DEPARTMENT OF ENVIRONMENTAL ENGINEERING
FACULTY OF CIVIL, ENVIRONMENTAL AND GEO ENGINEERING
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

SYLLABUS

UNDERGRADUATE PROGRAM (S1)

CURRICULUM 2018 - 2023

Catalog 2018

Undergraduate Program (S-1)
Environmental Engineering

DEPARTMENT OF ENVIRONMENTAL ENGINEERING
FACULTY OF CIVIL, ENVIRONMENTAL AND GEO ENGINEERING
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA

FOREWORD

Assalammualaikum Wr Wb.
Best Wishes,

Praise be to Allah SWT because of His gifts and blessings we have finished the preparation of Curriculum 2018-2023 and make it happen in the Curriculum Catalog 2018. This catalog contains the composition of the subject, the number of credits and other information contained in the new curriculum of the Department of Environmental Engineering FTSLK ITS. Preparation of the curriculum 2018 - 2023 has been through various stages, including analysis of competency needs required by stakeholders and users of graduates, so expected results in the form of a curriculum that meets the standards of competence, comprehensive and update.

The Catalog 2018 is expected to provide information and guidance to the academic community, students, parents of students and all parties about learning materials, types of knowledge and skills learned, including the standards and learning objectives, references used, and the type of assessment undertaken by Department of Environmental Engineering FTSLK ITS. In the end, it is expected that the learning system based on the curriculum 2018-2023 will produce graduates that meet the achievement of learning that has been set, update, achievement and competitive, so easily absorbed in the job market and even able to create field and employment opportunities.

In the end, we hope that all the information contained in this book will be of the greatest benefit. Thank you.

Wassalammualaikum Wr. Wb

Surabaya, January 2018
Head of Department

Adhi Yuniarto, ST., MT., PhD.

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PROFILE

The Department of Environmental Engineering is under the Faculty of Civil, Environment and Geo Engineering - Institute of Technology Sepuluh Nopember. The Department of Environmental Engineering was established in 1996 with the Environmental Engineering S-1 Program which is a change from the Program Study S-1 (Undergraduate) Sanitary Engineering. Currently the Department of Environmental Engineering has three programs, which are:

1. S-1 (Undergraduate) Environmental Engineering
2. S-2 (Master) Environmental Engineering
3. S-3 (Doctorate) Environmental Engineering

Vision:

References in the field of engineering and environmental management of international repute in the improvement of environmental quality.

Mission:

1. Conducting undergraduate and postgraduate education in internationally reputable engineering and environmental management.
2. Develop science and technology in the field of environmental engineering and management that prioritizes the quality of the environment, including coastal areas.
3. Disseminate and actively apply technological innovation work and methods to solve environmental quality problems.
4. Capture partnership networks with government agencies and private / industry at home and abroad in the field of environmental engineering and management.
5. Develop ethical values, morals, attitudes and softskills of the academic community.

Educational Objectives:

1. Producing graduates who devoted to God Almighty, noble personality, ethical, academic morality, has a strong attitude and values.
2. Producing graduates capable of designing engineering engineering in the field of environmental engineering, producing innovations in

preventing and implementing pollution controls, and applying innovative technology and designing environmental remediation solutions from pollutants, which are oriented towards updating and disseminating them through scientific publications at the national or international level.

3. Mastering the basic principles of theoretical concepts of natural science, application of engineering mathematics, engineering principles, basic control technologies and environmental pollution prevention processes, and the basic principles of the latest and latest technologies, as well as the process of restoring the polluted environment.
4. Able to manage jobs and make the right decisions based on problem identification, information and data analysis with the insight of sustainable development (sustainable development) covering environmental aspects and settlement, marine, energy, and information technology as well as promoting social awareness.

S-1 (Undergraduate) Environmental Engineering Program

The S-1 (Undergraduate) Environmental Engineering Program was opened in 1983 based on the Decree of the Director General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia No. 116/DIKTI/Kep/1984 named the Sanitary Engineering Program under Department of Civil Engineering FTSP - ITS. In 1996, the Sanitary Engineering Program was turn into Environmental Engineering Program based on the Decree of the Director General of Higher Education Department of Education and Culture of the Republic of Indonesia No. 224/DIKTI/Kep/1996. This Study Program has been awarded by National Accreditation Board of Higher Education (BAN PT) with **Accreditation A** for the period of November 14, 2015 - November 14, 2020 based on the Decree of National Accreditation Board No. 1155/BAN-PT/Akred/S/XI/2015 14th November 2015.

S-2 (Master) Environmental Engineering Program

S-2 (Master) Environmental Engineering Program was opened in 1999 based on the Decree of the Director General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia Number 15/DIKTI/Kep/1999. S-2 (Postgraduate) Environmental Engineering Study Program has two areas of expertise, namely Environmental Engineering and Environmental Sanitation Engineering.

In the field of Environmental Engineering, it is reviewed various environmental problems and solutions with emphasis on academic studies for scientific development. The Environmental Sanitation Engineering focuses on academic studies applicable to the field of keciptakaryaan. This field of expertise is the cooperation of FTSP with Education and Training Center Ministry of Public Works of Indonesia.

The S-2 (Master) Program has been awarded National Accreditation Board of Higher Education (BAN PT) with **Accreditation A** rating for period 9th January 2015 – 9th January 2020 based on Decree of National Accreditation Board No. 005/BAN-PT/M/I/2015, dated 9th January 2015.

S-3 (Doctorate) Environmental Engineering Program

The S-3 (Doctorate) Environmental Engineering Program was opened in 2009 based on the Decree of the Director General of Higher Education, Ministry of National Education of the Republic of Indonesia Number 1250/D/T/2009 dated 31st July 2009. The study program accepts students from graduates of S-2 (Master) Environmental Engineering or others related background.

Academic Facility

- Lecturing Room
- Examination and Seminars Room
- Laboratories
- Computer Room and Internet Network
- Library (Reading Room)
- Magazines/ Scientific Journals
- Lecturer Room
- Administration room

Management of Department of Environmental Engineering:

1. Head of Department:
   Adhi Yuniarto, ST., MT., PhD.
2. Secretary of Department:
   Arseto Yekti Bagastyo, ST., MT., MPhil., PhD.
3. Head of S-1 Study Program :
   Bieby Voijant Tangahu, ST., MT., PhD.
4. Secretary of S-1 Program:
   Welly Herumurti, ST., MSc.
5. Head of S-2 and S-3 Study Program:
   Dr.Ir. Ellina S. Pandebesie, MT.
6. Secretary of S-2 and S-3 Program:
   Ipung Fitri Purwanti, ST., MT., PhD.
7. Head of Laboratory:
   - Laboratory of Water Recovery Technology
     Prof. Ir. Wahyono Hadi, MSc., PhD.
   - Laboratory of Air Pollution and Climate Change
     Dr. Eng Ari Dipareza Syafe'i ST., MEPM
   - Laboratory of Solid Waste and B3
     Prof. Dr. Yulinah Trihadiningrum, MAppSc.
   - Laboratory of Environmental Remediation
     Prof. Dr. Ir. Sarwoko Mangkoedihardjo, MScES.
   - Laboratory of Environmental Quality Management
     Prof. Dr. Ir. Nieke Karnaningroem, Dipl.SE,. MSc.

The Department of Environmental Engineering currently has a staff of 29 permanent lecturers consisting of 23 doctorates (5 of whom are Professors), 6 masters, and some lecturers from other departments who foster basic subjects and public lectures.

Permanent Lecturers of Department of Environmental Engineering, ITS

NO	NAME	GRADUATE FROM			EXPERTISE
		S1 (Under-graduate)	S2 (Master)	S3 (PhD)	
1	Prof. Ir. Wahyono Hadi, M.Sc. PhD.	ITB	State Univ. of South Dakota, USA	Univ. Leuven, Belgium	Water Treatment
2	Dr.Ir. M. Razif, MM.	ITB	ITB	UB	Environmental Development and Management
3	Prof. Dr. Yulinah Trihadiningrum, MApp.Sc.	ITB	Univ. of New South Wales, Australia	Univ. of Antwerpen, Belgium	Solid and Hazardous Waste Treatment
4	Prof. Dr. Ir. Sarwoko Mangkoedihardjo, M.ScES.	ITB	Univ. of Gent, Belgia	Univ. Brawijaya	Environmental Sanitation and Phytoremediation
5	Prof. Dr. Ir. Nieke Karnaningroem, MSc.	ITB	IHE, Holland	Civil Eng, ITS	Environmental Management & Modeling

NO	NAME	GRADUATE FROM			EXPERTISE
		S1 (Under-graduate)	S2 (Master)	S3 (PhD)	
6	Dr. Ir. Agus Slamet, MSc.	ITS	IHE, Holland	ITS	Waste Water Treatment
7	Prof. Ir. Joni Hermana, MScES., PhD.	ITB	Univ. of Gent, Belgium	Univ. of Newcastl, England	Waste Water Treatment, Environmental Management System
8	Ir. Atiek Moesriati, MKes.	ITS	Univ. Of Airlangga, Surabaya		Environmental Health
9	Ir. Eddy Setiadi Soedjono, Dipl.SE, MSc., PhD.	ITS	IHE, Belanda	Univ. of Birmingham England	Water and Sanitation
10	Ir. Mas Agus Mardyanto, ME., PhD.	ITS	Univ. of Roorkee India	Univ. of Otawa	Ground Water Management

NO	NAME	GRADUATE FROM			EXPERTISE
		S1 (Under-graduate)	S2 (Master)	S3 (PhD)	
11	Ir. Bowo Djoko Marsomo, MEng.	ITB	Asian Institute of Technology		Water Treatment
12	Dr.Ir. Ellina S. Pandebesie, MT.	ITB	ITS	Chemical Eng. ITS	Solid Waste Manag. & Technology
13	Dr. Ir. R. Irwan Bagyo Santoso, MT.	ITS	ITB	ITS	Environmental Resource Management.
14	Dr. Ali Masduqi, ST., MT.	ITS	ITB	Civil Eng, ITS	Water Supply Manag. & Engineering
15	Susi Agustina Wilujeng, ST., MT.	ITS	ITB	Currently studying in ITB	Wastewater Treatment & Solid Waste Management.

NO	NAME	GRADUATE FROM			EXPERTISE
		S1 (Under-graduate)	S2 (Master)	S3 (PhD)	
16	Dr. Ir. Rachmat Boedisantoso, MT.	ITS	ITB	ITS	Air Quality Control and Management
17	Bieby Voijant Tangahu, ST. , MT.., PhD.	ITS	ITS	UK Malaysia	Waste Water Treatment
18	IDAA Warmadewanthi, ST., MT., Ph.D.	ITS	ITB	NTUST, Taiwan	Solid Waste Treatment
19	Adhi Yuniarto, ST., MT., PhD.	ITS	ITS	UT Malay. Malaysia	Environmental Management
20	Harmin Sulistiyaningtitah, ST., MT., PhD.	ITS	ITB	UKM, Malaysia	Solid and Hazard. Waste, and Phytoremediation

NO	NAME	GRADUATE FROM			EXPERTISE
		S1 (Under-graduate)	S2 (Master)	S3 (PhD)	
21	Ipung Fitri Purwanti, ST., MT., PhD.	ITS	ITS	UKM, Malaysia	Environmental Sanitation
22	Alia Damayanti, ST., MT.,PhD.	ITS	ITS	UTM, Malaysia	Environmental Sanitation
23	Dr. Abdu Fadli Assomadi, S.Si., MT.	Univ. Brawijaya	ITS	ITS	Env. Chemistry & Air Quality
24	Dr. Eng Ari Dipareza Syafe'i ST., MEPM.	ITS	NTU, Taiwan	Hiroshima Univ., Japan	Environmental Management & Air Quality
25	Arseto Yekti Bagastyo, ST., MT., MPhil. , PhD.	ITS	ITS dan The Univ. of Queensland	Univ. of Queensland	Hazardous Waste(water) Treatment
26	Welly Herumurti, ST.., MSc.	ITS	Univ. Petronas, Malaysia		Environmental Management
27	Alfan Purnomo, ST., MT.	ITS	ITS		Wastewater Treatment

NO	NAME	GRADUATE FROM			EXPERTISE
		S1 (Under-graduate)	S2 (Master)	S3 (PhD)	
28	Ervin Nurhayati, ST., MT., PhD.	ITS	ITS	National Chiao Tung University, Taiwan	Water Recovery
29	Iftitah Rahmatika, ST., M. ng.	UI	AIT Bangkok	Currently stidying in Tokyo	Water Treatment Technology

INFORMATION

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FACULTY OF CIVIL, ENVIRONMENT AND GEO ENGINEERING

Study Program	Environmental Engineering
Educational level	Undergraduate

Graduate Learning Achievement		
Attitude	1.1.1	Consider of God Almighty and capable of showing a religious attitude;
	1.2.1	Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
	1.3.1	Contribute to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
	1.4.1	Acting as a proud citizen and love of the country, having nationalism and a sense of responsibility to the state and nation;
	1.5.1	Respecting cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
	1.6.1	Cooperate and have social sensitivity as well as concern for society and environment;
	1.7.1	Law-abiding and disciplined in the life of society and country;
	1.8.1	Internalize academic values, norms, and ethics;
	1.9.1	Demonstrate a responsible attitude towards the work in the field of expertise independently;
	1.10.1	Internalize the spirit of independence, struggle, and entrepreneurship;
	1.11.1	Trying to the fullest to achieve the perfect result; and
	1.12.1	Cooperate to be able to take full advantage of the potential possessed.
Knowledge	2.1.1	Mastering the theoretical concepts of *science engineering*, *engineering principles*, and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental preservation, or environmental recovery;

	2.2.1	Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems;
	2.3.1	Mastering principles, methodology, and design techniques of environmental management system with integrated system approach;
	2.4.1	Mastering the latest principles and issues in economics, social, ecology in general; and
	2.5.1	Mastering communication techniques and latest technological developments.
Specific Skill(s)	3.1.1	Capable of applying mathematics, statistics, physics, chemistry, biology, microbiology, and *engineering principles* to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental recovery or environmental management;
	3.2.1	Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public;
	3.2.2	Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment;
	3.2.3	Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering as an effort to recover the environment;
	3.3.1	Able to prepare research proposal of minimal engineering problem in one aspect that is: provision of environmental infrastructure, protection of society from dangerous environment, environmental protection, environmental preservation, and environmental recovery with detailed and systematic implementation stages;
	3.3.2	Able to implement the proposed research design and report it in scientific papers;
	3.4.1	Able to propose and review alternative solutions for complex engineering problems at least in one aspect: the provision of environmental infrastructure, the protection of communities from hazardous environments, environmental protection, environmental preservation and environmental restoration by taking into account economic, health and

		safety factors of the public, cultural, social and environmental;
	3.4.2	Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental restoration;
	3.5.1	Able to apply the results of research and alternative formulation to determine the criteria of environmental engineering/ management;
	3.5.2	Able to analyze the criteria of engineering and system design/ process in environmental management;
	3.5.3	Capable of designing the best systems and processes in managing a reliable, secure, easy, affordable, and sustainable environment;
	3.6.1	Able to obtain information, understand criteria, local/ global resource potential and utilization in accordance with system design;
	3.6.2	Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management; and
	3.6.3	Able to determine the necessary resources according to the design of environmental management system that is reliable, safe, easy, affordable, and sustainable.
General Skill(s)	4.1.1	Able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology and;
	4.2.1	Able to show independent performance, quality, and measurable;
	4.3.1	Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism;
	4.4.1	Able to arrange scientific descriptions of the results of the study in the form of scientific papers;

	4.5.1	Able to take decisions appropriately in the context of problem solving in the field of expertise, based on the results of information and data analysis;
	4.6.1	Able to maintain and develop networks with counselors, colleagues, colleagues both inside and outside the institution;
	4.7.1	Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under their responsibility;
	4.8.1	Able to conduct self-evaluation process to work group under their responsibility, and able to manage learning independently; and
	4.9.1	Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

CURRICULUM 2018-2023 EXPLANATION

The curriculum of the S-1 (undergraduate) Environmental Engineering Program has a study load of 144 credits scheduled for eight semesters, divided into **preparatory stages** with a 36-credit study load (scheduled in two semesters) and **an undergraduate stage** for 108 credits (scheduled in six semesters). In addition, the student's credits received are 16 credits of mathematics and basic sciences, 7 credits of ITS detailed subject, 8 credits of national subject, and 2 credits of FTSLK.

The implementation system of education using Semester Credit System (SKS) is defined as a system of education implementation by using credit units of semester (SKS) to express student burden, lecturer workload, and program implementation load. Semester is an activity time unit consisting of 16 (sixteen) weeks of lectures or other scheduled activities, including evaluation activities.

- 1 (one) Credit for the learning process in the form of lectures, responses, or tutorials, interpreted as the implementation of the following activities:
    a. Face to face activity is 50 minutes per week per semester;
    b. Structural assignment activities is 60 (sixty) minutes per week per semester; and
    c. Independent activity is 60 (sixty) minutes per week per semester.
- 1 (one) Credit in the learning process in the form of seminars or other similar forms, interpreted as the implementation of the following activities:
    a. Face to face activity is 100 (one hundred) minutes per week per semester; and
    b. Independent activity is 70 (seventy) minutes per week per semester.
- 1 (one) Credit in the learning process in the form of practicum, studio practice, workshop practice, field practice, research, community service and/or other similar learning process, interpreted as the implementation of activities within 170 (one hundred and seventy) minutes per week per semester.

