studying hours;
- Strictly follow laboratory rules;
- Perform experiments under the guidance of teachers or laboratory managers;
- Refer to related documents for more information;
- Be active and proactive in class, actively research practical information, and apply knowledge when visiting factories and doing internships.

3. Key points requiring attention

3.1. Part 1: Occupational Safety in Wastewater Treatment

- Lesson 2: Safety measures and working principles.
- Lesson 3: Ensure safety when working at construction sites in public traffic areas
- Lesson 4: Working on wastewater facilities.
- Lesson 5: The Law on Occupational Safety in electricity and the effect of electric current on human body.

3.2. Part 2: Electrical Engineering in Wastewater Treatment

- All lessons.

3.3. Part 3: Machine, Equipment and Facility Operation

- Lesson 1: Machine components of a facility;
- Lesson 3: Equipment inspection and maintenance

3.4. Part 4: Efficient measurement, control and adjustment of equipment

- Lesson 1: Basis theory of measurement techniques and equipment;

- Lesson 2: Functional elements of measuring equipment.
- Lesson 3: Measuring techniques

3.5. Part 5: Internship at training institution

- All lessons.

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[7]. Tran Ngoc Lan (2017). *Occupational Safety and Health Handbook.* Information and Communication Publishing House.

[8]. *Law on Occupational Safety and Health, No. 84/2015/QH13I,* Information and Communication Publishing House, 2016.

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5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: OPERATION OF DRAINAGE SYSTEM

Module code: MD 03

Training duration: 345 hours; (Theory: 129 hours; Practice, laboratory, discussion, assignment: 198 hours; Examination: 18 hours).

I. Position and features:

- Position: “Operation of Drainage System” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This is a specialized module providing learners with specialized knowledge about the structure and features of water collection and drainage pipes, operating principles of collection and wastewater treatment systems. Graduates can perform the tasks related to the operation of drainage system at companies specializing in the collection and treatment of centralized wastewater and urban wastewater, including the preparation to perform the work, determining the amount of sludge in the sewer, manhole; cleaning, dredging manholes and drainage pipes; check the tightness of joints, condition of sewer pipes, auxiliary works; check the current condition of the manhole; check connection and discharge points; take some basic flood control measures.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Module objectives

II.1. Knowledge

- Be able to describe and classify materials and their properties.
- Be able to present the process of pipeline corrosion and remedies.
- Be able to present and identify some basic parameters of drainage pipes.
- Be able to present the equipment, components and accessories of drainage pipe structure.
- Be able to present the occupational safety regulations in pipe installation procedures.
- Be able to present and interpret the symbols and specifications of pipe installation and processing drawings.

- Be able to describe the functions of tools and handy instruments in pipeline processing and installation.
- Be able to present the legal basis for wastewater collection and discharge.
- Be able to present the composition, properties and classification of wastewater in drainage system.
- Be able to present and describe types of sewers, structure and operation of different types of wastewater drainage systems (combined, separate, semi-separate) and connection works.
- Be able to explain the advantages and disadvantages of typical materials used in the drainage system.
- Be able to demonstrate energy and material conservation measures in operation of drainage system.
- Be able to analyze the functions and tasks of the works in the drainage system such as sewers, manholes, pumping stations, split wells, and runoff discharge tanks.
- Be able to present the functions and tasks of load-reduction works in the drainage system.
- Be able to present and interpret the symbols and specifications of technical drawings.
- Be able to present the calculation method for sewer gradient.
- Be able to present the calculation method for distance and depth of manholes.
- Be able to present the method to determine the amount of sludge in sewer, manhole, and trough.
- Be able to demonstrate potential hazards during operation of drainage system.
- Be able to apply safety measures during operation of drainage system.
- Be able to present the preparation steps for operation of drainage system.
- Be able to present the steps to check and manage assets on the system (connection boxes, manhole covers, pipes).
- Be able to present the sampling plan as per requirements.
- Be able to present the process of sampling and sensory analysis of different wastewater samples.
- Be able to present the supervision procedures of discharge points.

II.2. Skills

- Be able to identify and check the materials.

- Be able to apply the solutions to solve the pipeline corrosion.
- Be able to calculate and evaluate some basic parameters of drainage pipes.
- Be able to select the equipment, components and accessories of drainage pipe structure.
- Be able to apply the occupational safety regulations in pipe installation procedures.
- Be able to read drawings and symbols on pipeline installation drawings.
- Be able to proficiently perform techniques of marking, splitting, bending, joining and joining pipes.
- Be able to make the products according to the manufacturing drawings.
- Be able to search and update new documents as a legal basis for wastewater collection and discharge.
- Be able to preliminarily assess the flow rate and sensory evaluation of wastewater composition.
- Be able to operate the drainage system as planned.
- Be able to identify and handle potential hazards during operation of drainage system.
- Be able to apply safety measures during operation of drainage system.
- Be able to identify the types of wastewater systems and connection works based on design/in reality.
- Be able to apply energy and material conservation measures in operation of drainage system.
- Be able to check and manage assets on the system (connection boxes, manhole covers, pipes).
- Be able to collect data from drawings and report deviations from reality.
- Be able to calculate the sewer gradient and gradient assessment; calculate the depth of the manhole and the distance between them.
- Be able to implement the method to determine the amount of sludge in sewer, manhole, and trough.
- Be able to perform the processes to inspect and evaluate joint tightness, condition of sewers, manholes, pressure capacity of manhole covers and discharge connection points.
- Be able to operate the structures in the drainage system: manholes, pumping stations, split wells, and runoff discharge tanks.

- Be able to operate, adjust, troubleshoot and improve the urban drainage system model.
- Be able to conduct reports on model operation.
- Be able to formulate a sampling plan as per requirements.
- Be able to apply the process of sampling and sensory analysis of different wastewater samples.
- Be able to apply the procedures to supervise the discharge points.
- Be able to read the map of discharge points and update new information according to reality.

II.3. Self-control ability and responsibility

- Comply with the rules and regulations on occupational safety and health.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Module contents

1. General contents and time allocation

No.	Module lesson	Time (hour)			
		Total	Theory	Practice, laboratory, discussion, assignment	Examination
1	***Part 1: Pipe material***	***195***	***45***	***140***	***10***

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 1: Overview of construction materials for sewers 1. Materials and their features 2. Corrosion and anti-corrosion	**15**	**15**		
	Lesson 2: Pipes and equipment on sewers 1. Pipes and sewers 2. Auxiliary equipment	**30**	**30**		
	Lesson 3: Introduction to workshop and sewer installation models 1. General instructions 2. Basic knowledge of technical drawings 3. Technical standards	**30**		**30**	
	Lesson 4: Practice handling materials in drainage pipe installation 1. Formulation of implementation plan 2. Marking technique 3. Splitting technique 4. Pipe deforming technique 5. Pipe joining and connecting technique	**110**		**110**	
	Examination	**10**			**10**
2	***Part 2: Operation of drainage system***	***120***	***56***	***58***	***6***

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 1: Categorization of wastewater and drainage system 1. Legal basis 2. Overview of wastewater 3. Wastewater collection and drainage system	**28**	**28**		
	Lesson 2: Basic structure and installation in the drainage system 1. Works in drainage system 2. Load-reduction works 3. Technical communication	**28**	**28**		
	Lesson 3: Practice operating drainage system model 1. Urban drainage 2. Industrial drainage	**58**		**58**	
	Examination	**6**			**6**
3	***Part 3: Sampling and supervising discharge points***	***30***	***28***		***2***
	Lesson 1: Sampling 1. Sampling plan 2. Sampling procedure 3. Sensory analysis of different types of wastewater	**16**	**16**		
	Lesson 2: Monitoring indirect discharge points 1. Factory inspection 2. Inspect indirect discharge points 3. Conduct sampling and on-site	**12**	**12**		

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	measurement 4. Use indirect discharge point registration map				
	Examination	**2**			**2**

2. Detailed contents:

PART I: PIPE MATERIAL

Lesson 1: Overview of construction materials for sewers

Time: 15 hours

1. Lesson objectives:

- Be able to describe and classify materials and their properties.
- Be able to present the process of pipeline corrosion and remedies.
- Be able to identify and check the materials.
- Be able to apply the solutions to solve the pipeline corrosion.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Materials and their features

2.1.1. Material classification

2.1.1.1. Metallic materials (steel, cast iron, stainless steel, etc.)

2.1.1.2. Non-metallic materials (uPVC, HPDE, PP, PE, composite)

2.1.1.3. Artificial materials. (concrete, crockery)

2.1.1.4. Natural materials (wood)

2.1.2. Material features

2.1.2.1. Physical features

2.1.2.2. Chemical features

2.1.2.3. Technological features

2.2. Corrosion and anti-corrosion

2.2.1. Corrosion process

2.2.1.1. External corrosion

2.2.1.2. Internal corrosion

2.2.2. Corrosion methods

2.2.2.1. Even surface corrosion

2.2.2.2. Pitting corrosion

2.2.2.3. Contact corrosion

2.2.2.4. Stress corrosion

2.2.3. Anti-corrosion

2.2.3.1. Passive anti-corrosion

2.2.3.2. Active anti-corrosion

Lesson 2: Pipes and equipment on sewers

Time: 30 hours

1. Lesson objectives:

- Be able to present and identify some basic parameters of drainage pipes.
- Be able to present the equipment, components and accessories of drainage pipe structure.
- Be able to calculate and evaluate some basic parameters of drainage pipes.
- Be able to select the equipment, components and accessories of drainage pipe structure.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Pipes and sewers

2.1.1. Pipe and sewer materials

2.1.2. Methods for assessing and evaluating material quality

2.1.3. Dimensions of pipes and sewers

2.1.3.1. Inner diameter

2.1.3.2. Outer diameter

2.1.3.3. Sewer length and node

2.1.3.4. Sewer gradient

2.1.4. Operating parameters

2.1.4.1. Volume

2.1.4.2. Volume

2.1.4.3. Volumetric flow, flow velocity, fullness

2.1.5. Pipe and sewer accessories

2.1.5.1. Shrink gasket, T-gasket, flange gasket

2.1.5.2. Pipe connection measures

2.2. Auxiliary equipment

2.2.1. Flow-breaking components: faucets, valves, drains, covers

2.2.2. Controlling and adjusting equipment pressure relief valve

2.2.3. Safety devices: check valve, pressure valve

Lesson 3: Introduction to workshop and sewer installation models

Time: 30 hours

1. Lesson objectives:

- Be able to present the occupational safety regulations in pipe installation procedures.
- Be able to apply the occupational safety regulations in pipe installation procedures.
- Strictly comply with occupational safety regulations.
- Be diligent, optimistic, hard-working, and self-responsible for assigned work

2. Lesson contents:

2.1. General instructions

2.1.1. Occupational safety

2.1.2. Introduction to device and model

2.1.3. Introduction to work

2.1.4. Formulation of work implementation plan

2.2. Technical standards

2.2.1. TCVN/QCVN/ISO/EN/DIN

2.2.2. Symbols in engineering field

2.2.3. Read simple drawings

Lesson 4: Practice handling materials in drainage pipe installation

Time: 110 hours

1. Lesson objectives:

- Be able to read drawings and symbols on pipeline installation drawings.
- Be able to identify and check the materials.
- Be able to proficiently perform techniques of marking, splitting, bending, joining and joining pipes.
- Be able to make the products according to the manufacturing drawings.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Formulation of implementation plan

2.1.1. Material identification

2.1.2. Examination

2.1.3. Measurements

2.2. Marking technique

2.2.1. Marking line

2.2.2. Punch

2.2.3. Head stamping

2.3. Splitting technique

2.3.1. Cut

2.3.2. File, saw, drill, chisel, trim

2.3.3. Inner lace and outer lace

2.4. Pipe deforming technique

2.4.1. Bending

2.4.2. Calculation method for bending part

2.5. Pipe joining and connecting technique

2.5.1. Pipe connection types

2.5.2. Connecting with screws, studs and dowels

2.5.3. Welding, soldering, gluing

2.5.4. Joint tightness inspection

Examination: 10 hour

PART II: OPERATION OF DRAINAGE SYSTEM

Lesson 1: Categorization of wastewater and drainage system

Time: 28 hours

1. Lesson objectives:

- Be able to present the legal basis for wastewater collection and discharge.
- Be able to present the composition, properties and classification of wastewater in drainage system.
- Be able to preliminarily assess the flow rate and composition of wastewater.
- Be able to present and describe types of sewers, structure and operation of different types of wastewater drainage systems (combined, separate, semi-separate) and connection works.
- Be able to explain the advantages and disadvantages of typical materials used in the drainage system.
- Be able to demonstrate energy and material conservation measures in operation of drainage system.
- Be able to search and update new documents as a legal basis for wastewater collection and discharge.
- Be able to preliminarily assess the flow rate and sensory evaluation of wastewater composition.
- Be able to operate the drainage system as planned
- Be able to identify the types of wastewater systems and connection works based on design/in reality.
- Be able to apply energy and material conservation measures in operation of drainage system.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Legal basis

2.1.1. Regulations on wastewater collection

2.2.2. Regulations on wastewater discharge

2.2. Overview of wastewater

2.2.1. Wastewater concept

2.2.2. Wastewater flow and composition

2.2.2.1. Daily chart, influence on wastewater and storm water flow

2.2.2.2. Calculation of dirty water and storm water flow

2.2.2.3. Daily peak and average of the day. Lowest amount at night, night average

2.2.2.4. Foreign water flow, determination and calculation of foreign water volume and composition

2.2.2.5. Overloaded water level: blockage, overflow, flood

2.2.3. Wastewater composition

2.2.3.1. Wastewater classification

2.2.3.2. Composition and information values of wastewater

2.3. Wastewater collection and drainage system

2.3.1. Missions and classification of drainage system

2.3.1.1. Mission of drainage

2.3.1.2. Drainage for individual households

2.3.1.2.1. Drainage pipe system for individual households

2.3.1.2.2. Combined and separate drainage system

2.3.1.3. Drainage: Urban drainage

2.3.1.3.1. Combined drainage system

2.3.1.3.2. Separate drainage system

2.3.1.3.3. Semi-separate drainage system

2.3.1.4. Drainage using pressure and vacuum

2.3.2. Sewer properties

2.3.2.1. Sewer cross-section

2.3.2.1.1. Type

2.3.2.1.2. Application

2.3.2.2. Sewer material

2.3.2.2.1. Type

2.3.2.2.2. Production and properties

Lesson 2: Basic structure and installation in the drainage system

Time: 28 hours

1. Lesson objectives:

- Be able to analyze the functions and tasks of the works in the drainage system such as sewers, manholes, pumping stations
- Be able to present the functions and tasks of load-reduction works in the drainage system.

- Be able to check and manage assets on the system (connection boxes, manhole covers, pipes).
- Be able to describe the as-built drawing of drainage system.
- Be able to collect data from drawings and report deviations from reality.
- Be able to calculate the sewer gradient and gradient assessment; calculate the depth of the manhole and the distance between them.
- Be able to calculate simple works.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Works in drainage system

2.1.1. Manhole

2.2.2. Pumping station

2.2.3. Special works (underground sewers)

2.2. Load-reduction works

2.2.1. Classification and missions

2.2.2.1. Storm water path

2.2.2.2. Type of storm water runoff tanks

2.2.2.3. Major sewer

2.2.2.4. Storm water sedimentation tank

2.2.2. Work order sorting

2.2.3. Equipment for load-reduction works

2.2.4. Storm water management

2.2.4.1. Storm water absorbent

2.2.4.2. Storm water usage

2.3. Technical communication

2.3.1. Types of technical drawings

2.3.1.1. Sewer map

2.3.1.2. Gradient map

2.3.1.3. Drainage system diagram

2.3.1.4. Construction drawings

2.3.2. Learn about technical drawings

2.3.2.1. Read and interpret necessary data

2.3.2.2. Calculation and evaluation of gradient at the bottom

2.3.2.3. Calculation of manhole depth and distance between them

2.3.2.2. Calculation of simple works

Lesson 3: Practice operating drainage system model

Time: 58 hours

1. Lesson objectives:

- Be able to operate, adjust, troubleshoot and improve the urban drainage system model.
- Be able to operate, adjust, troubleshoot and improve the industrial drainage system model.
- Be able to conduct reports on model operation.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Urban drainage

2.1.1. Drawing formulation

2.2.2. Operation of urban drainage system model

2.2. Industrial wastewater drainage

2.2.1. Drawing formulation

2.2.2. Operation of industrial wastewater drainage system model

Examination: 6 hours

PART III: SAMPLING AND SUPERVISING DISCHARGE POINTS

Lesson 1: Sampling

Time: 16 hours

1. Lesson objectives:

- Be able to present and formulate a sampling plan as per requirements.
- Be able to present and apply the process of sampling and sensory analysis of different wastewater samples.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Sampling plan

2.1.1. Sampling points

2.1.2. Time

2.1.3. Sample types

2.2. Sampling procedure

2.3. Sensory analysis of different types of wastewater

Lesson 2: Monitoring indirect discharge points

Time: 12 hours

1. Lesson objectives:

- Be able to present and properly apply the procedures for discharge inspection of factories as well as discharge points.
- Be able to read the map of discharge points and update new information according to reality.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Factory inspection

2.2. Inspect indirect discharge points

2.3. Conduct sampling and on-site measurement

2.4. Use indirect discharge point registration map

Examination: 2 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Pipeline workshop.
- AutoCAD-equipped computer room

2. Machine and equipment

- Computers, calculators.

3. Learning materials, tools and consumables

- Course books.
- Handouts.
- References.
- A0 and A4 papers, brush, etc.
- Necessary equipment and tools for practice.
- Equipment and materials to practice drainage pipe installation.
- Models and manuals for operation of urban and industrial drainage systems.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Pipe material

- Be able to describe and classify materials and their properties.
- Be able to present the process of pipeline corrosion and remedies.
- Be able to present and identify some basic parameters of drainage pipes.
- Be able to present the equipment, components and accessories of drainage pipe structure.
- Be able to present the occupational safety regulations in pipe installation procedures.
- Be able to present and interpret the symbols and specifications of pipe installation and processing drawings.
- Be able to describe the functions of tools and handy instruments in pipeline processing and installation.

1.1.2. Part 2: Operation of drainage system

- Be able to present the legal basis and provisions in the current laws of Vietnam on wastewater collection and drainage.
- Be able to present the composition, properties and classification of wastewater in drainage system.
- Be able to present and describe types of sewers, structure and operation of different types of wastewater drainage systems (combined, separate, semi-separate) and connection works.
- Be able to demonstrate energy and material conservation measures in operation of drainage system.
- Be able to analyze the functions and tasks of the works in the drainage system such as sewers, manholes, pumping stations
- Be able to present the functions and tasks of load-reduction works in the drainage system.
- Be able to present and interpret the symbols and specifications of technical drawings.

