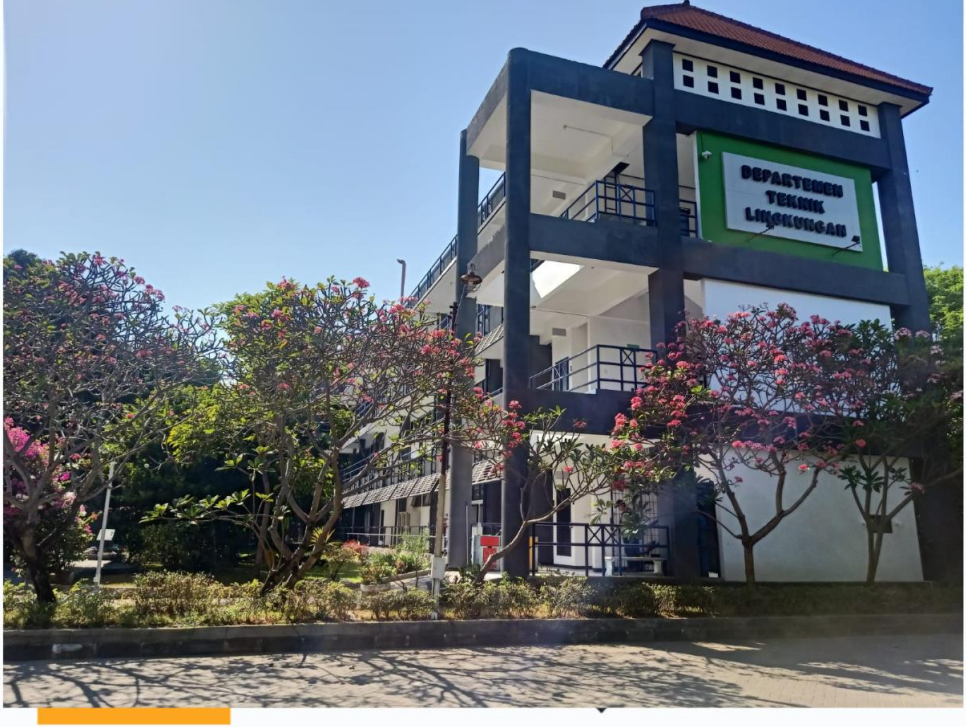

2023 CATALOG

UNDERGRADUATE PROGRAM
ENVIRONMENTAL ENGINEERING

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

ITS
Institut
Teknologi
Sepuluh Nopember

Catalog 2023

Undergraduate Program (UNDERGRADUATE)

Environmental Engineering

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

FOREWORD

Assalammualaikum Wr Wb.
Greetings,

Praise be to the presence of Allah SWT because for His grace and pleasure, we can complete the preparation of the 2023 Curriculum which is a modification of the 2023-2028 Curriculum and realize it in this 2023 Curriculum Document Book. This book contains the composition of courses, the number of credits and other information contained in the new curriculum of the Department of Environmental Engineering FTSPK ITS. The preparation of the 2023 curriculum has gone through various stages, including an analysis of the competency needs needed by stakeholders and users of graduate staff, so that the results are expected to be in the form of a curriculum that meets competency standards, is comprehensive and updated.

The 2023 Curriculum Document Book is expected to provide information and guidelines to the academic community, students, parents of students and all parties about learning materials, types of knowledge and skills learned, including learning standards and objectives, references used, and types of assessments carried out by the Department of Environmental Engineering FTSPK ITS. In the end, it is hoped that the learning system based on the 2023 curriculum will produce graduates who meet the learning outcomes that have been set, updated, outstanding and competitive, so that they are easily absorbed in the job market and even able to create jobs and opportunities.

In the end, we hope that all the information contained in this book is as useful as possible. Thanks.

Wassalammualaikum Wr. Wb

Surabaya, April 2023

Head of Department

Dr.Eng. Arie Dipareza Syafei, ST., MEPM

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PROFILE

The Department of Environmental Engineering is under the Faculty of Civil, Planning and Geo Engineering - Institut Teknologi Sepuluh Nopember. The Department Of Environmental Engineering Was Established In 1996 With The Environmental Engineering Undergraduate Study Program Which Is A Change From The Sanitary Engineering Undergraduate Study Program. Currently, The Department of Environmental Engineering has three study programs, namely:

1. Undergraduate Environmental Engineering Program
2. Graduate Environmental Engineering Program
3. Postgraduate Environmental Engineering Program

Vision:

To be a world-class Department and contribute to the independence of the nation and a reference in innovative education, research, and community service for environmental quality management and environmental infrastructure design residential, industrial and marine.

Mission:

1. Develop ethical, moral, attitude, entrepreneurial ability and soft skills of the academic community.
2. Organizing higher education in the field of engineering and environmental management of international reputation in order to produce dignified and competitive graduates.
3. Disseminate and actively apply innovative works of technology and methods for solving environmental problems.
4. Establish partnerships with educational and research institutions, government and/or industry at home and abroad in the field of environmental engineering and management.

Educational Objectives:

1. Producing graduates who are devoted to God Almighty have noble personalities, ethics, academic morals, have strong attitudes and values.

2. Producing graduates who are able to design engineering buildings in the field of environmental engineering, produce innovations in preventing and implementing pollution control, and apply innovative technology and design environmental recovery solutions from pollutants, which are oriented to the latest and disseminate them through scientific publications at the national or international level.

3. Mastering the basic principles of theoretical concepts of natural science, applications of engineering mathematics, engineering principles, basic control technology and environmental pollution prevention processes, and the basic principles of the latest and latest technology, as well as the process of restoring polluted environments.

4. Capable to manage work and make the right decisions based on problem identification, information and data analysis armed with sustaincapable development insights covering environmental and settlement aspects, marine, energy, and information technology and prioritizing social care.

Undergraduate Environmental Engineering Study Program

The Environmental Engineering Undergraduate 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 Number 116 / Discientific Papers/ Kep / 1984 under the name of the Sanitary Engineering Study Program. The management of the Undergraduate Sanitary Engineering Study Program is the Department of Civil Engineering FTSP – ITS. Then in 1996 the Sanitary Engineering Study Program changed to the Environmental Engineering Study Program based on the Decree of the Director General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia Number 224 / Discientific Papers/ Kep / 1996. This Study Program has received an assessment from the National Accreditation Board for Higher Education (BAN PT) with an A Accreditation rating for the period 14 November 2015 – 14 November 2020 based on the Decree of the National Accreditation Board No. 1155 / BAN-PT / Akred / S / XI / 2015 dated 14 November 2015.

In 2014 the Environmental Engineering Undergraduate Program received certification from the ASEAN University Network (AUN-QA) and in 2018 succeeded in obtaining accreditation from IABEE. IABEE accreditation has been extended until March 31, 2026 based on Certificate No. 00112.A.

Currently, the Department of Environmental Engineering collaborates in the field of Education and Research with various universities abroad that are on the

QS100 list, in addition to various collaborations with government and private institutions in Indonesia. In addition, based on BAN-PT Decree No. 9148/SK/BAN-PT/Akred-Itnl/S/VI/2021, the Undergraduate Program received a Superior Accreditation rating which is valid from June 30, 2021 to March 31, 2023.

Furthermore, the Undergraduate Program received an Excellent Accreditation rating from LAM Teknik which is valid from December 21, 2022 to December 20, 2027 with an Accreditation Certificate of Engineering LAM Decision No. 0159/SK/LAM Teknik/AS/XII/2022.

Postgraduate Environmental Engineering Program

Environmental Engineering Master's Study Program

The Environmental Engineering Master's Study 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. The Environmental Engineering Master's Study Program has two areas of expertise, namely the Environmental Engineering Expertise Field and the Environmental Sanitation Engineering Expertise Field.

In the field of environmental engineering expertise, various environmental problems and their solutions are studied with an emphasis on academic studies for scientific development. The field of expertise in Environmental Sanitation Engineering focuses on academic-applicable studies in the field of creative work. This area of expertise is a collaboration between FTSP and the Indonesian Ministry of Public Works Education and Training Center.

The Master's Study Program has received an assessment from the National Accreditation Board for Higher Education (BAN PT) with an Accreditation rating of A for the period 9 January 2015 – 9 January 2020 based on National Accreditation Board Decree No. 005/BAN-PT/M/I/2015, dated January 9 2015.

The Master's Study Program has received an assessment from the National Accreditation Board for Higher Education (BAN PT) with an Accreditation rating of A for the period 1 April 2020 – 1 April 2025 based on National Accreditation Board Decree No. 2069/SK/BAN-PT/Ak-PJJ/M/IV/2020, dated 1 April 2020.

Environmental Engineering Doctoral Study Program

The Environmental Engineering Doctoral Study 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 July 31 2009. This study program accepts students from graduates of the Master of Environmental Engineering or field other related things. Graduates of the S-1 Environmental Engineering degree with the title "cum laude" and a Thesis grade of A can also enter the Environmental Engineering S-3 Study Program directly.

The S-3 Study Program has received an assessment from the National Accreditation Board for Higher Education (BAN PT) with an Accreditation rating of A for the period 7 August 2019 – 7 August 2024 based on National Accreditation Board Decree No. 2948/SK//BAN-PT/Akred/D/VIII/2019, dated 7 August 2019.

Academic Facilities

- Lecture Room
- Courtroom and Seminar
- Laboratory
- Computer Room and Internet Network
- Library (Reading Room)
- Scientific Magazines/Journals
- Lecturer Room
- Administration Room

Management of the Department of Environmental Engineering:

1 Head of Department:
Dr.Eng. Arie Dipareza Syafei, ST., MEPM

2. Secretary of the Department of Academic and Student Affairs (I):
Harmin Soloist's Titah, ST., MT., PhD

3. Secretary of the Department of Finance and Ascess (II)
Ipung Fitri Purwanti, ST., MT., PhD

4. Graduate Program Coordinator:
Adhi Yuniarto, ST., MT., PhD

5. Department TKK Coordinator:
Ainul Firdatun Nisaa, ST., MSc.

6. Head of Laboratory:

- Water Recovery Technology Lab.
  Ir. Eddy Setiadi Soedjono, MSc., PhD
- Air Pollution and Climate Change Lab.
  Dr. Abdu Fadli Assomadi, SSi, MT.
- Solid Waste and Hazardous Lab.
  Arseto YeScientific papersBagastyo, ST., MT., MPhil, PhD
- Environmental Remediation Lab.
  Bieby Voijant, ST., MT., PhD
- Environmental Quality Management Laboratory
  Dr. Ir. Irwan Bagyo, MT.

The Department of Environmental Engineering currently has a teaching staff of 29 permanent lecturers consisting of 22 doctors (4 of whom are Professors), 4 masters, and several lecturers from other departments who foster basic courses and public lectures.

Dosen Tetap Departemen Teknik Lingkungan FTSPK-ITS / Staff Members of Department of Environmental Engineering, ITS

No	NAMA / NAME	LULUSAN DARI / GRADUATE FROM			KEPAKARAN / EXPERTISE
		Under-graduate	Graduate	Postgraduate	
1	Prof. Dr. Yulinah Trihadiningrum, MApp.Sc.	ITB	Univ. of New South Wales, Australia	Univ. of Antwerpen, Belgium	Solid and Hazardous Waste Treatment
2	Prof. Dr. Ir. Sarwoko Mangkoedihardjo, M.ScES.	ITB	Univ. of Gent, Belgia	Univ. Brawijaya	Environmental Sanitation and Phytoremediation
3	Prof. Dr. Sr. Nieke Karnaningroem, MSc.	ITB	IHE, Holland	Civil Eng, ITS	Environmental Management & Modeling
4	Prof. Ir. Joni Hermana, M.Sc.ES., Ph.D.	ITB	University of Ghent	Newcastle University	Environmental Pollution Control
5	Dr. Ir. Agus Slamet, MSc.	ITS	IHE, Holland	ITS	Industrial and Domestic Wastewater Treatment / Waste Water Treatment
6	Ir. Atiek Moesriati, MKes.	ITS	Univ. Airlangga, Surabaya		Environmental Health
7	Prof. Ir. Eddy Setiadi Soedjono, Dipl.SE, MSc., PhD.	ITS	IHE, Belanda	Univ. of Birmingham England	Drinking Water and Environmental Sanitation / Water and Sanitation
8	Ir. Mas Agus Mardyanto, ME., PhD.	ITS	Univ. of Roorkee India	Univ. of Otawa	Ground Water Management

No	NAMA / NAME	LULUSAN DARI / GRADUATE FROM			KEPAKARAN / EXPERTISE
		Under-graduate	Graduate	Postgraduate	
9	Dr. Ir. R. Irwan Bagyo Santoso, M.T.	ITB	ITB		Clean Water Management
10	Ir. Bowo Djoko Marsomo, MEng.	ITB	Asian Institute of Technology		Drinking Water Treatment Technology
11	Prof. Dr. Ali Masduqi, ST., MT.	ITS	ITB	Civil Eng, ITS	Management and Engineering of Drinking Water Supply / Water Supply Manag. & Engineering
12	Susi Agustina Wilujeng, ST., MT.	ITS	ITB	Currently studying in ITB	Wastewater Treatment &; Solid Waste Manag.
13	Bieby Voijant Tangahu, S.T., M.T., Ph.D.	ITS	ITS	Universiti Kebangsaan Malaysia	Remediation of pollutants by plants
14	Adhi Yuniarto, ST., MT., PhD.	ITS	ITS	University Teknologi Malaysia. Malaysia	Wastewater Treatment
15	IDAA Warmadewanthi, S.T., M.T., Ph.D.	ITS	ITB	National Taiwan University of Science and Technology	Solid Waste Management and B3
16	Harmin Sulistyaning Titah, ST., MT., PhD.	ITS	ITB	UKM, Malaysia	Environmental Remediation and Waste Management Technology

No	NAMA / NAME	LULUSAN DARI / GRADUATE FROM			KEPAKARAN / EXPERTISE
		Under-graduate	Graduate	Postgraduate	
17	Ipung Fitri Purwanti, ST., MT., PhD.	ITS	ITS	UKM, Malaysia	Environmental Sanitation
18	Dr. Abdu Fadli Assomadi, S.Si., M.T.	Universitas Brawijaya	ITS	ITS	Air Pollutant Dispersion Model
19	Dr. Eng Arie Dipareza Syafei ST., MEPM.	ITS	NTU, Taiwan	Hiroshima Univ., Japan	Environmental Management &; Air Quality
20	Arseto Yekti Bagastyo, ST., MT., MPhil. Phd.	ITS	ITS dan The Univ. of Queensland	Univ. of Queensland	Hazardous Waste(water) Treatment
21	Welly Herumurti, ST.., MSc.	ITS	Univ. Petronas, Malaysia		Environmental Management
22	Alfan Purnomo, ST., MT.	ITS	ITS		Wastewater Treatment
23	Ervin Nurhayati, ST., MT., PhD.	ITS	ITS	National Chiao Tung University, Taiwan	Water Recovery
24	Deqi Rizkivia Radita, ST., MS.	ITS	National Cheng Kung University		Solid Waste Management and Hazardous

No	NAMA / NAME	LULUSAN DARI / GRADUATE FROM			KEPAKARAN / EXPERTISE
		Under-graduate	Graduate	Postgraduate	
25	Ainul Firdatun Nice, ST., MSc	ITS	University of Stuttgart		Urban Water Management, Sanitation Planning
26	Arry Febrianto, S.Si., MT	ITB	ITB		Air and Waste Management
27	Mashudi, S.Si., MENVM	IPB	The University of Queensland		Post-Mining Remediation Technology and Environmental Biotechnology
28	Bara Awanda Marhendra, ST, M.Sc ETH	ITS	ETH Zürich, Switzerland		Biotechnology in Wastewater Treatment

INFORMATION

Department of Environmental Engineering

ITS Sukolilo Surabaya Campus

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Website: www.enviro.its.ac.id

Email: lingkungan@its.ac.id, postgraduate@enviro.its.ac.id

FACULTY OF CIVIL, ENVIRONMENTAL AND GEO ENGINEERING

Courses	Environmental Engineering
Education Level	Undergraduate

Code		Description of Program Learning Outcomes (PLO)
PLO-1	Attitude	Capable to show attitudes and characters that reflect: piety to True Source, noble ethics, sensitivity and care for social and environmental problems, respect cultural differences and pluralism, uphold law enforcement, prioritize the interests of the nation and the wider community, through innovation, creativity, and other potentials possessed.
PLO-2	General Skills	Capable to study and utilize science and technology in order to apply it to certain fields of expertise, and capable to make appropriate decisions from the results of their own work and group work through logical, critical, systematic and innovative thinking.
PLO-3		Capable to manage self-learning, and develop themselves as lifelong learners to compete at the national and international levels, in order to make a real contribution to solving problems by paying attention to the principle of sustainability.
PLO-4	Knowledge	Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems.
PLO-5		Mastering the principles and current problems in economics, social, ecology in general; as well as communication techniques and the latest technological developments.
PLO-6	Special Skills	Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs.
PLO-7		Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills and technical tools.