SUBJECT COMPOSITION

No	Subject Code	Subject Name (SN)	Credit
SEMESTER: I			
1.		Religious education	2
2.	SF184101	Physics I	4
3.		Mathematics I	3
4.	RE184101	Engineering Drawing	3
5.		Citizenship	2
6.		Indonesian Language	2
7.	RE184102	Environmental Microbiology	3
		Total Credits	19
SEMESTER: II			
1.		English	2
2.		Math II	3
3.	RE184201	Environmental Statistics	2
4.	SF184201	Physics II	3
5.		Introduction to Geospatial Techniques	2
6.		Pancasila	2
7.		Chemistry	3
		Total Credits	17
SEMESTER: III			
1.	RE184301	Environmental Chemistry	3
2.	RE184302	Water Resources Management	3
3.	RE184303	Air Pollution and Climate Change	3
4.	RE184304	Soil Mechanics and Geohydrology	3
5.	RE184305	Hydraulics	4
6.	RE184306	Structure Knowledge	3
		Total Credits	19
SEMESTER: IV			
1.	RE184401	Biological Unit Processes of Environmental Engineering	3
2.	RE184402	Solid Waste Management Design	4
3.	RE184403	Environmental Pollution Analysis Technique	4
4.	RE184404	Management of Gas Emissions and Air Ambient	3

No	Subject Code	Subject Name (SN)	Credit
5.	RE184405	Physics – Chemical Unit Processes in Environmental Engineering	2
6.	RE184406	Drinking Water Supply Design	3
		Total Credits	19
SEMESTER: V			
1.	RE184501	Wastewater Sewerage Design	3
2.		Technopreneur	3
3.	RE184502	Unit Operations in Environmental Engineering	4
4.	RE184503	Project Management	2
5.	RE184504	Urban Drainage Design	3
6.	RE184505	Environmental Remediation Techniques	3
		Total Credits	18
SEMESTER: VI			
1.	RE184601	Research Methods	3
2.	RE184602	Clean Technology	2
3.	RE184603	Water Treatment Plant Design	4
4.	RE184604	Wastewater Treatment Plant Design	4
5.		Insights and Technology Applications	3
6.		Elective Subject I	2
		Total Credits	18
SEMESTER: VII			
1.	RE184701	Hazardous Waste Management	3
2.	RE184702	Environmental Impact Assessment	3
3.	RE184703	Sludge Treatment Plant Design	4
4.	RE184704	Landfill Design	3
5.	RE184705	Enrichment Subject	3
6.		Elective Subject II	2
		Total Credits	18
SEMESTER: VIII			
1.	RE184801	Occupational Health and Safety	3
2.	RE184802	Audit and Environmental Management System	3
2.	RE184803	Project Work	2
3.	RE184804	Final Project	6
4.		Elective Subject III	2
		Total Credits	16

LIST OF OPTIONAL SUBJECTS

No	Subject Code	Subject Name (SN)	Credit
1	RE184901	Plambing	2
2	RE184902	Industrial Waste Management	2
3	RE184903	Phyitotechnology	2
4	RE184904	Environmental Economics	2
5	RE184905	Environmental Quality Biomonitoring	2
6	RE184906	Community-Based Drinking Water Supply	2
7	RE184907	Community Based Sanitation	2
8	RE184908	Air Pollutant Dispersion Model	2
9	RE184909	Fundamental Environmental Modeling	2
10	RE184910	Ecotoxicology	2

OPTIONAL TO SUPPORT THE DISSERTATION

Water Treatment Technology

No	Subject Code	Subject Name	Credit
1	RE184901	Plambing	2
2	RE184902	Waste Management Industry	2
3	RE184906	Community-Based Drinking Water Supply	2
4	RE184907	Community Based Sanitation	2

Environmental Quality Management

No	Subject Code	Subject Name	Credit
1	RE184902	Waste Management Industry	2
2	RE184904	Environmental Economics	2
3	RE184905	Environmental Quality Biomonitoring	2
4	RE184909	Basic Environmental Modeling	2

Environmental Remediation

No	Subject Code	Subject Name	Credit
1	RE184903	Phytotechnology	2
2	RE184910	Ecotoxicology	2

Air Pollution and Climate Change

No	Subject Code	Subject Name	Credit
1	RE18490	Dispersion Model of Air Pollutant	2

SYLLABUS CURRICULUM

- **SEMESTER I**

SUBJECT	**Subject Name**	: Islamic Religious Education
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCES

SUBJECT	**Subject Name**	: Protestant Christian Religious Education
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCES

SUBJECT	**Subject Name**	: Catholic Religious Education
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCES

SUBJECT	**Subject Name**	: Hindu Religoius Education
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCES

SUBJECT	**Subject Name**	: Buddha Religious Education
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCES

SUBJECT	**Subject Name**	: Physics I
	Subject Code	: SF184101
	Credit	: 4 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
In this subject students will learn to understand the basic laws of physics, particle kinematics; Particle dynamics; Work and energy; Rotation motion; Vibration and fluid Mechanics, through simple mathematical descriptions and introducing examples of the use of concepts, and conducting material analysis in the form of **practicum**. Practicum performed include physical pendulum, mathematical pendulum, spring constant, fluid viscosity, bullet motion, coefficient of friction, moment of inertia.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
• Cooperate to be able to take full advantage of their potential. • Master the theoretical concepts of classical physics and modern physics in depth;

- Mastering complete operational knowledge about functions, how to operate common physical instruments, analysis of data and information from such instruments;
- Able to formulate symptoms and physical problems through analysis based on observations and experiments.

SUBJECT LEARNING ACHIEVEMENT

Students are able to:

- understand the quantities of physics and unit systems, as well as the characteristics of scalar and vector quantities
- understand the definition of straight and curved motion graphically and mathematically and its application
- understand the basic principles of Newton's laws and the types of styles and their applications
- understand the concepts of work and energy, mechanical energy, the law of conservation of mechanical energy, and its application
- apply the concept of impulse and momentum, conservation of momentum, impact and its application
- understand the principle of firm and rolling motion and its application
- understand the concept of equilibrium of the tough body and its application
- understand the mechanics of changing things and their elasticity and application.
- understand simple harmonic vibrations, superposition 2 vibrations and its application.
- understand the concept of hydrostatics and hydrodynamics and its application.

SUBJECT MATTER

Magnitude and vector;
Kinematic particles: Position shift, velocity, acceleration, straight motion, curved motion (parabola and ridge); relative motion.
Dynamics particles: Newton's Law I, II and III, various forces (gravitational force, gravity, strap style, normal force, frictional force and spring force), force equilibrium, Newton I, II and III law applications;
Work and Energy: concept of work, kinetic energy, potential energy (gravity and spring), energy work theorem, energy conservation mechanical law,
Impulse and Momentum : impulse, momentum, collision (elastic and not elastic),;
Rotation dynamics: Angular shift, angular velocity and angular acceleration, force moment (torque), center of mass, moment force equilibrium, moment of

inertia, rotational kinetic energy, rolling motion, energy conservation law (translation and rotation)
Vibration: simple harmonic motion, simple harmonic motion energy, mathematical pendulum, physical pendulum, torsion pendulum, combined vibration aligned (parallel and perpendicular);
Fluid mechanics: hydrostatic pressure, Pascal principle, Archimedes principle, surface tension, continuity equation, Bernoulli equation, viscosity.

PREREQUISITE

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REFERENCES

- Halliday, Resnic, Jearl Walker. 2014. *Fundamental of Physics*. John Wiley and Sons, 10th ed: New York.
- Douglas C. Giancoli. 2014. *Physics for Scientists and Engineers.* Pearson Education, 4th ed: London.
- Lecturer Team. *Diktat Fisika I*. Fisika FMIPA-ITS
- Lecturer Team. *Soal-soal Fisika I*. Fisika FMIPA-ITS
- -, "Petunjuk Praktikum Fisika Dasar", Fisika, MIPA-ITS
- Sears & Zemanky. 2016. *University Physics*. Pearson Education, 14thed: USA.
- Tipler, PA.2008. *Physics for Scientists and Engineers* .6th ed, W.H. Freeman and Co, New York.

SUBJECT	**Subject Name**	:Mathematics I
	Subject Code	:
	Credit	: 3 credits
	Semester	: I (First)

SUBJECT DESCRIPTION

This subject equips students of matrix concepts, deteminants and systems of linear equations, the concept of mathematical thinking in solving engineering problems, modeling and others in engineering related to differential applications. The lecture material is more emphasized on the technique of solving real problems that can be formulated into the function of one independent variable.
The lecture material includes: matrix and determinant, solving system of linear equation, Eigen value, Eigen vector, real number system (obedience, absolute value), complex number, polar form of function and limit, derivative and application, indefinite integrals.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

SUBJECT LEARNING ACHIEVEMENT

- Able to understand the matrix and its determinants and its properties and able to solve the system of linear equations,, determine the value of Eigen and vector Eigen.
- Able to understand the notion of real number system, decimal form real number, real coordinate, nature of obedience, definition of absolute value, inequality, field coordinate, line, distance of two points, circle, parabola.
- Able to understand complex numbers and algebraic operations, polar form and root withdrawal equations in complex number systems.
- Able to understand the functions and concepts of limits, calculate function limits and determine the continuity of functions of simple functions.
- Able to understand the concept of derivative functions, can degrade the function of explicit or implicit, and can apply chain rules.
- Able to calculate change rates, draw functional charts, determine extreme points, up / down function intervals, subclass intervals and apply them to function optimization problems, Taylor / Maclaurin series and able to calculate tactual limit form.
- Able to understand the concept of integral and able to resolve integrals using fundamental theorems of calculus.

SUBJECT MATTER

- **The basic concept of matrix algebra**: matrix, determinants, elementary row operations and systems of linear equations, Eigen values, Eigen vectors.
- **The basic concept of a real number system**: definition of real number system, decimal point real number, real coordinate, nature of sequence, definition of absolute value, inequality, field coordinate, line, distance of two points, circle, parabola.
- **The basic concept of complex numbers**: addition, multiplication, quotient, complex polar form as well as algebraic operations and root withdrawal equations in complex number systems.
- **Concepts of function and limit**: domain, range, operasi fungsi, grafik fungsi (linier, kuadratik, transcendent), limit dan kontinuitas fungsi, limit dan kontinuitas fungsi trigonimetri.
- **Differential / derivative:** derivation of definitions (for polynomial, rational, transcendent and trigonometric functions), chain rules and implicit function derivatives.
- **Derivative Application:** related velocities, up / down intervals, spatial, graphic depiction with asymptotes and peaks, extreme values and

application of optimization problems, L'hopital theorem and Taylor / Maclaurin series.
- **Indefinite integrals:** turunan dan anti turunan, integral tak tentu , sifat linear integral tak tentu, rumus-rumus dasar integral tak tentu, integral tak tentu dengan substitusi.

PREREQUISITE

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REFERENCES

- ITS Lecturer Team of Mathematics Department. 2012. *Buku Ajar Kalkulus I*, 4th-Edition Mathematics Department of ITS.
- Anton, H. Dkk. 2012. *Calculus,* 10-th edition, John Wiley & Sons, New York.
- Kreyzig, E. 2011. *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore.
- Purcell, J, E, Rigdon, S., E. 2006. *Calculus,* 9-th edition, Prentice-Hall, New Jersey.
- James Stewart. 2012. *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada.

SUBJECT	**Subject Name**	: Engineering Drawing
	Subject Code	: RE184101
	Credit	: 3 credits
	Semester	: I (First)

SUBJECT DESCRIPTION

In this subject, students will be able to apply drawing techniques on building design in the field of Environmental Engineering, either manually or CAD. In general, the material studied is: the introduction of drawing tools, notations, various drawings and drawing applications on simple homes and buildings in the field of Environmental Engineering. The learning objectives will be achieved through face-to-face lectures, the task of drawing simple homes and building drinking water treatment and waste water.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Be cautious of God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Contributing to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;

- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
- Cooperate and have social sensitivity and concern for society and environment;
- Obey the law and discipline in social life and state;
- Internalize academic values, norms, and ethics;
- Demonstrate a responsible attitude towards the work in their own field of expertise; and
- Internalizing the spirit of independence, struggle, and entrepreneurship.

Mastery and Knowledge

- Able to explain basic principles of communication techniques and latest and latest technological developments.

General Skill(s)

- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs;
- Able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis;
- Able to maintain and develop a network with mentors, colleagues, colleagues both inside and outside the institution;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under the responsibility;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his/her responsibility; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to explain the basics of drawing techniques
- Students are able to draw sketches without rulers, with rulers and with autocad layout software, looks, floor plans and pieces of a building unit of environmental engineering.

SUBJECT MATTER

- Recognize the Property in drawing technique

- Fundamentals of drawing technique
- Draw sketches of floor plans and pieces without a ruler of a building
- Draw a sketch of the front, side and rear of a building
- Draw simple house building
- Drawing a building unit of drinking water
- Drawing a wastewater building unit
- Drawing the layout of drinking water treatment buildings
- Draw layout of wastewater treatment buildings
- Practice using autocad software
- Draw a simple house with autocad software
- Draw drinking water treatment buildings with autocad software
- Draw wastewater treatment buildings with autocad software
- Draw profiles extending drainage / piped water pipes

PREREQUISITE

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REFERENCES

- Ranal V. Giles, Jack B. Evett, Cheng Liu. 1996. *Theory and Problems of Fluid Mechanics and Hydraulics*. McGraw-Hill International Edition.
- Roberson, John A. & Crowe, Clayton T. 1997. *Enginering fluid mechanics*, 6th. Ed, John Wiley, New York..
- Triatmodjo, Bambang. 1995. *Hidraulika I*, Beta Offset, Yogyakarta.
- Vijay, P. Singh. 1996. *Environmental hydraulics*, Kluwer Academic, Dordrech.

SUBJECT	**Subject Name**	: Citizenship
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

SUBJECT LEARNING ACHIEVEMENT

SUBJECT MATTER

PREREQUISITE

REFERENCE

SUBJECT		
	Subject Name	: Indonesian Language
	Subject Code	:
	Credit	: 2 credits
	Semester	: I (First)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCE

SUBJECT		
	Subject Name	: Environmental Microbiology
	Subject Code	: RE184102
	Credit	: 3 credits
	Semester	: I (first)

SUBJECT DESCRIPTION
Students will be able to understand the principles of microbiology related to environmental and sanitation issues, public health, bioprocess for waste water treatment and solid waste, and bioremediation of environmental quality. Materials to be studied by students are the basics of microbiology, bioprocess in liquid and solid waste treatment, environmental quality bioremediation, sanitary microbiology, microorganism control, microbial pollutant measurement and molecular genetic engineering basics.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Be cautious of God Almighty and able to show a religious attitude;

- Uphold the value of humanity in performing duties based on religion, morals, and ethics;
- Perform a responsible attitude towards the work in the field of expertise independently.

Knowledge

- Mastering the theoretical concepts of engineering sciences, engineering principles, and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental preservation, or environmental restoration;
- Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems.

Specific Skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, recovery environment or environmental management;
- Able to find the source of engineering problems in environmental management efforts to solve engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and;
- Be able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Able to apply basic concepts of microbiology in conjunction with environmental pollution control in planning in the field of environmental engineering
- Able to produce environmental pollution processing concept with microbiological parameter analysis
- Able to define microbiological parameter planning criteria to be applied to building planning in the field of environmental engineering
- Able to collect and analyze data and information of microbiological parameters correctly.

• Able to use data based on the results of data analysis to support the planning of pollution control
SUBJECT MATTER
• Students will be able to understand the microbiological principles related to environmental and sanitation issues, public health, bioprocess for waste water treatment and solid waste, and bioremediation of environmental quality. • Materials to be studied by the students are the basics of microbiology, bioprocess in liquid and solid waste treatment, bioremediation of environmental quality, sanitary microbiology, microorganism control, microbial pollutant measurement and molecular genetic engineering basics.
PREREQUISITE
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REFERENCES
• Cappucino, J.G. dan Sherman, N. 2002. *Microbiology - a laboratory manual, 6th edition*. Benjamin Cummings, Sansome St., San Francisco. • Sterrit, R. M. dan Lester, J. N., 1988. *Microbiology for environmental and public health engineers*. E & F.N Spon, London, • Tortora, G. J., FUnke, B.R., dan Case, C. L., 2004. *Microbiology – an introduction, 8th edition*. Benjamin Cummings, Sansome St., San Francisco. • Trihadiningrum, Y. 2013. *Mikrobiologi Lingkungan*. Surabaya, ITS Press. • Alexander, M. 1990. *Biodegradation and Bioremidiation*. Academic Press. San Diego.

SEMESTER II

SUBJECT	**Subject Name**	: English
	Subject Code	:
	Credit	: 2 credits
	Semester	:II (Second)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT

SUBJECT MATTER
PREREQUISITE
REFERENCE

SUBJECT	**Subject name**	: Mathematics II
	Subject Code	:
	Credit	: 3 credits
	Semester	: II (Second)

SUBJECT DESCRIPTION
This subject provides basic concepts of mathematical thinking (completion existence, logic flow/ settlement procedure) to students in solving real problems and can solve engineering problems, modeling and others in engineering related to integral application. as well as the ability to follow advanced subjects that require basic concepts of mathematics and analysis. The lecture materials include: the concept of integration technique, certain integral concepts, improper integrals, intergral applications, polar coordinates and parametric equations and their applications to calculate the area of flat and arc length, sequence and improper series, power series, Taylor series and Mac Laurin series.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
• Able to master the basic concepts of integration techniques. • Able to complete a certain Integral. • Able to apply certain integrals on the plane area, the volume of objects by disc method and ring method, the center of mass, the application of Guldin's theorem, fluid force and pressure. • Able to understand the polar coordinate system and parametric equations, can draw the graph, apply on the width of the plain and the length of the arc. • Able to calculate the convergence of rows, able to test the unmeasured series convergence and calculate the number of incompatible series, transform the function into the Taylor series or Mac Laurint series
SUBJECT MATTER

- **The concept of integration techniques**: partial integrals, integral rational functions (linear factors, quadratic factors), integration of trigonometric functions, reduction formulas, integral to trigonometric substitution (root form).
- **Certain Integral Concepts**: certain specific and integral problems, calculating certain integrals, fundamental theorems of calculus I, certain integrals by substitution, functions expressed as certain integrals, fundamental theorems of calculus II and improper integral.
- **Certain integral applications:** flat area, rotary volume (disc method, ring), fluid force and pressure, work (effort), center of gravity (mass center) and Guldin's theorem.
- **Polar coordinates and parametric equations**: functions and graphs in polar coordinates, terrain plots and arc lengths in polar coordinates, functions in parametric form, area and length of arc parametric functions.
- **Unlimited line and series:** sequence, convergence sequence, infinite series, convergence test and counting the number of incompatible to convergent series, notions of power series, Taylor series and MacLaurint series.

PREREQUISITE

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REFERENCE

- Lecturer Team of Mathematics Department of ITS. 2012. *Buku Ajar Kalkulus 2* , 4th-Edition Mathematics Department of ITS.
- Anton, H. dkk,. 2012. *Calculus,* 10-th edition, John Wiley & Sons, New York.
- Kreyzig, E,. 2011. *Advanced Engineering Mathematics*, 10-th edition, John Wiley & Sons, Singapore.
- Purcell, J, E, Rigdon, S., E.,. 2006. *Calculus,* 9-th edition, Prentice-Hall, New Jersey.
- James Stewart. 2012. *Calculus*, ed.7, Brooks/cole-Cengage Learning, Canada.