1.1.3. Part 3: Sampling and supervising discharge points

- Be able to present the sampling plan as per requirements.
- Be able to present the process of sampling and sensory analysis of different wastewater samples.
- Be able to present the supervision procedures of discharge points.

1.2. Skills

1.2.1. Part 1: Pipe material

- Be able to identify and check the materials.
- Be able to apply the solutions to solve the pipeline corrosion.
- Be able to calculate and evaluate some basic parameters of drainage pipes.
- Be able to select the equipment, components and accessories of drainage pipe structure.
- Be able to apply the occupational safety regulations in pipe installation procedures.
- Be able to read drawings and symbols on pipeline installation drawings.
- Be able to proficiently perform techniques of marking, splitting, bending, joining and joining pipes.
- Be able to make the products according to the manufacturing drawings

1.2.2. Part 2: Operation of drainage system

- Be able to search and update new documents as a legal basis for wastewater collection and discharge.
- Be able to preliminarily assess the flow rate and sensory evaluation of wastewater composition.
- Be able to operate the drainage system as planned.
- Be able to identify the types of wastewater systems and connection works based on design/in reality.
- Be able to apply energy and material conservation measures in operation of drainage system.
- Be able to check and manage assets on the system (connection boxes, manhole covers, pipes).
- Be able to collect data from drawings and report deviations from reality.
- Be able to calculate the sewer gradient and gradient assessment; calculate the depth of the manhole and the distance between them.
- Be able to operate, adjust, troubleshoot and improve the urban drainage system model.
- Be able to conduct reports on model operation.

1.2.3. Part 3: Sampling and supervising discharge points

- Be able to formulate a sampling plan as per requirements.
- Be able to apply the process of sampling and sensory analysis of different wastewater samples.
- Be able to apply the procedures to supervise the discharge points.
- Be able to read the map of discharge points and update new information according to reality.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Work independently in changing working conditions, accept individual and partial responsibility for the team;
- Instruct and supervise others performing assigned tasks;
- Evaluate team activities, as well as performance outcomes.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Complete assignments on calculating sewer gradient, manhole depth and simple works.
- Complete assignments on formulating sampling plan.
- Practice drawing preparation and operation of drainage system.
- Evaluate based on practical ability: on the basis of observing learners performing models of drainage systems.
- Partake in group discussions and presentations on topics.

VI. Module implementation instructions

1. Scope of application

The “Operation of Drainage System” module can be used to teach learners at the intermediate, college and advanced German standards college levels for “Sewage engineering technicians”.

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.
- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.
- Teachers need to prepare learning materials with complete instructions for model operation.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Follow safety and hygiene measures when working with wastewater and in confined spaces of sewers.
- Practice as per the instructions of teachers.
- Refer to related documents for more information.
- Actively participate in class activities.

3. Key points requiring attention

3.1. Part 1: Pipe material

- Drainage sewer materials.
- Corrosion process and anti-corrosion measures.
- Auxiliary equipment in the drainage system.
- Material handling, marking, splitting, deforming, joining and connecting pipe techniques.

3.2. Part 2: Operation of drainage system

- Categorization of wastewater and drainage system;
- Wastewater flow and composition;
- Drainage sewer materials.
- Works in drainage system;
- Types of technical drawings.
- Be able to calculate simple works.
- Develop and operate a drainage system model

3.3. Part 3: Sampling and supervising discharge points

- All contents

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5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: MAINTENANCE OF DRAINAGE SYSTEM

Module code: MD 04

Training duration: 330 hours; (Theory: 45 hours; Practice, laboratory, discussion, assignment: 270 hours; Examination: 15 hours).

I. Position and features:

- Position: “Maintenance of Drainage System” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with knowledge on the principles and procedures for performing equipment maintenance tasks in the drainage system; the principles for ensuring occupational safety and electrical safety at work, responding to incidents as well as repairing minor faults within the scope of works. Graduates can perform the tasks related to the maintenance of drainage system at companies specializing in collection and treatment of centralized wastewater and urban wastewater, including preparing a work plan; implementing maintenance of sewers, manhole, auxiliary works; operating specialized equipment, etc.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Module objectives

II.1. Knowledge

- Be able to describe damage and causes of damage in the drainage system.
- Be able to describe the as-built drawing of drainage system.
- Be able to identify and handle potential hazards during maintenance of drainage system.
- Be able to describe the inspection procedures for drainage system.
- Be able to present the concept and describe the maintenance process, of drainage system.
- Be able to present the maintenance methods of drainage system.
- Be able to introduce the necessary machines and equipment for maintenance of drainage system.

- Be able to demonstrate energy and material conservation measures in maintenance of drainage system.
- Be able to present the hazards when working in public transport areas and in confined spaces.
- Be able to present the properties of toxic gases, as well as inspecting and safety ensuring methods when working in wastewater sewers.
- Be able to describe the maintenance measures of sewers, manholes, and connection points.
- Be able to describe the damage in sewers and structures in drainage system.
- Be able to explain the level of damage, causes and consequences of frequent damages on drainage system based on inspection results;
- Be able to propose remedies for damage to drainage system.
- Be able to describe the supervision procedures of discharge points.

II.2. Skills

- Be able to follow the maintenance procedure of drainage system.
- Be able to assess the extent, causes and consequences of frequent damages in drainage system.
- Be able to repair damage in drainage system.
- Be able to read the as-built drawing of drainage system.
- Be able to apply the inspection procedures for drainage system.
- Be able to apply the maintenance methods of drainage system.
- Be able to use the necessary machines and equipment for maintenance of drainage system.
- Be able to apply energy and material conservation measures in maintenance of drainage system.
- Be able to evaluate the level of frequent damage, causes and consequences of damage to sewers and works in drainage system.
- Be able to apply remedies to frequent damage in sewers and structures in drainage system.
- Be able to read technical drawings of sewers.
- Be able to differentiate and proficiently use personal protective and rescue equipment.
- Be able to formulate a sampling plan as per requirements.

- Be able to implement the process of sampling and sensory analysis of different wastewater samples.
- Be able to perform the processes to inspect and evaluate joint tightness, condition of sewers, manholes, pressure capacity of manhole covers and discharge connection points.
- Be able to perform the procedures for discharge inspection of factories as well as discharge points.
- Be able to formulate indirect discharge point registration map.

II.3. Self-control ability and responsibility

- Comply with the rules and regulations on occupational safety and health.
- Comply with regulations under the guidance of workshop assistants and instructors at the training institution.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.
- Comply with occupational safety regulations of training institution.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Module contents

1. General contents and time allocation

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Maintenance of drainage system***	***105***	***45***	***55***	***5***
	Lesson 1: Damage of drainage system 1. Internal and external corrosion 2. Cracking and fragmentation formation 3. Deposition and obstacle layers 4. Position displacement and mechanical abrasion	**15**	**10**	**5**	
	Lesson 2: Inspection measures of drainage system 1. Concepts 2. Simple visual inspection 3. Detailed visual inspection	**35**	**10**	**25**	
	Lesson 3: Maintenance of drainage system 1. Concepts 2. Sewer cleaning 3. Sewer renovation methods	**50**	**25**	**25**	
	Examination	**5**			**5**
2	***Part 2: Practice on maintenance of drainage system***	**225**		**215**	**10**
	Lesson 1: Introduction to working procedures at public facilities 1. Introduction to urban and industrial water drainage 2. Securing a workplace in public	**60**		**60**	

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	traffic areas. 3. Air composition				
	Lesson 2: Personal protective and rescue equipment 1. Personal protective equipment 2. Rescue equipment	**50**		**50**	
	Lesson 3: Sampling and supervising discharge points 1. Sampling 2. Monitoring indirect discharge points	**50**		**50**	
	Lesson 4: Maintenance of drainage system 1. Manhole entering procedure 2. Sewer maintenance methods 3. Sewer inspection via probe 4. Sewer inspection via camera 5. Sewer cleaning methods	**55**		**55**	
	Examination	**10**			**10**

2. Detailed contents:

PART I: MAINTENANCE OF DRAINAGE SYSTEM

Lesson 1: Damage of drainage system

Time: 15 hours

1. Lesson objectives:

- Be able to describe damage and causes of damage in the drainage system.
- Be able to assess the extent, causes and consequences of frequent damages in drainage system.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Internal and external corrosion

2.2. Cracking and fragmentation formation

2.3. Deposition and obstacle layers

2.4. Position displacement and mechanical abrasion

Lesson 2: Inspection measures of drainage system

Time: 35 hours

1. Lesson objectives:

- Be able to describe the as-built drawing of drainage system.
- Be able to read the as-built drawing of drainage system.
- Be able to describe and apply the inspection procedures for drainage system.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Concepts

2.2. Simple visual inspection

2.3. Detailed visual inspection

2.3.1. Qualitative inspection by optical method

2.3.1.1. Sewer probe

2.3.1.2. Sewer mirror, sewer inspection via camera

2.3.2. Qualitative inspection by measuring method

2.3.2.1. Tightness inspection

2.3.2.2. Leak detection

2.3.2.3. Deformation measurement

Lesson 3: Maintenance of drainage system

Time: 50 hours

1. Lesson objectives:

- Be able to describe damage and causes of damage in the drainage system.
- Be able to assess the extent, causes and consequences of frequent damages in drainage system.
- Be able to repair damage in drainage system.
- Be able to present and apply the maintenance methods of drainage system.
- Be able to use the necessary machines and equipment for maintenance of drainage system.
- Be able to demonstrate and apply energy and material conservation measures in maintenance of drainage system.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Concepts

2.2. Sewer cleaning

2.2.1. Purpose and necessity of sewer cleaning

2.2.2. Manual cleaning method

2.2.3. Hydraulic cleaning method

2.2.4. High-pressure cleaning method

2.2.5. Pressure pulling and pushing cleaning method

2.3. Sewer renovation methods

2.3.1. Type

2.3.2. Repairing measures

2.3.2.1. Repairing measures - Plastic coating

2.3.2.2. Anti-cracking spray

2.3.2.3. Waterproofing methods and lining supplement

2.3.3. Renovation method

2.3.3.1. Coating supplement

2.3.3.2. Pipe lining

2.3.3.3. Assembly methods

2.3.4. Construction method

2.3.4.1. Open construction work

2.3.4.2. Closed construction work

Examination: 4 hours

PART II: PRACTICE ON OPERATION, MAINTENANCE OF DRAINAGE SYSTEM

Lesson 1: Introduction to working procedures at public facilities

Time: 60 hours

1. Lesson objectives:

- Be able to present the hazards when working in public transport areas.
- Be able to present the risks when working at wastewater drainage and treatment facilities.
- Be able to present the hazards when working within confined spaces;
- Be able to read technical drawings of sewers.
- Be able to present the properties of toxic gases, as well as inspecting and safety ensuring methods when working in wastewater sewers.
- Comply with the rules and regulations on occupational safety and health.
- Comply with regulations under the guidance of instructors at the training institution.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Introduction to urban and industrial water drainage

2.1.1. Introduction to working on the street

2.1.2. Dangers on the street

2.1.3. Dangers when entering the sewer

2.1.4. Dangers when working in enclosed spaces

2.1.5. Drainage sewer system

2.1.6. Read sewer diagram

2.2. Securing a workplace in public traffic areas.

2.2.1. Safety equipment at construction site

2.2.2. Construction area zoning

2.2.3. Protection of workers and equipment with barriers

2.2.4. Protection of pedestrians with barriers and signs

2.3. Air composition

2.3.1. Toxic gases

2.3.2. Effects of toxic gases (especially H_2S)

2.3.3. Safety thresholds for sewer inspection via probe

Lesson 2: Personal protective and rescue equipment

Time: 50 hours

1. Lesson objectives:

- Be able to differentiate and proficiently use personal protective and rescue equipment.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Personal protective equipment

2.1.1. Items of personal protective equipment

2.1.2. Necessity of wearing protective equipment and personal protective equipment

2.1.3. Maintain regular equipment inspections

2.2. Rescue equipment

2.2.1. Items of rescue equipment

2.2.2. Use and carry rescue equipment

2.2.3. Maintain regular equipment inspections

Lesson 3: Sampling and supervising discharge points

Time: 50 hours

1. Lesson objectives:

- Be able to formulate a sampling plan as per requirements.
- Be able to implement the process of sampling and sensory analysis of different wastewater samples.
- Be able to perform the procedures for discharge inspection of factories as well as discharge points.
- Be able to formulate indirect discharge point registration map.
- Comply with regulations under the guidance of instructors at the training institution.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Sampling

2.2. Monitoring indirect discharge points

Lesson 4: Repair and Maintenance of Drainage System

Time: 55 hours

1. Lesson objectives:

- Be able to evaluate the level of frequent damage, causes and consequences of damage to sewers and works in drainage system.
- Be able to apply remedies to frequent damage in sewers and structures in drainage system.
- Be able to read technical drawings of sewers.
- Be able to perform proper inspection, maintenance procedures.
- Comply with the rules and regulations on occupational safety and health.
- Comply with regulations under the guidance of instructors at the training institution.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Manhole entering procedure

2.2. Sewer maintenance methods

2.3. Sewer inspection via probe

2.4. Sewer inspection via camera

2.5. Sewer cleaning methods

2.5.1. Manual cleaning

2.5.2. Spray-suction device

2.5.3. Cleaning with built-in device including water barrier, rinse hose and brush

2.5.4. High-pressure washing vehicle

2.5.5. Cleaning by outlet gate

2.5.6. Low-pressure washing vehicle

2.5.7. Sewer cleaning robot

Examination: 10 hour

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Pipeline workshop.

- Classroom at the factory, or the office of the internship unit.

2. Machine and equipment

- Computers, calculators.
- Equipment and machine used for operation and maintenance of drainage system at the internship unit.

3. Learning materials, tools and consumables

- Handouts for learners.
- Course books, reference materials…
- Procedure for guiding the operation, maintenance of drainage system at the internship unit.
- Personal protective and rescue equipment.
- Equipment and tools for warning and ensuring public traffic safety.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Maintenance of drainage system

- Be able to present the concept and describe the maintenance process, of drainage system.
- Be able to describe damage and causes of damage in the drainage system.
- Be able to describe the as-built drawing of drainage system.
- Be able to identify and handle potential hazards during maintenance of drainage system.
- Be able to describe the inspection procedures for drainage system.
- Be able to present the maintenance methods of drainage system.
- Be able to demonstrate energy and material conservation measures in maintenance of drainage system.

1.1.2. Part 2: Practice on maintenance of drainage system

- Be able to present the structure and functions of works in the drainage system.
- Be able to present the hazards when working in public transport areas.
- Be able to present the risks when working at wastewater drainage and treatment facilities.

- Be able to present the hazards when working within confined spaces.
- Be able to present the properties of toxic gases, as well as inspecting and safety ensuring methods when working in wastewater sewers.
- Be able to present the safety equipment at workplace, personal protective equipment, rescue equipment, and air composition to be examined in confined spaces.

1.2. Skills

1.2.1. Part 1: Maintenance of drainage system

- Be able to follow the maintenance procedure of drainage system.
- Be able to assess the extent, causes and consequences of frequent damages in drainage system.
- Be able to repair damage in drainage system.
- Be able to read the as-built drawing of drainage system.
- Be able to apply the inspection procedures for drainage system.
- Be able to apply the maintenance methods of drainage system.
- Be able to use the necessary machines and equipment for maintenance of drainage system.
- Be able to apply energy and material conservation measures in maintenance of drainage system.

1.2.2. Part 2: Practice on maintenance of drainage system

- Be able to evaluate the level of frequent damage, causes and consequences of damage to sewers and works in drainage system.
- Be able to apply remedies to frequent damage in sewers and structures in drainage system.
- Be able to read technical drawings of sewers.
- Be able to differentiate and proficiently use personal protective and rescue equipment.
- Be able to formulate a sampling plan as per requirements.
- Be able to implement the process of sampling and sensory analysis of different wastewater samples.
- Be able to perform the processes to inspect and evaluate joint tightness, condition of sewers, manholes, pressure capacity of manhole covers and discharge connection points.

- Be able to perform the procedures for discharge inspection of factories as well as discharge points.
- Be able to formulate indirect discharge point registration map.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Work independently in changing working conditions, accept individual and partial responsibility for the team.
- Instruct and supervise others performing assigned tasks.
- Gain supplementary knowledge for the module such as technical drawing skills, AutoCAD.
- Ensure occupational safety and health principles when working.
- Follow safety and hygiene measures when working with wastewater and in confined spaces of sewers.
- Comply with rules and regulations of the unit.
- Perform tasks assigned by the unit and team leader.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Evaluate through material handling at workshop.
- Partake in group discussions and presentations on topics.
- Evaluate through work efficiency or examinations in each topic and content at the internship unit's factory or company.

VI. Module implementation instructions

1. Scope of application

The “Maintenance of Drainage System” module can be used to teach learners at the intermediate, college and advanced German standards college levels for “Sewage engineering technicians”.

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.
- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.
- Guide learners before their internship course at internship unit.
- Set up goals for learners after completing their internship course at internship unit.

For teachers/lecturers at enterprise

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at company.
- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.
- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Refer to related documents for more information.
- Actively participate in class activities.
- Safely enter the manhole.
- Perform proper inspection, maintenance procedures.
- Comply with rules and regulations of the unit.
- Perform tasks assigned by the unit and team leader;
- Ensure occupational safety and health principles when working.
- Follow safety and hygiene measures when working with wastewater and in confined spaces of sewers.

3. Key points requiring attention

3.1. Part 1: Maintenance of drainage system

- Damage in sewer.
- Sewer inspection, maintenance methods.

3.2. Part 2: Practice on maintenance of drainage system

- Dangers when working at public facilities.
- Ensure safety when working at public facilities.
- Composition and effects of toxic gases.
- Personal protective and rescue equipment.
- All contents must be paid attention and implemented under the supervision of teachers or staff members of the company.

4. References

[1]. Nguyen Viet Anh (Ed) et al. (2017). *Sludge treatment of wastewater treatment plant.* Construction Publishing House.

[2]. Nguyen Viet Anh (Ed) and Tran Hieu Nhue (2017). *Operation and maintenance of centralized wastewater treatment plants*. Science and Technology Publishing House.

[3]. Tran Hieu Nhue et al. (1998). *Water supply and drainage*. Science and Technology Publishing House.

[4]. Assoc. Prof. Dr. Hoang Van Hue (Ed). *Water Drainage - Volume 1: Water drainage system*. Science and Technology Publishing House.

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5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: OPERATION AND MAINTENANCE OF PUMPING STATION

Module code: MD 05

Training duration: 315 hours; (Theory: 103 hours; Practice, laboratory, discussion, assignment: 195 hours; Examination: 17 hours).