PLO-8		Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
PLO-9		Ability to apply modern methods, skills and technical tools needed for engineering practice.
PLO-10		Capable to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the community; protect and preserve the environment; and efforts in environmental restoration.

2023 CURRICULUM EXPLAINATION

The curriculum of the Environmental Engineering Undergraduate Program has a study load of 144 credits scheduled in eight semesters, divided into **a preparatory stage with a study load of 36 credits (scheduled in two semesters) and** an Undergraduate stage **with a study load of 108 credits (scheduled in** six semesters). In addition, the credit load for basic science received by students consists of 18 credits of mathematics and basic science courses and 12 credits of Basic Science from Environmental Engineering so that there are a total of 30 credits of Basic Science, 7 credits of ITS characterizing courses, and 8 credits of national courses.

The education delivery system uses the Semester Credit System (SKS) which is interpreted as an education delivery system by using semester credit units (SKS) to express the burden of students, the workload of lecturers, and the burden of implementing programs. Semester is a unit of activity time 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 activities as follows:
    a. Face-to-face activities of 50 (fifty) minutes per week per semester;
    b. Structured assignment activities of 60 (sixty) minutes per week per semester; and
    c. Independent activities 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 activities as follows:
    a. Face-to-face activities of 100 (one hundred) minutes per week per semester; and
    b. Independent activities 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 processes, interpreted as the implementation of activities of 170 (one hundred and seventy) minutes per week per semester.

LIST OF UNDERGRADUATE PROGRAM COURSES

No	Course Code	Course Name	SKS
SEMESTER: I			
1	SM234101	Calculus 1	3
2	SF234101	Physics 1	5
3	SK234101	Chemistry 1	4
4	CL234101	Microbiology	4
5	CL234102	Engineering Drawing	3
		Number of credits	19
SEMESTER: II			
1	SM234201	Calculus 2	3
2	SF234202	Electrical and Magnetic Physics	4
3	CL234201	Statistics	3
4	CL234202	Surveying	3
5	CL234203	Chemistry 2	4
		Number of credits	17
SEMESTER: III			
1	CL234301	Soil Mechanics and Geohydrology	3
2	CL234302	Hydraulics	3
3	CL234303	Structural Computation	2
4	CL234304	Environmental Pollutant Analysis Technique	3
5	CL234305	Water Resources Management	3
6	CL234306	Air Pollution and Emission Control Technology	3
7	CL234307	Occupational Health and Safety	3
		Number of credits	20
SEMESTER: IV			
1	CL234401	Drinking Water Distribution System	4
2	CL234402	Wastewater Distribution System	4
3	CL234403	Drainage System	4
4	CL234404	Operation Unit	3
5	CL234405	Process Unit	3
6	CL234406	Environmental Management and Audit System	2

No	Course Code	Course Name	SKS
Number of credits			20
SEMESTER V			
1	CL234501	Design of Water Treatment Plant	4
2	CL234502	Design of Waste Water Treatment Plant	4
3	CL234503	Environmental Impact Analysis	3
4	CL234504	Design of Solid Waste Management	4
5	CL234505	Project Budgeting and Management	3
6	CL234506	Research Methodology	2
Number of credits			
SEMESTER VI			
1		Religious Education:	2
	UG234901	Islamic Studies	
	UG234902	Christian Studies	
	UG234903	Catholic Studies	
	UG234904	Hindu Studies	
	UG234905	Buddhis Studies	
	UG234906	Khonghucu Studies	
2	UG234911	Pancasila	2
3	UG234915	Technopreneurship	2
4	CL234601	Design of Final Disposal Site	4
5	CL234602	Hazardous and Toxic Material Waste Management	3
6		Elective Course	2
7		Elective Course	2
8		Enrichment Course	3
Number of credits			20
SEMESTER VII			
1	UG234912	Indonesian	2
2	UG234913	Civics	2
3	UG234914	English	2
4	UG234916	Applied Technology and Digital Transformation	3
5	CL234701	Environmental Remediation Technology	3
6	CL234702	Sustainable Environmental Infrastructure Design	4

No	Course Code	Course Name	SKS
7		Elective Course	2
8		Elective Course	2
Number of credits			20
SEMESTER VIII			
1	CL234801	Final Project	6
2	CL234802	Practical Work	2
Number of credits			8
ELECTIVE COURSES			
1	CL234601	Water Loss Management	2
2	CL234602	Community-Based Sanitation	2
3	CL234603	Industrial Sludge and Sewage Treatment	2
4	CL234604	Green Technology	2
5	CL234605	Climate Change	2
6	CL234606	Fitotechnology	2
7	CL234607	Environmental Economics	2
8	CL234701	Plumbing	2
9	CL234702	Business Pillars	2
10	CL234703	Sanitation of Coastal and Disaster Areas	2
11	CL234704	Numerical methods and dispersion of pollutants	2
12	CL234705	Environmental Modeling	2
13	CL234706	Environmental Ecotoxicology	2
14	CL234707	Self Development	9

UNDERGRADUATE PROGRAM CURRICULUM
SYLLABUS

- SEMESTER I

COURSES	**Course Name**	: Calculus I
	Course Code	: SM234101
	Credit	: 3 credits
	Semester	: I (One)

COURSE DESCRIPTION
This course equips students with matrix, deteminant and linear equation system concepts, mathematical thinking concepts in solving engineering problems, modeling and others in engineering related to differential applications. The lecture material emphasizes more on real problem solving techniques that can be formulated into the function of one independent varicapable.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Students are capable to identify and explain mathematical foundations which include pure, applied and computational basics • Students are capable to solve simple and practical problems by applying basic mathematical statements, methods and computation
COURSE LEARNING OUTCOMES
• Students are capable to apply basic mathematical concepts related to matrices and determinants • Students are capable to apply equations or inequalities and graphs of linear equation functions • Students are capable to apply the form of complex varicapables in polar form and draw the roots of the equation • Students are capable to determine the continuity of functions and derivatives • Students are capable to apply integrals through the fundamental theorem of calculus
SUBJECT MATTER
1. Real Number System • Real numbers • Absolute value • Equation graph • Lines, linear equations

2. Complex Numbers
    - Complex numbers
    - De moivre theorem

3. Matrices, Determinants and Systems of Linear Equations
    - Matrix and its operation
    - Operation of elementary rows and inverse matrices
    - Systems of linear equations
    - Determinants
    - Minor, cofactors and cramer's rule
    - Eigenvalues and eigenvectors

4. Function
    - Function definition and notation
    - Operations on functions
    - Function graph
    - Graph properties of functions
    - Inverse function

5. Limits and Conformity
    - Introduction to limit notation
    - Limit calculation
    - Limit at infinity
    - Continuity

6. Differentiation
    - Tangent and rate of change
    - Child functions
    - Differentiation
    - Chain rules and implicit differentiation

7. Child Applications
    - Related speeds
    - Hose up and hose down, function basin
    - Extreme relative, first and second derivative tests
    - Polynomial graphs and rational functions
    - Maximum or minimum value of a function
    - Application maximum and minimum issues
    - Rolle's theorem, the mean value theorem

8. Integration
    - Introduction
    - Anti-derivative, indeterminate integral
    - Integration with substitution
    - Area as limit
    - Certain integrals
    - The fundamental theorem of the first calculus
    - Approximation of the number of Reimann
    - The fundamental theorem of the second calculus

PREREQUISITE

-

REFERENCE

- ITS Mathematics Department Lecturer Team, Mathematics Diktat 1, 5th Edition of ITS Mathematics Department, 2020
- Anton, H. dkk, Calculus, 10-th edition, John Wiley & Sons, New York, 2012
- Kreyzig, E, Advanced Engineering Mathematics, 10-th edition, John Wiley & Sons, Singapore, 2011
- Purcell, J, E, Rigdon, S., E., Calculus, 9-th edition, Prentice-Hall, New Jersey, 2006
- James Stewart , Calculus, ed.7, Brooks/cole-Cengage Learning, Canada,2012

COURSES	**Course Name**	: Physics 1
	Course Code	: SF234101
	Credit	: 5 credits
	Semester	: I (One)

COURSE DESCRIPTION

In this course, students will learn to understand the basic laws of physics, particle kinematics; Particle dynamics; Work and energy; Rotational motion ; Vibration and fluid mechanics, through simple mathematical explanations and introducing examples of the use of concepts, and conducting material analysis in the form of practicum.

The practicum carried out includes: (1) physical pendulum, (2) mathematical pendulum, (3) spring constant, (4) fluid viscosity, (5) bullet motion, (6) friction coefficient, (7) moment of inertia.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and / or technology in accordance with their field of expertise
- Capable to show independent, quality, and measurcapable performance
- demonstrate an attitude of responsibility for work in their field of expertise independently

COURSE LEARNING OUTCOMES

- capable to apply logical, critical, systematic, and innovative thinking in solving problems and implementing physical science I.
- Capable to show independent, quality, and measurcapable performance
- demonstrate an attitude of responsibility for work in their field of expertise independently

SUBJECT MATTER

- Quantities and vectors: Magnitudes, unit systems, vectors;
- Particle kinematics: Shift in position, velocity, acceleration, straight motion, curvilinear motion (parabolic and circular), relative motion;
- Particle dynamics: Newton's laws I, II and III, various forces (gravitational force, gravity, rope tension force, normal force, frictional force, centripetal force, and spring force), force equilibrium, application of Newton's laws I, II and III;
- Work and energy: the concept of work, kinetic energy, potential energy (gravity and spring), energy work theorem, the law of conservation of mechanical energy, impulse, momentum, collision (elastic and inelastic), center of mass;
- Rotational dynamics: Angular shift, angular velocity and angular acceleration, angular momentum, moment of force (torque), equilibrium moment of force, moment of inertia, kinetic energy of rotation, rolling motion, law of conservation of angular momentum, analogy of motion (translation and rotation), rigid equilibrium of bodies;
- Oscillations and Waves: oscillation magnitude, oscillation deviation, oscillation speed and acceleration, oscillation energy, simple harmonic motion, combined 2 aligned vibrations, muffled vibration, simple harmonic motion energy, mathematical pendulum, physical pendulum, torsion pendulum, combined harmonic vibration (parallel and perpendicular);
- Mechanics of shape-shifting bodies: Elasticity, hydrostatics, fluid dynamics, Pascal's principle, Archimedes' principle, surface tension, continuity equation, Bernoulli's equation, viscosity.

PREREQUISITE

-

PUSTAKA
• Sears & Zemanky,"University Physics", Pearson Education, 14thed, USA, 2016 • Douglas C. Giancoli, 'Physics for Scientists and Engineers, Pearson Education, 4th ed, London, 2014 • Tim Dosen, "I'm a Monster," Insomnia • "Basic Physics Practicum Instructions", Physics, MIPA-ITS • Halliday, Resnic, Jearl Walker; 'Fundamental of Physics'. John Wiley and Sons, 10th ed, New York, 2014 • Tipler, PA, 'Physics for Scientists and Engineers ‘,6th ed, W.H. Freeman and Co, New York, 2008

COURSES	**Course Name**	: Chemistry 1
	Code COURSE	: SK234101
	Credit	: 4 credits
	Semester	: I (One)

COURSE DESCRIPTION
This subject studies the basic principles of chemistry including atomic theory, electron configuration, chemical bonds, substance state and phase changes, chemical reactions and stoichiomeri, Acid-Base Theory, Ionic Equilibrium in Solutions (Acid-Base, Solubility, Complexes and Precipitation), Chemical Thermodynamics, Chemical Kinetics and Electrochemistry.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Have good morals, ethics, responsibility and personality in completing their duties (A.1/PLO 1) • Responsible for own work and can be given responsibility for the achievement of the work of the organization (B.3 / PLO 5) • Capable to apply a chemical mindset and utilize science and technology in their fields in solving the problems faced (D.1 / PLO 8)
COURSE LEARNING OUTCOMES
• Students are capable to use the basic principles of chemistry as a basis for studying science related to chemistry. • Students can do basic chemical calculations
SUBJECT MATTER
1. Atomic Structure • Introduction to matter (elements, compounds, physical properties, chemical properties)

- Basic laws of combining elements (Proust, Lavoisier, Dalton)
- The development of models and atomic structure
- Underlying experiments (Dalton, Thompson, Rutherford, Bohr and Hydrogen Atomic Spectra)
- Electron configuration of an element and ions
- Periodic System of Elements
- Properties of periodicity of elements

2. Stoichiometry
   - Calculation of the concept of moles
   - Empirical formula and molecular formula
   - Concentration Unit (M, N, %, %, m, F, ppm, ppb)
   - Stoichiometry in Solution
   - Standardization

3. Chemical Bonds
   - Polar covalent and covalent bonds, dipole moments, metallic bonds, hydrogen bonds, and Van der Walls bonds
   - Molecular structure and shape geometry (Lewis structure, and hybridization)

4. Form of Substance
   - Gas Form (Laws of gas and their physical properties)
   - Liquid Form (physical properties of liquid: vapor pressure, boiling point, surface tension, viscosity)
   - Colligative properties of the solution
   - Solid Form (Crystal lattice, simple cube simple cube, face centered cube
   - centered cubic, kubus berpusat badan/body centered cubic, indeks Miller, persamaan Bragg)

5. Solution
   - Acid-Base Theory (Arrhenius Theory, Brønsted-Lowry, Lewis Theory)
   - Ionization degree and ionization constant
   - Acid-Base Strength
   - Weak acid-base equilibrium
   - Ionic equilibrium between solids and solutions
   - Buffer System
   - Solubility

6. Thermodynamics
    - Thermodynamic concepts (principles, states and processes)
    - Law I of Thermodynamics: internal energy, work and heat
    - Heat capacity, calorimetry and enthalpy
    - Second Law of Thermodynamics and spontaneity
    - Thermochemistry as well as its use to explain the spontaneity of chemical reactions
    - Calculations relating to the application of the Carnot engine

7. Chemical Equilibrium
    - Concept of Chemical Equilibrium and Equilibrium Constant (Reaction quotient, equilibrium constant Kp and Kc)
    - Le Chatelier's Principles
    - Factors affecting chemical equilibrium

8. Chemical Kinetics
    - The concept of chemical kinetics
    - Rate in chemical reactions
    - Determination of reaction rate, order and reaction rate constant
    - The influence of temperature on the reaction rate
    - Elementary reactions
    - Catalyst

9. Electrochemical
    - The concept of redox reactions
    - Electrochemical cell (electrodes and electrolyte solution in an electrochemical cell)
    - Effects of concentration and the Nerst equation
    - Use of electrochemical concepts for voltaic cell applications (batteries and fuel cells) as well as electrolysis
    - Corrosion and corrosion prevention

10. Enrichment
    Topics according to the faculty's area of interest (per faculty)

Practicum Module Plan Offered
1. Hydrogen oxidation
2. Stoichiometry: Law of conservation of mass
3. Mixture separation

4. Oxide pH test
5. The effect of concentration on reaction rate
6. BOD/COD Test
7. Acid-base titration
8. Solution properties: electrolyte and non-electrolyte
9. Fuel energy
10. Acid rain
11. Determination of phosphoric acid content in soft drinks
12. Exothermic and endothermic reactions
13. Lead Storage Batteries
14. Time-Release Vitamin C Tcapablets
15. The Empirical Formula of a Copper Oxide

Other topics are adapted to the enrichment material

PREREQUISITE

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PUSTAKA

- Chemistry Diktat 1 (prepared by the Chemistry Department Lecturer Team)
- Oxtoby, D.W., Gillis, H.P. and Campion, A., "Principles of Modern Chemistry", 7th Edition, Brooks/Cole, 2012.
- Chang, R. and Goldsby, K., "Chemistry", 11th Edition, McGraw-Hill, USA, 2012.
- Goldberg, D. E., "Fundamental of Chemistry", 4th Edition, McGraw-Hill Companies, 2007

COURSES	**Course Name**	: Microbiology
	COURSE Code	: CL234101
	Credit	: 4 credits
	Semester	: I (One)

COURSE DESCRIPTION

Students will be capable to understand the basic principles of microbiology and the basics of molecular genetic engineering. In addition, some of the material that must be understood and understood by students is as follows: microorganism control and measurement of microbial pollutants obtained from lectures and practicums in the laboratory.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to study and utilize science and technology in order to apply it to certain fields of expertise, and capable to make appropriate decisions from the results of their own work and group work through logical, critical, systematic and innovative thinking.
- Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems.
- Ability to apply modern methods, skills and technical tools needed for engineering practice.