SUBJECT	**Subject Name**	: Environmental Statistics
	Subject Code	: RE184201
	Credit	: 3 credits
	Semester	: II (Second)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTER
PREREQUISITE
REFERENCE

SUBJECT	**Subject Name**	: Physics II
	Subject Code	: SF184201
	Credit	: 3 credits
	Semester	: II (Second)

SUBJECT DESCRIPTION
In this subject students will learn to understand the basic laws of physics, Electric Field; Potential Electricity; Electric current ; Magnetic field; Electrical Motion (EMF) Inductions and Alternating Current, through simple mathematical descriptions and introducing examples of the use of concepts.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
• Master the theoretical concepts of classical physics and modern physics in depth;
SUBJECT LEARNING ACHIEVEMENT
Students are able to understand: • Electrical charges, electrical properties of materials, Coulomb Law; • electric field strength, and calculate the electric field strength; • Gauss's legal concepts and applications • electric potentials on charged conductors and calculating electrical potentials • concept of capacitance, dielectric material, and capacitor circuit • the force of the magnetic field to the electric current and the moving charge • the concept of electrical current and material resistance, the concept of ohm law, kirchof law • magnetic properties of the material and calculate the magnetic field

- principle of GGL (electric motion) induction, inductance
- concept of impedance, and phase angle in RLC circuit

SUBJECT MATTER

- **Electricity and Electric Field**
  Electrical charges, electrical properties of materials, Coulomb Law; electric field strength, line force, electric field strength calculation;
- **Gauss's Law**: flux, Gauss's Law and its application;
- **Electric potential:** potential energy, electric potential difference, electrical potential calculation, potential gradient;
- **Capacitors**: Capacitance, capacitor capacitance calculation, capacitor circuit, dielectric material, energy capacitor;
- **Electric current**: current and charge motion, resistivity, resistance, Ohm's law, emf, energy and electrical power;
- **Direct current circuit**: resistor circuit, Kirchoff law, electric measuring instrument, Transient R-C Symptom:
- **magnetic field**: flux and magnetic induction, Lorentz style, Biot Savard-Ampere law, calculation of magnetic field;
- **GGL (Electric Motion) Induction**: Faraday's Law, Lenz's Law, induced GGL, Self Inductance and Inductance coupling; energy on the inductor;
- **Alternating current**: reactance, Impedance, phasor diagram, series circuit and parallel R-L-C, Power, Resonance, transformer

PREREQUISITE

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REFERENCES

- Halliday, Resnic, Jearl Walker. 2014. *Fundamental of Physics*. John Wiley and Sons, 10th ed, New York.
- Douglas C. Giancoli,. 2014. *Physics for Scientists and Engineers , Pearson Education, 4th ed*: London.
- Tim Dosen. *Diktat Fisika II*. Fisika FMIPA-ITS.
- Tim Dosen. *Soal-soal Fisika II*. Fisika FMIPA-ITS.
- Sears & Zemanky. 2016. *University Physics*. Pearson Education, 14thed, USA.
- Tipler, PA. 2008. *Physics for Scientists and Engineers ',6th ed*: W.H. Freeman and Co, New York.

SUBJECT	**Subject Name**	: Introduction to Geospatial Techniques
	Subject Code	:
	Credit	: 2 credits

	Semester	: 2 (second)

SUBJECT DESCRIPTION
The purpose of this subject students are able to apply topographic data of land for planning purposes in the field of Environmental Engineering. In general, students will study the history of maps, positioning, unit system, map review, symbols, profiling, contouring, generalization. In applications in Environmental Engineering, students will also learn about the basics of photogrammetry, stereoscopes, aerial photography, land area identification, waterpass and the introduction of tools and their counts, polygons and the introduction of tools and calculations, tachymetry and the introduction of tools and calculations, plotting, contouring, and map sheet design, introduction of geographic information system (GIS). Learning objectives can be achieved with face-to-face lectures and practicum: field mapping and use of GPS.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Perform a responsible attitude towards the work in the field of expertise independently
SUBJECT LEARNING ACHIEVEMENT
• Able to explain and master the concepts and principles of geospatial information science and technology • Able to explain and master the basic concepts of methods and processes in data retrieval based on geospatial information science and technology • Able to analyze, interpret spatial data using geospatial information science and technology • Able to use geospatial information in its application in Civil Engineering, Environmental Engineering, Geomatics Engineering and Geophysical Engineering.
SUBJECT MATTER
Meaning of Geospatial Information; Use of Geospatial Information; History and Development; Methods of data collection and utilization of existing resources such as human resources and software and hardware in geospatial information, How to read maps for various purposes of work; WebGIS; Applications and Uses IG in the work of Civil Engineering, Environmental Engineering, Geomatics Engineering and Geophysical Engineering.
PREREQUISITE
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REFERENCES

- Sosrodarsono, Suyono & Masayosi Takasaki. 1992. *Pengukuran topografi dan teknik pemetaan*: Pradnya Paramita, Jakarta.
- Rais, Jacub. 1978. *Ilmu Ukur Tanah I dan II*: Jakarta. / ∑ 3 / 526.98 Rai I / I & II.
- Wongsotjitro, Soetomo, 1980, *Ilmu ukur tanah*. Kanisius, Yogyakarta.

SUBJECT	**Subject Name**	: Pancasila
	Subject Code	:
	Credit	: 2 credits
	Semester	: II (Second)

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
SUBJECT LEARNING ACHIEVEMENT
SUBJECT MATTTER
PREREQUISITE
REFERENCES

SUBJECT	**Subject Name**	: Chemistry I
	Subject Code	:
	Credit	: 3 credits
	Semester	: II (Second)

SUBJECT DESCRIPTION
This subject studies basic principles of chemistry including atomic theory, electron configuration, chemical bonding, substance form and phase change, chemical reactions and stoikhiomeri, acidic base theory, ionic equilibrium in solution (thermal acid, solubility, complex and precipitation), thermodynamics Chemistry, Kinetics Chemistry and Electrochemistry.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
• Students are able to demonstrate knowledge and apply the principles and concepts of chemistry.

- Students are able to study and solve qualitative and quantitative problems in chemical science both individually and in groups.
- Students believe that chemistry plays an important role in society.
- Students are able to think critically and empirically.
- Students believe that the principles of chemistry can be tested scientifically.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to use the basic principles of chemistry as a basis in studying chemistry related to chemistry.
- Students can perform basic chemical calculations.

SUBJECT MATTER

- Basic Chemical Concepts
- Atomic Models and Structures
- Electron Configuration and Chemical Bonding
- Substance Form and Phase Change
- Stoichiometry and Chemical Reaction
- Solution, Concentration, Colligative Properties
- Chemical equilibrium
- Basic Acidic Theory
- Ionic Equilibrium in Solutions (Acid Bases, Solubility, Complexes and Precipitation)
- Chemical thermodynamics
- Chemical Kinetics
- Electrochemistry

PREREQUISITE

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REFERENCES

- D. W. Oxtoby, H.P. Gillis and A. Champion. 2012. *Principles of Modern Chemistry", 7th edition*. Mary Finc: USA.
- R. Chang. 2009. *Chemistry", 7th edition*. McGraw Hill: USA.
- D. E. Goldberg. 2007. *Fundamental of Chemistry*. Mc Graw Hill Companies.
- Ulfin, I. K. Murwani, H. Juwono, A. Wahyudi dan F. Kurniawan. 2010. *Kimia Dasar*. ITS Press, Surabaya.

SEMESTER III

SUBJECT	**Subject Name**	: Environmental Chemistry
	Subject Code	: RE184301

	Credit	: 3 credits
	Semester	: III (Third)

SUBJECT DESCRIPTION

In this subject, students will be able to analyze the parameters of inorganic materials as environmental pollutants. In general the material studied is: qualitative and quantitative analysis of inorganic chemistry, hydrolysis, oxidation reduction, photochemistry, chemical reaction equilibrium, reaction kinetics, and inorganic material degradation in water, soil, and atmosphere. Learning objectives will be achieved through face-to-face lectures, lab work, individual assignments and group assignments.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
- Cooperate and have social sensitivity and concern for society and environment;
- Demonstrate a responsible attitude towards the work in the field of expertise independently;
- Internalizing the spirit of independence, striving, and entrepreneurship; and
- Trying to the fullest to achieve perfect results.

Knowledge

- Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems;
- Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems; and
- Mastering communication techniques and latest and latest technological developments.

Specific Skill(s)

- Able to apply engineering chemistry and principles to solve complex engineering problems at least in one aspect;
- Able to conduct research that includes identification, formulation, and analysis of engineering problems at least on one aspect; and

- Able to formulate alternative solutions for complex engineering problems at least on one aspect.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise, rules and ethics in order to produce solutions, ideas, designs or art criticisms;
- Able to develop scientific descriptions of studies in the form of scientific papers; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to use relevant chemical concepts to think critically about environmental facts and become the basis for environmental management
- Students are able to use the concept of reaction and kinetikanya as the basis for calculating some environmental management design criteria
- Students are able to use the concept of adsoption and ion exchange as a basis for studying part of the environmental management process
- Students understand the basics of chemical analysis required in environmental analysis, and their relevance to environmental management processes

SUBJECT MATTER

- Review the basic concepts of chemistry and classification of chemical compounds (organic-inorganic)
- Review of chemical pollutants (inorganic - organic) and cycles in nature
- Stoichiometry and equilibrium of chemical reactions (neutralization and precipitation)
- Reaction of oxidation and reduction in nature and waste treatment
- Reaction Kinetics
- Adsorption
- Corrosion and corrosion inhibitor principles
- The basis of qualitative and quantitative analysis of pollutants
- Practicum: laboratory work safety, introduction of laboratory equipment, neutralization and acidity regulation (volumetric titration), redox reactions (chlorination and iodometry, redox titration), solubility and

separation of metals (gravimetry), adsorption, reaction kinetics, spectrophotometry and turbidimetry.

PREREQUISITE

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REFERENCES

- Sawyer C. N., McCarty P. L. dan Parkin G. F., 2003. *Chemistry for Environmental Engineering and Science.* Mc Graw-Hill Singapore.
- Manahan, S. E. 2000. *Fundamental environmental chemistry, 2nd edition*. Taylor & Francis, Boca Raton.
- Manahan, Stanley E. 2000. *Environmental Science, Technology, and Chemistry*. Boca Raton: CRC Press LLC.
- Vogel. 1985. B*uku Teks Analisis Anorganik Kualitatif Makro Dan Semimikro, jilid 1 dan jilid 2*. Kalman Media Pusaka, Jakarta.
- Reynolds, J.P., Jeris, J.S., dah Theodore, L. 2002. *Handbook Of Chemical And Environmental Engineering Calculations*. John Wiley, New York.

SUBJECT	**Subject Name**	: Water Resources Management
	Subject Code	: RE184302
	Credit	: 3 credits
	Semester	: III (Third)

SUBJECT DESCRIPTION

The purpose of this subject, students are able to apply the comprehensive water resources management plan. In this subject, students study the understanding and concept of water resources management, legal aspects, climate, hydrological cycle, forest, river, lake, natural and artificial ponds, wetlands, ground water and rain water. Students also study freshwater resources, brackish water, peat water, natural resource management methods (conservation methods, calculation of carrying capacity and carrying capacity, self purification / DO-Sag curve methods), applications on reclamation and conservation measurements, utilization of treated wastes for irrigation , and recycle industrial and domestic wastewater. Subject objectives can be achieved with face-to-face lectures and water resources management planning tasks of a region

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Have a good attitude and mental and academic ethics, maintain values and norms, and personality as a nation of Indonesia; and

- Demonstrate responsible attitudes towards the work in the field of expertise independently.

Knowledge

- Mastering the theories and methods of management, analysis of environmental issues and environmental management efforts by taking into account the risks that occur.

Specific Skill(s)

- Able to analyze and solve problems that occur in the environment well by using management technology, establishing efforts that need to be done in solving the problems encountered, taking into account the aspects of Engineering - economic and environmental / health; and
- Able to do deepening or extension of science in the field of design, operation, and maintenance of engineering systems and environmental management to contribute original and tested.

General Skill(s)

- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanities in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics;

SUBJECT LEARNING ACHIEVEMENT

- Able to internalize values, norms, academic ethics, show a responsible attitude towards the work independently by doing the task without doing plagiarism;
- Able to apply the theory of engineering science, engineering design, methods and techniques that are needed for the analysis and design of environmental management efforts in doing the task independently;
- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanities in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics;
- Able to solve engineering and technological problems and design systems, processes and components on environmental management efforts including natural resource management, Uses and benefits of SDA, Application of Models on surface water (rivers and lakes), groundwater by conservation theory, Qual2KW Model, Storet Method, PSDA in coastal areas (mangroves) and peatlands, IWRM, Groundwater and evaporation theory and Polder, SDA theory related to polder / boezem, and water budget; and

• Able to perform deepening or extension of science in the field of design, operation, and maintenance of engineering systems and environmental management to contribute original and tested by making the task of review paper.
SUBJECT MATTER
• Regulations and legislation related to water and environmental resources management; , Sustainable water and environmental management, modeling related to SDA quality status with conservation theory, Qual2KW, Storet, PSDA in coastal areas (mangrove) and peatlands, ground water resources, Integrated Water Resources Management, Water budget, which are presented in the field of water and environmental resource management
PREREQUISITE
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REFERENCES

SUBJECT	**Subject Name**	: Air Pollution and Climate Change
	Subject Code	: RE184303
	Credit	: 3 credits
	Semester	: III (Third)

SUBJECT DESCRIPTION
The purpose of this subject, the students are able to outline the materials studied are: definition of air pollution, air pollution cases, air quality management regulations, air pollutant sources (source, extent, movement), air pollution parameters (particulate matter and gas), air pollution impacts (human and environmental), meteorological factors (air mass movement, temperature, pressure, humidity and wind), atmospheric structure, ozone depletion, greenhouse effect and global warming, air in Indonesia (blue sky program), management programs in several countries. Learning objectives will be achieved through face-to-face lectures, lab work, individual assignments and group assignments.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude: • Be cautious of God Almighty and capable of showing a religious attitude; • Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;

- contribute to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- acting as a proud citizen and love of the country, has nationalism and a sense of responsibility to the state and nation;
- appreciate the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
- cooperate and have social sensitivity as well as concern for society and environment;
- law-abiding and disciplined in the life of society and state
- internalize academic values, norms, and ethics;
- demonstrate a responsible attitude towards the work in the field of expertise independently; and
- internalize the spirit of independence, struggle, and entrepreneurship.

Knowledge

- Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental preservation, or environmental restoration;
- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach;
- Able to explain current principles and issues in economics, social, ecology in general; and
- Able to explain basic principles of communication techniques and latest and latest technological developments.

Specific Skill(s)

- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment;
- Able to prepare a research proposal for minimal engineering problems in one aspect, namely: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental recovery with detailed and systematic implementation stages;
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: the provision of environmental infrastructure, the protection of communities from hazardous

environments, environmental protection, environmental preservation, and environmental restoration by taking into account economic, public health and safety factors, cultural, social and environmental;

- Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental restoration;
- Able to apply research results and alternative formulas to determine engineering criteria / environmental management;
- Able to design the best systems and processes in managing a reliable, safe, easy, affordable, and sustainable environment;
- Able to get information, understand criteria, local / global resources potential and utilization in accordance with system design;
- Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management; and
- Able to define the necessary resources as per the design of a reliable, safe, easy, affordable, and sustainable environmental management system.

General Skill(s)

- Able to define the necessary resources as per the design of a reliable, safe, easy, affordable, and sustainable environmental management system;
- Able to demonstrate independent performance, quality, and measurable;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis;
- Able to maintain and develop a network with mentors, colleagues, colleagues both inside and outside the institution;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under the responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to explain the definition and understanding of air pollution
- Students are able to understand the concept of atmosphere and the mechanism of transport of pollutants in the atmosphere
- Students are able to comprehend thoroughly the scale in air pollution and its cases
- Students understand the parameters of air pollutants and their sources
- Students understand the sources of air pollutants
- Students understand the impacts of air pollution on humans, vegetation and animals, as well as the atmosphere (ecosystem), soil and water bodies
- Students understand air quality related regulations
- Students understand the concept of air pollution prevention and its policies
- Students understand various emission control tools

SUBJECT MATTER

- The concept of air pollution
- The concept and structure of the atmosphere, the transport of pollutants in the atmosphere
- The scale of air pollution and its cases
- Impact of pollution on humans, animals, vegetation, ecosystems
- Criteria and standards of ambient air quality, and emissions
- Indoor air quality (indoor)
- Prevention of air pollution and its policies
- Control of particulate and gas emissions

PREREQUISITE

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REFERENCES

- Vallero D. 2008. *Fundamental of Air Pollutions*. 4th Edition, Elsevier, New York.
- Boedisantoso, Rachmat. 2002. *Teknologi Pengendalian Pencemar Udara*. DUE-Like ITS, DEPARTEMEN Teknik Lingkungan FTSP-ITS, Surabaya.
- C. David Cooper, Alley, F. C. 1994. *Air Pollution Control A Design Approach*. Waveland Press Inc., Illinois, USA.
- Davis, Wayne T. 2000. *Air Pollution Control Engineering Manual*. Air and Waste Management Association, John Willey & Sons.
- Kenneth E. Noll. 1999. *Design of Air Pollution Control Devices*. American Academy of Environmental Engineering, USA.
- Ogawa, Akira. 1987. *Separation of Particles from Air and Gases*. CRC Press Florida.

- Seinfeld JH., Pandis SN. 2006. *Atmospheric Chemistry and Physics, from air Pollution to Climate Change*. John Wiley & Sons, Inc.

SUBJECT	**Subject Name**	: Soil Mechanics and Geohydrology
	Subject Code	: RE184304
	Credit	: 3 credits
	Semester	: III (Third)

SUBJECT DESCRIPTION

The purpose of this subject, students are able to use ground and groundwater data to support simple building planning in the field of Environmental Engineering. In general, students of soil and rock classification, soil and groundwater parameters, soil bearing capacity, side-to-ground pressure, ground water flow, pumping test, and groundwater modeling. Students will also study the use of soil and groundwater data in the design of simple buildings in the field of environmental engineering and groundwater wells. Learning objectives will be achieved through face-to-face lectures, individual and group assignments.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Internalize academic values, norms, and ethics; and
- Demonstrate responsible attitudes towards the work in the field of expertise independently.

Knowledge

- Engineering science theory, design engineering, advanced methods and techniques necessary for the analysis and design of environmental management efforts.

Specific Skill(s)

- Able to solve engineering and technological problems and design systems, processes and components on environmental management efforts including groundwater management and capable of designing shallow foundations and retaining walls with due regard to economic, health, and public safety, cultural, social and environmental factors; and
- Able to do deepening or extension of science in the field of design, operation, and maintenance of engineering systems and environmental management to contribute original and tested.

General Skill(s)

- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanities in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics.