I. Position and features:

- Position: “Operation and Maintenance of Pumping Station” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with knowledge on the principles and procedures for performing operation and equipment maintenance tasks in the drainage pumping stations; the principles for ensuring occupational safety and electrical safety at work, responding to incidents as well as repairing minor faults within the scope of works. Graduates can perform the tasks related to the operation and maintenance of drainage system at companies specializing in the collection and treatment of centralized wastewater and urban wastewater, including preparing a work plan; implementing pumping station operation and maintenance; operating measuring and control equipment at the pumping station; implementing industrial cleaning procedure; troubleshooting in operation, performing minor repairs; checking electricity, material consumption rates and implementing cost-cutting measures; producing a list of backup supplies and equipment and report to the shift leader; making a work diary and completing reporting within the scope of work.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Module objectives

II.1. Knowledge

- Be able to present the structure, tasks and classification of electromechanical equipment and machines of pumping station.
- Be able to present the structure, tasks and classification of measuring and controlling devices of pumping station.

- Be able to present the structure, tasks and classification of auxiliary equipment of pumping station.
- Be able to present and differentiate inspection methods at pumping station.
- Be able to describe the operating process of machines and equipment of pumping station.
- Be able to describe possible hazards and safety measures when operating and maintaining pumping station.
- Be able to describe the incidents at pumping station, as well as their causes and remedies.
- Be able to describe the countermeasures to special conditions at pumping station.
- Be able to present the general regulations on maintenance and process at pumping station.
- Be able to describe the important roles of maintenance activities at pumping station.
- Be able to describe how to formulate an organization plan and preparation of materials and equipment for maintenance and repair work at pumping station.
- Be able to list the maintenance methods for equipment at sewage pumping station.
- Be able to list the repair methods for equipment at sewage pumping station.
- Be able to describe the name, location, functions, tasks and structure of the pumps and equipment at pumping station.
- Be able to explain the operation and maintenance procedures of pumping station.

II.2. Skills

- Be able to identify the types of electromechanical equipment and machines of pumping station.
- Be able to identify the types of measuring and controlling devices of pumping station.
- Be able to identify the types of auxiliary equipment of pumping station.
- Be able to apply inspection methods at pumping station.
- Be able to evaluate potential hazards during operation and maintenance of pumping station.

- Be able to apply the operating process of machines and equipment of pumping station.
- Be able to apply troubleshooting procedure of pumping station.
- Be able to apply countermeasures to special conditions at pumping station.
- Be able to store information and conduct reports.
- Be able to formulate an organization plan and preparation of materials and equipment for maintenance and repair work at pumping station.
- Be able to apply the proper maintenance methods for equipment at sewage pumping station.
- Be able to apply the proper repair procedure for equipment at sewage pumping station.
- Be able to apply the proper operation and maintenance procedures of pumping station.

II.3. Self-control ability and responsibility

- Comply with the general regulations on maintenance and repair procedure at pumping station.
- Comply with the regulations on occupational safety and hygiene at internship unit.
- Be diligent, optimistic, hard-working, and self-responsible for assigned duties.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.
- Work independently or in a team, solve complicated issues and work in changing working conditions;
- Guide and supervise others to perform defined tasks; accept individual and collective accountability;
- Evaluate the quality of work outcomes and performance results of team members.

III. Module contents

1. General contents and time allocation

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Pumping station and auxiliary works***	***30***	***28***		***2***
	Lesson 1: Classification, functions and missions of air pumps and compressors 1. Commonly used machines at pumping station 2. Structure, functions and missions of machines at pumping station	**8**	**8**		
	Lesson 2: Classification, functions and missions of electrical equipment and flow meters 1. Electrical equipment and flow meters 2. Functions and missions of measuring and controlling devices at pumping station	**10**	**10**		
	Lesson 3: Classification, functions and missions of auxiliary works 1. Storage tanks 2. Pressure piping system 3. Valves and damper gates 4. Trash baskets/screens	**10**	**10**		

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	5. Functions and missions of auxiliary works				
	Examination	**2**			**2**
2	***Part 2: Operation and troubleshooting at pumping station***	***90***	***30***	***55***	***5***
	Lesson 1: Inspection procedure at pumping station 1. Inspection modes and their roles 2. Inspection subjects	**20**	**10**	**10**	
	Lesson 2: Operating procedure at pumping station 1. General regulations 2. Pre-start inspection 3. Pump start 4. Operational monitoring	**45**	**10**	**35**	
	Lesson 3: Detection and troubleshooting procedure for frequent issues 1. Frequent issues at pumping station 2. Cause evaluation 3. Troubleshooting 4. Responses to emergencies	**20**	**10**	**10**	
	Examination	5			5
3	***Part 3: Maintenance and repair at pumping station***	***105***	***45***	***55***	***5***

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 1: Regulations and importance of maintenance and repair activities 1. General regulations 2. Importance 3. Planning methods 4. Listing and supply preparation methods	**5**	**5**	**0**	
	Lesson 2: Maintenance procedure 1. General regulations on maintenance work 2. Main tasks in maintenance activities	**50**	**20**	**30**	
	Lesson 3: Repair procedure at pumping station 1. Minor repairs 2. Major repairs	**45**	**20**	**25**	
	Examination	5			5
4	***Part 4: Internship at pumping station***	***90***	***0***	***85***	***5***
	Lesson 1: Classification of pumps and equipment of pumping stations 1. Pump classification 2. Equipment classification	**5**		**5**	

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 2: Maintenance procedure at pumping station 1. Pump maintenance 2. One-way flow valve maintenance 3. Inspection and optimization of pumping time 4. Preventing odor in sewers and pumping station	**26**		**26**	
	Lesson 3: Cleaning procedure of pump and pump chamber 1. Pump cleaning 2. Pump chamber cleaning	**16**		**16**	
	Lesson 4: Dismantling/installing procedure 1. Starting and shutting down a system 2. Pump dismantling and installing	**38**		**38**	
	Test/Major assignment	**5**			**5**

2. Detailed contents

PART I: PUMPING STATION AND AUXILIARY WORKS

Lesson 1: Classification, functions and missions of pumps and air compressors

Time: 8 hours

1. Lesson objectives:

- Be able to present the classification and identification of equipment at sewage pumping station.
- Be able to present the structure, functions and missions of pumps at pumping station.
- Be able to identify the types of electromechanical equipment and machines of pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2. 1. Commonly used machines at pumping station

2.1.1 Centrifugal pump

2.1.2. Axial-flow pump

2.1.3. Submersible pump

2.1.4. Air compressor and blower

2.2. Functions and missions of machines at pumping station

2.2.1. Function

2.2.2. Missions

Lesson 2: Classification, functions and missions of electrical equipment and flow meters

Time: 10 hours

1. Lesson objectives:

- Be able to present the classification and identification of electrical equipment and flow meters at pumping station.
- Be able to present the structure, functions and missions of electrical equipment and flow meters at pumping station.
- Be able to identify the types of measuring and controlling devices of pumping station.

- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Electrical equipment and flow meters

2.1.1. Electrical cabinet

2.1.2. Electric motor

2.1.3. Electric generator

2.1.4. Flow meters

2.2 Functions and missions of measuring and controlling devices at pumping station

2.2.1. Function

2.2.2. Missions

Lesson 3: Classification, functions and missions of auxiliary equipment and works

Time: 10 hours

1. Lesson objectives:

- Be able to present the classification and identification of auxiliary equipment and works at pumping station.
- Be able to present the structure, functions and missions of auxiliary equipment and works at pumping station.
- Be able to identify the types of auxiliary equipment of pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Storage tanks

2.1.1. Suction tank

2.1.2. Discharge tank

2.2. Pressure piping system

2.2.1. Suction pipe

2.2.2 Discharge pipe

2.3. Valves and damper gates

2.4. Trash baskets/screens

2.4.1. Coarse screens

2.4.2. Fine screens

2.5. Functions and missions of auxiliary works

2.5.1. Function

2.5.2. Missions

Examination: 2 hours

PART II: OPERATION AND TROUBLESHOOTING AT PUMPING STATION

Lesson 1: Inspection procedure at pumping station

Time: 20 hours

1. Lesson objectives

- Be able to present and differentiate inspection methods at pumping station.
- Be able to apply inspection methods at pumping station.
- Be able to store information in shift handover and operation log.
- Be able to check the status and make a list of proposals for backup materials and equipment.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Inspection modes and their roles

2.1.1. Regular inspection

2.1.2. Periodic inspection

2.1.3. Extraordinary inspection

2.2. Inspection subjects

2.2.1. Composition, responsibilities and inspection organization

2.2.2. Inspection contents

2.3. Information storing and reporting methods

2.2.3.1. Storing information in operation log

2.2.3.2. Storing information in shift handover and operation log

2.4. Backup materials and equipment

Lesson 2: Operating procedure at pumping station

Time: 45 hours

1. Lesson objectives:

- Be able to describe the operating process of machines and equipment of pumping station.
- Be able to describe the operating method of pipeline system in combination with the valve system of pumping station.
- Be able to describe the operating method of trash screens of pumping station.

- Be able to describe the operating method of monitoring and controlling system of measuring devices.
- Be able to describe the operating method of electrical cabinet of pumping station.
- Be able to apply the operating process of machines and equipment of pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. General regulations

2.2. Pre-start inspection

2.2.1. Pump inspection

2.2.2. Inspection of equipment and auxiliary works

2.2.3. Inspection of electrical system

2.3. Pump start

2.4. Operational monitoring

2.4.1. Requirements for pumps in operation

2.4.2. Requirements for equipment and auxiliary works in operation

2.4.3 Cases where machine operation must be stopped

2.4.4. Ensure safety when stopping machine operation

Lesson 3: Detection and troubleshooting procedure for frequent issues

Time: 20 hours

1. Lesson objectives

- Be able to describe the incidents at pumping station, as well as their causes and remedies.
- Be able to describe the countermeasures to special conditions at pumping station.
- Be able to apply troubleshooting procedure of pumping station.
- Be able to apply countermeasures to special conditions at pumping station.
- Be able to store information and conduct reports.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Frequent issues at pumping station

2.1.1. Abnormal operation of pump

2.1.2. Abnormal operation of electric motor

2.1.3. Grid power failure or unbalanced phase voltage

2.1.4. Water overflow in pump chamber

2.1.5. Trash causing blockages in pumps and pipelines

2.2. Cause evaluation

2.2.1. Objective causes

2.2.2. Subjective causes

2.3. Troubleshooting

2.4. Responses to emergencies

2.4.1. Connection and operation of backup power supply

2.4.2. Installation of pumps and backup pipeline systems

2.5 Information storing and reporting methods

Examination: 5 hours

PART III: MAINTENANCE AND REPAIR AT PUMPING STATION

Lesson 1: Regulations and importance of maintenance and repair activities

Time: 5 hours

1. Lesson objectives

- Be able to present the general regulations on maintenance and repair procedure at pumping station.
- Be able to describe the important roles of maintenance and repair activities at pumping station.
- Be able to describe how to formulate an organization plan and preparation of materials and equipment for maintenance and repair work at pumping station.
- Be able to formulate an organization plan and preparation of materials and equipment for maintenance and repair work at pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. General regulations

2.2. Importance

2.3. Planning methods

2.4. Listing and supply preparation methods.

Lesson 2: Repair procedure at pumping station

Time: 50 hours

1. Lesson objectives

- Be able to list the maintenance methods for equipment at sewage pumping station;
- Be able to apply the proper maintenance methods for equipment at sewage pumping station.
- Comply with the general regulations on maintenance procedure at pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. General regulations on maintenance work

2.2. Main tasks in maintenance activities

2.2.1 Observation, inspection of general and external condition of pump and equipment

2.2.2. Observation, inspection of general and external condition of auxiliary works

2.2.3. Machine and equipment maintenance after each operation shift

2.2.3.1. Cleaning

2.2.3.2. Handle oil and water leaks

2.2.3.3. Tighten bolts and screws at parts of pumps and motors that are loosely shaking during operation

2.2.3.4. Industrial cleaning of machines and equipment at pumping station and workshop

2.2.4. Preserve and maintain materials, equipment, spare parts and repair components

2.2.5. Record and store information in operation log and shift handover book

Lesson 3: Repair procedure at pumping station

Time: 45 hours

1. Lesson objectives

- Be able to list the repair methods for equipment at sewage pumping station.
- Be able to apply the proper repair procedure for equipment at sewage pumping station.
- Comply with the general regulations on repair procedure at pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. Minor repairs

2.1.1. General regulations on minor repairs

2.1.2. Contents related to minor repairs

2.1.2.1. Pump repair

2.1.2.2. Repair of suction chamber valve door

2.1.2.3. Repair of trash screens

2.1.2.4. Repair of water distribution and drainage pipeline

2.2. Major repairs

2.2.1 General regulations on major repairs

2.2.2. Contents related to major repairs

2.2.2.1. Pump repair

2.2.2.2. Repair of suction chamber valve door.

2.2.2.3. Repair of trash screens

2.2.3.4. Repair of water distribution and drainage pipeline

Examination: 5 hours

PART IV: INTERNSHIP AT PUMPING STATION

Lesson 1: Classification of pumps and equipment of pumping stations

Time: 5 hours

1. Lesson objectives

- Be able to describe the name, location, functions, tasks and structure of the pumps and equipment at pumping station.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. Pump classification

2.2. Equipment classification

Lesson 2: Maintenance procedure at pumping station

Time: 26 hours

1. Lesson objectives

- Be able to explain the operation and maintenance procedures of pumping station.
- Be able to implement the proper operation and maintenance procedures of pumping station.
- Comply with the regulations on occupational safety and hygiene at internship unit.
- Follow the instructions from the person in charge at the internship unit.
- Be diligent, optimistic, hard-working, and self-responsible for assigned duties.

2. Lesson contents

2.1. Pump maintenance

2.2. One-way flow valve maintenance

2.2.1. Gate valve

2.2.2. Slide valve

2.3. Inspection and optimization of pumping time

2.4. Preventing odor in sewers and pumping station

Lesson 3: Cleaning procedure of pump and pump chamber

Time: 16 hours

1. Lesson objectives

- Explain the cleaning procedure of pump and pump chamber of pumping station.
- Implement the cleaning procedure of pump and pump chamber of pumping station.
- Comply with the regulations on occupational safety and hygiene at internship unit.
- Follow the instructions from the person in charge at the internship unit.
- Be diligent, optimistic, hard-working, and self-responsible for assigned duties.

2. Lesson contents

2.1. Pump cleaning

2.2. Pump chamber cleaning

Lesson 4: Dismantling/installing procedure

Time: 38 hours

1. Lesson objectives

- Follow the correct procedure for shutting down and restarting a system of a pumping station.
- Follow the correct procedure for dismantling and installing a pump in the system.
- Comply with the regulations on occupational safety and hygiene at internship unit.
- Follow the instructions from the person in charge at the internship unit.
- Be diligent, optimistic, hard-working, and self-responsible for assigned duties.

2. Lesson contents

2.1. Starting and shutting down a system

2.2. Pump dismantling and installing.

Test/Major Assignment: 5 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Practice workshops with pump model and auxiliary equipment.
- Practice workshops with sewage pumping station model.
- Classroom at pumping station, or the office of the internship unit.

2. Machine and equipment

- Computers, calculators, overhead projectors;
- Pumping station model.
- Machine and equipment of pumping station.
- Safety equipment and machine such as tripods and winches, personal protective and rescue equipment, etc.
- Supporting devices for traveling and communication

3. Learning materials, tools and consumables

Learning materials:

- Course books, reference materials.
- Handouts, practice guidelines.
- Operation manual and logbook
- Maintenance manual and logbook
- Equipment catalog
- Diagram of factory and pumping station

Tools:

- Personal protective set: protective clothing, reflective vest, S3 shoes, boots, gloves, hats, first aid box, etc.
- Hand-held tool kit.

Consumables:

- Personal bandages, etc.
- Supplies used in maintenance and repair.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Classification, functions and missions of auxiliary equipment and works of pumping station

- Be able to present the structure, tasks and classification of electromechanical equipment and machines of pumping station.

- Be able to present the structure, tasks and classification of measuring and controlling devices of pumping station.
- Be able to present the structure, tasks and classification of auxiliary equipment of pumping station.

1.1.2. Part 2: Operation and troubleshooting at pumping station

- Be able to present and differentiate inspection methods at pumping station.
- Be able to describe the operating process of machines and equipment of pumping station.
- Be able to describe the incidents at pumping station, as well as their causes and remedies.
- Be able to describe the countermeasures to special conditions at pumping station.

1.1.3. Part 3: Maintenance and repair at pumping station

- Be able to present the general regulations on maintenance and repair procedure at pumping station.
- Be able to describe the important roles of maintenance and repair activities at pumping station.
- Be able to describe how to formulate an organization plan and preparation of materials and equipment for maintenance and repair work at pumping station.
- Be able to list the maintenance methods for equipment at sewage pumping station.
- Be able to list the repair methods for equipment at sewage pumping station.

1.1.4. Part 4: Internship at pumping station

- Be able to describe the name, location, functions, tasks and structure of the pumps and equipment at pumping station.
- Be able to explain the operation and maintenance procedures of pumping station.

1.2. Skills

1.2.1. Part 1: Classification, functions and missions of auxiliary equipment and works of pumping station

- Be able to identify the types of electromechanical equipment and machines of pumping station.

- Be able to identify the types of measuring and controlling devices of pumping station.
- Be able to identify the types of auxiliary equipment of pumping station.

1.2.2. Part 2: Operation and troubleshooting at pumping station

- Be able to apply inspection methods at pumping station.
- Be able to apply the operating process of machines and equipment of pumping station.
- Be able to apply troubleshooting procedure of pumping station.
- Be able to apply countermeasures to special conditions at pumping station.
- Be able to store information and conduct reports.

1.2.3. Part 3: Maintenance and repair at pumping station

- Be able to formulate an organization plan and preparation of materials and equipment for maintenance and repair work at pumping station.
- Be able to apply the proper maintenance methods for equipment at sewage pumping station.
- Be able to apply the proper repair procedure for equipment at sewage pumping station.

1.2.4. Part 4: Internship at pumping station

- Be able to apply the proper operation and maintenance procedures of pumping station.
- Be able to implement the proper operation and maintenance procedures of pumping station.
- Follow the correct procedure for shutting down and restarting a system of a pumping station.
- Dismantle and reinstall a pump in the system.
- Identify and differentiate potential hazards during operation and maintenance of pumping station.
- Analyze and evaluate the impact of hazards on health and work performance.
- Use safety devices during operation and maintenance of pumping station.
- Follow company rules and standards in performing tasks to ensure safety.

1.3. Self-control ability and responsibility

- Be diligent, industrious, careful, precise.
- Ensure occupational safety while working.