COURSE LEARNING OUTCOMES

- Capable to understand the basic concepts of microbiology and its classification of microoganism that supports the field of environmental engineering
- Capable to understand the basic concepts of microbiology in water, soil and air media that support the field of environmental engineering
- Capable to conduct and determine criteria and analysis of microbiological environmental pollutants
- Capable to collect and analyze microbiological parameter data and information correctly

SUBJECT MATTER

- Students will be capable to understand the principles of microbiology including the cell structure of microorganisms; classification of microorganisms, microbiology of water, soil and air; bioenergetics; and enzyme kinetics; then capable to understand the basics of molecular genetics; control of microorganisms and measurement of microbial pollutants.
- The material that will be studied by students is the basics of microbiology, the basics of molecular genetics; control of microorganisms and measurement of microbial pollutants.

PREREQUISITE

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REFERENCE

- 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. 2021. Environmental Microbiology. MNC Publishing, Malang
- Alexander, M. 1990. Biodegradation and Bioremidiation. Academic Press. San Diego.

COURSES	**Course Name**	: Engineering Drawing
	Course Code	: CL234102
	Credit	: 3 credits
	Semester	: I (One)

COURSE DESCRIPTION

In this course, students will be capable to apply drawing techniques to building design in the field of Environmental Engineering, both manually and CAD. Broadly speaking, the material studied is: introduction to drawing tools, notation, various drawings and drawing applications in simple houses and buildings in the field of Environmental Engineering. Learning objectives will be achieved through face-to-face lectures, simple house drawing assignments and drinking water and wastewater treatment buildings.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

- Students understand the basics of technical drawing
- Students are capable to make floor plans and pieces of a building in the field of environmental engineering
- Students are capable to sketch building drawings in the field of environmental engineering without a ruler
- Students are capable to make technical drawings in the field of environmental engineering with a ruler
- Students are capable to make drawings in the field of environmental engineering with Autocad software

SUBJECT MATTER

- Know the Properties in drawing techniques
- Basics of engineering drawing
- Sketch Floor plans and cutouts without a ruler of a building
- Sketch the front, side and back view of a building
- Drawing simple house buildings
- Drawing a building unit in the field of drinking water
- Drawing a building unit of wastewater field

• Drawing the layout of a drinking water treatment building • Drawing the layout of wastewater treatment buildings • Practice using autocad software • Draw a simple house with autocad software • Drawing drinking water treatment buildings with autocad software • Drawing wastewater treatment buildings with autocad software • Drawing longitudinal profiles of drainage/wastewater pipes
PREREQUISITE
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REFERENCE
• Ranal V. Giles, Jack B. Evett, Cheng Liu, "Theory and Problems of Fluid Mechanics and Hydraulics", McGraw-Hill International Edition, 1996. • Roberson, John A. & Crowe, Clayton T., "Enginering fluid mechanics", 6th. Ed, John Wiley, New York, 1997. • Triatmodjo, Bambang, "Hidraulika I", Beta Offset, Yogyakarta, 1995. • Vijay, P. Singh," Environmental hydraulics", Kluwer Academic, Dordrech, 1996.

- SEMESTER II

COURSES	**Course Name**	: Calculus II
	Code COURSE	: SM234201
	Credit	: 3 credits
	Semester	: II (Two)

COURSE DESCRIPTION
Transcendent, differential and integral functions Integration Techniques, Unnatural Integrals Integral Applications Polar Form, Parametric function, differential and integral Rows and Series
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Capable to interpret the basic concepts of mathematics and compile proofs directly, indirectly, or by mathematical induction. • Capable to identify simple problems, form mathematical models and solve them. • Mastering standard methods in the field of mathematics.

- Capable to master the fundamental theories of mathematics which include the concepts of sets, functions, differentials, integrals, spaces and mathematical structures.
- Capable to identify problems, form mathematical models and solve them.

COURSE LEARNING OUTCOMES

- Students are capable to apply basic mathematical concepts related to transcendent functions.
- Students are capable to apply integration techniques.
- Students are capable to apply it both in the form of cartesian coordinate functions, as well as polar coordinates and parametric equations.
- Students are capable to determine the convergence of rows and infinite series and the number of infinite series that converge.
- Students are capable to transform functions into Taylor series or Maclaurin series.

SUBJECT MATTER

In this course, students will learn the following subjects:

- Transcendent functions, their differentials and integrals.
- Integration techniques and integrals are unnatural.
- Apply certain integrals to the area of a flat plane, the volume of a body, the length of the arc and the area of the shell of a rotating body, the center of mass, the application of Guldin's theorem.
- Polar coordinate systems and parametric equations, their graphic sketches and applications.
- The convergence of rows and infinite series, and counting the number of convergent infinite series, Taylor series and Maclaurin series.

PREREQUISITE

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REFERENCE

- ITS Mathematics Department Lecturer Team, Calculus TextREFERENCE 2, 5th Edition of ITS Mathematics Department, 2013
- Anton, H. dkk, Calculus, 10-th edition, John Wiley & Sons, New York, 2012
- Kreyzig, E, Advanced Engineering Mathematics, 10-th edition, John Wiley & Sons, Singapore, 2011
- Purcell, J, E, Rigdon, S., E., Calculus, 9-th edition, Prentice-Hall, New Jersey, 2006
- James Stewart , Calculus, ed.7, Brooks/cole-Cengage Learning, Canada,2012

COURSES	**Course Name**	: Electrical and Magnetic Physics
	Course Code	: SF234202
	Credit	: 4 credits
	Semester	: II (Two)

COURSE DESCRIPTION

In this course, students will learn to understand the basic laws of physics, Electric Field; Electric Potential; Electric Current ; Magnetic; Electromotive Force (EMF) Induction and Alternating Current, through simple mathematical descriptions and introducing examples of the use of concepts.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and / or technology in accordance with their field of expertise
- capable to show independent, quality, and measurcapable performance;
- demonstrate an attitude of responsibility for work in his field of expertise independently;

COURSE LEARNING OUTCOMES

- capable to apply logical, critical, systematic, and innovative thinking in solving problems and implementing physical science I.
- capable to show independent, quality, and measurcapable performance;
- demonstrate an attitude of responsibility for work in his field of expertise independently;

SUBJECT MATTER

- Electric force and field: Electric charge, Coulomb's Law;
- Electric field: electric field strength, force line, electric field strength calculation for point charge, line charge, ring, disk, cylinder;
- Gauss's Law: flux, line of force, Gauss's Law and its application to cylindrical and spherical charges;
- Electric potential: Potential energy, electric potential difference, electric potential relationship and electric field, calculation of electric potential for point charge, line charge, ring, disk, cylinder and sphere;
- Capacitors: Capacitance, capacitance calculation for parallel chip capicitors, cylindrical capacitors and spherical capacitors, series and parallel capacitor circuits, dielectric materials, capacitor energy;
- Electric current: Current and motion of charge, Ohm's law, resistivity, resistance, electric power;

- Direct current circuits: series and parallel resistor circuits, Kirchoff's law;
- Magnetic field: magnetic flux and induction, Lorentz force, Savard-Ampere Biot law, magnetic field calculation for straight wire current, ring, solenoid and toroid;
- GGL Induction: Faraday's Law, Lenz's Law, GGL induction, Self-inductance and articulated inductance; energy on the inductor;
- Alternating current: alternating current in resistors, inductors, capacitors, Impedance, R-L and R-C circuits for series and parallel, R-L-C series, Power, Resonance.

PREREQUISITE

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REFERENCE

- Sears & Zemanky,"University Physics", Pearson Education, 14thed, USA, 2016
- Douglas C. Giancoli, 'Physics for Scientists and Engineers, Pearson Education, 4th ed, London, 2014 3. Tim Dosen, " Fisika II", Fisika FMIPA-ITS
- Halliday, Resnic, Jearl Walker; 'Fundamental of Physics'. John Wiley and Sons, 10th ed, New York, 2014
- Tipler, PA, 'Physics for Scientists and Engineers ‘,6th ed, W.H. Freeman and Co, New York, 2008

COURSES	**Course Name**	:Statistics
	Course Code	: CL234201
	Credit	: 3 credits
	Semester	: II (Two)

COURSE DESCRIPTION

Students are capable to understand basic statistical concepts and methods

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to study and utilize science and technology in order to apply it to certain fields of expertise, and capable to make appropriate decisions from the results of their own work and group work through logical, critical, systematic and innovative thinking.
- Mastering the principles and current problems in economics, social, ecology in general; as well as communication techniques and the latest technological developments.

COURSE LEARNING OUTCOMES

- Capable to understand statistical data analysis methods;
- Capable to analyze planning and research data using statistical methods.

SUBJECT MATTER

- Descriptive analysis: mean, median, standard deviation, varian
- Descriptive analysis: determination of the number of samples based on population and space, presentation of data, frequency distribution, central value and dispersion, moment and cartesian
- Parametric and non-parametric statistical analysis, Probability: elements of set theory, random varicapables, probability distributions, empirical distribution models.
- Estimation and hypothesis: ways of estimation, hypothesis testing, variance test, normality test.
- Regression and correlation: time–series analysis, basic formulation of linear regression, variance analysis, multivariate, coefficient of determination.
- Population analysis: rate and ratio, cohort tcapable files, mortality and morbidity, basics of software applications, with tasks using computer software (Minitab-SPSS).

PREREQUISITE

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REFERENCE

- Helsel, D.R. & Hirsh, R.M., “Statistical methods in water resources”, Elsevier, London, 1993.
- McBean, Edward A., “Statistical procedures for analysis of environmental monitoring data and risk assessment”, Prentice-Hall, Upper Saddle, 1998.
- Pentecost, Allan, “Analysing environmental data”, Pearson Education, Essex, 1999
- Walpole, Ronald E. & Myers, Raymond H., "Science of opportunity and statistics for engineers and scientists", 4th edition, ITB, Bandung, 1995.
- Waluyo, Sihono Dwi, "Statistics for decision making", Ghalia Indonesia, Jakarta, 2001.
- Zer, Jerold H., “Biostatistical analysis”, 3rd. ed, Prentice-Hall, Englewood Cliffs, 1996

COURSES	**Course Name**	: Surveying
	Course Code	: CL234202
	Credit	: 3 credits
	Semester	: II (Two)

COURSE DESCRIPTION
The purpose of this course is that students are capable to apply land topography data for planning purposes in the field of Environmental Engineering. Broadly speaking, students will study map history, positioning, unit systems, map review, symbols, profiling, contouring, generalization. In application in Environmental Engineering, students will also learn about the basics of photogrammetry, stereoscopes, interpretation of aerial photography, determination of land area, waterpass and introduction to tools and counts, polygons and introduction to tools and counts, tachymetry and introduction to tools and calculations, plotting, contouring, and map sheet design, introduction to geographic information systems (GIS). Learning objectives can be achieved by face-to-face lectures and practicums: mapping in the field and the use of GPS.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
• Understanding 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 work purposes; WebGIS; • Application and Uses of IG in Civil Engineering, Environmental Engineering, Geomatics Engineering and Geophysical Engineering work.
PREREQUISITE
-
REFERENCE
• Sosrodarsono, Suyono & Masayosi Takasaki, 1992, "Topographic measurements and mapping techniques", Pradnya Paramita, Jakarta. • Rais, Jacub, 1978, "Science of Soil Measurement I and II",[s.n.]], Jakarta. / ∑ 3 / 526.98 Rai I / I &; II • Wongsotjitro, Soetomo, 1980, "The science of soil measurement", Kanisius, Yogyakarta.

COURSES	Course Name	: Chemistry 2

	Course Code	: CL234203
	Credit	: 4 credits
	Semester	: II (Two)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
•
PREREQUISITE
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REFERENCE
•

- SEMESTER III

COURSES	**Course Name**	: Soil Mechanics and Geohydrology
	Course Code	: CL234301
	Credit	: 3 credits
	Semester	: III (Three)

COURSE DESCRIPTION
The purpose of this course is that students are capable to use soil and groundwater data to support simple building planning in the field of Environmental Engineering. Broadly speaking, students Soil and rock classification, soil and groundwater parameters, soil carrying capacity, sideways soil pressure, groundwater flow, pumping tests, and groundwater modeling basis. Students will also learn the use of soil and groundwater data in the design of simple buildings in environmental engineering and groundwater wells. Learning objectives will be achieved through face-to-face lectures, individual and group assignments.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES

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SUBJECT MATTER

Introduction to soil mechanics and geohydrology in environmental engineering, rock cycle, weight-volume-plasticity relationship and soil structure, phase diagram, soil retaining wall, soil carrying capacity, shallow foundation, slope stability, Water resources management rules and regulations, granular soil characteristics, hydrological cycle, aquifer types, groundwater flow, radial flow, pumping test, well making, groundwater management

PREREQUISITE

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REFERENCE

- 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. Soil mechanics, vols. 1 and 2. Translated by Noor Endah Mochtar and Indra Surya B Mochtar, Erlangga, Jakarta.

COURSES	**Course Name**	: Hydraulics
	Course Code	: CL234302
	Credit	: 3 credits
	Semester	: III (Three)

COURSE DESCRIPTION

Hydraulics equips students with the ability to explain water characteristics, the concept of drainage in open and pressurized channels, energy equations or bernoulli, specific energy, water surface profiles, manning formulas, chezy, Hazen William, Darcy Weisbach, calculation of open channel cross-section and pressure pipe diameter, drainage on loop pipes with hardycross methods, discharge measuring instruments and hydraulic aspects of environmental engineering water buildings.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to study and utilize science and technology in order to apply it to certain fields of expertise, and capable to make appropriate decisions from the results of their own work and group work through logical, critical, systematic and innovative thinking.
- Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems.

- Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs

COURSE LEARNING OUTCOMES

- Students are capable to explain the theory / concept of streaming in open channels
- Students are capable to apply hydraulics formulas to drainage channels, wastewater channels, and discharge measuring instruments
- Students are capable to explain the theory / concept of drainage on pressurized channels
- Students are capable to apply hydraulics formulas to pressurized pipes and pressurized pipelines

SUBJECT MATTER

- Water characteristics
- Open channel cross-sectional geometry
- The concept of flow on open channels with the energy equation and Bernoully
- The equation of maning and cezy in the calculation of the dimensions of open channels
- Specific energy and critical depth
- Water surface profile
- Hydraulics Water discharge and building measuring instruments in environmental engineering
- The concept of pressurized flow, energy equation /bernoully
- Formula Hazen William, Darcy Weisbach
- Major losses and minor losses,
- Create HGL and EGL lines
- Flow concept in series pipe, equivalence pipe and parallel pipe
- Flow concept in inter-reservoir pipes
- Flow concept in loop pipes and Hardycross method
- Pumping system

PREREQUISITE

-

REFERENCE

- White, Frank M. 2010. Fluid Mechanics. 7th ed. McGraw-Hill. ISBN: 9780077422417
- Currie, I. G. Fundamental Mechanics of Fluids (Fourth Edition). CRC Press. ISBN: 9781439874608
- Munson, B. R., Young, D.F., Okiishi, T. H., 2002, Fundamentals of Fluid Mechanics, 4th. Ed., John Wiley & Sons, Inc. New York

COURSES		
	Course Name	: Structural Computation
	Course Code	: CL234303
	Credit	: 2 credits
	Semester	: III (Three)

COURSE DESCRIPTION
In this course, students will be capable to design simple concrete and steel structures in buildings in the field of Environmental Engineering. Broadly speaking, the material studied is: basic theory of structure, knowledge of concrete and steel technology, calculation of concrete and steel structures, and calculation of BOQ and RAB in simple Environmental Engineering buildings. Learning objectives will be achieved through face-to-face lectures, individual assignments and group assignments.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
• Building Structure Planning in Environmental Engineering
PREREQUISITE
-
REFERENCE
• Dipohusodo, I.,"Struktur Beton Bertulang", Gramedia Pustaka Utama, Jakarta, 1996. • McCormac,J.C., "Structural Steel Design", 3 rd. Ed, Harper & Row, New York, 1981. • Sieh, Yuan Yu, "Basic Theory of Structure, Suryadi Translation", Erlangga, Jakarta, 1985. • Hibbeler, R.C., "Engineering Mechanics, Statics 1 and 2, Translation of Yaziz Hasan", Prenhalindo, Jakarta, 1985.

COURSES		
	Course Name	: Environmental Pollutant Analysis Technique
	Course Code	: CL234304
	Credit	: 3 credits
	Semester	: III (Three)

COURSE DESCRIPTION
Students are capable to sampling and measuring pollutant parameters of drinking water, wastewater, soil and air quality and are capable to analyze and interpret data from laboratory analysis.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Capable to study and utilize science and technology in order to apply it to certain areas of expertise, and capable to make appropriate decisions from the results of their own work and group work through logical, critical, systematic and innovative thinking. • Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills and technical tools. • Ability to apply modern methods, skills and technical tools needed for engineering practice.
COURSE LEARNING OUTCOMES
• Capable to determine sampling points and take samples on water, soil and air media in accordance with appliccapable standard methods. • Capable to measure pollutant parameters in water, soil and air media. • Capable to analyze the results of measuring pollutant parameters / pollutant indicators in water, soil and air media. • Capable to interpret data from the analysis clearly and carefully to support building design in the fields of environmental engineering, pollution prevention and restoration of environmental quality.
SUBJECT MATTER
• Environmental quality standards for water, soil and air media; • Sampling methods include determination of sampling points, retrieval, transport, preservation and storage of samples. • Methods of testing physical, chemical and biological pollutant parameters on water, soil and air media.
PREREQUISITE
-
REFERENCE
• 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.

- Rump, H. H, Krist. H., (1988). Laboratory Manual for the Examination of Water, Waste Water, and Soil. VCH Verlagsgesellschaft. Weinheim.
- Add a REFERENCE for soil analysis
- Practicum Instructions for Environmental Pollution Analysis Techniques
- Add a REFERENCE for soil analysis

COURSES	**Course Name**	: Water Resources Management
	Course Code	: CL234305
	Credit	: 3 credits
	Semester	: III (Three)

COURSE DESCRIPTION

The purpose of this course is that students are capable to apply comprehensive water resources management planning. In this course, students learn the understanding and concepts of water resources management, legal aspects, climate, hydrological cycle, forests, rivers, lakes, natural and artificial ponds, wetlands, groundwater and rainwater. Students also study freshwater resources, brackish water, peat water, natural resource management methods (conservation methods, carrying capacity and carrying capacity calculation methods, self purification / DO-Sag curve methods), applications in conservation reclamation and measurement, utilization of treated waste for irrigation, and industrial and domestic wastewater recycle. The objectives of the course can be achieved with face-to-face lectures and the task of Planning the management of Water Resources of an area

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER

- Regulations and legislation related to water resources and environmental management;
- Sustaincapable water and environmental management
- Modeling related to the quality status of natural resources with conservation theory, Qual2KW, Storet
- PSDA in coastal areas (mangroves) and peatlands
- Groundwater resources
- Integrated Water Resources Management
- Water budget

• Completion of assignments in the form of papers presented in the field of water resources and environmental management
PREREQUISITE
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REFERENCE

COURSES	**Course Name**	: Air Pollution and Emission Control Technology
	Course Code	: CL234306
	Credit	: 3 credits
	Semester	: III (Three)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
•

COURSES	**Course Name**	: Occupational Safety and Health
	Course Code	: CL234307
	Credit	: 3 credits
	Semester	: III (Three)

COURSE DESCRIPTION
Students learn the aims and objectives of occupational safety and health, the concept of work accident pyramid, hazards, risks, occupational safety and health control (chemical, physical, biological factors) and ergonomics, work accident control efforts and personal protective equipment, sanitation and

hygiene in the work environment, house keeping, hazardous and toxic materials management, fire protection, emergency response procedures, noise measurement and control, basics of Occupational Safety and Health management and audit (SCOURSE3/OHSAS 18001). Appliccapable rules and regulations regarding Occupational Safety and Health. Safety and health procedures in the work environment in infrastructure in the field of environmental engineering (wastewater and drainage channels, drinking water piping systems, WWTP and drinking water treatment plant, garbage dump and landfill).

Task: Management of Occupational Safety and Health in industry and environmental infrastructure

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER

- The scope of SCOURSE3 according to OHSAS 8001 and according to ISO 45001
- Application of K3 Management System (SCOURSE3), Integration of SCOURSE3 with Organizational Management System, PDCA Cycle
- Aims and objectives of occupational safety and health management, pyramid concept of work accidents, hazards, risks, occupational safety and health control
- Chemical, physical, and biological factors, as well as occupational diseases
- Application of PPE, Hazard Communication, hazardous and toxic waste management, Application of occupational safety and health system in the Laboratory
- Fire protection and protection systems; Fire extinguisher, fire hydrant system, occupational safety and health factor in noise aspect and Emergency Response Procedure
- Steps to implement SCOURSE3 at the preparatory stage
- Steps for implementing SCOURSE3 at the development and implementation stage
- SCOURSE3 checklist
- How to compile a SCOURSE3 document
- SCOURSE3 auditor and audit process, as well as SCOURSE3 certification of the company

PREREQUISITE

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REFERENCE

- 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 of the Republic of Indonesia No. 50 of 2012 concerning the Implementation of Occupational Safety and Health Management System, State Gazette of the Republic of Indonesia, April 12, 2012.

- SEMESTER IV

COURSES	**Course Name**	: Drinking Water Distribution System
	Course Code	: CL234401
	Credit	: 4 credits
	Semester	: IV (Four)

COURSE DESCRIPTION

In this course, students will learn about planning the development of drinking water supply systems which include raw water units, transmission and distribution units, and service units. This course focuses on planning a drinking water distribution system with piped networks, which consists of determining service areas, determining water needs, analyzing distribution pipelines, and controlling leaks. After attending this lecture, students are capable to apply piping planning principles into the drinking water supply system. Lectures are equipped with the task of planning a drinking water supply system in a city.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER

- Basics of drinking water distribution system planning
- Calculate population projections and commercial social means
- Calculating projected water demand

- Explain raw water sources and raw water intake buildings and transmission pipes
- Stages of planning a drinking water distribution system
- Design criteria in drinking water distribution system planning
- Calculation of the diameter of the transmission and distribution pipeline
- Reservoir concept: distribution and calculation of ground reservoir and elevated reservoir volumes
- Complementary buildings of drinking water transmission and distribution pipeline systems
- Pipe type selection, pipe planting profile, junction details
- Calculation of RAB drinking water distribution system
- Water loss balance
- Water loss reduction planning
- The concept of energy efficiency in pumping systems

PREREQUISITE

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REFERENCE

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

COURSES	**Course Name**	: Wastewater Distribution System
	Course Code	: CL234402
	Credit	: 4 credits
	Semester	: IV (Four)

COURSE DESCRIPTION

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
• Source and quality of domestic wastewater • Wastewater dispensing system • Determining wastewater piping lines and service blocks • Determining discharge and loading • Determine the dimensions of wastewater distribution and its auxiliary buildings • Drawing the hydraulic profile of pipelines
PREREQUISITE
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REFERENCE
• 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

COURSES	**Course Name**	: Drainage System
	Course Code	: CL234403
	Credit	: 4 credits
	Semester	: IV (Four)

COURSE DESCRIPTION
In this course, students will learn about the concept of rainwater distribution, hydrological analysis, determination of catchment area, network plan, discharge calculation, calculation of channel dimensions and hydraulic profile. Students will also learn about the planning of complementary buildings which include sluices, culverts, siphons, gutters, waterfalls and pump houses, and flood control buildings which include retention ponds. Lectures are equipped with the task of planning a drainage system in a city.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
The rainwater distribution system includes a hydrological analysis system, calculation of channel dimensions and complementary buildings.

Determination of rain catchment areas, service areas and service sub-areas, rainwater distribution system planning criteria. Gravitational and pressurized delivery system. Stages in the planning of the Rainwater Distribution System and its supporting buildings, Bill of Quantity and operation and maintenance. Norms, standards, guidelines, criteria for rainwater distribution systems and statutory requirements. Collection of rainfall data, city and contour maps, land use, other supporting maps. Data analysis for rainwater distribution system planning, Drawing: layout (service blocks and determination of rainwater distribution networks), longitudinal and transverse pieces of channels, hydraulic profiles, Typical Sub-Buildings.

PREREQUISITE

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REFERENCE

- 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.
- Department of Public Works, SNI-Urban Drainage
- Suyono Sosrodarsono, Kensaku Takada. 1978. Hydrology (for Irrigation). Prandnya Paramita, Jakarta.
- Sijoatmojo S., Joyce, H., Pandebesie E. S., Salami I.R.S. . 2002. Drainage System Planning and Wastewater Planning Master Program – Textbook, Pusdiktek KIMPRASWIL, Bandung.

COURSES	**Course Name**	: Operation Unit
	Course Code	: CL234404
	Credit	: 3 credits
	Semester	: IV (Four)

COURSE DESCRIPTION

In this course, students will learn the basic theories of water treatment operations such as screen units, sedimentation, flotation, stirring, and filters (sand and membrane filters). This theory is the basic concept of designing water and wastewater treatment buildings. It is expected that students who have attended this lecture are capable to choose water and wastewater treatment operation units according to the characteristics of the water to be treated, and

are capable to calculate the dimensions of water and wastewater treatment units.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems. • Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs. • Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills and technical tools. • Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
COURSE LEARNING OUTCOMES
• Capable to choose operating units in water and wastewater treatment • Capable to determine design parameters that can be applied to the planning of water and wastewater treatment buildings • Capable to make the right decisions based on data analysis and information related to water and wastewater treatment • Capable to calculate the dimensions of water and wastewater treatment units
SUBJECT MATTER
• Basics of water and wastewater treatment operations; • Coarse sieve unit; • Deposition unit ; • Flotation unit; • Stirring unit; and • Filtration unit.
PREREQUISITE
-
REFERENCE
• Reynold, Tom D. & Paul A. Richards, “Unit operation and processes in environmental enginering”, 2nd.ed, PWS, Boston, 1996 • Qasim, Syed R, & Guang Zhu, “Water work engineering - planning, design and operation”, Prentice-Hall, Upper Saddle River, 2000. • Masduqi, Ali and Assomadi, Abdu F., "Water Treatment Operations and Processes", ITS Press, Surabaya, 2016 • Montgomery, JM. “Water Treatment Principles and Design”, John Wiley & Sons, New York, 1985

- Droste, LD., “Theory and Practice of Water and Wastewater Treatment”, John Wiley & Sons, New York, 1997

COURSES	**Course Name**	: Process Unit
	Course Code	: CL234405
	Credit	: 3 credits
	Semester	: IV (Four)

COURSE DESCRIPTION

In the field of environmental engineering, especially water and wastewater treatment, there are biological and chemical processes. These biological and chemical processes will be studied in this course with the aim that students are capable to determine the necessary processing processes according to the characteristics of the pollutants. In addition to the presentation of theory and calculation, in this course there is a practicum: Determination of kinetic coefficients in biological processes, coagulation processes, flocculation and sedimentation

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER

- Characteristics and types of water treatment, the basics of biological treatment based on oxygen demand (aerobic-anoxic-anaerobic), suspended and attached microbial growth processes, the process of removing organic compounds and nutrients, determination of biokinetic constants, nitrification and denitrification processes.
- Application of biological processes in water treatment: aerobic and anerobic processes (suspended and attached growth), activated sludge processes and their modifications (oxidation ditch, extended and tapered aeration, sequencing batch reactor, upflow anaerobic sludge blanket), biofiltration and modification (trickling filter, aerobic biofilter, rotating biological contactor, upflow anaerobic filter).
- Chemical processes: Coagulation-flocculation, water softening, redox reactions (Fe &Mn removal), disinfection and pH stability
- Ion exchange and adsorption
- Gas transfer: aeration and stripping

PREREQUISITE

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REFERENCE
• Reynold, Tom D., Paul A. Richards, 1996,"Unit operation and processes in environmental enginering", 2nd edition, PWS, Boston. • Benefield, Larry D., Judkins, Joseph. H., Weand, Barron L., 1982, "Process chemistry for Water and Wastewater Treatment", Prentice–Hall, Englewood Cliffs. • Metcalf & Eddy, 2003,"Wastewater Engineering: Treatment, Disposal, Reuse,", 4th edition, McGraw-Hill, New York. • Droste, R. L., 1997,"Theory and Practice of Water and Wastewater Treatment". JohnWiley, New York. • Duncan D. Mara, Wastewater treatment in Tropical Country. • Slamet, Agus and Masduqi, Ali, 2000, "Process Unit" TextREFERENCE Department of Environmental Engineering FTSP ITS.

COURSES	**Course Name**	: Environmental Management and Audit System
	Course Code	: CL234406
	Credit	: 2 credits
	Semester	: IV (Four)

COURSE DESCRIPTION
Students will be capable to apply environmental engineering science in the form of design / research / study and literature review along with case studies by following scientific rules or methodology correctly. Students are capable to compile Scientific papersin the form of research reports, planning, and literature studies based on applied science in the field of environmental engineering.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
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, reasons for application, objectives and success factors, PDCA model and content of the ISO 14001:2015 QMS standard
- Requirements with QMS usage guide and principles for preparation for ISO 14001:2015 QMS implementation
- Organizational context and leadership in QMS ISO 14001:2015
- Planning goals, objectives and programs in QMS ISO 14001:2015
- Support and Operation in ISO 14001:2015 QMS
- Performance Evaluation and improvement in QMS ISO 14001:2015
- Application of SML, and SML Certification
- The relationship between Environmental Audit and QMS with ISO 14000 Series, and the relationship between SML and PROPER
- Impact Evaluation on Environmental Audit and QMS using Product Life Cycle Analysis (LCA)
- Case study presentation (Group)

PREREQUISITE

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REFERENCE

- Fandeli,C.,Utami,R.N., Nurmansyah,S. 2008. Audit Lingkungan. Gadjah Mada University Press. Yogyakarta. Indonesia.
- Razif, M. and Yuniarto, A., 2001, Amdal and Environmental Audit, Teaching Module, Department of Environmental Engineering FTSP-ITS, Surabaya.
- National Standardization Agency. 2016. Environmental management systems – Requirements with usage guidance. SNI ISO 14001-2015.
- Ken Whitelaw. 2012. ISO 14001 Environmental Systems Handbook. Hoboken: Taylor and Francis.
- State Ministry of Environment and Forestry. 2015. PROPER. Company Performance Rating Assessment Program and Environmental Management. PROPER Secretariat Office, East Jakarta. Website: hhtp://proper.menlh.go.id

- SEMESTER V

COURSES	**Course Name**	: Design of Water Treatment Plant
	Course Code	: CL234501
	Credit	: 4 credits
	Semester	: V (Five)

COURSE DESCRIPTION

In this course, it discusses the design procedures for drinking water treatment buildings, starting from design preparation, procedures for designing treatment units in detail and instrumentation (making design notes), describing the layout of buildings and hydraulic profiles, describing the results of calculations, and calculating the volume of work and investment costs.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems.
- Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs.
- Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills and technical tools.
- Capable to analyze and apply research results and formulate alternative system and process design in environmental management.