SUBJECT LEARNING ACHIEVEMENT

- Able to internalize values, norms, academic ethics, show a responsible attitude towards the work independently by doing the task without doing plagiarism
- Able to apply the theory of engineering science, engineering design, methods and techniques that are needed for the analysis and design of environmental management efforts in doing the task independently
- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanities in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics
- Able to solve engineering and technological problems and design systems, processes and components on environmental management efforts including groundwater management and able to design a shallow foundation and retaining wall with due regard to economic, health and safety, public, cultural, social and environmental factors
- Able to perform deepening or extension of science in the field of design, operation, and maintenance of engineering systems and environmental management to contribute original and tested by making the task of review paper

SUBJECT MATTER

- Introduction to soil mechanics and geohydrology in environmental engineering, rock cycle, heavy-volume-plasticity relationship and soil structure, phase diagram, retaining wall, soil bearing capacity, shallow foundation, slope stability, Water resources management regulations and legislation, grained ground, hydrological cycle, aquifer species, groundwater flow, radial flow, pumping test, well-making, groundwater management

PREREQUISITE

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REFERENCES

- Adriano, Dorny C. (ed). 1999. *Contamination of groundwaters*. St Lucie, Boca Raton.
- Cernica, John N,. 1995. *Geotechnical engineering, soil mechanics*. John Wiley, New York.

- Das, Braja M,. 1994. *Mekanika tanah, jilid 1 dan 2*. Alih bahasa Noor Endah Mochtar dan Indra Surya B Mochtar, Erlangga, Jakarta.

SUBJECT	**Subject Name**	: Hydraulics
	Subject Code	: RE184305
	Credit	: 4 credits
	Semester	: III (Third)

SUBJECT DESCRIPTION

In this subject, students will learn about the science related to static (hydrostatic) and dynamic (hydrodynamic) water behavior and its application to closed channels (pipes) and open channels. After studying Hydraulics, students are able to explain and apply the principles of hydraulics to support environmental engineering building planning. This subject is equipped with **practicum**: Hydraulics of open channel and closed channel.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Be cautious of God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Contributing to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
- Cooperate and have social sensitivity and concern for society and environment;
- Obey the law and discipline in social life and state;
- Internalize academic values, norms, and ethics;
- Demonstrate responsible attitudes towards the work in their own field of expertise; and
- Internalize the spirit of independence, stability, and entrepreneurship

Knowledge

- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach; and

- Able to explain basic principles of communication techniques and latest and latest technological developments.

Specific Skill(s)

- Able to apply mathematics, statistics, physics, and engineering principles to solve the problem of drinking water distribution;
- Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs;
- Able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis; and
- Able to maintain and develop a network with mentors, colleagues, colleagues both inside and outside the institution.

General Skill(s)

- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under their responsibility;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to understand drainage concepts in open channels and pressurized channels
- Students are able to design the dimensions of open channels and pressurized channels to drain a water discharge
- Students are able to measure the speed and discharge of water by measuring instrument
- Students are able to apply hydraulic formula in water structures in the field of environmental engineering

SUBJECT MATTER

- Water characteristics
- Hydrostatic, geometrical cross-section
- Drainage concept on open channel, flow type
- Formula maning and cezy

- Discharge measuring instruments and aquatic environmental engineering
- Specific energy and critical depth
- Water surface flow profile
- The concept of pressurized flow, HGL and EGL lines
- Hazen William's Formula, Darcy Weisbach
- Major losses and minor losses,
- The drainage concept of series pipes, eqivalent pipes
- The drainage concept of a parallel pipe
- The concept of drainage on pipes between reservoirs
- The drainage concept of a loop pipe
- Hardy Cross calculations
- Pumping System

PREREQUISITE

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REFERENCES

- Ranal V. Giles, Jack B. Evett, Cheng Liu. 1996. *Theory and Problems of Fluid Mechanics and Hydraulics*. McGraw-Hill International Edition.
- Roberson, John A. & Crowe, Clayton T. 1997. *Enginering fluid mechanics*.6th. Ed, John Wiley, New York.
- Triatmodjo, Bambang. 1995. *Hidraulika I*.Beta Offset, Yogyakarta.
- Vijay, P. Singh. 1996. *Environmental hydraulics*. Kluwer Academic, Dordrech.

SUBJECT	**Subject Name**	: Structure Knowledge
	Subject Code	: RE184306
	Credit	: 3 credits
	Semester	: III (Third)

SUBJECT DESCRIPTION

In this subject, students will be able to design simple concrete and steel structures in buildings in the field of Environmental Engineering. In general, the materials studied are: basic theory of structure, concrete and steel technology knowledge, calculation of concrete and steel structures, and calculations of BOQ and RAB on simple Environmental Engineering buildings. Learning objectives will be achieved through face-to-face lectures, individual assignments and group assignments.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in the field of expertise independently.

Knowledge

- Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems; and
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach.

Spcific Skill(s)

- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology; and
- Able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems and design of environmental management systems that is protection of society from hazardous environments and environmental protection
- Able to select methods, technologies and utilize design tools and analysis of environmental engineering based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.
- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities appropriate to their area of expertise;
- Able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis

SUBJECT MATTER

- Planning of Building Structure in Environmental Engineering

PREREQUISITE
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REFERENCES
• Dipohusodo, I.,. 1996. *Struktur Beton Bertulang*. Gramedia Pustaka Utama, Jakarta. • McCormac,J.C. 1981. *Structural Steel Design*. 3 rd.Ed, Harper & Row, New York. • Sieh, Yuan Yu. 1985. *Teori Dasar Struktur, Alih Bahasa Suryadi*. Erlangga, Jakarta. • Hibbeler, R.C. 1985. *Mekanika Teknik, Statika 1 dan 2, Alih Bahasa Yaziz Hasan*. Prenhalindo, Jakarta.

- **SEMESTER IV**

SUBJECT	**Subject Name**	: Biological Process Unit - Environmental Engineering
	Subject Code	: RE184401
	Credit	: 3 credits
	Semester	: IV (Fourth)

SUBJECT DESCRIPTION
GRADUATE LEARNING ACHIVEMENT WHICH IS CHARGED TO THE SUBJECT
Attitude • Internalize academic values, norms, and ethics; • Trying to the fullest to achieve perfect results; and • Work together to be able to take full advantage of their potential. **Mastery of Knowledge** • Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental preservation, or environmental restoration; • Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems; **Specific Skill(s)**

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, recovery environment or environmental management;
- Able to conduct research that includes identification, formulation and analysis of engineering problems at least in one aspect, namely: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management;

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and;
- Able to demonstrate independent, quality, and measurable performance,;
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under their responsibility;
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Able to master theoretical concepts of science engineering, engineering principles, and engineering design on the biological process unit in the field of environmental engineering;
- Able to master the concept of natural science and the principle of application of engineering mathematics in biological process units in the field of environmental engineering;
- capable of applying mathematics, statistics, physics, chemistry, biology, microbiology, and engineering principles and engineering principles to biological process units in the field of environmental engineering;
- capable of undertaking research that includes the identification, formulation, and analysis of minimal engineering problems in the biological process unit in the field of environmental engineering;

SUBJECT MATTER

PREREQUISITE

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REFERENCES

SUBJECT	**Subject Name**	: Solid Waste Management Design
	Subject Code	: RE184402
	Credit	: 4 credits
	Semester	: IV (Fourth)

SUBJECT DESCRIPTION

Students are able to plan a waste management system that includes waste reduction and waste management. Materials to be studied include basics of waste management, waste reduction planning, garbage collection and removal, material recovery recovery planning, waste and mud treatment planning and incinerator pollution control. Estimated greenhouse gas emissions and various legislation related to waste management.

GRADUATE LEARNING ACHIVEMENT WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in the field of expertise independently.

Knowledge

- Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems; and
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach.

Specific Skill(s)

- Able to design the systems and processes necessary for environmental management with an analytical approach and taking into account technical standards, environmental safety and health, performance, reliability, ease of application, sustainability, and economic, health and safety, public, cultural, social and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology; and
- Able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Able to master the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems and design of environmental management systems that is protection of society from hazardous environments and environmental protection
- Able to select methods, technologies and utilize design tools and analysis of environmental engineering based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.
- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities appropriate to their area of expertise;
- Able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis
- Able to design waste reduction and waste management systems required for environmental management efforts with an analytical approach and taking into account applicable environmental, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and economic, health and safety factors public, cultural, social, and environmental issues.

SUBJECT MATTER

- Fundamentals of waste management include: definition, source of waste, classification and characteristics, composition, and estimation of waste generation
- Waste reduction which includes the limitation of waste generation; recycle; and waste utilization
- Waste management planning including segregation in the form of grouping and separation of waste according to type, quantity, and / or trash nature (magnetic separation, disc, etc.)
- Planning of garbage collection and removal from waste sources to temporary shelters, intermediate transit stations, or integrated waste treatment sites and trash hauling to the final waste processing site.
- Planning of Material Recovery Facility.
- Planning for waste processing which includes physical (enumeration and compaction), chemical (inseneration, pyrolysis and gasification), biological (composting aerobic and anaerobic, vermi komposting). Physical mud treatment (drying and filter press), chemical (incineration) and biological (aerobic and anaerobic composting
- Pollution control in incinerator and integrated waste treatment center.

- Estimated carbon emissions in waste management with different approaches such as calculations based on IPCC or US EPA
- Waste management legislation and institutions.
- The task of planning of garbage collection and transport, TPS, SPA and integrated waste treatment plant.

PREREQUISITE

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REFERENCES

- Landth, R.E., and Rebers, P. A. 1997. *Municipal Solid Waste - Problems and Solutions*. CRC Press
- Tchobanoglous, G., Thiesen, H., dan Vigil, S. A. 1993. *Integrated Solid Waste Management - Engineering Principles and Management Issues*. McGraw-Hill, New York.
- Tchobanoglous, G. Dan Frank, K. 2002. *Handbook of Solid Waste Management*. McGraw-Hill Professional, New York.
- Vesilind, P. Aarne, W. W. and Reinhart,D. 2002. *Solid Waste Engineering*, Brooks Cole, Pacific Grove.
- John S. 2005. *Cycling Of Waste Plastics - Pyrolysis And Lated Feedstock Cycling Technologies*. John Wiley and Sons. William, P.T. 2005. "Waste Treatment and Disposal", John Wiley and Sons.

SUBJECT	**Subject Name**	: Environmental Pollutants Analysis Technique
	Subject Code	: RE184403
	Credit	: 4 credits
	Semester	: IV (Fourth)

SUBJECT DESCRIPTION

Students are able to analyze the parameters of drinking water quality, waste water, waste and soil and able to interpret the data of laboratory analysis. Materials to be studied include analysis of the quality of clean water, wastewater and waste including sampling methods and sample preparation, sampling and field sampling in the field and laboratory, standardized solution, AQC, norms, standards, regulations and criteria for clean water, wastewater and garbage.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in the field of expertise independently;

- Trying to the fullest to achieve perfect results; and
- Cooperate to be able to take full advantage of their potential.

Knowledge

- Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems.

Specific Skill(s)

- Able to analyze the engineering criteria and system / process design in environmental management; and
- Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology; and
- Able to demonstrate independent, quality, and measurable performance.

SUBJECT LEARNING ACHIEVEMENT

- Able to apply measurements of drinking water and waste water parameters for environmental quality analysis.
- Able to analyze the measurement results of pollutant / pollutant indicators on drinking water, wastewater, air, and soil.
- Able to interpret data analysis results clearly and accurately to support the design of buildings in the field of environmental engineering, prevention of pollution and restoration of environmental quality.
- Able to make informed decisions based on data and information analysis

SUBJECT MATTER

- Norms, standards, regulations, and criteria for clean water, and waste water.
- Method of sampling and analysis of drinking water and waste water parameters

PREREQUISITE

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REFERENCES

- APHA, AWWA, WPFC. 2005. *Standard methods for examination of water and wastewater*, 21st.ed., APHA, AWWA, WPFC, Washington, DC.
- Sawyer, C. N., McCarty, P.L., Parkin, G. F. 2003. *Chemistry for environmental engineering and science*, 5thed., McGraw-Hill, Singapore.
- Davis, M. L., Cornwell, D. A. 2008. *Introduction to Environmental Engineering*. 4th ed. McGraw-Hill, Singapore.

- Tchobanoglous, G., Stensel, H. D., Tsuchihashi, R., Burton, F. 2014. *Wastewater Engineering Treatment and Resource Recovery*. 5th ed. McGraw-Hill, Singapore.
- Rump, H. H, Krist. H., 1988. *Laboratory Manual for the Examination of Water, Waste Water, and Soil.* VCH Verlagsgesellschaft. Weinheim.

SUBJECT	**Subject Name**	: Management of Gas Emissions and Air Ambient
	Subject Code	: RE184404
	Credit	: 3 credits
	Semester	: IV (Fourth)

SUBJECT DESCRIPTION

The purpose of this subject is for students to be able to plan Air Quality Monitoring program to support Local Air Pollution Control. In this subject, the materials studied are: control of air pollution, control of emissions from mobile sources (converter, scrubber, and emission reduction); the introduction of air control equipment from the source of immovable (gravity thickener, fabric filter/ baghouse, absorber (scrubber), ESP, Cyclone, adsorption tool, Insenerator/ Flare (combustion and Condensator) .The students will also study the determination of sampling point, the number monitoring stations and methods of measuring ambient air quality, determining number and point source emission sampling points, sampling methods and measuring the quality of air from line emissions (sources and area sources), as controls in air quality control The learning objectives will be achieved through face-to-face lectures, individual assignments and group assignments.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude:

- Be cautious of God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Contributing to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
- Cooperate and have social sensitivity and concern for society and environment;

- Obey the law and discipline in social life and state
- Internalize academic values, norms, and ethics;
- Demonstrate a responsible attitude towards the work in their own field of expertise; and
- Internalizing the spirit of independence, struggle, and entrepreneurship

Mastery of Knowledge:

- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach;
- Able to explain current principles and issues in economics, social, ecology in general; and
- Able to explain basic principles of communication techniques and latest and latest technological developments.

Specific Skill(s) :

- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: the provision of environmental infrastructure, the protection of communities from hazardous environments, environmental protection, environmental preservation, and environmental restoration by taking into account economic, public health and safety factors, cultural, social and environmental;
- Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental restoration;
- Able to apply research results and alternative formulas to determine engineering criteria / environmental management;
- Able to design the best systems and processes in managing a reliable, safe, easy, affordable, and sustainable environment;
- Able to get information, understand criteria, local / global resources potential and utilization in accordance with system design;
- Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management; and
- Able to define the necessary resources as per the design of a reliable, safe, easy, affordable, and sustainable environmental management system.

General Skill(s):

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent performance, quality, and measurable;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of

humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs;

- Able to develop scientific descriptions of studies in the form of scientific papers;
- Able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis;
- Able to maintain and develop a network with mentors, colleagues, colleagues both inside and outside the institution;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under the responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Able to explain basic principles and process of gas and particulate matter
- Able to develop designs in the field of air pollution control and research results to solve sophisticated issues related to the environment

SUBJECT MATTER

- Types and sources of air pollutants
- The basic theory of fluid flow and its application to the control of gas and particulate emissions
- Operation and processing of gas source of moving (catalityc converter), immovable source (adsorption, absorption, condensation and combustion) and particulate processing (settling chamber, cyclone, fabric filtration, electrostatic precipitator and wet colector)
- Design of immovable source gas processing (adsorption, absorption, condensation and combustion), immobilized sources (adsorption, absorption, condensation and combustion) and particulate processing (settling chamber, cyclone, fabric filtration, electrostatic precipitator and wet colector)
- Ambient Sampling Method (background and purpose, sampling point determination)
- Measurement and analysis of ambient air
- Monitoring of ambient air quality (laying of sampling points, determining number of stations)

PREREQUISITE

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REFERENCES

- Cooper, C. David & Alley, F.C. 2011. *Air Pollution Control, A Design Approach*. 4th.ed. Waveland Press. Long Grove.
- Kalliat T. & Valsaray. 2009. *Elements of Environmental Engineering, Thermodynamics and Kinetic.* CRC Press, New York.
- Theodore, Louis. 2008. *Air Pollutin Control Equipment Calculations*. John Wiley. New York.

SUBJECT	**Subject Name**	: Physic - Chemical Unit Processes in Environmental Engineering
	Subject Code	: RE184405
	Credit	: 2 credits
	Semester	: IV (Fourth)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Respect for cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
- Working together and having a social sensitivity and concern for the community and the environment;
- Demonstrate a responsible attitude towards the work in their own field of expertise;
- Internalizing the spirit of independence, striving, and entrepreneurship; and
- Trying to the fullest to achieve perfect results.

Knowledge

- Mastering the theoretical concepts of science engineering, engineering principles, and engineering design needed for the analysis of environmental problems;
- Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems; and
- Mastering communication techniques and latest and latest technological developments.

Specific skill(s)

- Able to apply the principles of chemical physics and engineering (engineering principles) to solve complex engineering problems at least in one aspect;
- Able to conduct research that includes identification, formulation, and analysis of engineering problems at least on one aspect; and
- Able to formulate alternative solutions for complex engineering problems at least on one aspect.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent performance, quality, and measurable;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism;
- Able to develop scientific descriptions of studies in the form of scientific papers; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

Students are able to understand the principles of physics characteristics of water chemistry and pollutants, processes occurring in processing, types of reactors and chemical physics processes that occur, and able to calculate the dosage of chemicals needed in water treatment as a basis for calculation and analysis of water treatment performance

SUBJECT MATTER

- Principles of Water Chemical Physics Characteristics
- Principles of Physical Process in Environmental Processing
- Principles of Chemical Process in Environmental Processing
- Reactor and Mixing Tank Unit
- Determination of chemical dosage of the treatment
- Adsorption and Ion Exchange capacity determination, activation and regeneration

PREREQUISITE

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REFERENCES

SUBJECT	**Subject Name**	: Drinking Water Supply Design
	Subject Code	: RE184406
	Credit	: 3 credits
	Semester	: IV (Fourth)

SUBJECT DESCRIPTION

In this subject, students will learn about water supply system development planning that includes raw water units, transmission and distribution units, and service units. This subject focuses on planning of drinking water distribution system with pipeline network, consisting of service area determination, water demand determination, distribution pipeline network analysis, and leakage control. After attending this lecture, students are able to apply the principle of pipeline planning into the drinking water supply system. Lectures are equipped with the planning of drinking water supply system within a city.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Be cautious of God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Contributing to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
- Working together and having social sensitivity and concern for society and environment;
- Obey the law and discipline in social life and state;
- Internalize academic values, norms, and ethics;
- Demonstrate responsible attitudes for the work in his own field of expertise; and
- Internalizing the spirit of independence, struggle, and entrepreneurship;

Knowledge

- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach;
- Able to explain current principles and issues in economics, social, ecology in general; and

- Able to explain basic principles of communication techniques and latest and latest technological developments.