- Comply with the rules of practice workshop.
- Comply with the regulations of company and internship unit.
- Handle equipment meticulously and safely.
- Be aware of career development
- Be responsible for completing assigned tasks.
- Work independently and solve occupational problems.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Evaluate the implementation of personal protection operations and safety measures at work.
- Evaluate through observing the use of equipment, machines, tools, etc.
- Evaluate through performance at company, or examination at school or company.

VI. Module implementation instructions

1. Scope of application

The “Operation and Maintenance of Pumping Station” module can be used to teach learners at the intermediate, college and advanced German standards college levels for “Sewage engineering technicians”.

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers at school:

- Teaching methods include presentation, integration, conservation, group discussion.
- Use equipment and images to visually illustrate the lessons.
- Teachers can use computers, projectors, and electronic lesson materials when teaching.
- The practice part is implemented in the following form:
  + Group discussion and assignment.
  + Practice at classroom and workshop.
- Guide learners before their internship course at company.
- Set up goals for learners after completing their internship course at company.

For teachers/lecturers at enterprise:

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at the company.
- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.
- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Strictly follow the rules of practice workshop.
- Perform experiments under the guidance of teachers or workshop managers.
- Refer to related documents for more information.
- Actively participate in class activities.
- Be active and proactive in class, actively research practical information, and apply knowledge when visiting factories and doing internships.

3. Key points requiring attention

- All lessons.

4. References

[1]. Le Dung (2017)., Construction Publishing House. *Pumps – Water Collection Works – Drainage and Water Supply Pumping Station*. Construction Publishing House.

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[6]. Vietnamese National Standards, TCVN 8417:2010 *Hydraulic structure - Procedure for Management, Operation and Maintenance of electrical pumping station* The Ministry of Agriculture and Rural Development, 2010.

5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: OPERATION OF WASTEWATER TREATMENT PLANT

Module code: MD 06

Training duration: 345 hours; (Theory: 96 hours; Practice, laboratory, discussion, assignment: 236 hours; Examination: 13 hours).

I. Position and features:

- Position: “Operation of Wastewater Treatment Plant” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with specialized knowledge on operating principles and monitoring procedures for clustered wastewater treatment works in wastewater treatment plants; occupational safety principles and electrical safety principles at work. Graduates can participate in tasks related to the operation of domestic and industrial wastewater treatment plants, including operation of clustered mechanical treatment system; operation of clustered biochemical treatment system; operation of mechanical-chemical complex of treatment systems; operation of disinfection works; operation of odor treatment systems; operation of sludge treatment systems; monitoring and record of daily operation log; information collection and preparation of relevant reports.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to present the legal basis in wastewater treatment, including treatment permission and discharge after treatment.
- Be able to describe the characteristics of domestic wastewater.
- Be able to present the treatment steps in wastewater treatment line.
- Be able to analyze the missions and functions of mechanical wastewater treatment works.
- Be able to analyze the missions and functions of chemical and biological wastewater treatment works.
- Be able to present the characteristics and industrial wastewater treatment methods for each industry.
- Be able to present the objectives and purposes of sludge treatment.

- Be able to present and classify water collection works.
- Be able to present and classify trash baskets/screens.
- Be able to present the factors affecting the operation of trash screens.
- Be able to present the tasks, functions, structure and operating principles of grit chamber.
- Be able to present the tasks, functions, structure and operating principles of primary sedimentation tank.
- Be able to present the types of raw trash collected from trash baskets/screens, grit chamber and primary sedimentation tank, and their treatment and disposal measures.
- Be able to describe the foundations and missions of wastewater treatment.
- Be able to present and differentiate biological methods of activated sludge and biofilm, as well as biofilm and their applications.
- Be able to present the microbial system and the decomposition processes of organic compounds such as carbon, nitrogen, and phosphorus in wastewater.
- Be able to present the decomposition processes of substances in wastewater in anaerobic or anoxic environment such as decarbonization, denitrification and phosphorus removal.
- Be able to present the structure and operation principle of SBR, ASBR, and MBR tanks.
- Be able to present the functions, tasks, classification and structure of the secondary sedimentation tank.
- Be able to present the functions, tasks and operating principles of biological wastewater treatment plants in natural conditions.
- Be able to present the wastewater characteristics of specific industries such as plating, food processing, textile, paper.
- Be able to present the operation parameters.
- Be able to classify sludge, its origin, composition and properties.
- Be able to analyze advantages and disadvantages of sludge treatment methods.
- Be able to present the natural sludge treatment methods, the structure and operating principles of sludge treatment devices.
- Be able to present the sludge stabilization and advanced treatment methods.
- Be able to present the operation parameters.
- Be able to present the inspection and adjusting methods of inlet flow rate.

- Be able to identify mechanical wastewater treatment systems and present their operating principles.
- Be able to identify biological wastewater treatment systems and present their operating principles.
- Be able to identify the activated sludge wastewater treatment systems and present their operation principles.

II.2. Skills

- Be able to calculate the basic operating parameters.
- Be able to evaluate the effectiveness of mechanical treatment systems.
- Be able to draw the schematic diagram of the biological treatment systems using activated sludge and membrane bioreactor as well as biofilm.
- Be able to calculate and evaluate the operation parameters.
- Be able to operate the wastewater treatment technology.
- Be able to collect, evaluate data and write reports.
- Be able to draw schematic diagrams of sludge treatment systems.
- Be able to calculate and evaluate the operation parameters.
- Be able to inspect and evaluate inlet flow rate.
- Be able to operate mechanical treatment works.
- Be able to operate biological wastewater treatment works.
- Be able to operate sludge treatment works.
- Be able to operate equipment, works, measures and control parameters of wastewater treatment plant.
- Be able to monitor and evaluate the operating status of equipment on the automatic control system.
- Be able to evaluate the wastewater treatment efficiency.
- Be able to maintain operation log, record work procedures and outcomes, prepare corresponding reports.

II.3. Self-control ability and responsibility

- Strictly comply with occupational safety regulations.
- Comply with regulations under the guidance of workshop assistants and instructors at the training institution.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

- Maintain a serious and forward-thinking approach to learning.
- Comply with occupational safety regulations of training institution
- Comply with privacy policies of internship unit.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Description

1. General contents and time allocation

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Overview of wastewater treatment***	***15***	***14***		***1***
	Lesson 1: Introduction to wastewater treatment 1. Legal basis in wastewater treatment 2. Overall technology diagram of a wastewater treatment plant	1	1		
	Lesson 2: Mechanical wastewater treatment 1. Functions and missions of works 2. Classification of works 3. Operating principles	3	3		
	Lesson 3: Chemical and biological wastewater treatment 1. Foundations and missions 2. Classification of biological treatment methods	5	5		

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	3. Physiochemical treatment methods				
	Lesson 4: Industrial wastewater treatment 1. Wastewater from paper production 2. Wastewater from plating industry 3. Wastewater from food processing industry 4. Wastewater from textile industry	2	2		
	Lesson 5: Overview of sludge in wastewater treatment system 1. Missions and purposes 2. Sludge classification and origins 3. Sludge composition and properties	3	3		
	Examination	**1**			**1**
2	***Part 2: Mechanical wastewater treatment***	***60***	***30***	***28***	***2***
	Lesson 1: Inlet works 1. Classification of works 2. Functions and missions of works 3. Operating principles of works	***2***	***2***		
	Lesson 2: Trash screens 1. Functions and duties of trash baskets/screens 2. Factors affecting the operation of trash screens	8	8		

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	3. Trash cleaning method for trash screens 4. Treat solid waste collected from trash baskets/screens				
	Lesson 3: Sand sediment and separation of suspended matters 1. Structure of grit chamber 2. Treatment of settled sand 3. Separation of suspended matters	26	12	14	
	Lesson 4: Primary sedimentation tank 1. Structure of primary sedimentation tank 2. Structure and operation of primary sedimentation tank 3. Instrument	22	8	14	
	Examination	2			2
3	***Part 3: Biological wastewater treatment***	***150***	***24***	***120***	***6***
	Lesson 1: Biofilm method 1. Biofilm 2. Structure and operating principle	3	3		
	Lesson 2: Activated sludge method in continuous flow condition 1. Technological diagram and general operation principle	133	13	120	

No.	Module lesson	Time (hour)			
		Total	Theory	Practice, laboratory, discussion, assignment	Examination
	2. Aerobic treatment 3. Nitrification and denitrification process 4. Activated sludge system 5. Phosphorus removal 6. Operation of chemical or biological wastewater treatment models 1.				
	Lesson 3: Special activated sludge treatment methods 1. SBR (Sequenced Batch Reactor) tank 2 ASBR tank 3. MBR (Membrane Bio-Reactor) tank	3	3		
	Lesson 4: Secondary sedimentation tank 1. Functions and missions of secondary sedimentation 2. Classification of secondary sedimentation tank 3. Functional zones and calculation parameters of sedimentation tank	4	4		
	Lesson 5: Natural wastewater treatment 1. Biological pond 2. Constructed wetlands, wastewater treatment plant combined with planting	1	1		

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	3. Maturation ponds				
	Examination	6			6
4	***Part 4: Sludge treatment***	***30***	***28***		***2***
	Lesson 1: Sludge treatment procedures 1. Thickening 2. Dewatering 3. Sludge conditioning 4. Sludge stabilization 5. Advanced sludge treatment	22	22		
	Lesson 2: Sludge recycle 1. Materials 2. Thermal treatment	6	6		
	Examination	2			2
5	***Part 5: Internship at wastewater treatment plant***	***90***		***88***	***2***
	Lesson 1: Mechanical cleaning process 1. Controlling influent 2. Trash baskets/screens 3. Grit chamber 4. Separation tank for suspended matter 5. Primary sedimentation	13		13	
	Lesson 2: Biological treatment works 1. Consolidate general knowledge 2. Overview and observation of treatment technologies.	50		50	

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	3. Aeration method 4. Measurement parameters and results interpretation 5. Secondary sedimentation 6. Phosphorus treatment using chemical precipitation method 7. Disinfection and stabilization of treated wastewater				
	Lesson 3: Sludge treatment works 1. Sludge condensation methods 2. Sludge dewatering methods 3. Sludge drying methods 4. Sludge stabilization 5. Biogas	22		22	
	Lesson 4: Overview of wastewater treatment plant 1. Biological treatment 2. Chemical and biological treatment 3. Sludge treatment	3		3	
	Examination	2			2

2. Detailed contents:

PART I: OVERVIEW OF WASTEWATER TREATMENT

Lesson 1: Introduction to wastewater treatment

Time: 1 hours

1. Lesson objectives:

- Be able to present the legal basis in wastewater treatment including treatment permission and discharge after treatment.
- Be able to describe the characteristics of domestic wastewater.
- Be able to present the treatment steps of a specific wastewater treatment plant.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Legal basis in wastewater treatment

2.1.1. Vietnamese National Standards

2.1.2. Regulations on wastewater treatment

2.2. Characteristics and features of domestic wastewater

2.2.1. Characteristics of domestic wastewater

2.2.2. Features of domestic wastewater

2.3. Overall technology diagram of a wastewater treatment plant

Lesson 2: Chemical wastewater treatment

Time: 3 hours

1. Lesson objectives:

- Be able to analyze the missions and functions of mechanical wastewater treatment works.
- Be able to present and classify water collection works.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Functions and missions of works

2.2. Classification of works

2.3. Operating principles of works

Lesson 3: Chemical and biological wastewater treatment

Time: 5 hours

1. Lesson objectives:

- Be able to describe the foundations and missions of wastewater treatment.
- Be able to analyze the missions and functions of chemical and biological wastewater treatment works.
- Be able to present the microbial system and the decomposition processes of organic compounds such as carbon, nitrogen, and phosphorus in wastewater.
- Be able to present and differentiate biological methods of activated sludge and biofilm as well as biofilm.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Foundations and missions

2.1.1. Classification of microorganisms by substance metabolizing capacity (energy sources, hydrogen, carbon), environmental conditions, living conditions

2.1.2. Organic decomposition process of carbon, nitrogen and phosphorus

2.2. Classification of biological treatment methods

2.2.1. Biofilm method

2.2.2. Activated sludge method

2.2.3. Special biological methods – High-load biological tank

2.3. Physiochemical treatment methods

2.3.1. Filtration

2.3.2. Flotation

2.3.3. Neutralization

2.3.4. Toxin elimination

2.3.5. Ion-exchange

2.3.6. Adsorption

2.3.7. Wet oxidation

2.3.8. Thermal treatment method – extraction

2.3.9. Evaporation

Lesson 4: Industrial wastewater treatment

Time: 2 hours

1. Lesson objectives:

- Be able to present the characteristics and industrial wastewater treatment methods for each industry.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Wastewater from paper production

2.2. Wastewater from plating industry

2.3. Wastewater from food processing industry

2.4. Wastewater from textile industry

Lesson 5: Overview of sludge in wastewater treatment system

Time: 3 hours

1. Lesson objectives:

- Be able to present the objectives and purposes of sludge treatment.
- Be able to present the classification and origin of sludge.
- Be able to describe the composition and properties of sludge.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Missions and purposes

2.2. Sludge classification and origins

2.3. Composition and properties

Examination: 1 hours

PART II: MECHANICAL WASTEWATER TREATMENT

Lesson 1: Inlet works

Time: 2 hours

1. Lesson objectives:

- Be able to present and classify water collection works.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Classification of works

2.2. Functions and missions of works

2.3. Operating principles of works

Lesson 2: Trash screens

Time: 8 hours

1. Lesson objectives:

- Be able to present the structure, principles and operating mechanism of different types of trash screens.
- Be able to present and classify trash baskets/screens.
- Be able to present the types of raw trash collected from trash baskets/screens, and their treatment and disposal measures.
- Be able to present the factors affecting the operation of trash screens.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Functions and duties of trash baskets/screens

2.1.1. Classification of trash baskets/screens

2.1.1.1. Forward/reverse filtration

2.1.1.2. Fine/coarse filtration

2.1.2. Structure and operation of some types of trash screens

2.2. Factors affecting the operation of trash screens

2.2.1. Wastewater flow rate through trash screens

2.2.2. Effects of flow rate

2.3. Trash cleaning method for trash screens

2.3.1. Manual trash cleaning

2.3.2. Trash cleaning via effects of water-level fluctuations

2.3.2.1. Measuring method

2.3.2.2. Emergency side road

2.4. Treat solid waste collected from trash baskets/screens

2.4.1. Necessity

2.4.2. Cleaning

2.4.3. Squeezing

2.4.4. Reuse or incineration

Lesson 3: Sand sediment and separation of suspended matters

Time: 26 hours

1. Lesson objectives:

- Be able to present the tasks, functions, structure and operating principles of grit chamber.
- Be able to read drawings and symbols on drawings.
- Be able to calculate the basic operating parameters.
- Be able to present the types of raw trash collected from grit chamber, and their treatment and disposal measures.
- Be able to present the factors affecting the operation of grit chamber,
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Structure of grit chamber

2.1.1. Foundations and missions

2.1.2. Parameters of grit chamber

2.1.2.1. Surface area, surface flow

2.1.2.2. Flow rate

2.1.2.3. Calculation of parameters

2.1.3. Classification based on operating principles

2.1.3.1. Horizontal flow grit chamber

2.1.3.2. Aerated grit chamber

2.2. Treatment of settled sand

2.2.1. Purposes

2.2.2. Equipment

2.2.3. Reuse and disposal

2.3. Separation of suspended matters

2.3.1. Missions and necessity of suspended matter separation

2.3.2. Classification of suspended matter separation tank

2.3.2.1. Structure and operating principles

2.3.2.2. Classification based on distribution of suspended matter

Lesson 4: Primary sedimentation

Time: 22 hours

1. Lesson objectives:

- Be able to present the tasks, functions, structure and operating principles of primary sedimentation tank.
- Be able to read drawings and symbols on drawings.
- Be able to calculate the basic operating parameters.
- Be able to present the types of raw trash collected from primary sedimentation tank, and their treatment and disposal measures.
- Be able to present the factors affecting the operation of primary sedimentation tank.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Structure of primary sedimentation tank

2.1.1. Foundations and missions

2.1.2. Design parameters of sedimentation tank

2.1.2.1. Calculation of volume, surface area, surface flow and hydraulic retention time

2.1.2.2. Result evaluation

2.1.3. Type

2.2. Structure and operation of primary sedimentation tank

2.2.1. Rectangular sedimentation tank

2.2.2. Circular sedimentation tank

2.2.3. Vertical sedimentation tank

2.2.4. Imhoff sedimentation tank

2.3. Instrument

2.3.1. Water distribution and collection

2.3.2. Sludge scraping and floating scum collection equipment

2.3.3. Sludge pump

Examination: 2 hours

PART III: BIOLOGICAL WASTEWATER TREATMENT

Lesson 1: Biofilm method

Time: 3 hours

1. Lesson objectives:

- Be able to present the wastewater treatment principles using biological membranes and biofilm.
- Be able to present the application of biofilm in wastewater treatment.
- Be able to present the structure and operation principle of biological filtration tanks.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Biofilm

2.1.1. Structure of microbial layers on biofilm

2.1.2. Fixed-bed biofilm - biological layer

2.1.3. Mobile-organic biofilm

2.2. Structure and operating principle

2.2.1. Trickling filter

2.2.2. Suspended carrier biofilm reactor

2.2.3. Fixed-bed filter

2.2.4. Biofilter

Lesson 2: Activated sludge method in continuous flow condition

Time: 133 hours

1. Lesson objectives:

- Be able to present the microbial system and the decomposition processes of organic compounds such as carbon, nitrogen, and phosphorus in wastewater.
- Be able to present the decomposition processes of substances in wastewater in anaerobic or anoxic environment such as decarbonization, denitrification and phosphorus removal.
- Be able to present and calculate the operation parameters.
- Be able to operate the treatment technology.
- Be able to collect, evaluate data and write reports.

- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Technological diagram and general operation principle

2.2. Aerobic treatment

2.2.1. Decarbonization process

2.2.2. Nitrogen treatment process

2.2.3. Types of aeration

2.2.4. Aerobic treatment works

2.3. Nitrification and denitrification process

2.3.1. Conditions and medium

2.3.2. Denitrification mechanism

2.4. Activated sludge system

2.4.1. Operating parameters of activated sludge (activated sludge concentration, sludge volume, SVI, surface load, sludge density, excess sludge and return activated sludge)

2.4.2. Evaluation of operating parameters

2.5. Phosphorus removal

2.5.1. Biological phosphorus removal

2.5.2. Chemical precipitation

2.6. Operation of biological wastewater treatment models

Lesson 3: Special activated sludge treatment methods

Time: 3 hours

1. Lesson objectives:

- Be able to present the structure and operation principle of SBR, ASBR, and MBR tanks.
- Be able to describe the processes occurring in the tank.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. SBR (Sequenced Batch Reactor) tank

2.2. ASBR (Advanced Sequencing Batch Reactor) tank

2.3. MBR (Membrane Bio-Reactor) tank

Lesson 4: Secondary sedimentation

Time: 4 hours

1. Lesson objectives:

- Be able to present the functions and missions of secondary sedimentation.
- Be able to present the functions, mission, classification, and operating principles of secondary sedimentation tank.
- Be able to present and calculate the operation parameters of secondary sedimentation tank.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Functions and missions of secondary sedimentation

2.2. Classification of secondary sedimentation tank

2.3. Functional zones and calculation parameters of sedimentation tank

Lesson 5: Natural wastewater treatment

Time: 1 hours

1. Lesson objectives:

- Be able to present the functions, tasks and operating principles of biological wastewater treatment plants in natural conditions.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Biological pond

2.1.1. Aeration ponds

2.1.2. Anaerobic ponds

2.2. Constructed wetlands, wastewater treatment plant combined with planting

2.3. Maturation ponds

Examination: 6 hours

PART IV: SLUDGE TREATMENT

Lesson 1: Sludge treatment procedures

Time: 22 hours

1. Lesson objectives:

- Be able to classify sludge, its origin, composition and properties.
- Be able to draw schematic diagrams of sludge treatment systems.
- Be able to analyze advantages and disadvantages of sludge treatment methods.
- Be able to present the natural sludge treatment methods, the structure and operating principles of sludge treatment devices.
- Be able to present the sludge stabilization and advanced treatment methods.
- Be able to present the operation parameters.
- Be able to calculate and evaluate the operation parameters.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Thickening

2.1.1. Non-mechanical thickening

2.1.2. Mechanical thickening

2.2. Dewatering

2.2.1. Non-mechanical dewatering - Sludge drying bed

2.2.2. Mechanical dewatering

2.3. Sludge conditioning

2.4. Sludge stabilization

2.4.1. Aerobic sludge stabilization

2.4.2. Anaerobic sludge stabilization

2.5. Advanced sludge treatment

2.5.1. Spray-drying

2.5.2. Incineration

Lesson 2: Sludge recycle

Time: 6 hours

1. Lesson objectives:

- Be able to present sludge recycle methods.
- Be able to present the applications and applicability of recycled sludge.

- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Materials

2.2. Thermal treatment

Examination: 2 hours

PART V: INTERNSHIP AT WASTEWATER TREATMENT PLANT

Lesson 1: Mechanical cleaning process

Time: 13 hours

1. Lesson objectives:

- Be able to present the inspection and adjusting methods of inlet flow rate.
- Be able to inspect and evaluate inlet flow rate.
- Be able to identify mechanical wastewater treatment systems and present their operating principles.
- Be able to operate mechanical treatment works.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Controlling influent of treatment plant

2.1.1. Adjusting influent

2.1.2. Parameters to measure during influent inspection

2.2. Trash baskets/screens

2.2.1. Classification of trash baskets/screens

2.2.2. Trash cleaning methods and equipment for trash baskets/screens

2.2.3. Treatment and disposal of trash collected from trash baskets/screens

2.2.4. Composition of trash collected from trash baskets/screens

2.2.5. Necessity of removing garbage from trash baskets/screens

2.3. Grit chamber

2.3.1. Classification of grit chamber

2.3.2. Sand extraction methods

2.3.3. Grit treatment

2.3.4. Purpose of sedimentation and undesirable effects

2.3.5. Necessity of removing sand and mineral material from tanks

2.4. Separation tank for suspended matter

2.4.1. Classification of suspended matter

2.4.2. Necessity of suspended matter separation

2.4.3. Separation method

2.5. Primary sedimentation

2.5.1. Mission of primary sedimentation tank

2.5.2. Classification of tank (square and circular)

2.5.3. Water inlet device

2.5.4. Sludge collection methods

2.5.5. Retention time

Lesson 2: Biological treatment works

Time: 50 hours

1. Lesson objectives:

- Be able to identify biological wastewater treatment systems and present their operating principles.
- Be able to operate biological wastewater treatment works.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Consolidate general knowledge

2.1.1. Metabolized substances

2.1.2. Biological and chemical processes in wastewater

2.1.3. Nitrification

2.1.4. Denitrification

2.1.5. Biological phosphorus removal

2.2. Overview and observation of treatment technologies

2.2.1. Natural method

2.2.1.1. Constructed wetland

2.2.1.2. Biological pond

2.2.2. Biofilm method

2.2.2.1. Fixed-bed filter

2.2.2.2. Trickling filter

2.2.2.3. Suspended carrier biofilm reactor

2.2.2.4. Spinning disk reactor

2.2.3. Activated sludge method

2.2.3.1. Simultaneous method

2.2.3.2. Interleaved method

2.2.3.3. Discontinuous method

2.2.3.4. Pre and post-denitrification

2.2.3.5. Stage connection

2.2.4. Closed cycle

2.2.5. Return activated sludge

2.3. Aeration method

2.3.1. Surface aeration

2.3.2. Pressure aeration

2.4. Measurement parameters and results interpretation

2.4.1. Reading and collecting measured parameters

2.4.2. Interpretation of measurement results and errors

2.5. Secondary sedimentation

2.5.1. Structure of secondary sedimentation chamber

2.5.2. Zones in secondary sedimentation chamber and their functions

2.5.3. Excess sludge and operating parameters

2.6. Phosphorus treatment using chemical precipitation method

2.6.1. Chemical precipitation process of phosphorus

2.6.2. Classification of precipitates per position of precipitants

2.6.2.1. Pre-precipitation

2.6.2.2. Simultaneous precipitation

2.6.2.3. Post-precipitation (Chemical treatment)

2.7. Disinfection and stabilization of treated wastewater

2.7.1. Disinfection methods

2.7.2. Water stabilization systems

Lesson 3: Sludge treatment works

Time: 22 hours

1. Lesson objectives:

- Be able to present knowledge related to sludge treatment, and sludge treatment methods.
- Be able to operate sludge treatment works.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Sludge condensation methods

2.2. Sludge dewatering methods

2.3. Sludge drying methods

2.4. Sludge stabilization

2.4.1. Aerobic and anaerobic decomposition

2.4.2. Types of process

2.4.3. Zones in anaerobic tank

2.4.4. Measurement parameters

2.5. Biogas

2.5.1. Gas treatment

2.5.2. Storage

2.5.3. Use

Lesson 4: Overview of wastewater treatment plant

Time: 3 hours

1. Lesson objectives:

- Be able to evaluate the wastewater treatment efficiency.
- Be able to maintain operation log, record work procedures and outcomes, prepare corresponding reports.
- Comply with privacy policies of internship unit.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Mechanical wastewater treatment

2.2. Chemical or mechanical wastewater treatment

2.3. Sludge treatment

Examination: 2 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Practical rooms of treatment models.
- Studying at factories or companies.

2. Machine and equipment

- Computers and overhead projectors.
- Practice model of mechanical wastewater treatment: grit chamber or sedimentation tank.

- Practice model of mechanical, biological or chemical wastewater treatment methods.

3. Learning materials, tools and consumables

- Handouts for learners.
- Course books, reference materials,
- Instrument and consumables
- Personal protective equipment.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Overview of wastewater treatment

- Be able to present the legal basis in wastewater treatment, including treatment permission and discharge after treatment.
- Be able to describe the characteristics of domestic wastewater.
- Be able to present the treatment steps in wastewater treatment line.
- Be able to analyze the missions and functions of mechanical wastewater treatment works.
- Be able to analyze the missions and functions of chemical and biological wastewater treatment works.
- Be able to present the characteristics and industrial wastewater treatment methods for each industry.
- Be able to present the wastewater characteristics of specific industries such as plating, food processing, textile, paper.
- Be able to present the objectives and purposes of sludge treatment.

1.1.2. Part 2: Mechanical wastewater treatment

- Be able to present and classify water collection works.
- Be able to present and classify trash baskets/screens.
- Be able to present the factors affecting the operation of trash screens.
- Be able to present the tasks, functions, structure and operating principles of grit chamber.
- Be able to present the tasks, functions, structure and operating principles of primary sedimentation tank.

- Be able to present the types of raw trash collected from trash baskets/screens, grit chamber and primary sedimentation tank, and their treatment and disposal measures.

1.1.3. Part 3: Biological wastewater treatment

- Be able to describe the foundations and missions of wastewater treatment.
- Be able to present and differentiate biological methods of activated sludge and biofilm, as well as biofilm and their applications.
- Be able to present the microbial system and the decomposition processes of organic compounds such as carbon, nitrogen, and phosphorus in wastewater.
- Be able to present the decomposition processes of substances in wastewater in anaerobic or anoxic environment such as decarbonization, denitrification and phosphorus removal.
- Be able to present the structure and operation principle of SBR, ASBR, and MBR tanks.
- Be able to present the functions, tasks, classification and structure of the secondary sedimentation tank.
- Be able to present the functions, tasks and operating principles of biological wastewater treatment plants in natural conditions.
- Be able to present the operation parameters.

1.1.4. Part 4: Sludge treatment

- Be able to classify sludge, its origin, composition and properties.
- Be able to analyze advantages and disadvantages of sludge treatment methods.
- Be able to present the natural sludge treatment methods, the structure and operating principles of sludge treatment devices.
- Be able to present the sludge stabilization and advanced treatment methods.
- Be able to present the operation parameters.

1.1.5. Part 5: Internship at wastewater treatment plant

- Be able to present the inspection and adjusting methods of inlet flow rate.
- Be able to identify mechanical wastewater treatment systems and present their operating principles.
- Be able to identify biological wastewater treatment systems and present their operating principles.
- Be able to identify the activated sludge wastewater treatment systems and present their operation principles.

1.2. Skills

1.2.1. Part 1: Overview of wastewater treatment

1.2.2. Part 2: Mechanical wastewater treatment

- Be able to calculate the basic operating parameters.
- Be able to evaluate the effectiveness of mechanical treatment systems.

1.2.3. Part 3: Biological wastewater treatment

- Be able to draw the schematic diagram of the biological treatment systems using activated sludge and membrane bioreactor as well as biofilm.
- Be able to calculate and evaluate the operation parameters.
- Be able to operate the wastewater treatment technology.
- Be able to collect, evaluate data and write reports.

1.2.4. Part 4: Sludge treatment

- Be able to draw schematic diagrams of sludge treatment systems.
- Be able to calculate and evaluate the operation parameters.

1.2.5. Part 5: Internship at wastewater treatment plant

- Be able to inspect and evaluate inlet flow rate.
- Be able to operate mechanical treatment works.
- Be able to operate biological wastewater treatment works.
- Be able to operate sludge treatment works.
- Be able to operate equipment, works, measures and control parameters of wastewater treatment plant.
- Be able to monitor and evaluate the operating status of equipment on the automatic control system.
- Be able to evaluate the wastewater treatment efficiency.
- Be able to maintain operation log, record work procedures and outcomes, prepare corresponding reports.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Improve knowledge through reading reference materials,
- Update information on operating procedures of new technology,
- Comply with occupational safety and health regulations when working with wastewater.
- Comply with occupational safety and health regulations when working with sludge.
- Strictly follow the rules and regulations of the factory and the internship unit.

- Have a sense of responsibility with the assigned tasks.
- Learn from colleagues
- Comply with privacy policies of internship unit.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Evaluate based on practical ability: observing the process of performing model operations.
- Observe learners operating the model.
- Evaluate through performance at company, or examination at school or company.

VI. Module implementation instructions

1. Scope of application

The “Operation of Wastewater Treatment Plant” module can be used to teach learners at the intermediate, college and advanced German standards college levels for “Sewage engineering technicians”.

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.
- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.
- Guide learners before their internship course at internship unit.
- Set up goals for learners after completing their internship course at internship unit.

For teachers/lecturers at enterprise

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at the company.
- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.

- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Complete all assigned assignments.
- Refer to related documents for more information.
- Actively participate in class activities.
- Actively seek out practical information, apply knowledge before practicing at wastewater treatment plant

3. Key points requiring attention

3.1. Part 1: Overview of wastewater treatment

3.2. Part 2: Mechanical wastewater treatment

- Trash screens.
- Grit chamber.
- Flotation process and grit chamber.

3.3. Part 3: Biological wastewater treatment

- Biological wastewater treatment.
- Activated sludge method in continuous flow condition.
- Secondary sedimentation

3.4. Part 4: Sludge treatment

- Sludge thickening
- Sludge dewatering
- Sludge stabilization

3.5. Part 5: Internship at wastewater treatment plant

- All contents of the module

4. References

[1]. Nguyen Viet Anh (Ed) and Tran Hieu Nhue (2017). *Operation and maintenance of centralized wastewater treatment plants* Science and Technology Publishing House.

[2]. Hoang Hue (1996). *Wastewater treatment*. Construction Publishing House, Hanoi.

[3]. Trinh Xuan Lai (2000) *Calculation and design of wastewater treatment works*. Construction Publishing House, Hanoi.

[4]. Tran Van Nhan and Ngo Thi Nga (1999). *Wastewater Treatment Technology course book.* Science and Technology Publishing House.

[5]. Tran Hieu Nhue (1999). *Drainage and industrial wastewater treatment*. Science and Technology Publishing House, Hanoi.

5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: ELECTRICAL INSTALLATION IN WASTEWATER TREATMENT

Module code: MD 07

Training duration: 330 hours; (Theory: 86 hours; Practice, laboratory, discussion, assignment: 223 hours; Examination: 21 hours).

I. Position and features:

- Position: “Electrical Installation in Wastewater Treatment” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with basic knowledge and practical skills on electrical safety techniques and measurement techniques, installation techniques for civil lighting circuits; knowledge and practical skills on electrical machines, maintenance methods for electrical machines in general and in wastewater treatment plants in particular. In addition, it also provides learners with knowledge and practical skills in installing dynamic controlling circuits in electrical cabinets, and troubleshooting electrical systems.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to present the fundamental principles and definitions of electrical safety techniques.
- Be able to present the types, roles, and functions of safety devices in electrical circuits.
- Be able to present the fundamental principles and definitions in the techniques for measuring and inspecting electrical equipment.
- Be able to present the inspecting methods and electrical circuit quantities need to be inspected; identify and describe the structure and uses of measuring devices.
- Be able to present the measurement principles and measuring values of devices in technical electrical circuits.
- Be able to classify household electrical circuits, their structures, functions and tasks.
- Be able to describe the principles of connecting devices to household electrical circuits.

- Be able to describe the principles of connecting safety devices to household electrical circuits.
- Be able to present the components and structure of machines and power stations.
- Be able to present the electrical structure of electrical machines such as electrical motors, pumps, air compressors, generators, sludge presses, and their operation and maintenance methods.
- Be able to analyze the damage and their causes to electrical machines used in environmental treatment.
- Be able to present and recognize symbols, names and orders of electrical devices on technical drawings of typical electrical circuit diagrams in a plant.
- Be able to classify switching devices, transformers, and describe their roles and functions in electrical circuits.
- Be able to classify switching devices, transformers, and describe their roles and functions in technical electrical circuit diagram.
- Be able to present the principles of connection, inspection and replacement of switching devices and transformers in electrical circuits.

II.2. Skills

- Be able to apply occupational safety and health regulations in the electrical field in specific cases.
- Master the electrical safety rules.
- Be able to convert and calculate measurands.
- Be able to measure and inspect electrical equipment on basic electrical circuits.
- Be able to apply measurements to actual equipment operation at factory.
- Be able to make connections in electrical circuits.
- Be able to connect electrical equipment to household electrical circuits as required.
- Be able to connect safety devices to household electrical circuits as required.
- Be able to explain the operating principles and applications of transformers, motors and generators.
- Be able to calculate for selecting conductors and tools for switching and protecting electrical machines in electrical cabinets. Be able to implement safe operation of electrical machines.

- Be able to propose measures to prevent damage to electrical machines used in environmental treatment.
- Be able to read electrical symbols and drawings inside and outside a work.
- Be able to apply inspection and cleaning procedures for electrical cabinets.
- Be able to connect switching devices and transformers to technical circuits and inspect their operation.

II.3. Self-control ability and responsibility

- Comply with the safety principles when exposing with power sources.
- Comply with the rules and regulations on electrical safety;
- Implement safety measures while working with electrical equipment.
- Be able to use electrical tools and measuring equipment proficiently.
- Be able to use multimeter.
- Be able to use electrical tools and measuring equipment proficiently.
- Be able to make connections of wires and cables as per technical requirements.
- Be able to perform the safety measures when connecting electrical equipment.
- Be able to perform the safety measures when connecting safety devices in an electrical circuit.
- Be able to use multimeter to measure the parameters of electrical machine.
- Be able to install control circuits, and connect motors per diagram.
- Be able to analyze, inspect and troubleshoot electrical machines.
- Be able to perform the safety measures when installing electrical equipment in an electrical cabinet.
- Be able to make the connection of electrical equipment in an electrical cabinet using proper technique.
- Be able to implement safety and inspection procedures when connecting electrical equipment in an electrical system.
- Be able to analyze, inspect and troubleshoot electrical system.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Description

1. General contents and time allocation

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Basic electrical installation technique***	***135***	***45***	***83***	***7***
	Lesson 1: Occupational safety regulations in electricity sector 1. Occupational safety and Labor Code 2. Occupational safety principles	2	2		
	Lesson 2: Connecting techniques of safety devices 1. Fuses in the power distribution cabinet 2. Safety switching for motor in power distribution cabinet 3. Conductive safety switches 4. NH fuse	40	10	30	
	Lesson 3: Installation techniques in household electrical circuits 1. Fuse matching 2. Circuit diagrams 3. Connection procedure in circuit diagram 4. Connection procedure for socket in circuit diagram	73	30	43	
	Lesson 4: Measurement and inspection techniques 1. Introduction to techniques and measuring value display devices 2. Voltage and amperage measuring method	13	3	10	

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Examination	**7**			**7**
2	***Part 2: Motor installation techniques in electrical circuits***	***105***	***13***	***85***	***7***
	Lesson 1: Motor connecting techniques in electrical circuit 1. Foundation for circuit diagram 2. Motor connecting techniques in electrical circuit	62	7	55	
	Lesson 2: Motor inspection and measuring techniques in electrical circuit 1. Inspect a recently repaired extension cable 2. Measure voltage at the terminal block of a three-phase motor 3. Measure insulation of electrical equipment and system 4. Potentiometric and current measurement based on an example of oxygen adjustment	36	6	30	
	Examination	**7**			**7**
3	***Part 3: Electrical equipment and systems of a factory***	***90***	***28***	***55***	***7***
	Lesson 1: Typical electrical circuit diagram of a factory 1. Symbols on an electrical circuit 2. Name 3. Position in a drawing	2	2		

No.	Module name	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 2: Basic electrical machines 1. Transformers 2. USV and UPS station 3. Backup power station	1	1		
	Lesson 3: Connecting techniques of switching devices and transformers 1. Simple motor protection circuit breaker with signal display board 2. Reversing protection circuit for starting wiper 3. Replacement of malfunctioned control transformer	80	25	55	
	Examination	**7**			**7**

2. Detailed contents

PART I: BASIC ELECTRICAL INSTALLATION TECHNIQUE

Lesson 1: Law on electrical safety

Time: 2 hours

1. Lesson objectives

- Be able to present the fundamental principles and definitions of electrical safety techniques.
- Be able to apply occupational safety and health regulations in the electrical field in specific cases.
- Comply with the safety principles when exposing with power sources.