COURSE LEARNING OUTCOMES

- Capable to analyze raw water quality parameters to be processed into drinking water and determine the treatment system with a flow chart.
- Capable to calculate the dimensions of drinking water treatment building units and the needs of chemicals and building affixes.
- Capable to describe the details of drinking water treatment and sludge treatment building units, building layouts and hydraulic profiles.
- Capable to calculate the volume of work and investment costs resulting from an IPAM system and building planning

SUBJECT MATTER

- Determination of water treatment building planning capacity and planning period based on population growth
- Determination of drinking water treatment building systems, determination of alternative treatment processes and determination of planning criteria based on raw water characteristics
- Planning of physical processing buildings: intake buildings, grit chambers, bar screens and settling units I
- Physical chemical processing building planning: fast stirring unit and slow stirrer mechanically, hydraulically and pneumatic, clarifier (2nd precipitator), fast sand filter unit, slow sand filter unit, chlorination unit, and reservoir building.
- Installation planning and instrumentation
- Planning of supporting buildings: pump house, generator house, laboratory, workshop, water meter box;

- Planning of the layout of the processing building and hydraulic profile
- Calculation of the volume of work and the cost of investment;
- Development and improvement of drinking water treatment capacity.

PREREQUISITE

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REFERENCE

- Qasim, Syed R, & Guang Zhu, "Water work engineering - planning, design and operation", Prentice-Hall, Upper Saddle River, 2000.
- Hendricks, D., "Water treatment unit processes, physical and chemical", Taylor and Francis, 2006
- ASCE, "Water treatment plant design", 2nd ed, McGraw-Hill, New York, 1990.
- Sanks R.L. (editor),"Water Treatment Plant Design, for the practicing engineer", Ann Arbor Science, Ann Arbor, 1980.
- Hadi W, Drinking Water Treatment Building Planning, 2018. ITS Press
- Masduqi A and Assomadi AF, Water Treatment Operations and Processes, 2016. ITS Press
- Kawamura S, 'Integrated Design of Water Treatment Facilities', A Wiley- Interscience Publication, John Wiley & Sons, Inc, New York, 1991.
- Tom D Reynolds and Paul A Ricahrdas (1996) : Unit Operations and Processes in Environmental Engineering, Second Edition, PWS Publishing Company

COURSES	**Course Name**	: Design of Waste Water Treatment Plant
	COURSE Code	: CL234502
	Credit	: 4 credits
	Semester	: V (Five)

COURSE DESCRIPTION

After attending this lecture, students are capable to design domestic wastewater treatment systems and buildings including sludge treatment buildings with all their equipment. Capable to pour the design results in detailed engineering drawings (DED, complete with detailed pieces needed including layout drawings and hydraulic profiles.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of management systems
- Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs.
- Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills and technical tools.
- Capable to analyze and apply research results and formulate alternative system and process design in environmental management.

COURSE LEARNING OUTCOMES

- Capable to implement theoretical concepts of engineering sciences, engineering principles in planning domestic wastewater treatment building systems
- Capable to plan alternative wastewater treatment processes based on wastewater characteristics and determine the best alternative.
- Capable to apply Environmental Engineering science in Detail Engineering Design (DED) consisting of: Building Planning of Domestic Wastewater Treatment Plant along with Sludge Treatment Building, which is equipped with detailed drawings of buildings, layout and hydraulic profiles.
- Capable to determine the bill of quantity (BOQ) and budget range investment results of the WWTP System and Building planning mentioned above

SUBJECT MATTER

- Determination of wastewater production based on projected population growth
- Determination of alternative domestic wastewater treatment processes and flow charts of treatment processes based on wastewater characteristics
- Establishment of planning criteria and preparation of mass balance sheets
- Preliminary calculation of selected operating and process building units, along with their layout and hydraulic profile
- Physical planning of processing buildings: Collection Wells, Grit Chambers, Bar Screens, Equalization Ponds and First Settling Units
- Planning of biological treatment buildings using suspended aerobic microorganisms: Activated sludge process (ASP) and its modification.
- Planning of biological treatment buildings using suspended aerobic microorganisms: Trickling Filter, RBC, and Biofilter.

- Planning of biological treatment buildings using hybrid aerobic microorganisms
- Planning of advanced processing buildings for biological processing of nutrients.
- Planning of biological processing buildings with anaerobic processes both with suspended systems and embedded systems
- Planning of sludge treatment buildings (thickening - digestion - dewatering - disposal)

PREREQUISITE

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REFERENCE

- Metcalf and Eddy (2014) : Wastewater Engineering Treatment and Resource Recovery, Mc Graw-Hill International Edition.
- Qasim, Syed R. and Guang Zhu (2018): Wastewater Treatment and Reuse: Theory and Design Examples, Volume 1: Principles and Basic Treatment, CRC Press, imprint for Taylor & Francis Group.
- Turovskiy, Izrail S. and P. K. Mathai (2006) : Wastewater Sludge Processing, A John Wiley & Sons, Inc., Publication
- Ministry of PUPR (2018). Detailed Engineering Planning Guidelines, Centralized Domestic Wastewater Management System, Book B
- Ministry of PUPR (2017). Detailed Engineering Planning Guidelines for Fecal Sludge Treatment Plant (IPLT), Main Book and Book A

COURSES	**Course Name**	: Environmental Impact Analysis
	Course Code	: CL234503
	Credit	: 3 credits
	Semester	: V (Five)

COURSE DESCRIPTION

Students are capable to compile Environmental Impact Analysis (EIA) documents consisting of Terms of Reference, Environmental Impact Analysis and Environmental Management Plan and Environmental Monitoring Plan, through working in teams consisting of various fields of expertise)

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to manage self-learning and develop themselves as lifelong learners to compete at the national and international levels in order to contribute significantly to solving problems by paying attention to the principles of sustainability.

- Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems.
- Mastering the principles and current problems in economics, social, ecology in general; as well as communication techniques and the latest technological developments.
- Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs.

COURSE LEARNING OUTCOMES

- Understand the basis of laws and regulations in the preparation of EIA documents
- Capable to scope important impacts, study area boundaries and study deadlines for the preparation of KA-Andal documents through teamwork
- Capable to conduct impact forecasts and evaluations for the preparation of Relicapable documents through teamwork
- Capable to formulate impact management and monitoring methods for the preparation of RKL and RPL documents through teamwork

SUBJECT MATTER

- Principles of environmental protection and management (Law 11/2020 and PP 22/2021) and a list of business activities for mandatory AMDAL, UKL-UPL, SPPL (Minister of Environment and Forestry 4/2021)
- Technical Approval and Operational Feasibility Letter in the field of Environmental Pollution Control (Minister of Environment and Forestry 5/2021)
- AMDAL Competency Certification, AMDAL Drafting Service Provider Institutions and Environmental Feasibility Test (Minister of Environment and Forestry 18/2021
- Important impact scoping process, study area boundaries and study deadlines
- Methods of collecting and analyzing data on environmental components (physical, chemical, biological)
- KA-Andal Form Preparation
- RELICAPABLE document drafting
- Preparation of RKL, RPL documents

PREREQUISITE

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REFERENCE

- Introduction to Environmental Impact Assessment, 4th edition, John Glasson, Riki THerivel and Andrew Chadwick, 2012.

- Assesing Impact: Handbook of EIA and SEA follow-up, Angus Morrison-Saunders and Jos Arts, 2004.
- Environmental Impact Assessment Training Manual, International Institute for Sustaincapable Development, 2016.
- Environmental Impact Assesment of Projects; Guidance on the preparation of the Environmental Impact Assessment Report, European Union, 2017.
- Environmental Feasibility Study (AMDAL, UKL-UPL, SPPL), Reda Rizal, 2016.
- Prof.Dr.Ir.Chafid Fandelli.,MS (2021): Analysis of Environmental Impacts, Its Implementation in the Era of Job Creation Law, ITY Yogyakarta.
- Law no. 32 of 2009, concerning Environmental Protection and Management
- Law No. 11 of 2020: About Job Creation
- Government Regulation No. 22 of 2021, Implementation of Environmental Protection and Management
- PermenKLHK No. 5 of 2021: concerning Procedures for Issuance of Technical Approvals and Operational Feasibility Letters in the Field of Environmental Pollution Control
- 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

COURSES	**Course Name**	: Design of Solid Waste Management
	Course Code	: CL234504
	Credit	: 4 credits
	Semester	: V (Five)

COURSE DESCRIPTION
This course discusses the basics of waste management based on appliccapable laws and regulations, understanding methods for classifying the characteristics and composition of waste generation and calculating the rate of waste generation as the basis for waste management planning analysis which includes waste reduction and handling activities.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems. • Capable to apply basic science and engineering principles in solving engineering problems, environmental management, and enviropreneurs. • Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills, and technical tools. • Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
COURSE LEARNING OUTCOMES
• Capable to explain the theoretical concepts of science-engineering and engineering principles needed for the analysis of environmental problems, namely community protection from a hazardous environment and environmental protection. • Capable to choose appropriate information and computing technology-based environmental engineering methods, technologies, and analyses to carry out engineering activities in an effort to handle environmental management problems. • Capable to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities values in accordance with their field of expertise. • Capable to make decisions appropriately in the context of solving problems in their field of expertise, based on the results of information and data analysis.
SUBJECT MATTER
• Legislation and waste management institutions. • The basics of waste management, including: definition, specific sources of waste and waste, classification and characteristics, composition, and estimation of waste generation. • Waste reduction, which includes: limiting waste generation, waste recycling, and waste reuse. • Principles in waste sorting and waste separation according to the type, size, and nature of waste (separation using mechanical equipment in the form of magnetic separation, disc screen, etc.). • Principles and calculations in the system of collecting and transferring waste from the source to the Temporary Shelter, 3R Temporary Shelter,

Intermediate Switching Station, or Integrated Waste Treatment Site (TPST), and the transportation system to the Final Processing Site.
- Principles and calculations in waste treatment systems physically (enumeration and compaction), chemical (incineration, pyrolysis, and gasification), biological (aerobic and anaerobic composting, composting vermi, black soldier fly), RDF.

PREREQUISITE

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REFERENCE

- TchobanoPLOus, G., Theisen, H., dan Vigil, S.A. (1993). Integrated Solid Waste Management: Engineering Prinsiple and Management Issue. McGraw Hill Inc., New York.
- TchobanoPLOus, G., Kreith, F. (2002). Handbook of Solid Waste Management, Second Edition. McGraw Hill Inc., New York.
- Vesilind, P.A., Worell, W.A., Reinhart, D.R. (2002). Solid Waste Engineering. Brooks Cole Publishing, Pacific Grove.
- Damanhuri, E., Padmi, T. (2016). Integrated Waste Management. ITB Press, Bandung.
- Landreth, R.E., Rebers, P.A. (1997). Municipal Solid Wastes – Problems and Solutions. CRC Press, Boca Raton.
- Williams, P.T. (2005). Waste Treatment and Disposal, Second Edition. John Wiley & Sons Ltd.
- Lens, P., Hamelers, B., Hoitink, H., Bidlingmaier, W. (2004). Resource Recovery and Reuse in Organic Solid Waste Management. IWA Publishing.

COURSES	**Course Name**	: Project Budgeting and Management
	Code COURSE	: CL234505
	Credit	: 3 credits
	Semester	: V (Five)

COURSE DESCRIPTION

Students can explain and calculate project implementation plans from the aspect of time and human resources, make bills of quantity and calculate cost estimates in Environmental Engineering work. The material studied includes project and project management principles, project daur/cycle, project organization, project planning, project scheduling, resource allocation, project budgeting and project control.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
• Project management definitions and functions • Stages of project development • Financing • Scheduling • Monitoring and evaluation • Economic and financial feasibility • Service provider selection • Project documents
PREREQUISITE
-
REFERENCE
• Suharto, I, "Project Management – From Conceptual to Operational" Erlangga, 1995 • Garmo , Sullivan " Engineering Economics" • Presidential Regulation Number 4 of 2015 concerning the Fourth Amendment to the Regulation on Procurement of Goods and Services • Presidential Regulation Number 38 of 2015 concerning Government Cooperation with Business Entities for Infrastructure Provision • Regulation of the Minister of Public Works of the Republic of Indonesia concerning the Implementation of Drinking Water, Drainage, Waste and Wastewater

COURSES	**Course Name**	: Research Methodology
	COURSE Code	: CL234506
	Credit	: 2 credits
	Semester	: V (Five)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
-
PUSTAKA
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- SEMESTER VI

COURSES	**Course Name**	: Islamic Studies
	COURSE Code	: UG234901
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
This Islamic Studies course discusses and explores materials with the substance of human relations with God to realize a generation of piety with the Qur'anic paradigm; human relations with fellow human beings in order to integrate Faith, Islam and Ihsan; and human relations with their environment in order to ground Islam to realize prosperity. Thus was born a generation of religious, humanist, broad-minded and caring.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
• Building the Qur'anic Paradigm • How Man Belongs to God • Integration of Faith, Islam and Ihsan • How Religion Guarantees Happiness • Grounding Islam in Indonesia • Religious Moderation in Islam (Deradicalization) • Islam Builds Unity in Diversity • Islam on Zakat and Taxes (Islamic Philanthropy) • The Role and Function of Mosques for the Histories of the People • Islam Faces the Challenges of Modernization • Islam's Contribution to the Development of World Civilization
PREREQUISITE
-

REFERENCE
• Wahyuddin, et al., Islamic Education Builds Student Character in Higher Education, Surabaya, Litera Jannata Perkasa Publisher, 2019. • Director General of Learning and Student Affairs of KemenristekdiScientific papers, Islamic Education for Higher Education, Jakarta, Director General of Belmawa, 2016. • Muhibbin, Zainul, et al, Islamic Education Building Madani Character, Surabaya, ITS Press, 2012. • Razaq, Nasruddin, Dinnul Islam, Bandung, Al-Ma,arif, 2005. • Iberani, Jamal Syarif et al, Knowing Islam, Jakarta: eL-Kahfi, 2003. • Imarah, Muhammad, Islam and Plurality of Differences and Plurality in the Frame of Unity, Jakarta, Gema Insani, 1999.

COURSES	**Course Name**	: Christian Studies
	Course Code	: UG234902
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
The Christian Studies course provides insight to students to develop a complete and strong personality based on Bible truth and common life, as well as apply science and technology responsibly supported by a correct understanding of divinity, humanity, ethics, culture, law, science and technology and politics.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
The material to be discussed is: Religion and Man, God in Christian Belief, Man according to Christian Teachings, Ethics and Christian Character Formation, Relationship of Christian Faith with Science and Technology, Interreligious Harmony, Guardian of God's Creation, Christian Association.
PREREQUISITE
-
REFERENCE
• Daniel Nuhamara, et al, 2016, "Christian Education for Public Universities", RISTEKDISCIENTIFIC PAPERS, Jakarta. • Hans Kung, 1999, “Etika PLObal”, Pustaka Pelajar, Yogyakarta.

- Henry C. Thiessen, 1995, "Systematic Theology", Wheat Mas, Malang.
- Herman Bavinck, 2011, “Dogmatika Reformed 1: Prolegomena”, Momentum, Surabaya.
- Herman Bavinck, 2011, "Reformed Dogmatics 2: God and Creation, Momentum, Surabya.
- J. Verkuyl, 1992, "Christian Ethics of Race, Nation and State", BPK Gunung Mulia, Jakarta.
- J. Verkuyl, 1992, "Christian Ethics General Section", BPK Gunung Mulia, Jakarta.
- John M. Frame, 2004, "The Doctrine of the Knowledge of God". Literature SAAT, Malang.
- K. Bertens, 2011, "Etika", Gramedia, Jakarta.
- Kenneth Richard Samples, 2015, “Without a Doubt, Literatur”, SAAT, Malang.
- Millard J. Erickson, 1999, "Christian Theology", Wheat Mas, Malang.
- Norman L. Geisler, 2015, "Etika Kristen" Reading list SAAT, Malang.
- Norman L. Geisler & Frank Turek, 2016, “I Don’t Enough Faith To Be An Atheis”, Literatur SAAT, Malang.
- Paul Enns, 2008, “The Moody Handbook of Theology”, Literatur SAAT, Malang .
- R. C. Sproul, 2012, "Basic Truths of Christian Faith", SAAT's Literature, Malang.

