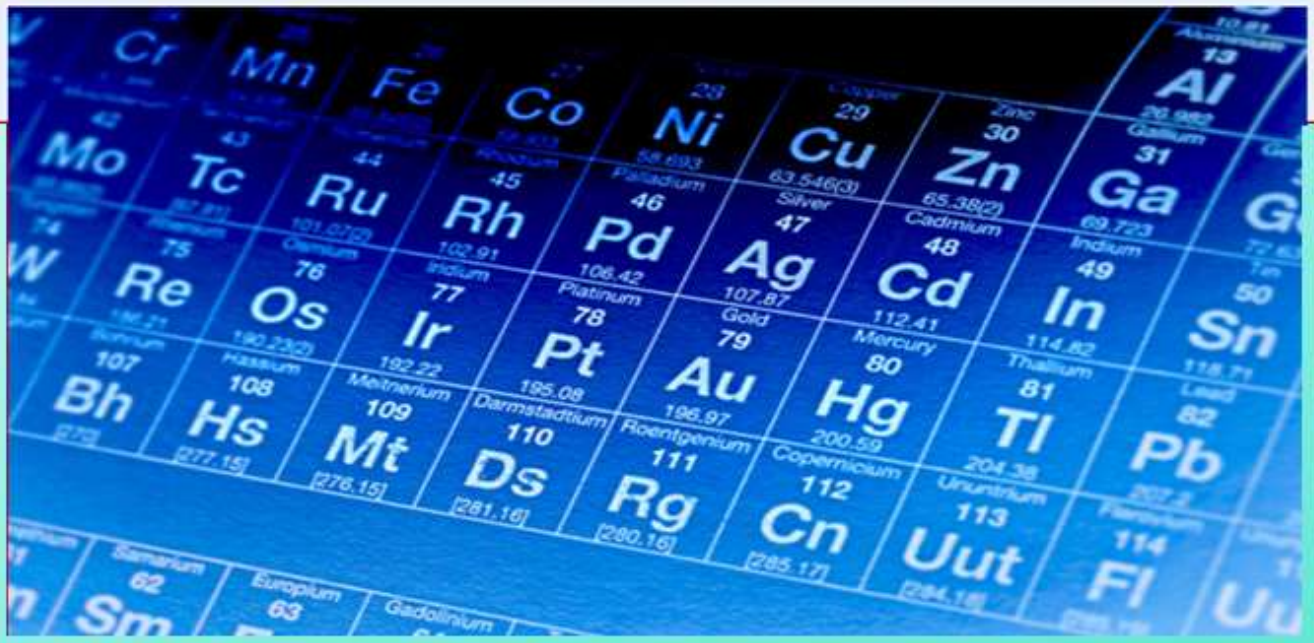
STUDENT GUIDE BOOK
BACHELOR DEGREE PROGRAM OF CHEMISTRY
Institut Teknologi Sepuluh Nopember



DEPERTMENT OF CHEMISTRY
2020

PREFACE

This academic handbook is compiled as a reference to all students on the curriculum of the bachelor of chemistry study program also provides guidance to students in preparing the thesis in order to produce good quality thesis and uniform. This book also helps supervisors to more easily carry out the task of guiding students. The preparation of this academic handbook has not been maximal especially with limited time, therefore constructive advice are expected to be perfected.

Surabaya, 9 January 2020
Head of Department

Prof. Dr. rer.nat. Fredy Kurniawan

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CHAPTER 1
INTRODUCTION

1.1 History of the Department of Chemistry

Department of Chemistry F-SCIENTICS currently manages two study programs namely Bachelor of Chemistry (S1) and Postgraduate Chemistry Program (S2/S3).