Specific Skill(s)

- Able to apply mathematics, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, or environmental restoration;
- Able to prepare a research proposal for minimal engineering problems in one aspect, namely: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental recovery with detailed and systematic implementation stages;
- Able to implement the proposed research design and report it in scientific papers;
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: the provision of environmental infrastructure, the protection of communities from hazardous environments, environmental protection, environmental preservation, and environmental restoration by taking into account economic, public health and safety factors, cultural, social and environmental;
- Able to recommend selected alternative solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental restoration;
- Able to apply research results and alternative formulas to determine engineering criteria / environmental management;
- Able to analyze the criteria of engineering and system design / process in environmental management;
- Able to design the best systems and processes in managing a reliable, safe, easy, affordable, and sustainable environment;
- Able to get information, understand criteria, local / global resources potential and utilization in accordance with system design;
- Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management; and
- Able to define the necessary resources as per the design of a reliable, safe, easy, affordable, and sustainable environmental management system.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;
- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students understand the basics of drinking water distribution system planning
- Students are able to calculate the projected water needs of a city
- Students are able to plan the distribution network of drinking water
- Students are able to calculate the budget of drinking water distribution pipeline network
- Students are able to plan the volume of reservoir and transmission pipe
- Students are able to plan for decreasing water loss and efforts to improve energy efficiency in pumping systems

SUBJECT MATTER

- Fundamentals of drinking water distribution system planning
- Calculates population projections and commercial social facilities
- Calculate the projected water needs
- Describes the source of raw water and the building of raw water and transmission pipes
- Stages of drinking water distribution system planning
- Design criteria in drinking water distribution system planning
- Calculation of transmission line diameter and distribution

- Reservoir distribution concept and calculation of ground reservoir and elevated reservoir volumes
- Complementary building of transmission and distribution piping system of drinking water
- Pipe type selection, pipe planting profile, detail junction
- RAB calculation of drinking water distribution system
- balance sheet of water loss
- planning for the reduction of water loss
- The concept of energy efficiency in the pumping system

PREREQUISITE

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REFERENCES

- Male, James W. & Walski, Thomas M. 1990. *Water distribution systems - a troubleshooting manual*. Lewis, Boca Raton.
- Thomas M. Walski, Donald V. Chase & Dragan A. Savic. 2001. *Water Distribution Modeling - haestad methods.* Haestad, Waterbury. + CD-ROM
- Twort, A.C. 2003. *A Textbook of water supply*. Edward Arnold, London.
- Japan Water Works Association. 1978. Suido shisetsu sekei shishin: *Design criteria for waterworks facilities.* Japan Water Works Association, Tokyo.

- **SEMESTER V**

SUBJECT	**Subject Name**	: Wastewater Sewerage Distribution Design
	Subject Code	:RE184501
	Credit	: 3 credits
	Semester	: V (Fifth)

SUBJECT DESCRIPTION

The objective of this subject is for the students The outline of the material studied are: sources and quality of waste water, sewerage system includes Full Sewerage system, small bore sewer and shallow sewer, service area determination and service sub-area, criteria planning of waste water distribution system. Students will also learn about the calculation of waste water quantities from various sources of waste water, calculation of sewerage dimensions, building crossings, Planting / installation of pipes and complementary buildings, hydraulic profiles, pumps and instrumentation. The lectures are equipped with the planning task of the sewerage system in a city.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Internalizing the spirit of independence, striving, and entrepreneurship;
- Trying to the fullest to achieve perfect results; and
- Working together to be able to take full advantage of their potential.

Knowledge

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design needed for the analysis of environmental problems;
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach; and
- Mastering communication techniques and latest and latest technological developments.

Specific skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology, and engineering principles and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments;
- Able to find the source of engineering problems in environmental management efforts to solve engineering problems at least in one aspect: community protection from hazardous environments;
- Able to formulate alternative solutions for complex engineering problems at least on one aspect;
- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology; and
- Be able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Able to design a complete waste water distribution system with supporting installation.
- Able to determine service area and waste water drainage method
- Able to produce the design concept of waste water distribution system, supporting building and operation and maintenance
- Able to define planning criteria for planning of sewerage system design
- Able to collect and analyze data and information correctly
- Able to make informed decisions based on data and information analysis

SUBJECT MATTER

- Source and quality of domestic wastewater
- Wastewater distribution system
- Determine the wastewater pipeline and service block
- Determine debits and charges
- Determine the dimensions of waste water distribution and its complementary buildings
- Draw hydrolysis profile of pipeline

PREREQUISITE

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REFERENCES

- ASCE & MPFC. 1969. *Design and construction of sanitary and storm sewer*. ASCE, Washingon D.C.
- Metcalf and Eddy, "Wastewater engineering: collection and pumping of wastewater"

SUBJECT	**Subject Name**	: Technopreneur
	Subject Code	:
	Credit	: 2 credits
	Semester	: V (Fifth)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

SUBJECT LEARNING ACHIEVEMENT

SUBJECT MATTER

PREREQUISITE

REFERENCES

SUBJECT	**Subject Name**	: Unit Operations in Environmental Engineering
	Subject Code	: RE184502
	Credit	: 4 credits
	Semester	: V (Fifth)

SUBJECT DESCRIPTION

In this subject, students will learn basic theories of water treatment operations such as unit screen, stirring, sedimentation, filters, and flotation. This theory is the basic concept of design of water and wastewater treatment buildings. It is expected that students who have attended this lecture are able to determine the criteria needed in designing buildings in the field of environmental engineering in accordance with water conditions to be processed. In addition to theoretical and computational exposure, there are practicum in this subject: stirring, sedimentation types I and II, and filtration (fast filters and membranes).

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Knowledge

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design needed for the analysis of environmental problems.

Specific Skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, recovery environment or environmental management.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;
- Able to develop scientific descriptions of studies in the form of scientific papers; and
- Be able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT
• Able to select operating units in water and wastewater treatment • Able to calculate the dimensions of water and wastewater treatment units • Able to design laboratory experiments for the determination of planning criteria that can be applied to the planning of water and wastewater treatment buildings • Able to make informed decisions based on data and information analysis related to water and wastewater treatment
SUBJECT MATTER
• Fundamentals of water and wastewater treatment operations • Screen unit is rough • Deposition unit • Flotation unit • Stirring unit • Filtration unit
PREREQUISITE
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REFERENCES
• Reynold, Tom D. & Paul A. Richards. 1996. *Unit operation and processes in environmental enginering*. 2nd.ed, PWS, Boston. • Qasim, Syed R, & Guang Zhu. 2000. *Water work engineering - planning, design and operation*. Prentice-Hall, Upper Saddle River. • Masduqi, Ali dan Assomadi, Abdu F. 2016. *Operasi dan Proses Pengolahan Air*. ITS Press, Surabaya. • Montgomery, JM. 1985. *Water Treatment Principles and Design*. John Wiley & Sons, New York. • Droste, LD. 1997. *Theory and Practice of Water and Wastewater Treatment*. John Wiley & Sons, New York.

SUBJECT	**Subject Name**	: Project Management
	Subject Code	: RE184503
	Credit	: 2 credits
	Semester	: V (Fifth)

SUBJECT DESCRIPTION
Students can explain and calculate project implementation plan from time aspect and human resource aspect, make bill of quantity and calculate cost estimation in Environmental Engineering job. Materials studied include project and project management principles, project cycle / cycle, project organization,

project planning, project scheduling, resource allocation, project budget and project control.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Be cautious of God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Contributing to the improvement of the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect for cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
- Working together and having social sensitivity and concern for the community and the environment;
- Obey the law and discipline in social life and state;
- Internalize academic values, norms, and ethics;
- Demonstrate a responsible attitude towards the work in their own field of expertise; and
- Internalizing the spirit of independence, struggle, and entrepreneurship.

Knowledge

- Able to explain the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design necessary for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection , environmental conservation, or environmental restoration;
- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach;
- Able to explain current principles and issues in economics, social, ecology in general; and
- Able to explain basic principles of communication techniques and latest and latest technological developments.

Specific skill(s)

- Able to apply mathematics, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous

environments, environmental protection, environmental preservation, or environmental restoration;

- Able to prepare a research proposal for minimal engineering problems in one aspect, namely: the provision of environmental infrastructure, the protection of the community from hazardous environments, environmental protection, environmental preservation, and restoration of the environment with a detailed and systematic implementation stages;
- Able to implement the proposed research design and report it in scientific papers;
- Ability to apply research results and alternative formulas to determine engineering / environmental management criteria; and
- Able to get information, understand criteria, local / global resources potential and utilization in accordance with system design.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;
- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to describe the definition and function of project management
- Students are able to describe the stages of project development
- Students are able to describe and calculate project financing

- Students are able to describe and plan project scheduling
- Students are able to monitor and evaluate the project
- Students are able to describe and calculate the economic and financial feasibility of a project
- Students are able to describe and carry out the selection activities of service providers
- Students are able to describe and compile project documents

SUBJECT MATTER

- Definition and function of project management
- Stages of project development
- Financing
- Scheduling
- Monitoring and evaluation
- Economic and financial feasibility
- Selection of service providers
- Project document

PREREQUISITE

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REFERENCES

- Suharto ,I. 1995. *Manajemen Proyek – Dari Konseptual Sampai Operasional*. Erlangga.
- Garmo , Sullivan " Engineering Economics"
- Presidential Regulation No. 4 of 2015 on the Fourth Amendment to the Regulation on Procurement of Goods and Services
- Presidential Regulation Number 38 Year 2015 on Government Cooperation with Business Entities for Provision of Infrastructure
- Regulation of the Minister of Public Works of the Republic of Indonesia on the Implementation of Drinking Water, Drainage, Waste and Wastewater

SUBJECT	**Subject Name**	: Urban Drainage Design
	Subject Code	: RE184504
	Credit	: 3 credits
	Semester	: V (Fifth)

SUBJECT DESCRIPTION

In this subject, students will learn about the concept of rainwater distribution, hydrological analysis, catchment area determination, network plan, discharge calculation, channel dimension calculation and hydraulic profile. Students will also learn about complementary building planning that includes water gates,

culverts, siphon, gutters, dumps and pump houses, and flood control buildings that include retention ponds. Lectures are equipped with drainage system planning tacredit within a city.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Internalize academic values, norms, and ethics;
- Demonstrate a responsible attitude towards the work in their own field of expertise; and
- Trying to the fullest to achieve perfect results.

Knowledge

- Engineering science theory, design engineering, advanced methods and techniques necessary for the analysis and design of environmental management efforts.

Specific skill(s)

- Able to find the source of engineering problems on environmental management efforts to solve engineering problems at least on one aspect: environmental protection, environmental preservation, environmental restoration and environmental management in the field of Urban Drainage Systems.

General Skill(s)

- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanities in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics.

SUBJECT LEARNING ACHIEVEMENT

- Able to internalize the values, norms, academic ethics, show the attitude of responsible for the work independently by doing the task without doing plagiasi.
- Able to apply the theory of engineering science, engineering design, methods and current techniques necessary for the analysis and design of environmental management efforts in doing the task independently.
- Able to solve engineering and technology problems and design systems, processes and components on environmental management efforts including planning and operating system and maintenance of Urban Drainage System with respect to economic, health and safety factors of public, cultural, social and environmental.

SUBJECT MATTER

The rainwater distribution system includes hydrological analysis system, calculation of channel dimension and complementary structure. Determination

of rain catchment area, service area and service sub-area, criteria for rainwater distribution system design. The distribution system is gravity and pressurized. Stages in the planning of Rain Water Distribution System and its supporting building, Bill of Quantity and its operation and maintenance. Norms, standards, guidelines, criteria for rainwater delivery systems and statutory requirements. Rainfall data collection, city and contour maps, land use, other supporting maps. Data analysis for rainwater drainage system design, Illustration: layout (service block and determination of rainwater distribution network), cross section and transverse channel, hydraulic profile, Typical auxiliary building.

PREREQUISITE

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REFERENCES

- ASCE & MPFC. 1969. *Design and construction of sanitary and storm sewer*. ASCE, Washington D.C..
- Chow, V.T. 1988, *Engineering Hydrology*. McGraw-Hill International Edition, New York.
- Chow, V.T. 1988. *Open Channel Hydraulics.* McGraw-Hill International Edition, New York.
- Departemen Pekerjaan Umum, SNI-Drainase Perkotaan
- Suyono Sosrodarsono, Kensaku Takada. 1978. *Hidrologi (untuk Pengairan)*. Prandnya Paramita, Jakarta.
- Sijoatmojo S., Joyce, H., Pandebesie E. S., Salami I.R.S. . 2002. *Perencanaan Sistem Drainase dan Perencanaan Air Limbah Program Magister* – Buku Ajar, Pusdiktek KIMPRASWIL, Bandung.

SUBJECT	**Subject Name**	: Environmental Remediation Techniques
	Subject Code	: RE184505
	Credit	: 3 credits
	Semester	: V (Fifth)

SUBJECT DESCRIPTION

In this subject, the materials to be given are: the introduction of the water and coastal environment covering physical, chemical and biological characteristics and biodiversity, sources and types of pollutants and their impacts, pollution transport and transformation, pollution control methods, water and coastal areas (detailed technology), coastal area management, coastal protection, coastal resources management, water pollution control regulation. Lecture equipped Duty: case study

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in his own field of expertise independently.

Knowledge

- Theoretical concepts of science-engineering (engineering sciences), engineering principles, and engineering design required for the analysis of environmental problems and recovery; and
- Principles, methodologies, and techniques of environmental recovery system design with an integrated system approach.

Specific skill(s)

- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology; and
- Able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- The theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principle), and engineering design needed for the analysis of environmental problems and design of environmental recovery systems that is protection of society from hazardous environments and environmental protection
- Capable of selecting methods, technologies and utilizing design tools and environmental engineering analysis based on appropriate information and computing technologies to carry out engineering activities in handling environmental restoration issues.
- Able to apply logical, critical, systematic, and innovative thinking in the context of scientific or technological development or implementation that

cares and implements the humanities value appropriate to their area of expertise; • Be able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis • Able to design the environmental restoration system and process of mitigating environmental recovery and handling required for environmental restoration with an analytical approach and taking into account applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and economic, health and public, cultural, social, and environmental safety.
SUBJECT MATTER
Chemical physical remediation; Bioremediation; Phytoremediation
PREREQUISITE
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REFERENCES
• ITRC, Advancing Environmental Solutions: http://www.itrcweb.org/ • The National Academies Press: https://www.nap.edu

- **SEMESTER VI**

SUBJECT	**Subject Name**	: Research Methods
	Subject Code	: RE184601
	Credit	: 3 credits
	Semester	: VI (Sixth)

SUBJECT DESCRIPTION
Students are able to design a research, make a research proposal, write a scientific report, and present the research results.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Be cautious of God Almighty and capable of showing a religious attitude; • Uphold the value of humanity in carrying out duties based on religion, morals, and ethics; • Contributing to the improvement of the quality of life of society, nation, state, and progress of civilization based on Pancasila;

- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect for cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
- Working together and having social sensitivity and concern for the community and the environment;
- Internalize academic values, norms, and ethics;
- Demonstrate a responsible attitude towards the work in their own field of expertise; and
- Internalizing the spirit of independence, struggle, and entrepreneurship.

Mastery of Knowledge

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental conservation, or environmental restoration;
- Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems;
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach;
- Mastering the latest principles and issues in economics, social, ecology in general; and
- Mastering communication techniques and latest and latest technological developments.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the humanities value in accordance with their expertise, scientific ordinances and ethics in order to generate solutions, ideas, designs or art criticisms;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;

- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

Specific Skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, recovery environment or environmental management;
- Able to find the source of engineering problems in environmental management efforts to solve engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management;
- Able to conduct research that includes identification, formulation and analysis of engineering problems at least in one aspect, namely: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management;
- Able to formulate alternative solutions for complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management with due regard to economic, health and safety, public, cultural, social and environment;
- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and analysis of environmental engineering based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

SUBJECT LEARNING ACHIEVEMENT

- Able to properly meditate the literature
- Able to prepare research proposals
- Able to write scientific articles
- Able to present research results

SUBJECT MATTER

- Able to understand the steps of preparing the research design;
- Able to determine the idea of the final project, design the research work, and arrange it in a research proposal;
- Able to develop methods of conducting research and writing scientific reports;
- Able to understand the presentation techniques of research results.

PREREQUISITE

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REFERENCES

- Beach, David P. & Torsten K.E., Alvager. 1992. *Handbook for Scientific and Technical Research*. Prentice Hall, Englewood Cliffs.
- Taha, Hamdy A. 2003. *Operation Research an Introduction*. 7th. Ed, Macmillan, New York.
- Tony Greenfield (ed). 1996. *Research Methods – Guidance for Postgraduates*. Arnold, London.

SUBJECT	**Subject Name**	: Clean Technology
	Subject Code	: RE184602
	Credit	: 2 credits
	Semester	: VI (Sixth)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Working together and having social sensitivity as well as concern for the community and the environment, particularly related to the source of pollution and the Environmental Quality Index; and
- Demonstrate a responsible attitude towards the work in the field of expertise independently, by understanding the choice of technology in environmental management.

Mastery of Knowledge

- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach, especially on Clean Technology; and
- Able to explain current principles and issues in economics, social, ecology in general; especially related to Clean Technology Business Opportunity.

Specific Skill(s)

- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment;
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: protection from harmful living environments by taking into account economic, health and safety, public, cultural, social and environmental factors; and
- Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: community protection from hazardous environments.

General Skill(s)

- Able to examine the implications of the development or implementation of science and technology which concerns and implements the value of humanities in accordance with their expertise, rules and scientific ethics in order to produce solutions, ideas, designs, especially on Clean Technology; and
- Able to develop scientific descriptions of study results in the form of scientific papers, particularly on the Application of Clean Technology in industrial environments.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to explain about the understanding of Clean Technology, Net Technology Gain, and Priority Scale of Clean Technology implementation
- Students are able to explain the example of the application of Clean Technology and its financial feasibility to the industry

SUBJECT MATTER

- Source of environmental pollution and Environmental Quality Index in Indonesia
- Clean Development Mechanism (CDM) and Agenda 21 in Indonesia
- Understanding Clean Technology and its application
- Clean Technology Business Opportunity
- Technical Problems in the Implementation of Clean Technology

- History of the Development of an Environmental Management Strategy, and some Clean Technology Strategies
- Choice of Clean Technology, Advantages of Clean Technology, 3R, hierarchy of pollution prevention, Priority Scale implementation of Clean Technology
- Choice of Clean Technology Application for Reduction of Pollution Source
- Choice of Clean Recycling Technology Application
- Example of Application of Clean Technology to Industry
- Financial Feasibility Study on the Application of Clean Technology to the industry

PREREQUISITE

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REFERENCES

- Office of the State Minister of Environment and Forestry. 2015. Indonesia Environmental Quality Index
- Murdiyarso, D. 2007. *CDM: Mekanisme Pembangunan Bersih*. Percetakan Grafika Mardi Yuana, Bogor.
- Kantor Menteri Negara Lingkungan Hidup. 1997. *Publikasi awal Agenda 21 Indonesia Strategi Nasional untuk Pembangunan Berkelanjutan.*
- Raka, I.D.G., Zen, M.T., Soemarwoto, O., Djajadiningrat, S.T.,Saidi, Z.,et al. 1999. *Paradigma Produksi Bersih Mendamaikan Pembangunan Ekonomi dan Pelestarian Lingkungan*. Penerbit Nuansa, bekerja sama dengan Pusat Penelitian Teknologi Institut Teknologi Bandung (PPT-ITB).
- Indrasti, N.S., Fauzi, A.M. 2009. *Produksi Bersih*. Penerbit IPB Press. Percetakan PT Gramedia.