COURSES	**Course Name**	: Catholic Studies
	COURSE Code	: UG234903
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
Students are capable to explain the nature of humans as religious beings who have quality faith and piety, are capable to apply noble morality, and make Catholic teachings as a basis for thinking and behaving in working according to their areas of expertise, both in individual performance and teamwork in group work.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•

SUBJECT MATTER
• Human's Call to Life according to Scripture • Human's Relationship with Self, Neighbor, Environment, and God • Faith is lived in plurality • The Work of Jesus Christ and the Kingdom of God • Socialized church • Christian ethics
PREREQUISITE
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REFERENCE
• KemenristekdiScientific papers. 2016. Catholic Religious Education for Higher Education. Jakarta: Director General of Belmawa KemenristekdiScientific papersSupporters: • Indonesian Bishops' Conference. Catechism of the Catholic Church [print 8]. Jakarta: KWI & Kanisius, 2013 • Achmad, N. Religious Pluralism, Harmony in Diversity. Jakarta: Kompas REFERENCE Publisher, 2001. • Barbour, Ian G. God's Spokesperson between Science and Religion. Bandung: Mizan Publishers, 2000. • Griffin, David Ray. God and Religion in the Post Modern World. Yogyakarta: Canisius, 2005. • Ismartono, SJ, I. Catholic Religion Lecture at Public Universities. Jakarta: Obor, 1993. • Sugiarto. I. Xylophone. Religion faces the times. Jakarta: APTIK, 1992. • Leahy Louis. Contemporary Philosophy of Divinity. Yogyakarta: Kanisius & BPK Gunung Mulia, 1994. • Sumartana, Th. Religious Revival in the Era of PLObalization in Political Reform, Religious Revival, and Consumerism. Yogyakarta: Dian/Interfidei, 2000

COURSES	**Course Name**	: Hindu Studies
	Course Code	: UG234904
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
The Hindu Studies course discusses and explores materials with the substance of human relations with Hyang Widdhi (God Almighty) for the improvement

of faith and taqwa (Sraddha and bhaScientific papers); human relations with fellow humans in building a humanist civilization; and human relations with their environment in realizing welfare (jagadhita), so as to be capable to form Hindus and Indonesian people who are humanist independent, responsible and have care.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Devoted to God Almighty and capable to show a religious attitude (S.1);
- Uphold human values in carrying out duties based on religion, morals and ethics (S.2);
- Cooperate and have social sensitivity and concern for the community and the environment (S.6)
- Capable to maintain and develop cooperation networks and cooperation results inside and outside their institutions (KU.6)

COURSE LEARNING OUTCOMES

- Understanding Hindu Philosophy (Tattwa) in building sraddha and bhaScientific papers(faith and taqwa) to God Almighty (Sanghyang Widdhi Wasa).
- Understand the teachings of Hindu Ethics to uphold human values in forming an honest, law-abiding, creative, healthy and adaptive personality.
- Capable to practice Event Values to improve Hindu morality and spirituality.
- Capable to realize Hindu values in PLObal associations.

SUBJECT MATTER

- Purpose and Function of Hindu Education
- History of Hinduism
- Brahmavidya/Hindu Theology
- Vedic
- Man in Hindu perspective
- Hindu ethics/morality
- Panca Maha Yadnya
- Religious art
- Religious Harmony
- Deradicalization in a Hindu perspective

PREREQUISITE

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REFERENCE

- Directorate General of Learning and Student Affairs, 2016, Hindu Education for Higher Education, Ministry of Research and Technology of Higher Education of the Republic of Indonesia

- Singer, Wayan, 2012. Tattwa (Hindu Divinity, Surabaya, Paramita
- Drafting Team, 1997, Hindu Education for Higher Education, Hanuman SaScientific papers
- Wiana, 1994, How Hindus Live God, Manikgeni .
- Wiana, 1982, Niti Sastra, Directorate General of Hinduism and Buddhism.
- Titib, 1996, Vedic Holy Word Practical Guide to Life, Paramita.
- Pudja, 1997, Hindu Theology, Mayasari

COURSES	**Course Name**	: Buddhis Studies
	Course Code	: UG234905
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION

Buddhism as one of the national compulsory subjects

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER

- Tipitaka/Tripitaka Scripture
- Philosophy and History of the Meaning of Buddhism and Human Life
- The laws of Buddhism are universal
- The Concept and Meaning of AN ALMIGHTY GOD in Buddhism
- Moral values as a guide to human life (Sila)
- Science and Technology in human life in the view of Buddhism.
- The concept of Buddhist society and inter-religious harmony.
- The Concept and Urgency of Buddhist Cultural and Political Dynamics in the National Context.

PREREQUISITE

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REFERENCE

- Buddhist Education for Higher Education print I
- Dhammapada Scriptures
- The Milinda King Debate (summary of Milinda Panha by Indonesian Theravada Bhiku Pesala Sangha)

COURSES		
	Course Name	: Khonghucu Studies
	COURSE Code	: UG234906
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
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COURSES		
	Course Name	: Pancasila
	COURSE Code	: UG234911
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
The Pancasila course is one of the general/national compulsory courses. In this lecture, students will gain knowledge and learning experience to increase understanding and awareness of: a sense of nationality and patriotism through insight into Pancasila so that they become citizens who have competitiveness, as well as high discipline and active participation in building a peaceful life based on the Pancasila value system. After this lecture, students are expected to be capable to realize themselves to be good citizens who are capable to support their nation and country. Citizens who are intelligent, civilized and responsible for the survival of the Indonesian state in practicing their knowledge, technology and art abilities.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Contribute to improving the quality of life in society, nation, state, and progress of civilization based on Pancasila

- Respect the diversity of cultures, views, religions and beliefs as well as the original opinions or findings of others
- Work together and have social sensitivity and concern for society and the environment
- Capable to examine the implications of the development or implementation of technological science that pays attention to and applies humanities values in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs or art criticism

COURSE LEARNING OUTCOMES

- Capable to understand the importance of history to strengthen the identity of the nation and Indonesian national identity
- Capable to analyze national factual problems based on the perspective of Pancasila
- Capable to analyze the concept of science and technology development based on Pancasila values
- Capable to practice social sensitivity, environmental care and patriotism

SUBJECT MATTER

- The Urgency of Pancasila Education in Indonesia
- Pancasila in the Perspective of Indonesian History
- Pancasila as the Basis of the Republic of Indonesia
- Pancasila as the Philosophy and Ideology of the State
- Pancasila as an Ethical System and the implementation of Pancasila precepts
- Pancasila as a Basic Value for the Development of Science and Technology in Indonesia

PREREQUISITE

-

REFERENCE

- KemenristekdiScientific papers. 2016. Pancasila Education for Higher Education. Jakarta: Director General of Belmawa Ministry of Higher Education
- Bahar, Saafroedin (ed). 1992. Minutes of the Session of the Investigating Board for Preparatory Efforts for Indonesian Independence (BPUPKI): Preparatory Committee for Indonesian Independence (PPKI) 29 May – 19 August 1945. Jakarta: State Secretariat of the Republic of Indonesia.
- Bertens, Kees. 2004. Ethics. Jakarta: Gramedia.
- Friedman, Thomas. 2006. The World is Flat: A Brief History of the 21st Century. Jakarta: Dian Rakyat
- Kattsof, Louis O. 1992. Pengantar Filsafat. Yogyakarta: Tiara Wacana.

- Latif, Yudi. 2011. Negara Paripurna, Jakarta: PT. Gramedia Pustaka Utama.
- Latif, Yudi. 2018. Wawasan Pancasila: A Guiding Star for Culture. Jakarta: Mizan.
- Magnis-Suseno, Franz. 2006. Political Ethics: Basic Moral Principles of Modern Statehood. Jakarta: Gramedia Pustaka Utama Publisher.
- Schwab, Klaus. 2016. The Fourth Industrial Revolution. New York: Crown Business.
- Sukarno. 2001. Lend Pancasila the Basis of National Philosophy. Jakarta: National Committee Commemorating the Birth of Pancasila June 1, 1945 – June 1, 1964.
- Soedarso. 2014. Filsafat Pancasila Identitas Indonesia. Surabaya: Pustaka Radja.

COURSES	**Course Name**	: Technopreneurship
	COURSE Code	: UG234915
	Credit	: 2 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
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COURSES	**Course Name**	: Design of Final Disposal Site
	COURSE Code	: CL234601
	Credit	: 4 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
Students are capable to plan the final waste processing site, starting from the selection of the landfill site to operational planning and landfill closure planning. The material to be studied includes landfill needs, landfill site selection, landfill cell planning, leachate treatment plants and gas management, planning supporting facilities and infrastructure. Operation and maintenance of landfill, landfill mining and landfill closure.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
• Landfill-based landfill planning which includes land needs, landfill design layout and supporting buildings, waste mining, and landfill closure • Landfill site selection methods, landfilling, gas and leachate management. • Leachate processing techniques: physical, chemical and biological processing • Stages of planning for landfill and supporting buildings, as well as operation and maintenance, waste mining and landfill closure • Preparation of landfill design drawings
PREREQUISITE
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REFERENCE
• 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.

COURSES	**Course Name**	: Hazardous and Toxic Material Waste Management
	Code COURSE	: CL234602
	Credit	: 3 credits
	Semester	: VI (Six)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems. • Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs. • Capable to design the best and sustaincapable systems and processes in environmental management by applying modern methods, skills and technical tools. • Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
COURSE LEARNING OUTCOMES
• Capable to understand and explain problems in Hazardous and Toxic Material Waste management, as well as appliccapable laws and regulations in the application of Hazardous and Toxic Material Waste management and environmental management. • Capable to understand and explain the types, characteristics, techniques of Hazardous and Toxic Material Waste identification, as well as theoretical and engineering concepts in Hazardous and Toxic Material Waste management that support the achievement of environmental management goals • Capable to choose appropriate and innovative Hazardous and Toxic Material Waste management methods and technologies for the purpose of protecting the community and the environment from hazardous conditions, as well as their recovery • Capable to apply logical, critical, systematic, and innovative thinking for the implementation and development of Hazardous and Toxic Material Waste management science and technology, in order to support quality expertise in the field of Hazardous and Toxic Material Waste management.
SUBJECT MATTER

- Problems in Hazardous and Toxic Material Waste management in developed and developing countries, as well as laws and regulations on Hazardous and Toxic Material Waste management and specific waste
- Types, characteristics and techniques of identification of Hazardous and Toxic Material Waste and specific waste, sources of producing Hazardous and Toxic Material Waste
- Pattern of distribution of Hazardous and Toxic Material Waste in the environment
- Hazardous and Toxic Material Waste packaging and storage techniques
- Hazardous and Toxic Material Waste collection and transportation system
- Corrosive type Hazardous and Toxic Material Waste treatment technology (neutralization), containing heavy metals (precipitation), stabilization/solidification (S/S) treatment techniques, incineration techniques, biological Hazardous and Toxic Material Waste treatment techniques
- Material recovery technology from Hazardous and Toxic Material Waste
- Emergency program in Hazardous and Toxic Material Waste management
- Principles of Hazardous and Toxic Material Waste recovery techniques: electrochemistry, ion exchange, reverse-osmosis
- Design criteria for the Final Disposal Place of Hazardous and Toxic Material Waste
- Final disposal technology, closure and maintenance of postoperative Hazardous and Toxic Material Waste landfill
- Various forms of obstacles and violations in Hazardous and Toxic Material Waste management, including violations of the Basel convention.

PREREQUISITE

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REFERENCE

- Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management
- Regulation of the Minister of Environment and Forestry No. 6/2021 concerning Procedures and Requirements for Hazardous and Toxic Waste Management
- Decree of the Minister of Environment and Forestry No. P.12/MENLHK/SETJEN/PLB.3/5/2020 concerning Storage of Hazardous and Toxic Waste

- Minister of Environment and Forestry Regulation No. P.4/MENLHK/SETJEN/KUM.1/1/2020 concerning Transportation of Hazardous and Toxic Waste
- Government Regulation No. 27 of 2020 concerning Specific Waste Management
- Regulation of the Minister of Environment and Forestry No. P.74/MENLHK/SETJEN/KUM.1/10/2019 concerning the Emergency Program for Management of Hazardous and Toxic Substances and/or Hazardous and Toxic Waste
- Trihadiningrum, Y., 2016. Hazardous and Toxic Waste Management. Teknosain, Yogyakarta
- 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
- UNEP, 1992. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- Keputusan Presiden No. 61 Tahun 1993 tentang Pengesahan Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- Regulation of the Minister of Environment and Forestry No. P. 56/MenLHK-Sekjen/2015 concerning Management of Hazardous and Toxic Waste for Health Service Activities
- Abalansa S, Mahrad BE, Icely J, Newton, E 2021 Electronic waste, an environmental problem exported to developing countries: The Good, the Bad and the Ugly. Sustainability 13(9) 5302: 1- 35. DOI:10.3390/su13095302

- SEMESTER VII

COURSES	**Course Name**	: Indonesian
	Course Code	: UG234912
	Credit	: 2 credits
	Semester	: VII (Seven)

COURSE DESCRIPTION

Indonesian course is one of the general/national compulsory courses. Students will explore the course material including: (a) academic ethics; (b) referencing techniques; (c) the systematics of Scientific Papers and the formulation of Indonesian used in Scientific Papers by taking into account the rules of grammar, PUEBI, and KBBI; (d) the preparation of Scientific Papers logically, critically, systematically, and innovatively using good and correct Indonesian; (e) effective presentation techniques. The material studied is useful in compiling Scientific papersin the form of lecture assignments, research reports, and Scientific papersthat are competed.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Internalize academic values, norms, and ethics;
- Document, store, secure, and recover data to ensure validity and prevent plagiarism
- Capable to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities values in accordance with their field of expertise

COURSE LEARNING OUTCOMES

- Capable to explain and apply academic ethics correctly in compiling Scientific Papers;
- Capable to find, store, and process references through the mendeley application to avoid plagiarism;
- Capable to explain and / or provide examples of systematics, Indonesian formulations used in Scientific Papers by taking into account grammatical rules, PUEBI, and KBBI;
- Capable to apply logical, critical, systematic, and innovative thinking in the preparation of the preliminary Scientific Papers using good and correct Indonesian
- Capable to apply logical, critical, systematic, and innovative thinking in the preparation of Scientific Papers results and discussions using good and correct Indonesian
- Capable to apply logical, critical, systematic, and innovative thinking in the preparation of Scientific Papers conclusion section using good and correct Indonesian
- Capable to present the results of the preparation of Scientific Papers orally according to the principles of effective communication

SUBJECT MATTER

- Academic ethics of writing scientific papers.
- Mendeley referencing techniques and applications to referencing systems.

- Systematics, selingkung styles, and grammatical rules Indonesian in Scientific Papers.
- Effective presentation.