- 1970-1980
  The Bachelor of Chemistry program was established out of its desire and need for Chemistry education as outlined in its Development Master Plan (RIP-ITS), at that time it was still referred to as the Chemistry department.
- 1983-1984
  The Bachelor of Chemistry program began in the 1983/1984 school year and was officially operated in 1983, precisely in September 1983 along with the structuring of organizational structures in its environment in accordance with PP No. 5 of 1980.
- 1986-1993
  The Department of Chemistry has also devoted the knowledge possessed by its human resources in helping to prepare high-quality Chemistry teachers for high school in eastern Indonesia(especially) as many as 196 experts madya (Diploma III).
- 2004
  In 2004 post-graduate Chemistry Master Program (S2) ITS was established. In almost 30 years since its inception, the Department of Chemistry FMIPA ITS always improving itself and managed to get a block grant Technological and Professional Skills Development Project (TPSDP) Batch III of 687,071 U.S. dollars for the period 2004-2007.
- 2007
  Bachelor Program (S1) program in the Department of Chemistry FMIPA ITS obtained an A grade from the National Accreditation Board (BAN) in accordance with the certificate No. 001 / BAN-PT / Ak-X / S1 / I / 2007 dated January 13, 2007.
- 2009
  In 2009 its Post Graduate Doctoral Program in Chemistry (S3) was established.
- 2016
  Bachelor of Chemistry Study Program have been certfied by AUN-QA
  Master of Chemistry Study Program was accredited A based on BAN-PT decree No. 2428/SK/BAN-PT/Akred /M/X/2016
- 2017
  ITS Doctoral Study Program in Chemistry is accredited A based on BAN-PT decree No. 4392/SK/BAN-PT/Akred/D/XI/2017
- 2018
  Bachelor of Chemistry Study Program was accredited A based on BAN-PT decree No. 1393/ BAN-PT/Akred /S/V/2018

1.2 Vision of the Department of Chemistry

The Department of Chemistry being a chemistry learning center which creates graduates with international qualifications as an agent of developing the knowledge of science and technology.

1.3 Mission of Department of Chemistry

- To carry out an efficient high level of education in the field of chemistry up to the stage of postgraduate, in order to produce graduates who are approved and known at the international level.
- To perform innovative and creative researches to develop the knowledge of chemistry.
- To organize activities by providing the society services that are connected with chemistry.
- To organize activities by socializing chemistry and the capability of Department. of Chemistry ITS
- To uphold and maintain the grades of academic, moral and ethics in order to achieve a better quality of life

1.4 The Objectives of Department of Chemistry

The Program Education Objectives (PEOs) of Bachelor of Chemistry (BoC) state and describe the expected accomplishments of graduates, as mentioned bellow:

- To produce graduates who able to use their knowledge, skills, and competence in the area of chemistry for their professional career at national and international level (PEO1).
- To produce graduates who able to have good quality as an individual, and as a member or leader in diverse teams, in interdisciplinary and multidisciplinary settings (PEO2).
- To produce graduates who can follow the ethical principles and responsibilities of a chemist to serve the society and environment (PEO3).


SPS 024519

BAN-PT

Sertifikat Akreditasi

Badan Akreditasi Nasional Perguruan Tinggi

berdasarkan Keputusan BAN-PT No. **1393/SK/BAN-PT/Akred/S/V/2018**, menyatakan bahwa Program Studi **Kimia**, Pada Program Sarjana **Institut Teknologi Sepuluh Nopember, Surabaya** terakreditasi dengan peringkat

Terakreditasi A

*Sertifikat akreditasi ini berlaku 5 (lima) tahun sejak tanggal **30 - Mei - 2018** sampai dengan **30 - Mei - 2023**.*

Jakarta, 30 - Mei - 2018

Prof. T. Basaruddin
Direktur Dewan Eksekutif

Figure 1. Accreditation of Bachelor of Chemistry Study Program by BAN-PT


AUN-QA
A Touch of Quality

ASEAN University Network

ASEAN UNIVERSITY NETWORK
PRESENTS THIS CERTIFICATE TO

Undergraduate Program in Chemistry
Of the
Institut Teknologi Sepuluh Nopember, Indonesia

FOR SUCCESSFULLY COMPLETING THE AUN ACTUAL QUALITY ASSESSMENT AT PROGRAMME LEVEL

ASEAN UNIVERSITY NETWORK certifies that
the Undergraduate Program in Chemistry of Institut Teknologi Sepuluh Nopember has
been audited and found to be in accordance with the requirement of the standard details of
the
ASEAN UNIVERSITY NETWORK QUALITY ASSURANCE STANDARD

Original Approval Date: 15 October 2016
Subject to the continued satisfactory operation of the programme's Management System, this certificate is valid until: 14 October 2020

Certificate Number:
AP1?5ITSSEP16

The provision of further clarification regarding the scope of this certificate, validity, and applicability may be obtained by contacting kern@aunsec.org

Assoc. Prof. Nantana Gajaseni, Ph.D.
Executive Director
ASEAN University Network

ASEAN University Network Office of the Secretariat
Room 310, Jamjuree 1 Building, Chulalongkorn University, Phyathai Road
Bangkok 10330, Thailand