2. Lesson contents

2.1. Occupational safety and Labor Code

2.1.1. Occupational safety regulations

2.1.2. Occupational safety when working with electricity

2.2. Occupational safety principles

2.2.1. Five electrical safety principles

2.2.2. Triple-safety principle

Lesson 2: Connecting techniques of safety devices

Time: 40 hours

1. Lesson objectives

- Be able to present the types, roles, and functions of safety devices in electrical circuits.
- Master the electrical safety rules.
- Comply with the rules and regulations on electrical safety; Implement safety measures while working with electrical equipment.
- Be serious about learning and research.

2. Lesson contents

2.1. Fuses in power distribution cabinet

2.2. Safety switching for motor in power distribution cabinet

2.3. Conductive safety switches

2.4. NH fuse

Lesson 3: Installation techniques in household electrical circuits

Time: 73 hours

1. Lesson objectives

- Be able to classify household electrical circuits, their structures, functions and tasks.
- Be able to make connections in electrical circuits.
- Be able to make connections of wires and cables as per technical requirements.
- Be able to describe the principles of connecting devices to household electrical circuits.
- Be able to connect electrical equipment to household electrical circuits as required.
- Be able to perform the safety measures when connecting electrical equipment.
- Be able to describe the principles of connecting safety devices to household electrical circuits.
- Be able to connect safety devices to household electrical circuits as required.
- Be able to perform the safety measures when connecting safety devices in an electrical circuit.
- Be serious about learning and research.

2. Lesson contents

2.1. Fuse matching

2.2. Circuit diagrams

2.2.1. Open and closed circuit diagram

2.2.2. Series circuit diagram

2.2.3. Cross circuit diagram

2.3. Connection procedure in circuit diagram

2.4. Connection procedure for socket in circuit diagram

Lesson 4: Measurement and inspection techniques

Time: 13 hours

1. Lesson objectives

- Be able to present the fundamental principles and definitions in the techniques for measuring and inspecting electrical equipment.
- Be able to convert and calculate measurands.
- Be able to use electrical tools and measuring equipment proficiently.
- Be able to present the inspecting methods and electrical circuit quantities need to be inspected; identify and describe the structure and uses of measuring devices.
- Be able to measure and inspect electrical equipment on basic electrical circuits.
- Be able to use multimeter.

- Be able to present the measurement principles and measuring values of devices in technical electrical circuits.
- Be able to apply measurements to actual equipment operation at factory.
- Be able to use electrical tools and measuring equipment proficiently.
- Be serious about learning and research.

2. Lesson contents

2.1. Introduction to techniques and measuring value display devices

2.1.1. Measuring techniques

2.1.1.1. Measuring equipment, measuring chain

2.1.1.2. Measuring procedure

2.1.1.3. Analogue transmission technique of measured values

2.1.1.4. Digital transmission technique of measured values

2.1.1.5. Causes of error

2.1.2. Measuring value display devices

2.2. Voltage and amperage measuring method

2.2.1. Instruction on measuring electrical elements

2.2.1.1. Measuring electrical elements

2.2.1.2. Measuring voltage

2.2.1.3. Measuring amperage

2.2.1.4. Measuring resistance

2.2.2. Measuring insulation

2.2.2.1. Overview of insulation resistance

2.2.2.2. Inspection schedule

2.2.2.3. Requirements for insulation measuring devices

2.2.2.4. Resistance value and measurement at construction site

2.2.3. Insulation monitoring device and measuring practice guideline

Examination: 7 hours

PART II: MOTOR INSTALLATION TECHNIQUES IN ELECTRICAL CIRCUITS

Lesson 1: Motor connecting techniques in electrical circuit

Time: 62 hours

1. Lesson objectives

- Be able to present the electrical structure of electrical machines such as electrical motors, pumps, air compressors, generators, sludge presses, and their operation and maintenance methods.
- Be able to calculate for selecting conductors and tools for switching and protecting electrical machines in electrical cabinets.
- Be able to implement safe operation of electrical machines.
- Be able to install control circuits, and connect motors per diagram.
- Be serious about learning and research.

2. Lesson contents

2.1. Foundation for circuit diagram

2.1.1. Open and closed protection circuit diagram

2.1.2. Self-locking by contactor

2.1.3. Timer relay

2.2. Motor connecting techniques in electrical circuit

2.2.1. Star-delta circuit

2.2.2. Star-delta circuit with soft start

2.2.3. Dahlander circuit

Lesson 2: Motor inspection and measuring techniques in electrical circuit

Time: 36 hours

1. Lesson objectives

- Be able to present how to inspect an electrical circuit.
- Be able to present the measurement principles and measuring values of devices in technical electrical circuits to ensure safety.
- Be able to apply measurements to actual equipment operation at factory.
- Be able to analyze the damage and their causes to electrical machines used in environmental treatment.
- Be able to propose measures to prevent damage to electrical machines used in environmental treatment.
- Be able to analyze, inspect and troubleshoot electrical machines.
- Be serious about learning and research.

2. Lesson contents

2.1. Inspect a recently repaired extension cable

2.2. Measure voltage at the terminal block of a three-phase motor

2.3. Measure insulation of electrical equipment and system

2.4. Potentiometric and current measurement based on an example of oxygen adjustment

Examination: 7 hours

PART III: ELECTRICAL EQUIPMENT AND SYSTEMS OF A FACTORY

Lesson 1: Typical electrical circuit diagram of a factory

Time: 2 hours

1. Lesson objectives

- Be able to present and recognize symbols, names and orders of electrical devices on technical drawings of typical electrical circuit diagrams in a plant.
- Be able to read electrical symbols and drawings inside and outside a work.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. Symbols on an electrical circuit

2.2. Name

2.3. Position in a drawing

Lesson 2: Machines and power stations

Time: 1 hour

1. Lesson objectives

- Be able to present the components and structure of machines and power stations.
- Be able to explain the operating principles and applications of transformers, motors and generators.
- Be able to use multimeter to measure the parameters of electrical machine.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents

2.1. Transformer

2.1.1. Small-sized transformers

2.1.2. Short circuit characteristics

2.1.3. Special small-sized transformers

2.1.4. Scattered field transformers

2.1.5. Power chart of a transformer

2.2. USV and UPS station

2.3. Backup power station

Lesson 3: Connecting techniques of switching devices and transformers

Time: 80 hours

1. Lesson objectives

- Be able to classify switching devices, transformers, and describe their roles and functions in electrical circuits.
- Be able to connect switching devices and transformers to circuits and inspect their operation.
- Be able to make the connection of electrical equipment in an electrical cabinet using proper technique.
- Be able to apply inspection and cleaning procedures for electrical cabinets.
- Be able to perform the safety measures when installing electrical equipment in an electrical cabinet.
- Be able to implement safety and inspection procedures when connecting electrical equipment in an electrical system.
- Be able to present the principles of connection, inspection and replacement of switching devices and transformers in electrical circuits.
- Be able to connect switching devices and transformers to technical circuits and inspect their operation.
- Be able to analyze, inspect and troubleshoot electrical system.
- Be serious about learning and research.

2. Lesson contents

2.1. Simple motor protection circuit breaker with signal display board

2.2. Reversing protection circuit for starting wiper

2.3. Replacement of malfunctioned control transformer

Examination: 7 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Practical rooms of motors and electrical equipment.

2. Machine and equipment

- Electrician toolkit, training model.
- Electrical installation cabin.
- Motor, engine.

3. Learning materials, tools and consumables

- Handouts for learners.
- Electrical equipment training models.
- Diagrams, drawings;
- Soft electrical cable, tapes, etc.
- Electrical safety toolkit, electrician toolkit.
- Protective equipment

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Basic electrical installation technique

- Be able to present the fundamental principles and definitions of electrical safety techniques.
- Be able to present the types, roles, and functions of safety devices in electrical circuits.
- Be able to present the fundamental principles and definitions in the techniques for measuring and inspecting electrical equipment.
- Be able to present the inspecting methods and electrical circuit quantities need to be inspected; identify and describe the structure and uses of measuring devices.
- Be able to present the measurement principles and measuring values of devices in technical electrical circuits.
- Be able to classify household electrical circuits, their structures, functions and tasks.
- Be able to describe the principles of connecting devices to household electrical circuits.
- Be able to describe the principles of connecting safety devices to household electrical circuits.

1.1.2. Part 2: Motor installation techniques in electrical circuits

- Be able to present the electrical structure of electrical machines such as electrical motors, pumps, air compressors, generators, sludge presses, and their operation and maintenance methods.
- Be able to analyze the damage and their causes to electrical machines used in environmental treatment.

1.1.3. Part 3: Electrical equipment and systems of a factory

- Be able to present and recognize symbols, names and orders of electrical devices on technical drawings of typical electrical circuit diagrams in a plant.
- Be able to present the components and structure of machines and power stations.
- Be able to classify switching devices, transformers, and describe their roles and functions in electrical circuits.
- Be able to classify switching devices, transformers, and describe their roles and functions in technical electrical circuit diagram.
- Be able to present the principles of connection, inspection and replacement of switching devices and transformers in electrical circuits.

1.2. Skills

1.2.1. Part 1: Basic electrical installation technique

- Be able to apply occupational safety and health regulations in the electrical field in specific cases.
- Master the electrical safety rules.
- Be able to convert and calculate measurands.
- Be able to measure and inspect electrical equipment on basic electrical circuits.
- Be able to apply measurements to actual equipment operation at factory.
- Be able to make connections in electrical circuits.
- Be able to connect electrical equipment to household electrical circuits as required.
- Be able to connect safety devices to household electrical circuits as required.

1.1.2. Part 2: Motor installation techniques in electrical circuits

- Be able to explain the operating principles and applications of transformers, motors and generators.
- Be able to calculate for selecting conductors and tools for switching and protecting electrical machines in electrical cabinets.
- Be able to implement safe operation of electrical machines.
- Be able to propose measures to prevent damage to electrical machines used in environmental treatment.

1.1.3. Part 3: Electrical equipment and systems of a factory

- Be able to read electrical symbols and drawings inside and outside a work.
- Be able to connect switching devices and transformers to circuits and inspect their operation.

- Be able to apply inspection and cleaning procedures for electrical cabinets.
- Be able to connect switching devices and transformers to technical circuits and inspect their operation.

1.3. Self-control ability and responsibility

- Comply with the safety principles when exposing with power sources.
- Comply with the rules and regulations on electrical safety; Implement safety measures while working with electrical equipment.
- Be able to use electrical tools and measuring equipment proficiently.
- Be able to use multimeter.
- Be able to use electrical tools and measuring equipment proficiently.
- Be able to make connections of wires and cables as per technical requirements.
- Be able to perform the safety measures when connecting electrical equipment.
- Be able to perform the safety measures when connecting safety devices in an electrical circuit.
- Be able to use multimeter to measure the parameters of electrical machine.
- Be able to install control circuits, and connect motors per diagram.
- Be able to analyze, inspect and troubleshoot electrical machines.
- Be able to perform the safety measures when installing electrical equipment in an electrical cabinet.
- Be able to make the connection of electrical equipment in an electrical cabinet using proper technique.
- Be able to implement safety and inspection procedures when connecting electrical equipment in an electrical system.
- Be able to analyze, inspect and troubleshoot electrical system.

2. Method

- Evaluate through examination: oral examination, multiple choice, essay, observing practical activities.

VI. Module implementation instructions

1. Scope of application

"Electrical Installation in Wastewater Treatment" module can be used to teach learners at college and advanced German standards college levels for "Sewage Engineering Technician".

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers

- Teaching methods include presentation, integration, conservation, group discussion.
- Use equipment and images to visually illustrate the theoretical lessons.
- Practice skills in using electrician's tools and circuit assembly skills.
- Teachers can use computers, projectors, and electronic lesson materials when teaching.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Strictly follow the rules of practice workshop.
- Perform experiments under the guidance of teachers or workshop managers.
- Refer to related documents for more information.
- Actively engage in activities in class and search for in-practice information.

3. Key points requiring attention

- All lessons.

4. References

[1]. General Directorate of Vocational Training. *Electrical Engineering course book*.

[2]. Dang Van Dao and Le Van Doanh (2001). *Electrical Engineering*. Education Publishing House.

[3]. Vu Quang Hoi *Engine Control Techniques course book*. Education Publishing House.

5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: MAINTENANCE OF WASTEWATER TREATMENT PLANT

Module code: MD 08

Training duration: 300 hours; (Theory: 56 hours; Practice, laboratory, discussion, assignment: 238 hours; Examination: 6 hours).

I. Position and features:

- Position: “Maintenance of Wastewater Treatment Plant” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with knowledge on the principles and procedures for performing operation and equipment maintenance tasks in wastewater treatment plant; the principles for ensuring occupational safety and electrical safety at work, responding to incidents as well as repairing minor faults within the scope of works. Graduates can perform the tasks related to the maintenance of wastewater treatment stations at a plant or company specializing in the collection and treatment of centralized wastewater and urban wastewater, including implementing maintenance tasks as requested by the company; making a list of backup equipment within the assigned scope; repairing machines and equipment within the assigned scope; maintaining machines and equipment of wastewater treatment plant; implementing the principles on occupational safety and environmental sanitation; recording operation log and conducting reports, etc.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to identify the objectives of maintenance tasks at a wastewater treatment plant.
- Be able to present and classify maintenance strategies.
- Be able to present the list of materials and equipment within the assigned scope.
- Be able to list out the potential incidents during maintenance.
- Be able to present the maintenance procedures for machines, equipment and works at a wastewater treatment plant.
- Be able to present and describe hand-held tools, equipment and machines for maintenance.

II.2. Skills

- Be able to make maintenance plans for works, machines and equipment within the assigned scope.
- Be able to formulate a preparation plan of materials and equipment within the assigned scope.
- Be able to perform proper inspection, maintenance procedures for machines and equipment.
- Be able to use hand-held tools, equipment and machines for maintenance.
- Be able to record maintenance log.
- Be able to update the maintenance activities into machine, equipment and construction monitoring log.

II.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Comply with measures to ensure occupational safety when performing inspection and maintenance work at a wastewater treatment plant.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Description

1. General contents and time allocation

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Repair and Maintenance of Wastewater Treatment Plants***	***120***	***56***	***60***	***4***
	Lesson 1: Overview 1. Maintenance and inspection concepts 2. Objectives of maintenance of	**20**	**18**	**2**	

No.	Module lesson	Time (hour)			
		Total	Theory	Practice, laboratory, discussion, assignment	Examination
	wastewater treatment plant 3. Maintenance strategies 4. Making a list and classifying the importance of machinery and equipment 5. Inspection and maintenance planning 6. Making a list of backup supplies and equipment 7. Occupational safety when performing inspection and maintenance work at a wastewater treatment plant				
	Lesson 2: Maintenance of machine and equipment 1. Mechanical wastewater treatment works 2. Biological or chemical wastewater treatment works 3. Sludge treatment works 4. Cleaning pump chamber and treatment tanks 5. Electrical control and lighting system 6. Reporting on maintenance and inspection results 7. Updating equipment and machine monitoring log	**96**	**38**	**58**	
	Examination	**4**			**4**
2	***Part 2: Practice on maintenance***	***180***		***178***	***2***

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	of wastewater treatment plant 1. Mechanical wastewater treatment works 2. Biological or chemical wastewater treatment works 3. Sludge treatment works 4. Electrical control and lighting system 5. Reporting on maintenance and inspection results 6. Updating equipment and machine monitoring log				
	Examination	**2**			**2**

2. Detailed contents:

PART I: MAINTENANCE OF WASTEWATER TREATMENT PLANT

Lesson 1: Overview

Time: 20 hours

1. Lesson objectives:

- Be able to identify the objectives of maintenance tasks at a wastewater treatment plant.
- Be able to present and classify maintenance strategies.
- Be able to make maintenance plans for works, machines and equipment within the assigned scope.
- Be able to present the list materials and equipment within the assigned scope.
- Be able to formulate a preparation plan of materials and equipment within the assigned scope.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Maintenance and inspection concepts

2.2. Objectives of maintenance of wastewater treatment plant

2.3. Maintenance strategies

2.4. Making a list and classifying the importance of machinery and equipment

2.5. Inspection and maintenance planning

2.6. Making a list of backup supplies and equipment

2.7. Occupational safety when performing inspection and maintenance work at a wastewater treatment plant.

Lesson 2: Maintenance of machine and equipment

Time: 96 hours

1. Lesson objectives:

- Be able to present the maintenance procedures for machines, equipment and works at a wastewater treatment plant.
- Be able to perform proper inspection, maintenance procedures for machines and equipment.
- Be able to list out the potential incidents during maintenance.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Mechanical wastewater treatment works

2.1.1. Submersible pump

2.1.2. Screw pump

2.1.3. Sludge pump

2.1.4. Trash screens

2.1.5. Hand valve, gate valve, milling gate

2.1.6. Flow meters

2.2. Biological or chemical wastewater treatment works

2.2.1. Air blower

2.2.2. Air compressor

2.2.3. Chemical dosing pump

2.2.4. Stirrer

2.2.5. Hand valve, gate valve, milling gate

2.2.6. Flow meters

2.3. Sludge treatment works

2.3.1. Centrifugal concentrator

2.3.2. Centrifugal water separator

2.3.3. Belt press machine

2.4. Cleaning pump chamber and treatment tanks

2.4.1. Pump chamber

2.4.2. Equalization tank

2.4.3. Grit chamber

2.4.4. Primary sedimentation tank

2.4.5. Biological tank

2.4.6. Secondary sedimentation tank

2.4.7. Disinfection tank

2.4.8. Sludge thickening tank

2.5. Electrical control and lighting system

2.5.1. Electrical control system

2.5.2. Lighting system

2.6. Report of maintenance and inspection results

2.7. Update on equipment and machine monitoring log

Examination: 4 hours

PART II: PRACTICE ON MAINTENANCE OF WASTEWATER TREATMENT PLANT

Time: 180 hours

1. Lesson objectives:

- Be able to present the maintenance procedures for machines, equipment and works at a wastewater treatment plant.
- Be able to perform proper inspection, maintenance procedures for machines and equipment.
- Be able to present and describe hand-held tools, equipment and machines for maintenance.
- Be able to use hand-held tools, equipment and machines for maintenance.
- Be able to record maintenance log.
- Be able to update the maintenance activities into machine, equipment and construction monitoring log.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Mechanical wastewater treatment works

2.2. Biological or chemical wastewater treatment works

2.3. Sludge treatment works

2.4. Electrical control and lighting system

2.5. Report results

2.6. Update on equipment and machine monitoring log

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms
- Practice workshops with model
- Practice: Studying at factories or office of companies.