PREREQUISITE

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REFERENCE

- Alwi, Hasan, 2007, Standard Grammar Indonesian, Third Edition, Balai Pustaka: Jakarta.
- Director General of Learning and Student Affairs KemenristekdiScientific papers, Indonesian for Higher Education, 2016, Jakarta, Director General of Belmawa.
- Big Dictionary Indonesian (online or offline), Ministry of Education and Culture of the Republic of Indonesia, https://kbbi.kemdikbud.go.id/
- General Guidelines for Indonesian Spelling (PUEBI), 2016, http://badanbahasa.kemdikbud.go.id/lamanbahasa/sites/default/files/PUEBI.pdf
- Pratapa, Suminar, 2018, Scientific ethics, Copyright, and Plagiarism.
- Rosmawaty, 2017, Writing Scientific Papers, 2017.
- The Structure, Format, Content, and Style of a Journal-Style Scientific Paper, Bates Collage, http://jrtdd.com/wp-content/uploads/2018/05/Howto-Write-a-Paper-in-Scientific-Journal-Style-and-Format.pdf

COURSES	**Course Name**	: Civics
	COURSE Code	: UG234913
	Credit	: 2 credits
	Semester	: VII (Seven)

COURSE DESCRIPTION

Civics basically discusses Indonesia, namely: being a citizen with Indonesian personality, building a sense of nationality and loving the Indonesian homeland, thus will be capable to become a good and educated citizen (Smart and good citizen) in the life of society, nation and democratic state

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Contribute to improving the quality of life in society, nation, state, and civilization based on Pancasila
- Acting as citizens who are proud and love the country, have nationalism and a sense of responsibility to the state and nation

- Obey the law and discipline in social and state life
- Capable to be responsible for the achievement of group work results and supervise and evaluate the completion of work assigned to workers under their responsibility.

COURSE LEARNING OUTCOMES

- Understand the substance of citizenship education to have an Indonesian personality, build a sense of nationality and love the motherland, so as to become a good and educated citizen (smart and good citizen) in the life of society, nation and democratic state.
- Understand the correlation of civic education with life values so that they become citizens with Indonesian personalities who have competitiveness, discipline and active participation in building a peaceful life based on the Pancasila value system
- Understand the application of the concept of citizenship, to make good citizens who are capable to support the nation and state, democratic citizens who are intelligent, civilized and responsible for the survival of the Indonesian state in practicing their knowledge, technology and art abilities.
- Understand the contribution of citizenship in shaping attitudes and values: respecting diversity, being capable to work together, having trustworthiness, social sensitivity and high love for the community, nation and state of Indonesia.

SUBJECT MATTER

- The nature and challenges of civics
- State: Constitution and Democracy
- Law Enforcement: Rights and Duties of Citizens, Legal Certainty and Justice 4. National Identity and Integration
- Nusantara Insights and Regional Autonomy
- National Resilience and National Defense
- Anti-Corruption Education

PREREQUISITE

-

REFERENCE

- Kemenristekdikti. 2016. Civic Education Module for Higher Education. Jakarta: Director General of Belmawa KemenristekdiScientific papers
- Armaidy Armawi, Geostrategy Indonesia, Jakarta, Directorate General of Higher Education, 2006
- Azyumardi Azra, New paradigm of National Education and Reconstruction and Democratization, Kompas Publishers, Jakarta, 2002

- Bahar, Dr. Saefrodin, "State Context, Human Rights, Sinar Harapan Library, Jakarta, 2000.
- Kaelan, Civic Education, UGM Press, Yogyakarta 2005.
- Slamet Soemiarno, Geopolitics of Indonesia, Jakarta, Directorate General of Higher Education, 2006

COURSES	**Course Name**	: English
	COURSE Code	: UG234914
	Credit	: 2 credits
	Semester	: VII (Seven)

COURSE DESCRIPTION

In this course, students will learn basic concepts in English which include writing, speaking/presentation, listening, and reading skills and be capable to apply them to express their ideas and thoughts orally and in writing in academic life related to science and technology and everyday.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Internalize academic values, norms, and ethics.
- Capable to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities values in accordance with their field of expertise.
- Capable to show independent, quality, and measurcapable performance.

COURSE LEARNING OUTCOMES

- Capable to write sentences and paragraphs in good and correct English in accordance with the rules of writing sentences and paragraphs as well as standard English grammar
- Capable to do academic presentations well using effective presentation aids (PPT).
- Capable to apply listening strategies to answer questions from conversations (dialogue / conversation) and lectures (talk) in English correctly and capable to do note taking correctly.
- Capable to apply appropriate reading strategies such as scanning, skimming and reading for details as well as vocabulary understanding strategies to answer reading questions correctly.

SUBJECT MATTER

- Subject – Verb Agreement
- Phrases and clauses

- Sentence types
- Paragraph
- Academic presentation
- Listening to short conversation
- Listening to longer conversation
- Listening to talks and note taking
- Reading strategies
- Vocabulary recognition
- Reading for details:
- Text pattern organizations

PREREQUISITE

-

PUSTAKA

- Tim Dosen Bahasa Inggris ITS, "Improving English Skills for Academic Purposes, A Conceptual and Practical Integration,"
- Becker Lucinda & Joan Van Emden, "Presentation Skills for Students, Palgrave, Macmillan, 2010
- Hogue Ann, Oshima Alice, "Introduction to Academic Writing", Longman,1997
- Johnston Susan S, Zukowski Jean/Faust, "Steps to Academic Reading," Heinle, Canada, 2002
- Mikulecky, Beatrice S, "Advanced Reading Power", Pearson Education, New York, 2007
- Preiss Sherry, "NorthStar: Listening and Speaking," Pearson Education, New York 2009
- Bonamy David, "Technical English," Pearson Education, New York, 2011
- Fellag Linda Robinson, "College Reading," Houghton Mifflin Company, 2006
- Fuchs Marjorie & Bonner Margaret, " Focus on Grammar; An Integrated Skills Approach," Pearson Education, Inc, 2006
- Hague Ann, " First Steps in Academic Writing," Addison Wesley Publishing Company, 1996
- Hockly Nicky & Dudeney Gavin, "How to Teach English with Technology, Pearson Education Limited, 2007
- Phillipd Deborah, " Longman Preparation Course for the TOEFL Test," Pearson Education, Inc, 2003
- Root Christine & Blanchard Karen, " Ready to Read Now, Pearson Education, New York, 2005

- Root Christine & Blanchard Karen, " Ready to Write, Pearson Education, New York, 2003
- Weissman Jerry, "Presenting to Win, the Art of Telling Your Story, Prentice Hall, 2006

COURSES	**Course Name**	: Applied Technology and Digital Transformation
	Course Code	: UG234916
	Credit	: 3 credits
	Semester	: VII (Seven)

COURSE DESCRIPTION

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to cooperate and have social sensitivity, as well as concern for the community and the environment,
- Capable to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities values in accordance with their field of expertise
- Capable to use Technology Applications, in Digital Transformation for the development or implementation of technological science based on scientific rules, procedures and ethics in order to produce solutions, and ideas
- Capable to compile a final report on the Student Creativity Program (PKM) or Research / Innovation Project Program

COURSE LEARNING OUTCOMES

- Capable to explain the concept of Digital Transformation in public life properly and correctly according to the rules of the Law
- Students are capable to utilize research centers both locally and nationally with Technology Applications
- Capable to have conservation insights on natural and human resources in applying science and technology for the benefit of Sustaincapable Development with SDG's Theories and Concepts.
- Capable to complete the making of Student Creativity Program (PKM) Proposals and similar programs in preparing project-based innovations along with PKM Proposal Outputs (Articles, Posters and Videos).

SUBJECT MATTER

- Digital Literacy Knowledge and Concepts

- Systems Thinking Theory and Information Transformation
- Introduction and Knowledge of Science Technopark (STP)
- ITS and National Research Roadmap Knowledge
- Konsep SDGs (Sustaincapable Development Goals)
- Open Source Technology and IT Ethics
- Student Creative Program (PKM) Proposal Concept

PREREQUISITE

-

REFERENCE

- Digital Literacy : Tools and Methodologies for Information Society. Pier Casera Rivoltella, Universitas Cottolica del Sacro Cuore, Italy
- Akhmad Hidayatno, "SYSTEMS THINKING", Mindset for Better Understanding of Problems. 2016. Universitay of Indonesia.
- National Literacy Movement, Ministry of Education and Culture Jakarta, 2017
- REFERENCE of the Development Team of the Scientific Technology and Communication Insights Course, "Technology Insights & Scientific Communication", ITS Press, Surabaya, 2015.
- Alfred Watkins and Michel Ehst, “Science, Technology and Innovation: Capacity Building for Sustaincapable Growth and Poverty Reduction”, The International Bank for Reconstruction and Development, Washington DC, 2008.
- Frieder Meyer Krahmer, “Innovation and Sustaincapable Development-Lesson for Innovation Policies, “ A Springer-Verlag Company, Heidelberg, 1998.
- REFERENCE : DIRECTION for the Implementation of Sustaincapable Development Goals / SDGsTeam Leader SDGs Secretariat Ministry of National Development Planning / Bappenas, February 1, 2018, Contact Address: Website : sdgs.bappenas.go.id

COURSES	**Course Name**	: Environmental Remediation Technology
	Course Code	: CL234701
	Credit	: 3 credits
	Semester	: VII (Seven)

COURSE DESCRIPTION

In this course, students are expected to be capable to explain the basic concepts of environmental restoration including appliccapable laws and regulations that become the legal basis, as well as determine scenarios for the stages of implementation, explain several types of remediation technology and determine the right technology in conducting environmental remediation.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Mastering the theoretical concepts of environmental engineering and management needed for the analysis of environmental problems and the design of environmental management systems. • Mastering the principles and current problems in economics, social, ecology in general; as well as communication techniques and the latest technological developments. • Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs. • Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
COURSE LEARNING OUTCOMES
• Capable to explain the understanding and development of the environmental recovery system and appliccapable laws and regulations related to environmental recovery. • Students are capable to plan environmental recovery scenarios, explain methods and planning environmental recovery at environmental recovery sites • Capable to explain the basic concepts of remediation technology physically, chemically, biologically, and thermally in water and soil media • Capable to determine the type of environmental remediation technology applied to polluted environments
SUBJECT MATTER
• Definition and concept of environmental restoration; • Regulations underlying environmental restoration. • Stages of remediation implementation • Types of environmental remediation technologies include physical, chemical, biological, and thermal methods • Application of remediation technology on polluted land.
PREREQUISITE
-
PUSTAKA
• ITRC, Advancing Environmental Solutions: http://www.itrcweb.org/ • The National Academies Press: https://www.nap.edu/

- 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.
- UNEP-, 2004. Integrated Watershed Management Ecohydrology & Phytotechnology -- Manual - United Nation Environmental Program, Pp 246
- M., Erwin E.J., et al. 2004. Plant Analysis Procedures 2nd Edition. Kluwer Academic Publisher.
- Mangkoedihardjo, S., and G. Samudro. Applied Phytotechnology, Graha Ilmu, 2010.
- Kennen, K., and Kirkwood, N.2015.Phyto principles and resources for site remediation and landscape design. New York: Routledge
- Purwanti, I.F., Titah, H.S., dan Kurniawan, S.B., Biological Treatment of Aluminium Recycling Industry, LAP LAMBERT Academic Publishing, 2018
- Mangkoedihardjo, S. Pengertian Istilah Prasarana Lingkungan, Nasmedia, 2021.
- Mangkoedihardjo, S. 2022. Coastal Protection. Makassar: Nas Media Pustaka
- Environmental Remediation Engineering Practicum Instructions

COURSES	**Course Name**	: Sustainable Environmental Infrastructure Design
	Course Code	: CL234702
	Credit	: 4 credits
	Semester	: VII (Seven)

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
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- SEMESTER VIII

COURSES		
	Course Name	: Final Project
	Course Code	: CL234801
	Credit	: 6 credits
	Semester	: VIII (Eight)

COURSE DESCRIPTION
Students will be capable to apply environmental engineering science in the form of design / research / study and literature review along with case studies by following scientific rules or methodology correctly. Students are capable to compile Scientific papersin the form of research reports, planning, and literature studies based on applied science in the field of environmental engineering.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
• drinking water treatment, • wastewater treatment, • Waste Management, • environmental sanitation, • B3 Waste Management, • Emission and Ambient Control, • Occupational Health and Safety
PREREQUISITE
• Research Methodology • Have or are taking courses that support the Final Project (including elective courses) with a minimum number of credits of 120 credits
REFERENCE
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COURSES		
	Course Name	: Practical Work
	Course Code	: CL234802

	Credit	: 2 credits
	Semester	: VIII (Eight)

COURSE DESCRIPTION
Students are capable to understand the application of their knowledge to real cases, directly involved both passively and actively in the field work environment in the field of environmental engineering. Students will be capable to compile practical work reports based on topics and data from fieldwork.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
•
COURSE LEARNING OUTCOMES
•
SUBJECT MATTER
• drinking water treatment, • wastewater treatment, • Waste Management, • environmental sanitation, • B3 Waste Management, • Emission and Ambient Control, • Occupational Health and Safety
PREREQUISITE
-
REFERENCE
•

- ELECTIVE COURSES

COURSES	**Course Name**	: Water Loss Management
	Course Code	: CL234601
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION
Water loss management equips students with the ability to explain the concepts of understanding water loss in urban drinking water supply, water balance calculation, commercial water loss management, DMA planning, physical water loss and water loss reduction strategies.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs
- Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
- Ability to apply modern methods, skills and technical tools needed for engineering practice.
- Capable to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the community; protect and preserve the environment; and efforts in environmental restoration.

COURSE LEARNING OUTCOMES

- Students are capable to explain the concept of understanding water loss
- Students are capable to explain the calculation of water balance
- Students are capable to explain commercial water loss management
- Students are capable to explain physical water loss management

SUBJECT MATTER

- Understanding water loss and NRW;
- Water Balance;
- NRW control techniques;
- Leak detection;
- Precision and accuracy of water meters; water meter maintenance;
- Perencanaan District metered area (DMA); Step Test;
- Pengendalian Tekanan Air (Pressure management),
- Commercial Water Loss Reduction Strategies
- Physical Water Loss Reduction Strategies
- District Planning meter Area
- Step test

PREREQUISITE

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REFERENCE

- Farley M., Wyeth G., Ghazali ZB., Istandar A., Singh S. (2008). The Manager's Non-Revenue Water Handbook, A Guide to Understanding Water Losses. USAID.
- Guidelines for Reducing Non-Revenue Water (NRW). BPPSAPMCementrian of Public Works

COURSES	**Course Name**	: Community-Based Sanitation
	Course Code	: CL234602
	Credit	: 2 credits

	Semester	: Elective

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
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COURSES	**Course Name**	: Industrial Sludge and Sewage Treatment
	Course Code	: CL234603
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION
After attending this lecture, students are capable to plan the treatment of liquid waste and industrial sludge, including being capable to explain the principles of recovery principles from liquid waste and industrial sludge.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs • Capable to analyze and apply research results and formulate alternative system and process design in environmental management. • Ability to apply modern methods, skills and technical tools needed for engineering practice. • Capable to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the community; protect and preserve the environment; and efforts in environmental restoration.
COURSE LEARNING OUTCOMES

- Capable to explain the sources, types, and characteristics of liquid waste and sludge from various industries as well as quality standards and standards appliccapable to the treatment of industrial liquid waste and sludge
- Capable to explain the concept of treatment and recovery of liquid waste and sludge from industry
- Capable to choose alternative technologies in processing and recovering liquid waste and industrial sludge
- Capable to design and evaluate various treatment technologies both physically-chemically, biologically in liquid waste and industrial sludge

SUBJECT MATTER

- Characterization and classification of liquid waste and sludge from industry
- Laws and regulations and quality standards for effluent industrial liquid waste and quality standards for the use of sludge as a planting medium
- The concept of treatment of liquid waste and sludge from industry (primary, secondary and tertiary treatment)
- Physical-chemical treatment technology of liquid waste and sludge
- Biological treatment technology of liquid waste and sludge (aerobic and anaerobic)
- Sludge treatment technology by a combination of physical-chemical and biological processes (biodrying)
- Technology of recovery and utilization of liquid waste and sludge from industry

PREREQUISITE

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REFERENCE

- Numerow, N.L. 2006. Industrial Waste Treatment. Elsevier Science & Technology Books
- Metcalf & Eddy (2014) Wastewater Engineering; Treatment, Disposal, and Reuse, 5th Edition. McGraw Hill Book Co. N.Y.
- Ranade, V.V. & Bhandari, V.M. (2014) Industrial Wastewater Treatment, Recycling, and Reuse. IChemE. Advancing Chemical Engineering World Wide.
- Qasim, S.R. (1999) Wastewater Treatment Plants Planning, Design, and Operation, 2nd Edition. Taylor & Francis
- Various journals and supporting research

COURSES	**Course Name** : Green Technology

	Course Code	: CL234604
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER

- Sources 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 Opportunities
- Technical Problems in the Implementation of Clean Technology
- History of the Development of Environmental Management Strategies, and several Clean Technology Strategies
- Clean Technology Options, Clean Technology Advantages, 3Rs, pollution prevention hierarchy, Clean Technology implementation priority scale
- Clean Technology Application Options for Pollution Source Reduction
- Application Options Clean Technology Recycling
- Examples of the Application of Clean Technology in Industry
- Financial Feasibility Study of the Application of Clean Technology in Industry

PREREQUISITE

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REFERENCE

- Office of the State Minister of Environment and Forestry. 2015. Indonesia Environmental Quality Index
- Murdiyarso, D. 2007. CDM: Clean Development Mechanism. Mardi Yuana Graphic Printing, Bogor.
- Office of the Minister of State for the Environment. 1997. Preliminary publication of Indonesia's Agenda 21 National Strategy for Sustaincapable Development.
- Raka, I.D.G., Zen, M.T., Soemarwoto, O., Djajadiningrat, S.T., Saidi, Z., et al. 1999. The Clean Production Paradigm Reconciles Economic

Development and Environmental Preservation. Publisher Nuansa, in collaboration with the Bandung Institute of Technology Technology Research Center (PPT-ITB).
- Indrasti, N.S., Fauzi, A.M. 2009. Clean Production. Publisher IPB Press. Printing PT Gramedia.