Figure 2. Sertification of Bachelor of Chemistry Study Program by AUN-QA

CHAPTER 2
ORGANIZATION STRUCTURE

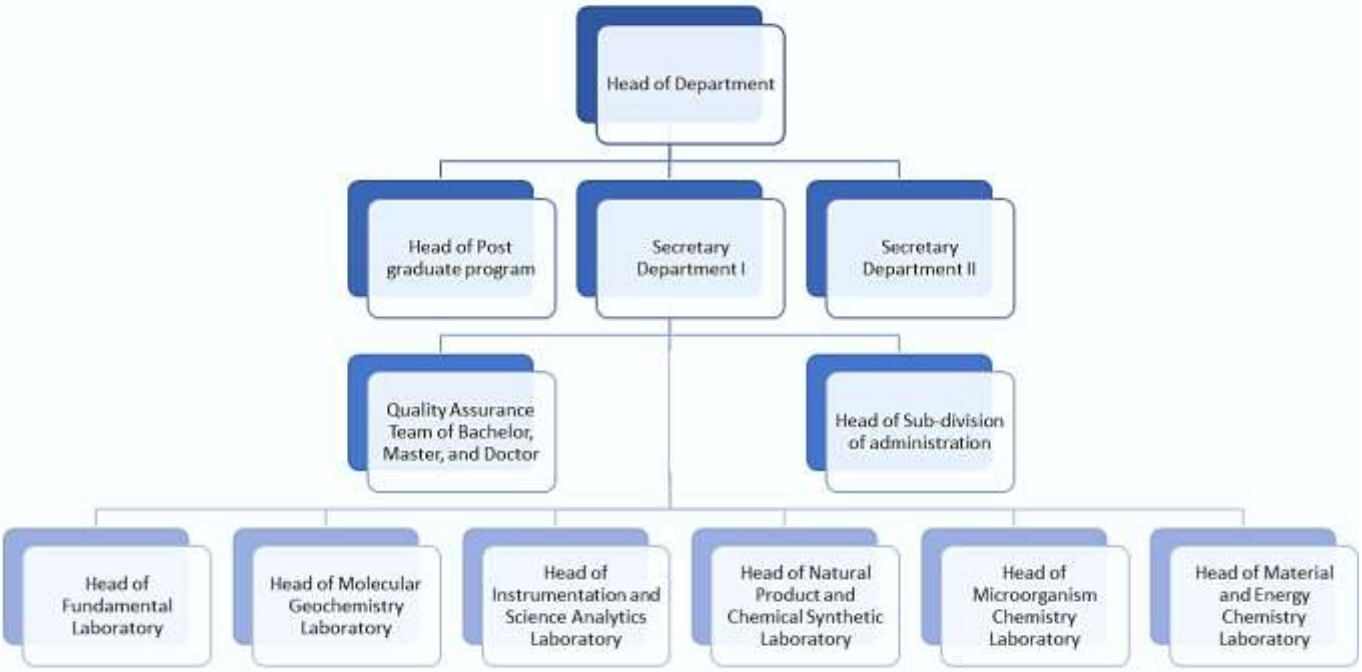

Figure 3. Organization Structure in Department of Chemistry

Table 1. Structural Composition in Department of Chemistry

Head of Department	Prof. Dr. rer.nat. Fredy Kurniawan, M.Si
Secretary I (Academic Affairs)	Dr. Yuly Kusumawati, M.Si.
Secretary II (Planning, Finance, and Infrastructure Affairs)	Yatim Lailun Ni'mah, M.Si, Ph. D
Head of Postgraduate Program Study	Prof. Dr. Didik Prasetyoko, M.Sc
Doctoral Study Program Quality Team	• Prof. Dr. Taslim Ersam • Prof. Dr. R. Y. Perry Burhan, M.S. • Prof. Drs. Syafsir Akhlus • Prof. Drs. Surya Rosa Putra, M.S. • Prof. Dr.rer.nat. Irmina Kris M, M. Si. • Prof. Drs. Mardi Santoso, Ph.D. • Prof. Dr. Didik Prasetyoko, M. Sc. • Prof. Hamzah Fansuri, Ph.D. • Prof. Djoko Hartanto, M.S.
Quality Team of Master Study Program	• Suprapto, Ph. D (Analytical Chemistry) • Prof. Dr.rer.nat. Irmina K. Murwani,