2. Machine and equipment

- Computers, calculators.

- Practice model of mechanical, biological or chemical wastewater treatment methods.
- Computers, calculators.
- Personal protective equipment.

3. Learning materials, tools and consumables

- Handouts for learners.
- Course books, reference materials…

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Repair and Maintenance of Wastewater Treatment Plants

- Be able to identify the objectives of maintenance tasks at a wastewater treatment plant.
- Be able to present and classify maintenance strategies.
- Be able to present the list materials and equipment within the assigned scope.
- Be able to list out the potential incidents during maintenance.

1.1.2. Part 2: Practice on maintenance of wastewater treatment plant

- Be able to present the maintenance procedures for machines, equipment and works at a wastewater treatment plant.
- Be able to present and describe hand-held tools, equipment and machines for maintenance.

1.2. Skills

1.2.1. Part 1: Maintenance of wastewater treatment plant

- Be able to make maintenance plans for works, machines and equipment within the assigned scope.
- Be able to formulate a preparation plan of materials and equipment within the assigned scope.

1.2.2. Part 2: Practice

- Be able to perform proper inspection, maintenance procedures for machines and equipment.
- Be able to use hand-held tools, equipment and machines for maintenance.
- Be able to record maintenance log.

- Be able to update the maintenance activities into machine, equipment and construction monitoring log.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Work independently in changing working conditions, accept individual and partial responsibility for the team.
- Instruct and supervise others performing assigned tasks.
- Follow safety and hygiene measures when working with wastewater and in confined spaces.
- Evaluate the quality of work outcomes and performance results of team members.
- Solve occupational problems.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Partake in group discussions and presentations on topics.
- Evaluate through performance at company or plant, or examination at company or plant.

VI. Module implementation instructions

1. Scope of application

"Maintenance of Wastewater Treatment Plant" module can be used to teach learners at college and advanced German standards college levels for "Sewage Engineering Technician".

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers at school

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.
- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.
- Teachers need to prepare learning materials with complete instructions for implementing inspection and maintenance activities.

For teachers/lecturers at enterprise

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at the company.
- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.
- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Refer to related documents for more information.
- Actively participate in class activities.
- Perform proper inspection, maintenance procedures.

3. Key points requiring attention

3.1. Part 1: Maintenance of wastewater treatment plant

- Be able to evaluate the importance of each type of machine and equipment;
- Be able to make a list of backup supplies and equipment for maintenance work;
- Be able to make maintenance plans for machines and equipment within the assigned scope.

3.2. Part 2: Practice on maintenance of wastewater treatment plant

- Be able to perform proper inspection, maintenance procedures for machines and equipment.
- Apply the measures to ensure occupational safety when performing inspection and maintenance work at a wastewater treatment plant.

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5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: QUALITY SUPERVISION OF WASTEWATER TREATMENT PROCEDURE

Module code: MD 09

Training duration: 345 hours. (Theory: 90 hours; Practice, laboratory, discussion, assignment: 245 hours; Examination: 10 hours).

I. Position and features:

- Position: “Quality Supervision of Wastewater Treatment Procedure” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with specialized knowledge on methods of sampling and analyzing samples to assess the water quality and treatment efficiency of wastewater treatment plant. Graduates can take part in the tasks of monitoring the quality of influent and effluent wastewater treatment plant or wastewater treatment station and system of centralized wastewater treatment companies, including monitoring the operating processes of a plant, proposing recommendations to improve the quality of operation and record-storage activities; determining the parameters of influent and effluent and sampling plan; sampling wastewater and sludge; preparing analysis; analyzing basic parameters (pH, BOD_5, COD, ammonium, nitrate, bacteria...) and recording results; evaluating experimental results and proposing measures to improve quality; recording operation log and reports within the scope of work.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to present the meaning and objectives of sampling, sampling conditions, sampling methods and making sampling records.
- Be able to present the methods for sample homogenization, sample filtration and sample preservation.
- Be able to describe the method for measuring field parameters.
- Be able to present the methods for analyzing pollution indicators and operating parameters in wastewater treatment plant.

II.2. Skills

- Be able to take samples and make sampling records.
- Be able to take samples of wastewater and sludge, as well as store samples properly.
- Be able to inspect and measure field parameters.
- Be able to determine the sediments in influent and effluent using Imhoff cone.
- Be able to determine the filterable solids, the amount of dry matter, the calcined residue, and loss in calcination.
- Be able to measure the content of dissolved oxygen in water using electrodes and improved Winkler method in laboratory.
- Be able to analyze the acidity and alkalinity via calculating the concentration of CO_2 using acid-base titration method.
- Be able to define the hydrogen sulfide concentration using methylene blue and lead paper.
- Be able to analyze the overall and individual parameters in wastewater using available cuvettes and standard curve construction methods.
- Be able to eliminate the errors in analysis.
- Be able to calculate and evaluate the analysis results.
- Be able to implement sensory evaluation for parameters of wastewater and sludge at work site.
- Be able to measure the parameters of wastewater at work site.
- Be able to make sampling minutes.
- Be able to analyze such operating parameters as: COD, BOD_5, nitrogen, phosphorus, and solids.
- Be able to analyze microbiological parameters such as coliform.
- Be able to observe microorganisms using microscope and evaluate the status of activated sludge sample.
- Be able to synthesize data from the quality analyzing process of wastewater and sludge.
- Be able to calculate the treatment efficiency of wastewater treatment plant and report results.

II.3. Self-control ability and responsibility

- Have a sense of discipline in studying, cooperating and helping each other.
- Comply with laboratory and factory regulations.
- Ensure the integrity of analysis results.

- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Description

1. General contents and time allocation

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Analysis of wastewater and sludge***	***210***	***90***	***115***	***5***
	Lesson 1: Sampling and analyzing on-site parameters 1. Sampling of wastewater and sludge 2. On-site measurement parameters	**15**	**15**		
	Lesson 2: Analytical methods of wastewater and sludge parameters 1. Overall parameters 2. Individual parameters 3. Solids in wastewater and sludge 4. Other parameters	**75**	**75**		
	Lesson 3: Practice of sampling and on-site analysis 1. Sampling of wastewater and sludge 2. Visual inspection 3. Measurement of on-site parameters: temperature, pH,			**9**	

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	electrical conductivity, turbidity, sludge volume 4. Fill in sampling minutes				
	Lesson 4: Practice of determining solids 1. Determine sediments in influent sample using Imhoff cone 2. Filterable solids in treated water 3. Activated sludge and content of dry matter			**16**	
	Lesson 5: Practice of determining operating parameters 1. Measuring oxygen content 2. Determine acidity and alkalinity 3. Determine hydrogen sulfide			**20**	
	Lesson 6: Practice of analyzing pollution parameters in wastewater 1. Determine some overall parameters 2. Determine individual parameters 3. Microbiological analysis 4. Quality evaluation of treated water			**70**	
	Examination				**5**
2	**Part 2: Practice of analysis of wastewater and sludge**	***135***		***130***	***5***

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 1: Sampling and analyzing on-site parameters 1. Preparatory work 2. Determine sampling location 3. Implement sampling procedure 4. Fill in sampling minutes 5. Transport and storage samples at laboratory	**15**		**15**	
	Lesson 2: Analysis of wastewater and sludge parameters 1. Overall parameters 2. Individual parameters 3. Solids in wastewater 4. Other parameters 5. Microbiological analysis	**85**		**85**	
	Lesson 3: Quality evaluation of treated water 1. Synthesis of analysis data 2. Calculate treatment efficiency of treatment works 3. Compare with QCVN 4. Report results	**30**		**30**	
	Examination	**5**			**5**

2. Detailed contents:

PART I: ANALYSIS OF WASTEWATER AND SLUDGE

Lesson 1: Sampling and analyzing on-site parameters

Time: 15 hours

1. Lesson objectives:

- Be able to present the meaning and objectives of sampling, sampling conditions, sampling methods and making sampling records.
- Be able to take samples and make sampling records.
- Be able to present the methods for sample homogenization, sample filtration and sample preservation.
- Be able to take samples of wastewater and sludge, as well as store samples properly.
- Be able to describe the method for measuring field parameters.
- Be able to inspect and measure field parameters.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Sampling of wastewater and sludge

2.1.1. Sampling method

2.1.2. Sampling storage

2.1.3. Sampling minutes

2.2. On-site measurement parameters

2.2.1. Visual inspection smell, color, turbidity

2.2.2. Basic physical and chemical parameters

2.2.3. Sludge sedimentation volume

Lesson 2: Analytical methods of wastewater and sludge parameters

Time: 75 hours

1. Lesson objectives:

- Be able to present the methods for analyzing pollution indicators and operating parameters in wastewater treatment plant.
- Be able to eliminate the errors in analysis.
- Be able to calculate and evaluate the analysis results.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Overall parameters

2.1.1. Total hardness

2.1.2. COD, BOD_5

2.2. Individual parameters

2.2.1. Nitrogen parameter

2.2.2. Phosphorus parameter

2.3. Solids in wastewater and sludge

2.3.1. Sediments

2.3.2. Filterable substances

2.3.3. Dry matter, residue, loss in calcination, and dry matter content

2.4. Other parameters

2.4.1. Alkalinity

2.4.2. Acidity

Lesson 3: Practice of sampling and on-site analysis

Time: 5 hours

1. Lesson objectives:

- Be able to implement the sampling of wastewater and sludge, as well as sample preservation using proper technique.
- Be able to inspect and measure field parameters.
- Be able to fill in sampling minutes.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Sampling of wastewater and sludge

2.2. Visual inspection

2.3. Measurement of on-site parameters: temperature, pH, electrical conductivity, turbidity, sludge volume

2.4. Fill in sampling minutes

Lesson 4: Practice of determining solids

Time: 20 hours

1. Lesson objectives:

- Be able to determine the sediments in influent and effluent using Imhoff cone.
- Be able to determine the filterable solids, the amount of dry matter, the calcined residue, and loss in calcination.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Determine sediments in influent and effluent using Imhoff cone

2.2. Filterable solids in treated water

2.2.1. Determine dry matter

2.2.2. Determine calcination residue

2.2.3. Determine loss in calcination

2.3. Activated sludge and content of dry matter

2.3.1. Determine dry matter

2.3.2. Determine calcination residue

2.3.3. Determine loss in calcination

Lesson 5: Practice of determining operating parameters

Time: 20 hours

1. Lesson objectives:

- Be able to measure the content of dissolved oxygen in water using electrodes and improved Winkler method in laboratory.
- Be able to analyze the acidity and alkalinity via calculating the concentration of CO_2 using acid-base titration method.
- Be able to define the hydrogen sulfide concentration using methylene blue and lead paper.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.

- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Measure oxygen content

2.1.1. Measurement using electrode

2.1.2. Measurement using improved Winkler method

2.2. Determine acidity and alkalinity

2.2.1. Determine acidity

2.2.2. Determine alkalinity

2.3. Determine hydrogen sulfide

2.3.1. Methylene blue

2.3.2. Lead paper

Lesson 6: Practice of analyzing pollution parameters in wastewater

Time: 70 hours

1. Lesson objectives:

- Be able to analyze the overall and individual parameters in wastewater using available cuvettes and standard curve construction methods.
- Be able to eliminate the errors in analysis.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Determine some overall parameters

2.1.1. Determine COD

2.1.2. Determine BOD_5

2.1.3. Determine lime reserve and organic acid content in compost slurry

2.2. Determine individual parameters

2.2.1. Using test kit

2.2.1.1. Determine ammonium, nitrate, nitrite, total nitrogen

2.2.1.2. Determine ortho-phosphate, total phosphorus

2.2.2. Determine using standard curve construction method

2.2.2.1. Standard curve construction method

2.2.2.2. Determine ammonium, nitrate, nitrite

2.2.2.3. Determine ortho-phosphate

2.3. Microbiological analysis

2.3.1. Microscopic examination of activated sludge samples

2.3.2. Analysis of Coliform and E. coli

2.4. Post-treatment quality evaluation

2.4.1. Calculate treatment efficiency of wastewater treatment plant

2.4.2. Compare with QCVN and conclude

Examination: 5 hours

PART II: PRACTICE OF ANALYSIS OF WASTEWATER AND SLUDGE

Lesson 1: Sampling and analyzing on-site parameters

Time: 15 hours

1. Lesson objectives:

- Be able to implement sampling of wastewater and sludge, transporting and preserving samples at the factory's laboratory.
- Be able to perform on-site parameter determination.
- Be able to fill in sampling minutes.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Preparatory work

2.2. Determine sampling location

2.3 Implement sampling procedure

2.3.1. Sensory evaluation: smell, color, turbidity

2.3.2. Measurement of on-site parameters: temperature, pH, DO, electrical conductivity, turbidity

2.3.3. Measure of sludge sedimentation volume

2.4. Fill in sampling minutes

2.5. Transport and storage samples at laboratory

Lesson 2: Analysis of wastewater and sludge parameters

Time: 80 hours

1. Lesson objectives:

- Be able to analyze such operating parameters as: COD, BOD_5, nitrogen, phosphorus, solids, etc.
- Be able to analyze microbiological parameters such as coliform.
- Be able to observe microorganisms using microscope and evaluate the status of activated sludge sample.
- Comply with regulations under the guidance of workshop assistants.

- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Determine some overall parameters

2.1.1. Determine COD

2.1.2. Determine BOD_5

2.2. Determine individual parameters

2.2.1. Nitrogen parameter

2.2.2. Phosphorus parameters

2.3. Solids in wastewater

2.3.1. Sediments

2.3.2. Filterable substances

2.3.3. Dry matter, residue, loss in calcination, and dry matter content

2.4. Other parameters

2.4.1. Alkalinity

2.4.2. Acidity

2.5. Microbiological analysis

2.5.1. Observing microorganisms under a microscope

2.5.2. Analysis of Coliform

Lesson 3: Quality evaluation of treated water

Time: 30 hours

1. Lesson objectives:

- Be able to synthesize data from the quality analyzing process of wastewater and sludge.
- Be able to calculate the treatment efficiency of wastewater treatment plant and report results.
- Comply with regulations under the guidance of workshop assistants.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.

- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Synthesis of analysis data

2.2. Calculate treatment efficiency of treatment works

2.3. Compare with QCVN

2.4. Report results

Examination: 5 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Biochemistry practice laboratory.
- Studying at factories or laboratories.

2. Machine and equipment

- Computers, calculators.
- Laboratory equipment

3. Learning materials, tools and consumables

Learning materials:

- Handouts for learners.
- Course books, reference materials…

Tools:

- Laboratory instruments: pipette, burette, etc.
- Laboratory equipment
- Protection equipment

Consumables:

- Chemicals, test kit, etc.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Analysis of wastewater and sludge

- Be able to present the meaning and objectives of sampling, sampling conditions, sampling methods and making sampling records.

- Be able to present the methods for sample homogenization, sample filtration and sample preservation.

1.1.2. Part 2: Practice of analysis of wastewater and sludge

- Be able to describe the method for measuring field parameters.
- Be able to present the methods for analyzing pollution indicators and operating parameters in wastewater treatment plant.

1.2. Skills

1.2.1. Part 1: Analysis of wastewater and sludge

- Be able to take samples and make sampling records.
- Be able to take samples of wastewater and sludge, as well as store samples properly.
- Be able to inspect and measure field parameters.
- Be able to determine the sediments in influent and effluent using Imhoff cone.
- Be able to determine the filterable solids, the amount of dry matter, the calcined residue, and loss in calcination.
- Be able to measure the content of dissolved oxygen in water using electrodes and improved Winkler method in laboratory.
- Be able to analyze the acidity and alkalinity via calculating the concentration of CO_2 using acid-base titration method.
- Be able to define the hydrogen sulfide concentration using methylene blue and lead paper.
- Be able to analyze the overall and individual parameters in wastewater using available cuvettes and standard curve construction methods.
- Be able to eliminate the errors in analysis.
- Be able to calculate and evaluate the analysis results.

1.2.2. Part 2: Practice

- Be able to implement sensory evaluation for parameters of wastewater and sludge at work site.
- Be able to measure the parameters of wastewater at work site.
- Be able to make sampling minutes.
- Be able to analyze such operating parameters as: COD, BOD_5, nitrogen, phosphorus, and solids.
- Be able to analyze microbiological parameters such as coliform.
- Be able to observe microorganisms using microscope and evaluate the status of activated sludge sample.

- Be able to synthesize data from the quality analyzing process of wastewater and sludge.
- Be able to calculate the treatment efficiency of wastewater treatment plant and report results.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Work independently in changing working conditions, accept individual and partial responsibility for the team.
- Instruct and supervise others performing assigned tasks.
- Comply with laboratory and factory regulations.
- Ensure the integrity of analysis results.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Observe learners' performance during practice at the laboratory. The experiments include titration, determination of solid mass, optical measurement, etc.
- Observe earners' performance during internship at factory's laboratory. The experiments include titration, determination of solid mass, optical measurement, etc.
- Repeating practice of analysis steps.

VI. Module implementation instructions

1. Scope of application

"Quality Supervision of Wastewater Treatment Procedure" module can be used to teach learners at college and advanced German standards college levels for "Sewage Engineering Technician".

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers at school

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.

- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.
- Teachers need to prepare learning materials with complete instructions for conducting experiments.

For teachers/lecturers at enterprise

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at the company.
- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.
- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Have a sense of discipline in studying, cooperating and helping each other.
- Complete all assignments of the self-studying hours.
- Ensure the integrity of analysis results.
- Strictly follow laboratory rules at school and internship unit.
- Perform experiments under the guidance of teachers or laboratory managers.
- Refer to related documents for more information.
- Actively participate in class activities.

3. Key points requiring attention

3.1. Part 1: Analysis of wastewater and sludge

- Sampling and sample preservation techniques.
- Analyzing techniques of wastewater and sludge parameters.

3.2. Part 2: Practice of analysis of wastewater and sludge

- Sampling and sample preservation techniques.
- Analyzing techniques of wastewater and sludge parameters.
- Synthesize data and report results.