SUBJECT	**Subject Name**	: Water Treatment Plant Design
	Subject Code	: RE184603
	Credit	: 4 credits
	Semester	: VI (Sixth)

SUBJECT DESCRIPTION

In this subject, the students study: Basic planning, selection of water treatment process, design and calculation of dimension of drinking water treatment buildings including small scale IPAM, up to estimated investment cost. Examples of water treatment design results are also provided in this subject.

Tacredit: Drinking Water Treatment Planning with surface water raw water processing capacity of minimum 100 L / sec, including budget cost.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in his own field of expertise independently.

Knowledge

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles, and engineering design required for the analysis of environmental problems and design of environmental management systems at least in one aspect of community protection from hazardous environments, environmental protection, environmental conservation or environmental restoration; and
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach.

Specific skill(s)

- Able to formulate alternative solutions for complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, and environmental restoration taking into account economic, health and safety, public, cultural, social and environmental factors; and
- Able to design the systems and processes necessary for environmental management with an analytical approach and taking into account applicable technical, safety and health standards, performance aspects, reliability, ease of application, sustainability, and economic, health and safety, public, , and the environment.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that cares and implements the humanities value appropriate to its area of expertise; and
- Be able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Mastering the theoretical concepts and principles of engineering water treatment technology in depth
- Mastering the principles, methodology, and design techniques of drinking water treatment plants
- Able to apply and utilize the science and technology of drinking water treatment in the design of drinking water treatment

- Able to design systems and drinking water treatment process with analytical approach
- Able to formulate problem solving in drinking water treatment

SUBJECT MATTER

Preparation of design (design), collection of necessary data; Calculation of production capacity, calculation of raw water requirements, phasing and period of planning; Selection of processing process, process flow diagram, preliminary sizing; Design and Calculation of dimensions of water treatment buildings (intake, pre sedimentation, quick stirrer, slow stirrer, sedimentation, filter, chemical affixing unit), hydraulic profile, layout of processing plant; Equipment Installation and Instrumentation; Planning supporting building of pump house, generator house, laboratory, workshop, water meter box; Estimated investment cost; Development and improvement of drinking water treatment capacity.

PREREQUISITE

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REFERENCES

- Hadi W. 2012. *Perencanaan Bangunan Pengolahan Air Minum*. ITS Press.
- Masduki A. 2011. *Pengolahan Air Minum*. ITS Press.
- Masduki A dan Assomadi AF. 2011. *Unit Proses dan Operasi Pengolahan Air*. ITS Press.
- Design of Water Treatment Facilities. 1991. *A Wiley- Interscience Publication*. John Wiley & Sons, Inc, New York.

SUBJECT	**Subject Name**	: Wastewater Treatment Plant Design
	Subject Code	: RE184604
	Credit	: 4 credits
	Semester	: VI (Sixth)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Internalize academic values, norms, and ethics;
- Trying to the fullest to achieve perfect results; and
- Working together to be able to take full advantage of their potential.

Mastery of Knowledge

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental conservation, or environmental restoration;
- Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems;
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach; and
- Mastering communication techniques and latest and latest technological developments.

Specific skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, recovery environment or environmental management;
- Able to formulate alternative solutions for complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management with due regard to economic, health and safety, public, cultural, social and environment; and
- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment;

General Skill(s)

- Ability to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and;
- Able to demonstrate independent, quality, and measurable performance;
- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

• Able to master the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design in wastewater treatment building planning (BPAL); • Able to master the concept of natural science and the principle of application of mathematical engineering in planning of BPAL; • Mastering principles, methodology, and design techniques of environmental management system with integrated system approach to planning of BPAL; and • Master the latest and latest communication techniques and technological developments in BPAL planning.
SUBJECT MATTER
PREREQUISITE
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REFERENCES

- **SEMESTER VII**

SUBJECT	**Subject Name**	: Hazardous Waste Management
	Subject Code	:RE184701
	Credit	: 3 credits
	Semester	: VII (Seventh)

SUBJECT DESCRIPTION
Students are able to plan the management of hazardous and toxic waste materials which include reduction, storage, collection, transportation, utilization, processing, and hazardous and toxic waste materials (B3). Materials to be studied include basics on B3 waste, legal aspects and legislation. B3 waste reduction concept, B3 waste handling techniques, B3 waste utilization, physical-chemical and biological treatment, and accumulation of B3 waste.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Be able to demonstrate a responsible attitude towards the work in their own field of expertise; and • Obey the rules and discipline in organizational life and society. **Knowledge** • The theoretical concepts of science-engineering, engineering principles, and engineering design required for the analysis of environmental issues and the design of environmental management systems are minimal in one

aspect: community protection from hazardous environments, environmental protection, environmental preservation and environmental restoration; and
- Principles, methodologies, and techniques for designing waste management systems with an integrated system approach.

Specific skill(s)
- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of application, sustainability, and economic, health and safety, public, , and the environment; and
- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach

General Skill(s)
- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that cares and implements the humanities value appropriate to its area of expertise; and
- Be able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT
- Able to explain the theoretical concepts of science-engineering, engineering principles and engineering design required for the analysis of environmental problems
- Able to design a B3 waste management system for the purpose of community protection from hazardous environments, environmental protection and environmental restoration.

SUBJECT MATTER
- Issues in B3 waste management in developed and developing countries, as well as regulations on B3 waste management
- Characteristics and techniques of identification of B3 waste, sources, B3 waste generators
- Packaging techniques and storage of B3 waste
- B3 collection and transport system
- B3 corrosive waste treatment technique (neutralization), containing heavy metals (precipitation), stabilization / solidification (S / S) processing techniques, incineration techniques, B3 waste treatment techniques biological way,

- Principles of B3 waste recovery techniques: electrochemistry, ion exchange, reverse-osmosis
- Design criteria of B3 waste landfill (TPA)
- Final hoarding techniques, closure and maintenance of the post-operative B3 waste landfill
- The principle of environmental remediation is contaminated with B3 waste in a physical-chemical-biological way

PREREQUISITE

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REFERENCES

- Trihadiningrum, Y., 2016. *Pengelolaan limbah bahan berbahaya dan beracun*. Teknosain, Yogyakarta.
- Peraturan Pemerintah No. 101 Tahun 2014 tentang Pengelolaan Limbah Bahan Berbahaya dan Beracun.
- LaGrega, M.D., P.L. Buckingham, dan J.C. Evans, 2001. *Hazardous waste management*. Second Edition. McGraw-Hill International Editions, New York.
- Blackman, W. C., 2004. *Basic hazardous waste management.- 3rd. Edition*. CRC
- Pichtel, J., 2005. *Waste management practices - municipal, hazardous, and industrial*. CRC

SUBJECT	**Subject Name**	: Environmental Impact Assessment
	Subject Code	: RE184702
	Credit	: 3 credits
	Semester	: VII (Seventh)

SUBJECT DESCRIPTION

Students study the legal aspects of AMDAL, the AMDAL procedure. data collection and analysis techniques, initial environmental ties, scoping methods, formal and non-formal impact prediction methods, impact evaluation methods, and RKL and Environmental Monitoring Plan (RPL).
Group tacredit: drafting of AMDAL documents (KA, Andal, RKL, and RPL)

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Working together and having social sensitivity and concern for the community and the environment; and

- Demonstrate a responsible attitude towards the work in their own field of expertise; especially in the completion of group tacredit of compiling and assessing EIA documents.

Mastery of Knowledge

- Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach, especially in the preparation and evaluation of AMDAL documents;
- Able to explain current principles and issues in economics, social, ecology in general; especially in the process of essential scoping; and
- Able to explain basic principles of communication techniques and latest and latest technological developments, especially in the preparation of RKL and RPL.

Specific skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least on one aspect of community protection from hazardous environments, by preparation of EIAs at DED, prior to preconstruction activities;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public, especially during the scoping process by identifying the cause of the impacts;
- Be able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment, especially during the scoping process with the identification of environmental components to be affected;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment, with the preparation of evaluation of environmental management directives through technological, socio-economic and institutional approaches; and
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect, namely: community protection from hazardous environments, taking into account economic, health and safety, public, cultural, social and environmental factors, through the preparation of RKL documents.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology, especially when assessing Amdal documents;

- Able to demonstrate independent, quality, and measurable performance; especially in completing the task of preparation and assessment of AMDAL documents in accordance with the division of assigned individual tacredit;
- Able to develop scientific descriptions of studies in the form of scientific papers, particularly in the preparation and evaluation of AMDAL documents;
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis; especially in the formulation of environmental feasibility considerations of Amdal study; and
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility, especially when compiling and assessing the Amdal documents in the group.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to prepare Amdal documents in groups
- Students are able to assess Amdal documents in groups

SUBJECT MATTER

- Principles of environmental protection and management (Law 32/2009), Environmental Permits (PP 27/2012), and types of activities required for EIA (PermenLH 5/2012)
- Competence of AMDAL compilers (KTPA and ATPA), license of AMDAL (KPA) commission assessor, authority of KPA Pusat, Propinsi, Kabupaten / Kota
- Guidelines for Preparation of Amdal (Permen LH 16/2012)
- Important impact scoping processes, study boundaries and study deadlines
- Amdal document assessment methods and techniques (PermenLH 8/2013)
- Methods of data collection and analysis of physical, chemical, biological, socio-economic and cultural aspects of public health
- Preparation and presentation of KA-Andal documents
- Forecasting and impact evaluation methods
- Environmental management and monitoring methods
- Preparation of ANDAL, RKL, RPL documents
- Presentation of Amdal documents in team
- Assessment of Amdal documents in the team

PREREQUISITE

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REFERENCES

- Fandeli, C. 2017. *Analisis Mengenai Dampak Lingkungan dalam Pembangunan Berbagai Sektor*. Gadjah Mada University Press, Yogyakarta.
- Fandeli, C. 2013. *Metodologi Analisis Mengenai Dampak Lingkungan*. STTL Press, Yogyakarta.
- Fandeli, C, 2000. *Analisis Mengenai Dampak Lingkungan -Prinsip Dasar Dalam Pembangunan*. Liberty, Yogyakarta.
- Canter, LW. 1996. *Environmental Impact Assessment*. 2nd edition, McGraw-Hill, New York.
- Razif, M. dan Yuniarto, A., 2001. *Amdal dan Audit Lingkungan, Modul Ajar*. Teknik Lingkungan FTSP-ITS, Surabaya.

SUBJECT	**Subject Name**	: Sludge Treatment Plant Design
	Subject Code	: RE184703
	Credit	: 4 credits
	Semester	: VII (Seventh)

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in his own field of expertise independently.

Mastery of Knowledge:

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principles), and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, environmental protection, environmental conservation, or environmental restoration; and
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach.

Specific Skill(s):

- Able to formulate alternative solutions for complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental

restoration and environmental management with due regard to economic, health and safety, public, cultural, social and environment; and

- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment.

General Skill(s):

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and; and
- Be able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Master the theoretical concepts and principles of mud processing technology engineering in depth
- Mastering the principles, methodology, and mud processing design techniques
- Able to apply and utilize the science and technology of sludge processing in the design of mud processing
- Able to design sludge systems and processing from various sources with an analytical approach
- Able to formulate problem solving in mud processing

SUBJECT MATTER

This subject contains a review of mud processing technology produced from drinking water treatment, centralized domestic wastewater, and domestic wastewater. Sludge treatment studies include typical mudflow processing lines according to the type of mud, alternative technologies, as well as calculation of the dimensions of operating units and required process units. This subject is complemented by a major task consisting of mud processing planning planning from domestic and centralized centralized waste processing.

PREREQUISITE

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REFERENCES

- Turovskiy, I. S. & Mathai, P. K. 2006. *Wastewater Sludge Processing*. John Wiley & Sons, Inc.
- Kurita Handbook of Water Treatment. 1999. Kurita Water Industries Ltd.
- Metcalf & Eddy .2003. *Wastewater Engineering*; Tatment, Disposal, use, McGraw Hill Book Co. N.Y.

- Permen PUPR 04 2017

SUBJECT	**Subject Name**	: Landfill Design
	Subject Code	: RE184704
	Credit	: 3 credits
	Semester	: VII (Seven)

SUBJECT DESCRIPTION

Students are able to plan the final waste processing site (TPA), starting from the selection of landfill sites to operational planning and landfill closure planning. Materials to be studied include landfill requirements, site selection of landfill, waste landfill planning, leachate treatment plant and gas management, supporting facilities and infrastructure planning. Operation and maintenance of landfill, landfill mining and landfill closure.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in his own field of expertise independently.

Knowledge

- Mastering the theoretical concepts of science-engineering (engineering sciences), engineering principles, and engineering design needed for the analysis of environmental problems; and
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach.

Specific Skill(s)

- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and; and

- Be able to make informed decisions in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Able to apply theoretical concepts of science-engineering (engineering sciences), engineering principles, and engineering design required for the analysis of environmental problems
- Able to apply principles, methodology, and design techniques of environmental management system with integrated system approach
- Be able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technologies to carry out engineering activities in the planning of TPA
- Able to design a Waste Processing Place system, landfill closure and TPA mining processes required for environmental management with an analytical approach and taking into account applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, as well as economic, health and safety of the public, cultural, social, and environmental;

SUBJECT MATTER

- Sanitary landfill based landfill planning covering land needs, design layout of landfill and supporting building, waste mining, and landfill closure
- Site selection method for landfill, landfill, gas management and leachate.
- Leachate treatment techniques: physical, chemical and biological treatment
- Planning stage of landfill and its supporting building, as well as its operation and maintenance, waste mining and landfill closure
- Preparation of TPA design drawings

PREREQUISITE

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REFERENCES

- Reinhart, D. R. dan Townsend, T. G. 1998. *Landfill Bioreactor Design and Operation*. Lewis Publishers., Pacific Grove.
- William, P.T. 2005. *Waste Treatment and Disposal*. John Wiley and Sons.
- Kementerian Pekerjaan Umum, Diseminasi Sektor Persampahan, 2013. Tchobanoglous, G. dan Frank, K. 2002. *Handbook of solid waste management*. McGraw-Hill Professional, New York.
- Landth, R. E., and Rebers, P. A. 1997. *Municipal solid waste - problems and solutions*. CRC Pss.

- Tchobanoglous, G., Thiesen, H., dan Vigil, S. A. 1993. *Integrated solid waste management - engineering principles and management issues*. McGraw-Hill, New York.

- **SEMESTER VIII**

SUBJECT	**Subject Name**	: Occupational Health and Safety
	Subject Name	: RE184801
	Credit	: 3 credits
	Semester	: VIII (Eighth)

SUBJECT DESCRIPTION
Students learn the purpose and objectives of occupational safety and health, the concept of work accidents pyramids, hazards, ricredit, occupational safety and health control (chemical, physical, biological factors) and ergonomics, work accident control measures and personal protective equipment, higene in the work environment, house keeping, hazardous and toxic materials management (B3), fire protection, emergency response procedures, noise measurement and control, K3 management and audit basics (SMK3 / OHSAS 18001). Regulations and regulations applicable on K3. Occupational safety and health procedures in the environmental engineering infrastructure (sewerage and drainage, piped water systems, IPAL and IPA buildings, TPS and TPA). Task: OSH management in industry and environmental infrastructure
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Working together and having social sensitivity as well as concern for the society and environment, especially during the preparation of SMK3 documents in groups; and • Demonstrate a responsible attitude towards the work in their own field of expertise; particularly in the completion of group tacredit of compiling and assessing SMK3 documents. **Mastery of Knowledge** • Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach, especially in the preparation and assessment of SMK3 documents; • Able to explain current principles and issues in economics, social, ecology in general; particularly in the process of identifying ricredit in the preparation of SMK3 documents; and

- Able to explain basic principles of communication techniques and latest and latest technological developments, especially in the preparation of SMK3 documents.

Specific skill(s)

- Able to apply mathematics, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least on one aspect of community protection from hazardous environments, with the preparation of SMK3 documents for activities in operation;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public, especially during the process of identification of work disease resikodan;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment, especially during the process of identifying ricredit and occupational diseases;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment, with the preparation of sustainable SMK3 programs; and
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect, namely: the protection of people from hazardous environments, taking into account economic, public health and safety, cultural, social and environmental factors through the preparation of SMK3 documents;

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology, especially during the preparation of SMK3 programs;
- Able to demonstrate independent, quality, and measurable performance; especially in completing the task of preparing and assessing the document SMK3 in accordance with the division of assigned individual tacredit;
- Able to develop scientific descriptions of studies in the form of scientific works, especially in the preparation and assessment of SMK3 documents;
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis; particularly in the formulation of checklists for SMK3; and
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under their responsibility, especially when compiling and appraising SMK3 documents in groups

SUBJECT LEARNING ACHIEVEMENT

- Students are able to prepare dolumen SMK3 for organizations with employees over 100 people in groups
- Students are able to assess SMK3 dolumen for organizations with employees above 100 people in groups

SUBJECT MATTER

- The scope of SMK3 according to OHSAS! 8001 and according to ISO 45001
- Implementation of K3 Management System (SMK3), Integration of SMK3 with Organization Management System, PDCA Cycle
- The purpose and objective of safety and health management (K3), the concept of work accident pyramid, hazard, risk, OHS control
- Chemical, physical, and biological factors, as well as occupational diseases
- Application of PPE, Hazard Communication, Management of B3, Application of K3 system in Laboratory
- Fire protection and protection systems; APAR, fire hydrant system, K3 Factor in noise aspect and Emergency Respond Procedure
- Steps of SMK3 implementation in the preparation stage
- Steps of SMK3 implementation at development and implementation stage
- SMK3 checklist
- How to compile SMK3 documents
- SMK3 auditor and audit process, as well as corporate SMK3 certification

PREREQUISITE

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REFERENCES

- Hammer, Willie. 1981. *Occupational safety management and engineering*. Prentice Hall, Upper Saddle.
- Holliday, George H. 1995. *Environmental, safety gulatory compliance for the oil and gas industry.* Penwell.
- Karvianian, H.R. 1990. *Occupational and environmental safety engineering and management*. VanNostrand inhold, New York.
- Roger L. Wabeke. 1998. *Air Contaminants and Industrial Hygiene Ventilation*, CRC Pss LLC.
- Government Regulation No. 50 of 2012 on Implementation of Occupational Safety and Health Management System, State Gazette of the Republic of Indonesia, 12 April 2012.