	MSi. (Inorganic Chemistry) • Dr. Hendro Juwono (Physical Chemistry) • Prof. Dr. Taslim Ersam,MS (Organic Chemistry)
Quality Team of Bachelor Study Program	• Suprapto, Ph.D (Analytical Chemistry) • Dra. Ratna Ediati, Ph.D (Inorganic Chemistry) • Dr. Eko Santoso, M.S. (Physical Chemistry) • Drs. Agus Wahyudi, M. S. (Organic Chemistry) • Herdayanto S. Putro, M. Si (Biochemistry)
Head of Fundamental Laboratory	Dr. Hendro Juwono,M. Si.,
Head of Molecular Geochemistry Laboratory	Dr. Yulfi Zetra,M. S.
Head of Instrumentation and Science Analysis Laboratory	Dra. Ita Ulfin,M. Si.
Head of Material and Energy Chemistry Laboratory	Dr. Djoko Hartanto, M. S.
Head of Natural Product and Chemical Synthetic Laboratory	Prof. Dr. Mardi Santoso
Head of Microorganism Chemistry Laboratory	Adi Setyo Purnomo, Ph. D

Table 2. List of Lecturers of Bachelor of Chemistry Study Program

No.	Name	Education History	Areas of Expertise
1	Prof. Dr. Taslim Ersam, M.S.	S1 Andalas University	Chemistry
		S2 Gadjah Mada University	Organic Chemistry
		S3 Bandung Institute of Technology	Organic Chemistry
2	Dr. Ir. Endah Mutiara Marhaeni Putri, M. Si	S1 Institut Teknologi Sepuluh Nopember	Chemical Engineering
		S2 Airlangga University	Pharmaceutical Chemistry
		S3 Airlangga University	Chemistry
3	Ir. Endang Purwanti Setya Ningsih, MT	S1 Institut Teknologi Sepuluh Nopember	Chemical Engineering
		S2 Institut Teknologi Sepuluh Nopember	Chemical Engineering
4	Ratna Ediati, M.S., Ph.D	S1 Bandung Institute of Technology	Chemistry
		S2 Bandung Institute of Technology	Physical Chemistry

No.	Name	Education History	Areas of Expertise
		S3 University of Manchester Institute of Science and Technology, UK	Chemistry
5	Prof. Dr. R.Y. Perry Burhan, M.Sc.	S1 Andalas University	Chemical
		S2 Bandung Institute of Technology	Organic Chemistry
		DEA University of Louis Pasteur, France	Organic Chemistry
		S3 University of Louis Pasteur, France	(Geo) Organic Chemistry
6	Dr. Yulfi Zetra, MS.	S1 Andalas University	Chemistry
		S2 Bandung Institute of Technology	Organic Chemistry
		S3 Institut Teknologi Sepuluh Nopember	Organic Chemistry
7	Drs. Refdinal Nawfa, MS.	S1 Andalas University	Chemistry
		S2 Bandung Institute of Technology	Chemistry
8	Prof. Dr. Syafsir Akhlus, M.Sc.	S1 Andalas University	Chemical
		S2 Bandung Institute of Technology	Chemistry Physics
		S3 ENSIC-NPL, France	Process Chemistry
9	Prof. Dr. Djoko Hartanto, M.Si.	S1 Gajah Mada University	Chemical
		S2 Gajah Mada University	Inorganic Chemistry
		S3 Institut Teknologi Sepuluh Nopember	Inorganic Chemistry
10	Drs. Muhammad Nadjib M., MS.	S1 Bandung Institute of Technology	Chemistry
		S2 Bandung Institute of Technology	Analytical Chemistry
11	Prof. Dr. Surya Rosa Putra, MS.	S1 Bandung Institute of Technology	Chemistry
		S2 Bandung Institute of Technology	Biochemistry
		S3 University of Louis Pasteur, France	Bioorganic Chemistry

No.	Name	Education History	Areas of Expertise
12	Drs. Agus Wahyudi, MS.	S1 Gajah Mada University	Chemical
		S2 Gajah Mada University	Organic Chemistry
13	Drs. R. Djarot Sugiarso KS., MS.	S1 Airlangga University	Chemistry
		S2 Airlangga University	Chemistry
14	Dra. Harmami, MS.	S1 Gajah Mada University	Chemistry
		S2 Airlangga University	Chemistry
15	Dr. Hendro Juwono. M.Si.	S1 Gajah Mada University	Chemistry
		S2 Bandung Institute of Technology	Physical Chemistry
		S3 Gajah Mada University	Physical Chemistry
16	Dra. Ita Ulfin, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Airlangga University	Pharmaceutical Chemistry
17	Lukman Atmaja, M.Si, Ph.D.	S1 Bandung Institute of Technology	Chemistry
		S2 Bandung Institute of Technology	Physical Chemistry
		S3 The University Birmingham, English	Polymer Chemistry
18	Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Gadjah Mada University	Inorganic Chemistry
		S3 Humboldt University, Germany	Inorganic Chemistry
19	Prof. Mardi Santoso, Ph.D.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S3 The University of New South Wales, Australia	Organic Chemistry
20	Dr. Eko Santoso, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Physical Chemistry