4. References

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5. Notes and explanations (if any)

APPENDIX 03

MODULE PROGRAM

Module name: ERROR ANALYSIS AND TROUBLESHOOTING

Module code: MD 10

Training duration: 330 hours; (Theory: 73 hours; Practice, laboratory, discussion, assignment: 242 hours; Examination: 15 hours).

I. Position and features:

- Position: “Error Analysis and Troubleshooting” module is taught along with other Specialized modules, and after the Fundamental modules.
- Features: This specialized module provides learners with general knowledge on evaluating and identifying methods for errors during the operation of various types of equipment and works in wastewater collection and treatment system. It also provides knowledge about emergency situations and how to respond promptly and effectively. Learners can recognize the necessity of corrective measures and data analysis methods to prevent future errors or to provide better solutions in emergencies.
- This module can be divided into chapters with different training durations and objectives as per the regulations on training duration for each module. However, this module must ensure its following main objectives.

II. Objectives

II.1. Knowledge

- Be able to present the concept, importance and impact of incidents and troubleshooting in drainage and wastewater treatment.
- Be able to describe and classify the impact level of potential incidents and risks in drainage and wastewater treatment.
- Be able to describe the troubleshooting procedures for incidents in drainage and wastewater treatment.
- Be able to describe and classify the types of incidents in drainage system.
- Be able to describe the responding and handling process for incidents in drainage system.
- Be able to describe and present technological incidents of wastewater treatment.
- Be able to describe and present equipment malfunctions of wastewater treatment.

- Be able to describe the responding and handling process for incidents in wastewater treatment.
- Be able to describe and classify incidents at internship unit.
- Be able to present and describe the incident troubleshooting process at internship unit.

II.2. Skills

- Be able to recognize the importance and impact of incidents and troubleshooting in drainage and wastewater treatment.
- Be able to evaluate the impact of incidents and risks on the operation of drainage and wastewater treatment at each level.
- Be able to use proper troubleshooting procedures for incidents in drainage and wastewater treatment.
- Be able to analyze the causes of incidents in drainage system.
- Be able to evaluate the impact of incidents and propose a plan to ensure continuous and stable operation of drainage system.
- Be able to apply proper responding and handling process for incidents in drainage system.
- Be able to handle incidents in drainage system properly.
- Be able to write reports and store records of drainage system as per regulations.
- Be able to analyze the causes of technological incidents in wastewater treatment.
- Be able to analyze the causes of incidents related to machine and equipment in wastewater treatment.
- Be able to apply proper responding and handling procedures for incidents in wastewater treatment.
- Be able to troubleshoot incidents in wastewater treatment properly.
- Be able to write reports and store records in wastewater treatment as per regulations.
- Be able to analyze the causes of incidents in drainage and wastewater treatment at internship unit.
- Be able to apply proper responding and handling procedures for incidents in drainage and wastewater treatment at internship unit.
- Be able to troubleshoot incidents in drainage and wastewater treatment at internship unit within assigned duties.
- Be able to write reports and store records at internship unit as per regulations.

II.3. Self-control ability and responsibility

- Strictly comply with occupational safety regulations.
- Comply with regulations under the guidance of instructors at the training institution.
- Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.
- Comply with occupational safety regulations of training institution.
- Comply with privacy policies of internship unit.
- Work independently or in a team, solve complicated issues and work in changing working conditions.
- Guide and supervise others to perform defined tasks; accept individual and collective accountability.
- Evaluate the quality of work outcomes and performance results of team members.

III. Description

1. General contents and time allocation

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
1	***Part 1: Overview of incident and troubleshooting***	***30***	***28***		***2***
	Lesson 1: Concept of incident 1. Concepts and definitions 2. Cause classification	**3**	**3**		
	Lesson 2: Cause of incident 1. Incident outside of wastewater treatment plant 2. Incident inside of wastewater treatment plant	**3**	**3**		

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 3: Impact level of incident 1. Basic to determine impact level of incident 2. Hierarchy of potential incidents and risks at wastewater treatment plant	**2**	**2**		
	Lesson 4: Troubleshooting process 1. Incident identification method 2. Assess occurrence probability 3. Solution and prevention methods 4. Documentation and update manuals	**20**	**20**		
	Examination	**2**			**2**
2	***Part 2: Incidents and troubleshooting at drainage system***	***45***	***15***	***27***	***3***
	Lesson 1: Incidents of drainage system 1. Incidents related to water quality 2. Incidents related to hydraulic flow 3. Incidents related to equipment 4. Incidents related to electrical system 5. Incidents related to damage to works	**27**	**10**	**17**	

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Lesson 3: Troubleshooting, preventing measures and emergency response to incidents of drainage system 1. Organization procedures for incident troubleshooting and emergency response. 2. Emergency situations training	**15**	**5**	**10**	
	Examination	**3**			**3**
3	***Part 3: Incident and troubleshooting at wastewater treatment plant***	***120***	***30***	***85***	***5***
	Lesson 1: Common incidents at wastewater treatment plant 1. Incidents related to operation 2. Incidents related to machines and equipment 3. Incidents related to electrical system 4. Incidents related to fire and explosion	**95**	**20**	**75**	
	Lesson 2: Troubleshooting, preventing measures and emergency response to incidents of wastewater treatment plant 1. Organization procedures for incident troubleshooting and emergency response. 2. Emergency situations training	**20**	**10**	**10**	

No.	Module lesson	Time (hour)			
		Total	**Theory**	**Practice, laboratory, discussion, assignment**	**Examination**
	Examination	**5**			**5**
4	***Part 4: Practice of troubleshooting*** 1. Common incidents of drainage system 2. Common incidents at wastewater treatment plant 3. Incident responding and troubleshooting procedures 4. Report results 5. Update logbook and store information	***135***		***130***	***5***
	Examination	**5**			**5**

2. Detailed contents:

PART I: OVERVIEW OF INCIDENT AND TROUBLESHOOTING

Lesson 1: Concept of incident

Time: 3 hours

1. Lesson objectives:

- Be able to present and classify the concept and causes of incidents in drainage and wastewater treatment.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Concepts and definitions

2.1.1. Concepts

2.1.2. Definition

2.2. Cause classification

2.2.1. Short-term

2.2.2. Long-term

2.2.3. Objective

2.2.4. Subjective

Lesson 2: Cause of incident

Time: 3 hours

1. Lesson objectives:

- Be able to present the causes of incidents in drainage and wastewater treatment.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Incident outside of wastewater treatment plant

2.1.1. Power outage

2.1.2. Influent quality

2.2. Incident inside of wastewater treatment plant

2.2.1. Incidents related to operation

2.2.2. Incidents related to machines and equipment

2.2.3. Incidents related to electrical system

2.2.4. Incidents related to fire and explosion

Lesson 3: Impact level of incident

Time: 2 hours

1. Lesson objectives:

- Be able to recognize the importance and impact of incidents and troubleshooting in drainage and wastewater treatment.
- Be able to describe and classify the impact level of potential incidents and risks in drainage and wastewater treatment.
- Be able to evaluate the impact of incidents and risks on the operation of drainage and wastewater treatment at each level.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Basic to determine impact level of incident

2.1.1. Economic loss/repair cost

2.1.2. Alternative equipment

2.1.3. Impact on receiving source

2.2. Hierarchy of potential incidents and risks at wastewater treatment plant

2.2.1. Common incidents

2.2.2. Emergencies

Lesson 4: Troubleshooting process

Time: 20 hours

1. Lesson objectives:

- Be able to president the importance of incident troubleshooting in drainage and wastewater treatment.
- Be able to describe and classify the impact level of potential incidents and risks in drainage and wastewater treatment.
- Be able to use proper troubleshooting procedures for incidents in drainage and wastewater treatment.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Incident identification method

2.1.1. Sampling for analysis

2.1.2. Process monitoring system (EMSR)

2.1.3. Direct inspection

2.2. Assess occurrence probability

2.3. Solution and prevention methods

2.3.1. Planning for prevention methods

2.3.2. Prepare backup machines, equipment and chemicals

2.3.3. Information series processing

2.3.2. Implement prevention measures

2.3.4. Use documents and checklists

2.3.5. Regulations for operator

2.4. Documentation and update manuals

2.4.1. Prepare analysis reports, protect evidence

2.4.2. Lessons

2.4.3. Training

Examination: 2 hours

PART II: INCIDENTS AND TROUBLESHOOTING AT DRAINAGE SYSTEM

Lesson 1: Incidents and troubleshooting at drainage system

Time: 27 hours

1. Lesson objectives:

- Be able to describe and classify the types of incidents in drainage system.
- Be able to analyze the causes of incidents in drainage system.
- Be able to evaluate the impact of incidents and propose a plan to ensure continuous and stable operation of drainage system.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Incidents related to water quality

2.1.1. Organic matter overload

2.1.2. Excessive sand, gravel and other inorganic solids

2.1.3. Unusual smell and color of wastewater

2.1.4. Ingress of strange sewage

2.2. Incidents related to continuous flow

2.2.1. Hydraulic overload

2.2.2. Sudden increase in flow

2.2.3. Interrupted/unstable flow

2.3. Incidents related to equipment

2.3.1. Malfunctioned pump

2.3.2. Pump or suction pipeline clogging

2.4. Incidents related to electrical system

2.5. Incidents related to damage to works

Lesson 2: Troubleshooting, preventing measures and emergency response to incidents of drainage system

Time: 15 hours

1. Lesson objectives:

- Be able to describe the responding and handling process for incidents in drainage system.
- Be able to apply proper responding and handling process for incidents in drainage system.

- Be able to handle incidents in drainage system properly.
- Be able to write reports and store records of drainage system as per regulations.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Organization procedures for incident troubleshooting and emergency response.

2.2. Emergency situations training

2.2.1. Identify emergency situations

2.2.2. Training plan

2.2.3. Training participants

2.2.4. Materials and equipment

2.2.5. Results and evaluation

Examination: 3 hours

PART III: INCIDENT AND TROUBLESHOOTING AT WASTEWATER TREATMENT PLANT

Lesson 1: Common incidents at wastewater treatment plant

Time: 95 hours

1. Lesson objectives:

- Be able to describe and present technological incidents of wastewater treatment.
- Be able to analyze the causes of technological incidents in wastewater treatment.
- Be able to describe and present equipment malfunctions of wastewater treatment.
- Be able to analyze the causes of incidents related to machine and equipment in wastewater treatment.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Incidents related to operation

2.1.1. Grit chamber

2.1.2. Primary sedimentation tank

2.1.3. Biological tank

2.1.4. Secondary sedimentation tank

2.2. Incidents related to machines and equipment

2.2.1. Trash screens

2.2.2. Submersible pump

2.2.3. Air blower

2.2.4. Air compressor

2.2.5. Stirrer

2.2.6. Centrifugal concentrator

2.2.7. Centrifugal water separator

2.2.8. Belt press machine

2.3. Incidents related to electrical system

2.3.1. Transformer

2.3.2. Electric generator

2.4. Incidents related to fire and explosion

Lesson 2: Troubleshooting, preventing measures and emergency response to incidents of wastewater treatment plant

Time: 45 hours

1. Lesson objectives:

- Be able to describe the responding and handling process for incidents in wastewater treatment.
- Be able to apply proper responding and handling procedures for incidents in wastewater treatment.
- Be able to troubleshoot incidents in wastewater treatment properly.
- Be able to write reports and store records in wastewater treatment as per regulations.
- Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
- Maintain a serious and forward-thinking approach to learning.

2. Lesson contents:

2.1. Organization procedures for incident troubleshooting and emergency response.

2.2. Emergency situations training

2.2.1. Identify emergency situations

2.2.2. Training plan

2.2.3. Training participants

2.2.4. Materials and equipment

2.2.5. Results and evaluation

Examination: 4 hours

PART IV: PRACTICE OF TROUBLESHOOTING

Time: 135 hours

1. Lesson objectives:
   - Be able to describe and classify incidents at internship unit.
   - Be able to analyze the causes of incidents in drainage and wastewater treatment at internship unit.
   - Be able to present and describe the incident troubleshooting process at internship unit.
   - Be able to apply proper responding and handling procedures for incidents in drainage and wastewater treatment at internship unit.
   - Be able to troubleshoot incidents in drainage and wastewater treatment at internship unit within assigned duties.
   - Be able to write reports and store records at internship unit as per regulations.
   - Comply with regulations under the guidance of workshop assistants.
   - Maintain workplace safety and hygiene, protect assets, and adhere to working principles.
   - Be diligent, optimistic, hard-working, careful and self-responsible for assigned work results.
   - Maintain a serious and forward-thinking approach to learning.
2. Lesson contents:
   2.1. Common incidents of drainage system
   2.2. Common incidents at wastewater treatment plant
   2.3. Incident responding and troubleshooting procedures
   2.4. Report results
   2.5. Update logbook and store information

Examination: 5 hours

IV. Module implementation conditions

1. Specialized classrooms and workshops

- Theory classrooms.
- Studying at factories or laboratories.

2. Machine and equipment

- Computers, calculators.
- Personal protective equipment.

3. Learning materials, tools and consumables

Learning materials:

- Handouts for learners.
- Course books, reference materials…
- Operator's manual/manufacturer's manual.

Tools:

- A0 paper, pens, colored paper, etc.

4. Other conditions

V. Assessment contents and methods

1. Description

1.1. Knowledge

1.1.1. Part 1: Overview of incident and troubleshooting

- Be able to present the concept, importance and impact of incidents and troubleshooting in drainage and wastewater treatment.
- Be able to describe and classify the impact level of potential incidents and risks in drainage and wastewater treatment.
- Be able to describe the troubleshooting procedures for incidents in drainage and wastewater treatment.

1.1.2. Part 2: Incidents and troubleshooting at drainage system

- Be able to describe and classify the types of incidents in drainage system.
- Be able to describe the responding and handling process for incidents in drainage system.

1.1.3. Part 3: Incident and troubleshooting at wastewater treatment plant

- Be able to describe and present technological incidents of wastewater treatment.
- Be able to describe and present equipment malfunctions of wastewater treatment.
- Be able to describe the responding and handling process for incidents in wastewater treatment.

1.1.4. Part 4: Practice of troubleshooting

- Be able to describe and classify incidents at internship unit.
- Be able to present and describe the incident troubleshooting process at internship unit.

1.2. Skills

1.2.1. Part 1: Overview of incident and troubleshooting

- Be able to recognize the importance and impact of incidents and troubleshooting in drainage and wastewater treatment.

- Be able to evaluate the impact of incidents and risks on the operation of drainage and wastewater treatment at each level.
- Be able to use proper troubleshooting procedures for incidents in drainage and wastewater treatment.

1.2.2. Part 2: Incidents and troubleshooting at drainage system

- Be able to analyze the causes of incidents in drainage system.
- Be able to evaluate the impact of incidents and propose a plan to ensure continuous and stable operation of drainage system.
- Be able to apply proper responding and handling process for incidents in drainage system.
- Be able to handle incidents in drainage system properly.
- Be able to write reports and store records of drainage system as per regulations.

1.2.3. Part 3: Incident and troubleshooting at wastewater treatment plant

- Be able to analyze the causes of technological incidents in wastewater treatment.
- Be able to analyze the causes of incidents related to machine and equipment in wastewater treatment.
- Be able to apply proper responding and handling procedures for incidents in wastewater treatment.
- Be able to troubleshoot incidents in wastewater treatment properly.
- Be able to write reports and store records in wastewater treatment as per regulations.

1.2.4. Part 4: Practice of troubleshooting

- Be able to analyze the causes of incidents in drainage and wastewater treatment at internship unit.
- Be able to apply proper responding and handling procedures for incidents in drainage and wastewater treatment at internship unit.
- Be able to troubleshoot incidents in drainage and wastewater treatment at internship unit within assigned duties.
- Be able to write reports and store records at internship unit as per regulations.

1.3. Self-control ability and responsibility

- Attend all classes.
- Have a sense of discipline in studying, cooperating and helping each other.
- Comply with the regulations and strictly follow the instructions of the person in charge at the enterprise.

- Work independently in changing working conditions, accept individual and partial responsibility for the team.
- Instruct and supervise others performing assigned tasks.
- Follow safety and hygiene measures when working with wastewater and in confined spaces.
- Evaluate the quality of work outcomes and performance results of team members.
- Solve occupational problems.

2. Method

- Oral examination, multiple choice test, essay: Ask questions about the main and central issues.
- Observe learners performing group exercises or group presentations.
- Observe learners working during internship at a wastewater treatment plant or company.

VI. Module implementation instructions

1. Scope of application

"Error Analysis and Troubleshooting" module can be used to teach learners at college and advanced German standards college levels for "Sewage Engineering Technician".

2. Introductions on module teaching and learning methods

2.1. For teachers/lecturers/trainers at enterprise

For teachers/lecturers at school

- Teaching methods include presentation, integration, conservation, group discussion, and practice;
- Following each lesson, it is required to offer questions and assignments for learners to complete independently outside of training hours.
- Teachers can use a combination of computers, projectors, and electronic lesson materials when teaching.
- Teachers need to prepare learning materials with complete instructions for conducting experiments.

For teachers/lecturers at enterprise

- Joint training enterprises need to appoint qualified teachers and lecturers to train learners during their internship at the company.

- Teachers and business trainers need to be trained in pedagogical ability, the ability to assess learners' capacity and organize the appropriate division of tasks for learners.
- Teaching methods include presentation, conversation, group discussion, practice and application of practical models.
- Teaching aids such as computers, projectors, etc. can be used, and teachers can new tools to enrich the lecture content.

2.2. For learners

- Attend class on schedule with sufficient learning hours as required.
- Complete all assignments of the self-studying hours.
- Strictly follow the rules of wastewater treatment plant.
- Perform assigned tasks according to the instructions of the lecturer at the factory or company.
- Refer to related documents for more information.
- Actively participate in class activities.

3. Key points requiring attention

- Cause of incident.
- Hierarchy of incident.
- Analyze the causes, consequences and appropriate measures to handle incidents.
- Organization procedures for incident troubleshooting and emergency response.

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5. Notes and explanations (if any)

Certification of the equivalence and quality of the “Sewage Engineering Technician” vocational training program.

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Đào tạo nghề trong " Chuyên gia công nghệ xử lý nước thải"

Kính thưa Ông/ Bà,

Kết quả cho chương trình đào tạo thí điểm 3 năm cho "Chuyên gia công nghệ xử lý nước thải" đã có ở Phòng Công nghiệp và Thương mại Dresden.

Chúng tôi xác nhận tính tương đương của chương trình đào tạo nghề "Chuyên gia công nghệ xử lý nước thải" trong quy chế đào tạo nghề về kỹ thuật môi trường do Luật Đào tạo nghề của Cộng hòa Liên bang Đức ban hành phiên bản từ ngày 17.06.2002 đến 04.05.2020.

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