SUBJECT	**Subject Name**	: Audit and Environmental Management System
	Subject Code	: RE184802
	Credit	: 3 credits

	Semester	: VIII (Eighth)

SUBJECT DESCRIPTION
Students will be able to apply environmental engineering science in the form of design / research / study and literature review and case study by following scientific principles or methodology correctly. Students are able to develop scientific papers in the form of research reports, planning, and literature review based on applied science in the field of environmental engineering.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Working together and having social sensitivity and concern for the community and the environment, especially when compiling Environmental Audit documents in groups; and • Demonstrate a responsible attitude towards the work in their own field of expertise; particularly in the completion of group assignments of compiling and appraising SML documents. **Mastery of Knowledge** • Able to explain principles, methodologies, and techniques of designing environmental management systems with an integrated system approach, especially in the preparation and assessment of SML documents; • Able to explain current principles and issues in economics, social, ecology in general; particularly in the process of identifying significant impacts in the preparation of SML documents; and • Able to explain basic principles of communication techniques and latest and latest technological developments, especially in the preparation of Environmental Audit documents. **Specific skill(s)** • Able to apply mathematics, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least on one aspect of community protection from hazardous environments, with the preparation of Environmental Auditing and SML documents for the current activities operate; • Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public, especially during the process of identifying aspects and impacts; • Be able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and conserve the environment, especially when the process of identifying environmental aspects of the impacts;

- Be able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment, with the preparation of sustainable SML programs; and
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: protection from harmful living environments, taking into account economic, public health and safety, cultural, social and environmental factors, through the preparation of SML documents and the assessment of Proper.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology, especially when developing SML programs;
- Able to demonstrate independent, quality, and measurable performance; especially in completing the task of preparing and assessing the SML document in accordance with the assigned individual assignment of tacredit;
- Able to develop scientific descriptions of study results in the form of scientific papers, especially in the preparation and assessment of Environmental Audit and SML documents;
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis; particularly in the formulation of checklists for environmental audits and SML; and
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility, especially when compiling and assessing the SML document in the group.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to prepare an Environmental Audit report in a group
- Students are able to prepare SML documents in groups
- Students are able to assess SML documents in groups

SUBJECT MATTER

- Basic principles, processes, research, assessment and regulation of Environmental Audit
- Environmental audit protocols, checklists, and data collection practices for environmental audit reports
- Types of environmental audit reports, environmental auditor requirements and competency certification

- History, implementation reasons, objectives and success factors, PDCA model and content of the standard SML ISO 14001: 2015
- Requirements with guidance on the use of SML and principles for the preparation of implementation of ISO 14001: 2015 SML
- Organizational context and leadership in SML ISO 14001: 2015
- Planning goals, objectives and programs in SML ISO 14001: 2015
- Support and Operations in SML ISO 14001: 2015
- Evaluation Performance and improvement in SML ISO 14001: 2015
- Implementation of SML, and SML Certification
- Environmental Audit and SML linkage with ISO 14000 Series, and SML link with PROPER
- Impact Evaluation on Environmental and SML Audits using Product Life Cycle Analysis (LCA)
- Presentation of case studies (Groups)

PREREQUISITE

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REFERENCES

- Fandeli,C.,Utami,R.N., Nurmansyah,S. 2008. *Audit Lingkungan*. Gadjah Mada University Press. Yogyakarta. Indonesia.
- Razif, M. dan Yuniarto, A., 2001, *Amdal dan Audit Lingkungan*, Modul Ajar , Teknik Lingkungan FTSP-ITS, Surabaya.
- Badan Standardisasi Nasional. 2016. *Sistem manajemen lingkungan – Persyaratan dengan panduan penggunaan.* SNI ISO 14001-2015.
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SUBJECT	**Subject Name**	: Project Work
	Subject Code	: RE184803
	Credit	: 2 credits
	Semester	: VIII (Eighth)

SUBJECT DESCRIPTION

Students are able to understand the application of their knowledge in real cases, directly involved both passively and actively in the field work environment in the field of environmental engineering. Students will be able to prepare practical work reports based on topics and fieldwork data.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- contribute to improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- acting as a proud citizen and love of the country, having nationalism and a sense of responsibility to the state and nation;
- respecting cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
- cooperate and have social sensitivity and concern for society and environment;
- law-abiding and disciplined in social life and state;
- internalize academic values, norms, and ethics;
- demonstrate a responsible attitude towards the work in the field of expertise independently;
- internalize the spirit of independence, struggle, and entrepreneurship;
- strive to achieve the perfect result; and
- work together to be able to take full advantage of the potential possessed.

Mastery of Knowledge

- Mastering the theoretical concepts of science-engineering, engineering principles, and engineering design required for the analysis of environmental issues and design of environmental management systems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, or environmental restoration;
- Mastering the concept of natural science and the principle of application of mathematical engineering for the analysis of environmental management system problems;
- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach;
- Mastering the latest principles and issues in economics, social, ecology in general; and
- Mastering communication techniques and latest and latest technological developments.

Specific skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments,

environmental protection, environmental preservation, recovery environment or environmental management;

- Able to find the source of engineering problems in environmental management efforts to solve engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management;
- Able to conduct research that includes identification, formulation and analysis of engineering problems at least in one aspect, namely: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management;
- Able to formulate alternative solutions for complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, environmental restoration and environmental management with due regard to economic, health and safety, public, cultural, social and environment;
- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology and;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the humanities value in accordance with their expertise, scientific ordinances and ethics in order to generate solutions, ideas, designs or art criticisms;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;

- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility; and
- Able to conduct a self-evaluation process against workgroups that are under his responsibility, and able to manage learning independently.

SUBJECT LEARNING ACHIEVEMENT

- Able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology in employment;
- Be able to demonstrate independent, quality, and measurable performance in the practical workplace;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on rules, procedures and scientific ethics in order to generate solutions and ideas on issues in the field;
- Able to prepare a scientific description of the results of the study in the form of a practical work report;
- Able to maintain and develop networks with mentors, working groups, workforce at work and on campus;
- Be able to take responsibility for the achievement of practical work.

SUBJECT MATTER

Choice for students:

- Drinking Water Treatment,
- Wastewater Treatment,
- Waste management,
- Environment sanitation,
- Waste Management B3,
- Control of Emissions and Ambien,
- Occupational Health and Safety

PREREQUISITE

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REFERENCES

SUBJECT	**Subject Name**	: Final Project
	Subject Code	: RE184804
	Credit	: 6 credits

	Semester	: VIII (Eighth)

SUBJECT DESCRIPTION
Students will be able to apply environmental engineering science in the form of design / research / study and literature review and case study by following scientific principles or methodology correctly. Students are able to develop scientific papers in the form of research reports, planning, and literature review based on applied science in the field of environmental engineering.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Be cautious of God Almighty and capable of showing a religious attitude; • Uphold the value of humanity in carrying out duties based on religion, morals, and ethics; • Contributing to the improvement of the quality of life of society, nation, state, and progress of civilization based on Pancasila; • Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation; • Respect for cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others; • Working together and having social sensitivity and concern for the community and the environment; • Obey the law and discipline in social life and state; • Internalize academic values, norms, and ethics; • Demonstrate a responsible attitude towards the work in their own field of expertise; and • Internalizing the spirit of independence, struggle, and entrepreneurship. **Knowledge** • Able to explain the concept of natural science and the principle of application of mathematical engineering to the analysis of problems of environmental management system; • Able to explain principles, methodology, and design techniques of environmental management system with integrated system approach; • Able to explain current principles and issues in economics, social, ecology in general; and • Able to explain basic principles of communication techniques and latest and latest technological developments. **Specific skill(s)** • Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least

in one aspect: community protection from hazardous environments, environmental protection, environmental conservation, or environmental restoration;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering as an effort to restore the environment;
- Able to implement the proposed research design and report it in scientific papers;
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: the provision of environmental infrastructure, the protection of communities from hazardous environments, environmental protection, environmental preservation, and environmental restoration by taking into account economic, public health and safety factors, cultural, social and environmental issues;
- Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure, the protection of communities from hazardous environments, environmental protection, environmental preservation, and environmental restoration;
- Ability to apply research results and alternative formulas to determine engineering / environmental management criteria;
- Able to analyze the engineering criteria and system / process design in environmental management;
- Able to design the best systems and processes in managing a reliable, safe, easy, affordable, and sustainable environment;
- Capable of obtaining information, understanding criteria, local / global resource potential and utilization in accordance with system design;
- Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management; and
- Able to define the necessary resources as per the design of a reliable, safe, easy, affordable, and sustainable environmental management system.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;

- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;
- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Able to carry out the final task of research (with a minimum of 2 variables) or design (including a minimum of one sub-district or industry equivalent to 20,000 residents and 2 aspects of review) or REFERENCES review (with a minimum of 30 REFERENCES / references and 5 recent journals - the last 5 years and case examples).
- Able to prepare a final report report properly and correctly.
- Able to arrange the paper in accordance with the topic of the final project.
- Able to present the final work as a scientific publication.

SUBJECT MATTER

Choice for students:

- Drinking Water Treatment,
- Wastewater Treatment,
- Waste management,
- Environment sanitation,
- Waste Management B3,
- Control of Emissions and Ambien,
- Occupational Health and Safety

PREREQUISITE

- Research methodology
- Already or is taking subjects that support the Final Project (including elective subjects) with the minimum credit amount 120 credit

REFERENCES

- **OPTIONAL SUBJECTS**

SUBJECT	**Subject Name**	: Plumbing
	Subject Code	: RE184901
	Credit	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION
In this subject the students will learn: basic plumbing system planning or piping in high rise building along with its component, covering plumbing system of clean water, wastewater and ven, rain water, and water for firefighter. After attending this lecture, students are able to plan plumbing systems in multi-story buildings, including placement of pipes and dimensional calculations. **Tasks:** planning of multi-storey building plot system (more than 3 floors).
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Demonstrate a responsible attitude towards the work in his own field of expertise independently. **Knowledge** • Mastering the theoretical concepts of science-engineering, engineering principles, and engineering design required for the analysis of environmental problems; and • Mastering principles, methodology, and design techniques of environmental management system with integrated system approach. **Specific Skill(s)** • Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of application, sustainability, and economic, health and safety, public, , and the environment; and • Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues. **General Skill(s)**

- able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that cares and implements the value of humanities appropriate to their area of expertise; and
- able to take decisions appropriately in the context of problem solving in the field of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Theoretical concepts of science-engineering (engineering sciences), engineering principles (engineering principle), and engineering design needed for the analysis of environmental problems and design of environmental management systems is the protection of society from hazardous environments and environmental protection
- Able to select methods, technologies and utilize design tools and analysis of environmental engineering based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.
- Able to apply logical, critical, systematic, and innovative thinking in the context of scientific or technological development or implementation that cares and implements the humanities value appropriate to their area of expertise;
- Be able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis
- Able to design the plumbing system required for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, health and safety factors of public, cultural, social , and the environment.

SUBJECT MATTER

- Building and Piping Systems

PREREQUISITE

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REFERENCES

- Pedoman plumbing Indonesia", DPU, Jakarta, 1979.
- Noerbambang, Soufyan Mohammad & Morimura S. 1999. *Perancangan dan pemeliharaan sistem plambing*. Pradnya Parmita, Jakarta.
- Woodson, R. Dodge. 1998. *Plumber's and pipefitter's calculations manual*. McGraw-Hill, New York.

- Handbook on Plumbing Installation for Buildings (May 2001), Revision 1 – 4.12.2006 – Addition added to 4.5, Water Supplies Department, HKSARG.

SUBJECT	**Subject Name**	: Industrial Waste Management
	Subject Code	: RE184902
	Credit	: 2 creditss
	Semester	: Optional

SUBJECT DESCRIPTION

- Pollution Control, Waste Reduction Methods, Pollution Control Plans. Waste Treatment Industry: Characterization of Industrial Waste, Selection of Process Unit and Operation Unit, Quality Standard of Effluent, Processing Process Evaluation. Industrial Waste Management Audit: Definition, Purpose, and Audit Function, Types of Audits, Waste Audit. PROPER: Proper Goals, Background, Proper Developments in Indonesia, Proper as Instrument of Observance, Ranking Flow. Community Development and Community Relation, quantity and quality of domestic and industrial wastewater. **Task**: Planning an industrial waste management

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Internalize academic values, norms, and ethics;
- Demonstrate a responsible attitude towards the work in their own field of expertise;
- Internalizing the spirit of independence, striving, and entrepreneurship;
- Trying to the fullest to achieve perfect results; and
- Working together to be able to take full advantage of their potential.

Knowledge

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs.
- Be able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;

- Be able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under the responsibility

Specific skill(s)

- Able to design the systems and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and attention to economic, public health and safety, social, and environment; and
- Capable of selecting resources and utilizing design tools and environmental engineering analysis based on appropriate information and computing technology to carry out engineering activities in handling environmental management issues.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology; and
- Able to demonstrate independent performance, quality, and measurable.

SUBJECT LEARNING ACHIEVEMENT

- Able to describe industries that produce waste, sources, types, characteristics, including industrial B3 waste;
- Able to determine the concept of end of pipe; Various types of major pollutant components in liquid, solid and gas wastes;
- Able to evaluate various technologies for biological-chemical, biological disposal of waste materials in solid and gaseous wastes;
- Able to determine the type and principles of the latest technologies in industrial waste treatment; and
- Able to explain the concept and design the implementation of Clean Technology in industrial activities.

SUBJECT MATTER

- The concept of end of pipe and the principle of processing liquid, gas and solid waste
- Evaluation of biological chemical pollution removal technology
- Nitrogen and phosphorus-rich pollution removal technologies, organic and metals
- The latest technology in industrial waste treatment

PREREQUISITE

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REFERENCES

- Reynolds, T. Richard, A.P. 1996. Unit Operations and Processes in Environmental Engineering. 2nd Ed. PWS Publishing Company.

- Tchobanoglous, G. 2002. Wastewater Engineering: Treatment and Reuse. 3rd Ed. McGraw-Hill Science/Engineering/Math.
- Numerow, N.L. 2006. Industrial Waste Treatment. Elsevier Science & Technology Books
- Eckenfelder, W. W. 1999. Industrial Waste Pollution Control. McGraw-Hill Science/Engineering/Math.
- Petterson, J. W. 1985. Industrial Wastewater Treatment Technology. Butterworth Pubs.

SUBJECT	**Subject Name**	: Phytotechnology
	Subject Code	: RE184903
	Credit	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION

In this subject, students will study the mechanism of phytophrocess: evapotranspiration and transpiration, photosynthesis and respiration, fitostabilization, rizofiltration, rizodegradation, phytoextraction, fitodegradation, fitovolatilisasi. Factors that affect the phytooprocess. Measurement of plant parameters: plant dimensions and parts thereof, wet weight and dry weight, and growth. Bioaccumulation and biotranformation of plant substances. Examples of the application of phytotechnology to solve environmental problems: establishing green open spaces, green open spaces, water resources conservation, wastewater treatment processes, restoration of polluted environments.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Demonstrate a responsible attitude towards the work in their own field of expertise;
- Trying to the fullest to achieve perfect results; and
- Working together to be able to take full advantage of their potential.

Knowledge

- Mastering principles, methodology, and design techniques of environmental management system with integrated system approach.

Specific Skill(s)

- Able to conduct research that includes identification, formulation and analysis of engineering problems at least in one aspect, namely: community protection from hazardous environments, environmental protection,

environmental preservation, environmental restoration and environmental management.

General Skill(s)

- Able to develop scientific descriptions of studies in the form of scientific papers;
- Able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility; and
- Able to conduct a self-evaluation process against workgroups that are under his responsibility, and able to manage learning independently.

SUBJECT LEARNING ACHIEVEMENT

- Able to plan fitoteknologi in prevention of pollution and restoration of environmental quality
- Being able to choose the right technology to prevent environmental pollution and restore environmental quality
- Able to understand the processes of transformation of substances or pollutants by plants to be able to produce the concept of processing or restoring the environment
- Able to define planning criteria in Phyotechnology planning

SUBJECT MATTER

- Phytoremediation mechanisms include photosynthesis and respiration, fitostabilization, rizofiltration, rizodegradation, phytoextraction, fitodegradation, fitovolatilization, hydraulic control, evapotranspiration capacity.
- Selection of phytoremediation system, including: selection of plant species, type of pollutant, land, climate and post-phytoremediation management.
- Norms, standards, guidelines, criteria of phytotechnology systems and legislation.

PREREQUISITE

REFERENCES

- ITRC, 2001. *Technical and Regulatory Guidance Document, Phytotechnology*. Interstate Technology Regulatory Council, USA. Pp 84 + appendices A-F
- UNEP-, 2004. *Integrated Watershed Management Ecohydrology & Phytotechnology* -- Manual - United Nation Environmental Program, Pp 246.

- Basra, A.S.,Ranjit K.B. 1997. *Mechanisms of Environmental Stress Resistance in Plants*. Harwood Academic Publisher.
- Prasad, M. N.V. 1999. *Heavy Metal Stress in Plants From Biomolecules to Ecosystem 2nd Edition*. Springer.
- M., Erwin E.J., et al. 2004. *Plant Analysis Procedures 2nd Edition*. Kluwer Academic Publisher.

SUBJECT	**Subject Name**	: Environmental Economics
	Subject Code	: RE1848904
	Credit	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION

Students will study: basic concepts of environmental economics, economic system, basic theory of environmental economics, environmental degradation, environmental quality economics, environmental protection economics, environmental valuation, policy instruments to protect the environment, finance environmental management, and environment (concepts, methods and applications), trade pollution and environmental protection, natural resource accounting for sustainable development.

Task: Environmental Economic Calculation on the project in the Field of Environmental Engineering

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Be cautious of God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in carrying out duties based on religion, morals, and ethics;
- Contributing to the improvement of the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- Serve as a proud citizen and love of the homeland, has nationalism and a sense of responsibility to the state and nation;
- Respect for cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
- Working together and having social sensitivity and concern for the community and the environment;
- Obey the law and discipline in social life and state;
- Internalize academic values, norms, and ethics;

- Demonstrate a responsible attitude towards the work in their own field of expertise; and
- Internalizing the spirit of independence, struggle, and entrepreneurship.

Knowledge

- Able to explain current principles and issues in economics, social, ecology in general; and
- Able to explain basic principles of communication techniques and latest and latest technological developments.