No.	Name	Education History	Areas of Expertise
		S3 Institut Teknologi Sepuluh Nopember	Physical Chemistry
21	Prof. Dr. Fahimah Martak, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Inorganic Chemistry
		S3 Bandung Institute of Technology	Inorganic Chemistry
22	Prof. Hamzah Fansuri, M.Si. Ph.D.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Inorganic Chemistry
		S3 Curtin University of Tech., Australia	Catalyst Chemistry
23	Nurul Widiastuti, M.Si., Ph.D.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Physical Chemistry
		S3 Curtin University of Tech., Australia	Physical Chemistry
24	Prof. Dr. Didik Prasetyoko. M,Sc.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 University of Technology Malaysia	Inorganic Chemistry
		S3 University of Technology Malaysia	Inorganic Chemistry
25	Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Analytical Chemistry
		S3 University of Regensburg, Germany	Analytical Chemistry
26	Suprapto, M.Si. Ph.D.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Analytical Chemistry
		S3 University of Manchester, UK	Analytical Chemistry
27	Dr. Afifah Rosyidah, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Bandung Institute of Technology	Inorganic Chemistry
		S3 Bandung Institute of Technology	Inorganic Chemistry

No.	Name	Education History	Areas of Expertise
28	Sri Fatmawati, M.Sc., Ph.D.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Kyushu University, Japan	Organic Chemistry
		S3 Kyushu University, Japan	Organic Chemistry
29	Dr. Yuly Kusumawati, M.Si.	S1 Bandung Institute of Technology	Chemistry
		S2 Bandung Institute of Technology	Physical Chemistry
		S3 Bandung Institute of Technology double degree with Universite Pierre Marie Curie	Physical Chemistry
30	Herdayanto Sulistyo Putro, S.Si., M.Si.	S1 Bandung Institute of Technology	Chemistry
		S2 Bandung Institute of Technology	Biochemistry
31	Yatim Lailun Ni'mah, M.Si., Ph.D	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Institut Teknologi Sepuluh Nopember	Analytical Chemistry
		S3 NTUST, Taiwan	Chemistry
32	D. Sc. Arif Fadlan, M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Institut Teknologi Sepuluh Nopember	Organic Chemistry
		S3 Nara Institute of Science and Techology, Japan	Organic Chemistry
33	Adi Setyo Purnomo, M.Sc., Ph.D.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Kyushu University, Japan	Biochemistry
		S3 Kyushu University, Japan	Biochemistry
34	Wahyu Prasetyo Utomo, S.Si., M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Institut Teknologi Sepuluh Nopember	Inorganic Chemistry
35	Zjahra Vianita Nugraheni, S.Si., M.Si.	S1 Institut Teknologi Sepuluh Nopember	Chemistry

No.	Name	Education History	Areas of Expertise
		S2 Institut Teknologi Sepuluh Nopember double degree with Asian Institute of Technology, Thailand	Organic Chemistry
36	Hamdan Dwi Rizki, S.Si., M.Si	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S2 Institut Teknologi Sepuluh Nopember	Biochemistry
37	Dr. Triyanda Gunawan	S1 Institut Teknologi Sepuluh Nopember	Chemistry
		S3 Institut Teknologi Sepuluh Nopember	Physical Chemistry