COURSES	**Course Name**	: Climate Change
	Course Code	: CL234605
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION

This course contains material on understanding the basic concepts and classification of organic chemistry and its potential as pollutants in order to identify them to support the field of environmental management expertise. In addition, it is also studied about the basic principles of degradation and analysis of organic pollutants both through the delivery of lecture materials and practicum in the laboratory.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Respect the diversity of cultures, views, beliefs, and religions as well as the original opinions/findings of others
- Mastering the basic principles of theoretical concepts of natural science, applications of engineering mathematics, fundamental engineering principles, engineering science, and environmental engineering design and environmental management systems
- Mastering the basic principles of control technology and environmental pollution prevention processes and mastering the concept of its application with an integrated system approach

COURSE LEARNING OUTCOMES

- Capable to understand the basic concepts of climate change phenomena due to increasing greenhouse gases, carbon cycles, sinkers and emitters
- Capable to understand PLObal atmospheric cycles, climate and the influence of climate change PLObally and regionally (based on its geographical territory)
- Students are capable to understand the impact of climate change, adaptation options, and can assess the vulnerability of an area to climate change, know mitigation options

- Students understand the concept of calculating emissions based on activities, calculation models and verifying the results of calculating the carbon footprint of an activity

SUBJECT MATTER

- Introduction: The Earth dan Greenhouse's gas principles, Climate Change, and Energy balance models
- The Greenhouse Gases: An overview, carbon principles, methane, and other gas, cycle and resources,
- PLObal Impact and Consequency of Climate Change on geograpichal teritorial based
- Carbon reservoir, biogeochemistry, atmospheric reservoir; PLObal Carbon cycling: marine and terrestial carbon sycle, emission dan sinker
- Climate and Weather, definision, pressure vs temperatur and current, factor affecting them
- PLObal Ocean Circulation, PLOuds, Storm, and Climate
- Impact, adaptation, and vulnerability
- Paleoclimate: what can we learn from the past? Learn to Climate Change Mitigation
- RANPI Indonesian Programme
- Carbon dioxides Emission: human activities as sources of emission, ideal carbon in atmosphere: how to determine it?
- Scientific consensus and uncertainty, the IPCC science assessment (project) and Brief of Climate Modeling
- Calculate for footprint carbon emission

PREREQUISITE

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PUSTAKA

- Sir John Houghton, 2004, PLObal Warming the Complete Briefing, 3rd-ed, Cambridge University Press.
- UNFCCC, Climate Change: Impact, Vulnerability and Adaptation in Developing Country
- Baird, Colin., Cann, Michael., 2005,"Environmental Chemistry", 3th edition, W. H. Freeman, New York.
- Reynolds, J.P., Jeris, J.S., dah Theodore, L. 2002." Handbook Of Chemical And Environmental Engineering Calculations". John Wiley, New York.

COURSES	**Course Name**	: Fitotechnology
	Course Code	: CL234606

	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION
Students understand the mechanism of the phytoremediation process, understand the norms and criteria, and are capable to choose the right type of technology to prevent pollution and encourage environmental recovery.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
• Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs • Capable to analyze and apply research results and formulate alternative system and process design in environmental management. • Ability to apply modern methods, skills and technical tools needed for engineering practice. • Capable to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the community; protect and preserve the environment; and efforts in environmental restoration.
COURSE LEARNING OUTCOMES
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SUBJECT MATTER
• Phytoremediation mechanisms, including: photosynthesis and respiration, phytostabilization, rhizofiltration, rhizodegradation, phytoextraction, phytodegradation, phytovolatilization, hydraulic control, evapotranspiration capacity. • Selection of phytoremediation system, including: selection of plant species, types of pollutants, land, climate and post-phytoremediation management. • Norms, standards, guidelines, phytotechnology system criteria and legislation
PREREQUISITE
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REFERENCE
• ITRC, 2009. Technical and Regulatory Guidance and Decision Trees, Revised, Washington: ITRC • 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.
- Kennen, K., and Kirkwood, N.2015.Phyto principles and resources for site remediation and landscape design. New York: Routledge
- Mangkoedihardjo, S & Samudro, G. 2010. Applied Phytotechnology. Yogyakarta: Graha Ilmu Yogyakarta
- Mangkoedihardjo, S. 2021. Pengertian Istilah Prasarana Lingkungan. Makassar: Nas Media Pustaka
- Mangkoedihardjo, S. 2022. Coastal Protection. Makassar: Nas Media Pustaka

COURSES	**Course Name**	: Environmental Economics
	Course Code	: CL234607
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

- Students are capable to describe the scope and benefits of environmental economics
- Students are capable to describe basic theories for environmental economic analysis
- Students are capable to describe and calculate the value (valuation) of the environment from the impact of damage and the impact of environmental pollution
- Students are capable to describe and calculate the balance of natural resources and the environment
- Students are capable to describe and calculate the value of payments for environmental services

SUBJECT MATTER

- Scope and benefits of environmental economics
- Basic theories of environmental economics

- Economic valuation of the impact of damage and the impact of environmental pollution
- Balance of natural resources and environment
- Payment for environmental services

PREREQUISITE

-

REFERENCE

- Djajadiningrat S, "Introduction to Environmental Economics", LP3ES, 1997
- Fauzi . A, "Natural Resources and Environmental Economics" Gramedia ,2006
- Suparmoko M, et al, "Economic Valuation of Natural Resources &; Environment", BPFE-Yogyakarta, 2014
- Suparmoko.M. Ratnaningsih . M, "Environmental Economics", BPFE-Yogyakarta, 2016
- Government Regulation of the Republic of Indonesia Number 46 of 2017 concerning Environmental Economic Instruments

COURSES	**Course Name**	: Plumbing
	Course Code	: CL234701
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

- The theoretical concepts of engineering sciences, engineering principles, and engineering design are needed for the analysis of environmental problems and the design of environmental management systems, namely community protection from hazardous environments and environmental protection
- Capable to choose methods, technologies and utilize appropriate information and computing technology-based environmental engineering design and analysis tools to carry out engineering activities in an effort to handle environmental management problems.

- Capable to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities values in accordance with their field of expertise;
- Capable to make decisions appropriately in the context of solving problems in their field of expertise, based on the results of information and data analysis
- Capable to design plumbing systems needed for environmental management efforts with an analytical approach and consider appliccapable technical, safety and environmental health standards, aspects of performance, reliability, ease of application, sustainability, and pay attention to economic, public health and safety, cultural, social, and environmental factors.

SUBJECT MATTER

- Building Piping and Pumping Systems

PREREQUISITE

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REFERENCE

- Indonesian plumbing guidelines", DPU, Jakarta, 1979.
- Noerbambang, Soufyan Mohammad &; Morimura S., "Design and maintenance of plumbing systems", Pradnya Parmita, Jakarta, 1999.
- Woodson, R. Dodge, “Plumber's and pipefitter's calculations manual”, McGraw-Hill, New York, 1998
- Handbook on Plumbing Installation for Buildings (May 2001), Revision 1 – 4.12.2006 – Addition added to 4.5, Water Supplies Department, HKSARG.

COURSES	**Course Name**	: Business Pillar
	Course Code	: CL234702
	Credit	: 2 credits
	Semester	: Systems

COURSE DESCRIPTION

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

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COURSE LEARNING OUTCOMES

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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
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COURSES	**Course Name**	: Sanitation of Coastal and Disasters Areas
	Course Code	: CL234703
	Credit	: 2 credits
	Semester	: Systems

COURSE DESCRIPTION
In this course, students will learn the application of community participation approach methods, awareness of community insights about sanitation. The application of sanitation systems is simple: septic tanks, communal septic tanks, cubluks, infiltration fields, evapotranspiration, composting and biogas. Provision of appropriate sanitation applications according to the will and ability of the community in procurement and operation and maintenance. Management organization. Community-based sanitation tariff calculation and application. The lecture is completed with an assignment: Case study of sanitation in one village.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
• Community empowerment-based sanitation system planning • Community participation approach methods and appropriate sanitation technology in accordance with the conditions of the planning area • Norms, standards, guidelines, criteria of community-based sanitation systems • Data collection and existing conditions of the planning area • Community empowerment for sanitation operation and maintenance
PREREQUISITE
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REFERENCE

- 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.

COURSES	**Course Name**	: Numerical methods and dispersion of pollutants
	Course Code	: CL234704
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION
In this course, students will learn more about atmospheric chemistry-physics, structure, air flow / circulation, heat and matter equilibrium, air layer formation (thermodynamics), mixing layer, local climate, radiation, atmospheric stability; The flow of gases and particles in air circulation (convection, dispersion, settling); surface roughness (urban, suburban, rural); Dispersion models (box, gaussian, street canyon models); Utilization of air pollutant dispersion modeling in air quality planning and management.
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
• 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. Air Pollution Control Technology. DUE-Like ITS Environmental Engineering 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.

COURSES	**Course Name**	: Environmental Modeling
	Course Code	: CL234705
	Credit	: 2 credits
	Semester	: Elective

COURSE DESCRIPTION
PROGRAM LEARNING OUTCOMES CHARGED BY COURSES
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COURSE LEARNING OUTCOMES
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SUBJECT MATTER
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PREREQUISITE
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REFERENCE
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COURSES	**Course Name**	: Environmental Ecotoxicology
	COURSE Code	: CL234706
	Credit	: 2 credits
	Semester	: Options

COURSE DESCRIPTION

Environmental ecotoxicology is a science that studies the characteristics of substances in terms of their toxic properties to organisms. This science can be applied to various fields such as industry, drinking water treatment and wastewater treatment. This course will equip students with an analysis of substance exposure in the environment based on the nature of the substance and its environment and various methods to determine the level of toxicity of a substance in the environment. After studying this course, students are capable to design ecotoxicology research in its application in the field of environmental engineering. The tasks that students must make are: reviewing journals related to the results of toxicology research and designing toxicology research and making papers on concepts and programs for preventing environmental pollution and restoring polluted environments in the field of ecotoxicology by taking into account legal, economic, financial, and socio-cultural aspects.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to apply basic science and engineering principles in solving engineering problems, environmental management and enviropreneurs
- Capable to analyze and apply research results and formulate alternative system and process design in environmental management.
- Ability to apply modern methods, skills and technical tools needed for engineering practice.
- Capable to identify sources of environmental pollution and apply engineering science in the field of environmental engineering to protect the community; protect and preserve the environment; and efforts in environmental restoration

COURSE LEARNING OUTCOMES

- Capable to identify environmental problems through the field of ecotoxicology which includes: drinking water, wastewater, garbage, settlement drainage by deepening science in the field of environmental engineering.
- Capable to design ecotoxicological research in various fields such as industry, drinking water treatment and wastewater treatment, etc.
- Capable to analyze and synthesize the application of environmental engineering in the field of ecotoxicology in preventing environmental pollution.
- Capable to compile concepts and programs for environmental pollution prevention and recovery of polluted environments in the field of ecotoxicology by taking into account legal, economic, financial, and socio-cultural aspects.

SUBJECT MATTER

- Definition: toxicology, toxin or poison, poisoning, toxicity, degree of toxicity, development of toxicological science, objectives of environmental toxicology.
- Ecotoxicology of drinking water, wastewater, drainage and garbage.
- Xenobiotic processes enter the environment and organisms.
- Physical chemical properties that affect ecokinetics, transformation and transport in ecokinetics.
- Effect analysis: toxicant properties and effects on biota, ecotoxicity test, concentration curve and effect (Dose Response).
- Various methods of identifying and analyzing pollution problems.
- Design ecotoxicological research in various fields.
- Procedures for preparing environmental recovery designs from legal, economic, financial, and socio-cultural aspects.

PREREQUISITE

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REFERENCE

- Ariens. E.J., E. Mutschler, A.M. Simonis, General Toxicology Introduction, Gadjah Mada University Press, Yogyakarta, 1993.
- Casarret, Curtis. D. Klaassen, Toxicology: The basic Science of Poisons, Fifth Edition, McGraw Hill, New York, 1996.
- Connel, D.W, and G.J. Miller, Environmental Chemistry and Toxicology of Pollution, Translation by Yanti Koestoer, UI Press, Jakarta
- Jorgensen, Sven E., Handbook of estimation methods in ecotoxicology and environmental chemistry, Lewis, New York, 1998.
- Peakall, David, Animal biomarkers as pollution indikators - with a contribution on immunology, Chapman and Hall, London, 1992.
- Mangkoedihardjo, S., Toksikologi lingkungan, Jurusan Teknik Lingkungan, ITS, Surabaya, 1999.
- Moriarty, F., Ecotoxicology - The studi of pollutants in ecosystems, second edition, Academic Press, San Diego, 1993.
- Soemirat, J. Environmental Toxicology, Gadjah Mada University Press, Yogyakarta, 2003.
- Mangkoedihardjo, S., dan G. Samudro. Ekotoksikologi Teknosfer, Guna Widya, 2009.
- Mangkoedihardjo, S. Pengertian Istilah Prasarana Lingkungan, Nasmedia, 2021.

COURSES	**Course Name**	: Self Development

	Course Code	: CL234707
	Credit	: 9 credits
	Semester	: Elective

COURSE DESCRIPTION

This course provides students with understanding and skills to expand their contributions to society and/or stakeholders outside ITS in the field of environmental engineering. This course combines an integrated introduction to theory and hands-on experience in developing ideas and applying various problems in the field.

PROGRAM LEARNING OUTCOMES CHARGED BY COURSES

- Capable to work together and have social sensitivity and high concern for the community and the environment (PLO-4)
- Mastering the basic principles of control technology and environmental pollution prevention processes and mastering the concept of its application with an integrated system approach (PLO-7)
- Capable to make quick and precise decisions armed with sustaincapable development insights (PLO-11)

COURSE LEARNING OUTCOMES

- Capable to increase social sensitivity
- Capable to work together in teams to solve both social and technical problems
- Capable to take risks with the right calculations
- Capable to plan the resolution of existing problems well and carefully
- Capable to adapt to the situation at hand and survive in uncertain conditions.
- Responsible for their own work and can be given responsibility for the achievement of teamwork results by prioritizing ethics

SUBJECT MATTER

- Capable to increase social sensitivity
- Capable to work together in teams to solve both social and technical problems
- Capable to take risks with the right calculations
- Capable to plan the resolution of existing problems well and carefully
- Capable to adapt to the situation at hand and survive in uncertain conditions.
- Responsible for their own work and can be given responsibility for the achievement of teamwork results by prioritizing ethics

PREREQUISITE

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REFERENCE
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