Specific skill(s)

- Able to apply math, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental conservation, or environmental restoration;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the public;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering as an effort to restore the environment;
- Able to develop a research proposal for minimal engineering problems in one aspect, namely: the provision of environmental infrastructure, the protection of the community from hazardous environments, environmental protection, environmental preservation, and restoration of the environment with a detailed and systematic implementation stages;
- Able to implement the proposed research design and report it in scientific papers;
- Ability to apply research results and alternative formulas to determine engineering / environmental management criteria;
- Able to analyze the engineering criteria and system / process design in environmental management;
- Able to design the best systems and processes in managing a reliable, safe, easy, affordable, and sustainable environment;
- Capable of obtaining information, understanding criteria, local / global resource potential and utilization in accordance with system design; and
- Able to conduct analysis to determine the suitability of resources with the design of engineering systems / environmental management;

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs;
- Able to develop scientific descriptions of studies in the form of scientific papers;
- Able to make informed decisions in the context of problem solving in their areas of expertise, based on the results of information and data analysis;
- Able to maintain and develop networks with counselors, colleagues, colleagues both within and outside of their institutions;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility;
- Able to conduct a self-evaluation process against working groups that are under his responsibility, and able to manage learning independently; and
- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Students are able to describe the scope and benefits of environmental economics
- Students are able to describe the basic theory for environmental economic analysis
- Students are able to describe and calculate the environmental values of impacts of damage and impact of environmental pollution
- Students are able to describe and calculate the balance of natural resources and environment
- Students are able to describe and calculate the value of payments for environmental services

SUBJECT MATTER

- Scope and benefits of environmental economics
- Basic theory of environmental economics
- Economic valuation of impact of damage and impact of environmental pollution
- Balance of natural resources and environment
- Payment of environmental services

PREREQUISITE
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REFERENCES

- Djajadiningrat S. 1997. *Pengantar Ekonomi Lingkungan*. LP3ES.
- Fauzi .A. 2006. *Ekonomi Sumber Daya Alam dan Lingkungan*. Gramedia.
- Suparmoko M, dkk. 2014. *Valuasi Ekonomi Sumber Daya Alam & Lingkungan*. BPFE-Yogyakarta.
- Suparmoko.M. Ratnaningsih .M. 2016. *Ekonomika Lingkungan*. BPFE-Yogyakarta.
- Regulation of the Government of the Republic of Indonesia Number 46 Year 2017 on Environmental Economic Instruments

SUBJECT	**Subject Name**	: Environmental Quality Biomonitoring
	Subject Code	: RE184905
	Credit	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION

Students will learn the basic concepts of biomonitoring of soil quality, water, and air, benefits in environmental quality management of water and soil. Understanding the early warning system, the advantages and disadvantages of biomonitoring, and the relevance to quality standards of environmental quality. Criteria of indicator organisms, various organism indicators (bacteria, diatomic, algae, weeds, macroinvertebrates, lichens, birds, plants, fish) determinant factors characteristic of the indicator organism. Biomonitoring techniques: the use of taxa and population (abundance, diversity, biotic index, and environmental quality classification). Selection of biomonitoring methods, and applications in the field. Sampling technique of indicator organism.

Task: Planning of biomonitoring a particular environment

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Able to demonstrate a responsible attitude towards the work in their own field of expertise; and
- Obey the rules and discipline in organizational life and society.

Knowledge

- The theoretical concepts of science required for the analysis of environmental issues and environmental management systems on environmental conservation and environmental restoration; and

- Principles, methodology, and environmental management with an integrated system approach.

Specific Skill(s)

- Able to conduct analysis to determine resource conformity with environmental management; and
- Able to explain principles, methodology, and techniques of environmental management system with integrated system approach.

General Skill(s)

- Able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology appropriate to their area of expertise; and
- Able to make decisions appropriately in the context of problem solving in the area of expertise, based on the results of information and data analysis.

SUBJECT LEARNING ACHIEVEMENT

- Able to explain the theoretical concepts needed for the analysis of environmental problems
- Able to design environmental quality biomonitoring systems for the protection of hazardous environments, and environmental restoration

SUBJECT MATTER

- Concept of monitoring and biomonitoring of environmental quality
- Environmental quality monitoring system physical-chemical way, advantages and disadvantages
- Early warning system of environmental quality and biologic response
- Criteria of indicator organisms
- Basic methods in biomonitoring: abundance, diversity index, biotic index, and classification of environmental quality
- The biotic index system with macroinvertebrates and fish
- Index system with algae and diatomae
- Bacteria as bioindicator of water quality
- Lichenes, bacteria, flora and fauna as air quality biomonitors
- Criteria and types of organisms for environmental bioremediation
- Classification of fertility rate of water bodies / trophic status
- Sampling methods for water and air quality measurements with biomonitoring

PREREQUISITE

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REFERENCES

- Elefteriou, A. and A. McIntyre, 2005. *Methods for the study of marine benthos*. 3rd Ed. Blackwell Publishing, Victoria.

- Prasad, N.P. and Y. Singh, 1996. *Algal indicators of water pollution*. Bishen Singh Mahendra Pal Singh, Dehra Dun.
- ASTM Standards on Environmental Sampling, 1997. 2nd Ed. ASTM, West Conshohocken.
- Wellburn, A., Air pollution and climate change. *The Biological Impact.* Longman Singapore Publishers, Singapore.

SUBJECT	**Subject Name**	: Community-Based Drinking Water Supply
	Subject Code	: RE184906
	Credit	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION

In this subject, students will study: a small-scale water supply model run by the community. This model uses a community participation approach using technology that suits the needs of the community. The use of simple technology and management organizations for the provision of drinking water is also studied in this subject. After attending this lecture, students are able to choose appropriate technology for water supply based on community empowerment.

Task: Case study of drinking water supply of a village

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

- Able to design systems, and processes necessary for environmental management efforts with an analytical approach and taking into account applicable applicable technical, safety and health standards, performance aspects, reliability, ease of implementation, sustainability, and economic, health and safety, , social, and environment; and
- Able to examine the implications of the development or implementation of science and technology that take into account and apply the humanities value in accordance with their expertise, rules and scientific ethics in order to produce solutions, ideas, design or art criticism.

SUBJECT LEARNING ACHIEVEMENT

Students are able to understand, plan and develop water supply system based on community empowerment from various aspects.

SUBJECT

- Methods Approach to community participation, community awareness on clean and healthy lifestyles, community-based management organizations.

- Planning of drinking water system <5 Lt / s based on community empowerment.
- Appropriate technology for raw water supply: Selection of raw water, water catchment building, dug well, borehole, hand pump, hydra pump, rain water container (PAH).
- Simple water treatment technology: slow sand filter, household scale water filter.
- Transmission and distribution piping system by gravity and pumping, press release basin, reservoir, public faucet, common hydrant, home connection.
- Community drinking water tariff calculation.
- Simple elevation and discharge measurement methods.
- Operation and maintenance of appropriate drinking water supply technology.
- Norms, standards, guidelines, criteria of a community-based water supply system

PREREQUISITE

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REFERENCES

- Mayanja, R. 2006. *Gender, water and sanitation case studies on best practices*. New York: Department of Economic and Social Affairs-United Nation
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- Mukherjee, N., Wijk, C., 2002. *Sustainability Planning and Monitoring in Community Water Supply and Sanitation: A guide to the methodology for participatory assessment (MPA) for community-driven development programs*. Washington DC: The World Bank - Water and Sanitation Program.

SUBJECT	**Subject Name**	: Community Based Sanitation
	Subject Code	: RE184907
	Credit	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION
In this subject, students will learn the application of community participation approach method, awareness of community insight about sanitation. Application of simple sanitation systems: septic tanks, communal septic tanks, cubluks, recharge fields, evapotranspiration, composting and biogas. Provision of appropriate sanitation applications in accordance with the willingness and ability of the community in the procurement and operation and maintenance. Organizational management. Calculation and application of community-based sanitation rates. The lecture comes with the task: a case study of sanitation in a village.
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
• Able to plan a well-organized sanitation management system especially in the aspects of operation and maintenance • Able to choose appropriate technology for sanitation based on community empowerment • Able to produce the concept of sanitation system design, as well as operation and maintenance
SUBJECT LEARNING ACHIEVEMENT
Students are able to understand and develop sanitation based on community empowerment from various aspects.
SUBJECT MATTER
• Community-based sanitation system planning • Methods of approaching community participation and appropriate sanitation technologies in accordance with the conditions of the planning area • Norms, standards, guidelines, criteria for community-based sanitation systems • Data collection and condition of existing planning area • Community empowerment for sanitation operation and maintenance
PREREQUISITE
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REFERENCES
• WHO. 2010. *Monitoring, Supervisory & Evaluation Tools for Community-Based Initiatives*. Cairo: WHO Regional Office for the Eastern Mediterranean. • McCommon, C., Warner, D., Yohalem, D., 1990. *Community Management of Rural Water Supply and Sanitation Services*. Washington, DC: UNDP and The World Bank - Water and Sanitation Program.

- Mukherjee, N., Wijk, C., 2002. *Sustainability Planning and Monitoring in Community Water Supply and Sanitation: A guide to the methodology for participatory assessment (MPA) for community-driven development programs*. Washington DC: The World Bank - Water and Sanitation Program.
- Shordt, K., van Wijk, C., Brikké, F., Hesselbarth, S., 2004. *Monitoring Millennium Development Goals for Water and Sanitation: A review of experiences and challenges.* Delft: IRC International Water and Sanitation Centre.

SUBJECT	**Subject Name**	: Air Pollutant Dispersion Model
	Subeject Code	: RE184908
	Credits	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION

In this course, students will learn more about atmospheric chemistry, structure, air flow / circulation, heat and matter balance, air layer formation (thermodynamics), mixing layer, local climate, radiation, atmospheric stability; The flow of gases and particles in the air circulation (convection, dispersion, settling); surface roughness (urban, suburban, rural); Model dispersion (model box, gaussian, street canyon); Utilization of air pollutant dispersion modeling in air quality planning and management.

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude:

- Devoted to God Almighty and capable of showing a religious attitude;
- Uphold the value of humanity in performing duties based on religion, morals, and ethics;
- Contribute in improving the quality of life of society, nation, state, and progress of civilization based on Pancasila;
- Serve as a proud citizen and love of the motherland, has nationalism and a sense of responsibility to the state and nation;
- Respect for cultural diversity, views, religion, and beliefs, as well as the original opinions or findings of others;
- • Working together and having social sensitivity and concern for the community and the environment;
- Obey the law and discipline in social life and state
- Internalize academic values, norms, and ethics;

- • Demonstrate responsible attitudes for the work in the field of expertise; and
- • Internalize the spirit of independence, stability, and entrepreneurship

Mastery and Knowledge:

- Able to explain the theoretical concepts of science-engineering, engineering principles, and engineering design needed for the analysis of environmental problems and design of environmental management systems at least on one aspect of community protection from hazardous environments, protection environment, environmental preservation, or environmental restoration;
- Able to explain the concept of natural science and the principles of engineering mathematics application to the analysis of environmental management system problems;
- • Ability to explain principles, methodology, and design techniques of environmental management system with integrated system approach; and
- • Able to explain the basic principles of communication techniques and the latest technological developments.

Special Skill(s):

- Able to apply mathematics, statistics, physics, chemistry, biology, microbiology and engineering principles to solve complex engineering problems at least in one aspect: community protection from hazardous environments, environmental protection, environmental preservation, or environmental restoration;
- Able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the community;
- Be able to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect and preserve the environment;
- Able to prepare a research proposal for minimal engineering problems in one aspect: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental preservation, and environmental restoration with detailed and systematic implementation stages;
- Able to implement the proposed research design and report it in a scientific paper;
- Able to propose and review alternative solutions for complex engineering problems at least in one aspect: the provision of environmental infrastructure, community protection from hazardous environments,

environmental protection, environmental preservation and environmental restoration by taking into account economic, health and safety factors , cultural, social and environmental;

- Able to recommend alternative selected solutions for complex environmental engineering problems at least in one aspect: the provision of environmental infrastructure, community protection from hazardous environments, environmental protection, environmental conservation and environmental restoration;
- Able to apply research results and alternative formulas to determine engineering/environmental management criteria;
- Able to design the best systems and processes in managing a reliable, safe, easy, affordable, and sustainable environment;
- Be able to obtain information, understand criteria, local/global resource potential and utilization in accordance with system design;
- Able to conduct analysis to determine the suitability of resources with design of engineering systems/environmental management; and
- Able to define the necessary resources as per the design of a reliable, safe, easy, affordable, and sustainable environmental management system..

General Skill(s):

- Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology;
- Able to demonstrate independent, quality, and measurable performance;
- Able to examine the implications of the development or implementation of science and technology that concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs;
- Able to develop scientific descriptions of studies in the form of a scientific paper;
- Be able to make informed decisions in the context of problem solving in the areas of expertise, based on the results of information and data analysis;
- Able to maintain and develop a network with mentors, colleagues, colleagues both inside and outside the institution;
- Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to workers who are under the responsibility;
- Able to conduct a self-evaluation process upon working groups that are under his/her responsibility, and able to manage learning independently; and

- Able to document, store, secure, and rediscover data to ensure validity and prevent plagiarism.

SUBJECT LEARNING ACHIEVEMENT

- Able to understand the type of dispersion model
- Able to understand the parameters that influence dispersion
- Able to use and apply dispersion models

SUBJECT MATTER

PREREQUISITE

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REFERENCES

- De Visscher A. 2014. *Air Dispersion Modeling*. John Wiley & Sons, Inc, New Jersey
- Vallero D. 2008. *Fundamental of Air Pollutions. 4th Edition*, Elsevier, New York
- Boedisantoso, Rachmat. 2002. *Teknologi Pengendalian Pencemar Udara*. DUE-Like ITS Teknik Lingkungan FTSP-ITS, Surabaya.
- C. David Cooper, Alley, F. C. 1994. *Air Pollution Control A Design Approach*. Waveland Press Inc., Illinois, USA.
- Davis, Wayne T. 2000.*Air Pollution Control Engineering Manual*. Air and Waste Management Association, John Willey & Sons.

SUBJECT	**Subject Name**	: Fundamental Environmental Modeling
	Subject Code	: RE184909
	Credits	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION

LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT

Attitude

- Have a good attitude and mental and academic ethics, maintain values and norms, and personality as a nation of Indonesia; and
- Demonstrate responsible attitudes towards the work in the field of expertise independently.

Knowledge

- Mastering the theories and methods of management, analysis of environmental issues and environmental management efforts by considering into the risks that occur.

Special Skill(s)

- Able to analyze and solve problems that occur in the environment well by using management technology, establishing efforts that need to be done in solving the problems encountered, considering the aspects of Engineering - economic and environmental / health; and
- Able to deepen and extend the science in the field of designing, operating, and maintaining engineering systems and environmental management to contribute original and tested results.

General Skill(s)

- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanity in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics..

SUBJECT LEARNING ACHIEVEMENT

- Able to internalize values, norms, academic ethics, show a responsible attitude towards the work independently by doing the task without doing plagiarism
- Able to apply the theory of engineering science, engineering design, methods and techniques that are needed for the analysis and design of environmental management efforts in doing the task independently
- Able to develop logical, critical, systematic, and creative thinking through scientific research, creation of design in science and technology that concerns and implements the value of humanities in accordance with their field of expertise, prepares scientific conception and result of study based on scientific rules, procedures, and ethics
- Able to solve engineering and technological problems and design systems, processes and components on environmental management efforts including natural resource management, Uses and benefits of natural resources, Application of models on surface water (rivers and lakes), groundwater by conservation theory, Qual2KW model, Storet Method, PSDA in coastal areas (mangroves) and peatlands, IWRM, Groundwater and evaporation theory and Polder, SDA theory related to polder/boezem, and water budget.
- Able to perform deepening or extension of science in the field of design, operation, and maintenance of engineering systems and environmental management to contribute original and tested by making the task of review paper

SUBJECT MATTER
Regulations and legislation related to water and environmental resources management; Sustainable water and environmental management, modeling related to HR quality status with conservation theory, Qual2KW, Storet, PSDA in coastal areas (mangrove) and peatlands, groundwater resources, Integrated Water Resources Management, Water budget, presented in the field of water and environmental resource management
PREREQUISITE
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REFERENCES

SUBJECT	**Subject Name**	: Ecotoxicology
	Subject Code	: RE184910
	Credits	: 2 credits
	Semester	: Optional

SUBJECT DESCRIPTION
LEARNING ACHIEVEMENT OF GRADUATE WHICH IS CHARGED TO THE SUBJECT
Attitude • Devoted to God Almighty and capable of showing a religious attitude; • Uphold the value of humanity in carrying out duties based on religion, morals, and ethics; and • Demonstrate a responsible attitude towards the work in the field of expertise independently. **Knowledge** • Engineering science theories, design engineering, advanced methods and techniques necessary for the analysis and design of environmental management efforts. **Special Skill(s)** • Able to solve engineering and technological problems, and design systems, processes and components on environmental management efforts including drinking water management, waste water, waste management, settlement drainage, wastewater control systems, solids and gases, air pollution control and occupational health and safety (K3) by utilizing other fields of science (if necessary, in this case environmental toxicology) and

considering to the economic, health and safety factors of the public, cultural, social and environmental.

General Skill(s)

- Able to perform academic validation or studies in accordance with their areas of expertise, especially the field of environmental toxicology in solving problems in the community or relevant industries through the development of knowledge and expertise.

SUBJECT LEARNING ACHIEVEMENT

- Able to identify environmental problems through ecotoxicology which include: drinking water, waste water, garbage, drainage of settlements by doing deepening scientific field of environmental engineering.
- Able to design ecotoxicological research in various fields such as industry, drinking water treatment and wastewater treatment, etc.
- Able to analyze and synthesize environmental engineering applications in the field of ecotoxicology in preventing environmental pollution.
- Able to prepare the concept and program of prevention of environmental pollution and restoration of polluted environment in the field of ecotoxicology by considering the legal, economic, financial, and socio-cultural aspects.

SUBJECT MATTER

Environmental ecotoxicology is the study of the characteristics of matter in terms of its toxic properties to organisms. This science can be applied to various fields such as industry, drinking water processing and wastewater processing. This lecture course will equip students on the analysis of the exposure of substances in the environment based on the nature of the substance and its environment and various methods to determine the toxicity of a substance in the environment. After studying this course, students are able to design ecotoxicology research in their application in the field of environmental engineering. The tasks that students should make are: reviewing journals related to toxicology research results and designing toxicology research.

PREREQUISITE

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REFERENCES

- Ariens. E.J., E. Mutschler, A.M. Simonis. 1993. *Toksikologi Umum Pengantar*, Gadjah Mada University Press, Yogyakarta.
- Casarret, Curtis. D. Klaassen. 1996. *Toxicology: The basic Science of Poisons*, Fifth Edition, McGraw Hill, New York..
- Connel, Dw, dan G.J. Miller, *Kimia dan Toksikologi lingkungan Pencemaran*, Terjemahan oleh Yanti Koestoer, UI Press, Jakarta.

- Jorgensen, Sven E. 1998. *Handbook of estimation methods in ecotoxicology and environmental chemistry*, Lewis, New York.
- Peakall, David. 1992. *Animal biomarkers as pollution indikators - with a contribution on immunology*, Chapman and Hall, London.