CHAPTER 3
CURRICULUM OF BACHELOR OF CHEMISTRY

Program Study	**Chemistry**
Educational Level	**Bachelor (B.Sc.)**

Chemistry Graduates Learning Outcomes (According to IQF/*KKNI* Level 6)		
Attitude and Grades (A)	a.	Be conscious towards God The Almight and able to show religious attitude.
	b.	To uphold the humanity grade in implementing the daily tacredits based on religion, moral, and ethics.
	c.	Contribute to increasing the life quality of the community, nation, country and the human civilization based on the principles of Pancasila.
	d.	Play a role as a proud citizen who loves and have pride for the country, have a sense of nationalism and also responsibilities towards the country and nation.
	e.	Appreciate the culture diversities, point of views, religions and beliefs, and opinions or discoveries of other people.
	f.	Working together and having social awareness towards the local community and environment.
	g.	Obey the laws and disciplines in living socially and living as a citizen.
	h.	Internalise the grades, the nomrs, and the academic ethics.
	i.	Show a responsible attitude towards the work being done independently in their specified field of experties.
	j.	Internalise the spirit to be independent, hard working and to be an entrepreneur.
	k.	Putting their maximum effort in order to gain the best results.
	l.	Working together in order to maximally use the potential of the students.
Managerial Skills (B)	a.	Being able to think logically, critically, systematically, and innovatively in the context of developing or implementing the knowledge and technology that focuses on the human grades based on their field of experties.
	b.	Able to work independently with high quality and quantified results.
	c.	Able to study the implications of science and technology developments that focuses on implementing the grades in accorandce to their field of expertise based on the principles, procedures and scientific ethics in creating solutions, ideas, designs or artistic criticisms.
	d.	Compiling a scientific description based on the research findings in the form of final assignment reports, and uploading them in the university website.
	e.	Able to make a precise decision in the context of problem solving in their field of experies, based on data and information analysis.

	f.	Able to maintain and develop the professional relationships with supervisor, colleague, and peer group, in both within and outside their environment.
	g.	Able to be responsible for the results obtained from group assigments as well as supervising and evaluating on finishing the tacredits given to the subordinates who are under their responsibilities.
	h.	Able to carry out self assesments towards their group who is under their responsibilities, and able to carry out self learning independently.
	i.	Able to documentate, save, secure and rediscover the data in order to guarantee their validity and to avoid piracy.
	j.	Able to develop oneself and compete on both national and international levels.
	k.	Able to implement the principles of sustainability in developing the knowledge.
	l.	Able to implement the information technology and communication in the context of performing their tacredits.
	m.	Able to implement the knowledge of entrepeneurship and understand the principles of technopreneurship.
Mastered Knowledge (C)	a.	Mastering the theoretical concepts of structure, characteristics and changes on energy and its kinetics, identifications, separations, characterizations, transformations, micromolecular chemical synthesis and their applications.
	b.	Mastering the complete operational knowledge on functions, how to operate the general chemical instruments, and analyzing data and information obtained from the specified instrument.
	c.	Mastering the basic principles of softwares to be used for analysis and synthesis on both general chemistry subjects and the more specific chemistry fields, such as organic chemistry, biochemistry, analytic, physical chemistry, or anorganic chemistry.
	d.	Mastering the principles and ways of handling andgerous chemicals.
Working Capacities (D)	a.	Able to create the right conclusions based on the identification results, analysis, isolations, transformations and chemical synthesis that have been carried out.
	b.	Able to solve science and technology problems, particularly in the field of general chemistry and in simple scopes such as identifications, analysis, isolations, transformations, and micromolecular synthesis through implementing the knowledge of structures, behavior, molecular changes in terms of both their enery and kinetics, analysis and synthesis methods in specific chemistry, and implementing them towards their relevant technology.
	c.	Able to perform analysis on a variety of alternative solutions in identifying, analyzing, isolating, transforming and synthesis on the available chemicals and present finding analysis in order to decide the right conclusion.
	d.	Able to take advantage of the chemistry knowledge in everyday life and in creating job opportunities.
	e.	Able to use software to analyse and synthesis in both general and specific chemistry, such as organic chemistry, biochemistry, analytic, physical chemistry, and anorganic chemistry.
	f.	Able to complete the tacredits and handle andgerous chemicals in accorandce to the health and safety standards.
	g.	Able to anticipate and reduce the effects of using chemical substances in the community, environmentally, socially, and economically.

Bachelor of Chemistry (BoC) Learning Outcomes		
Attitude and Grades (A)	**LO 1**	Able to report his/her own work in a good and discipline manners
	LO 2	Able to internalize the spirit of independence, struggle, and entrepreneurship
Managerial Skills (B)	**LO 3**	Able to collect data and information correctly, analyze and use analysis for correct decision making
	LO 4	Able to give alternative solutions with the characters of leadership, creativity and communication ability
	LO 5	Able to take responsibility for his/her own work and to be give the responsibility of the achievement of an organization
Mastered Knowledge (C)	**LO 6**	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	LO 7	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
Working Capacities (D)	**LO 8**	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	LO 9	Able to apply chemistry mindset in driving the creation of job opportunities

LIST OF COURSES (BOC PROGRAM)

A. COMPULSORY COURSES

No.	Course Code	Course Name	Credits	ECTS
		1st SEMESTER		
1	UG184914	English	2	3.2
2	UG18490x	Religion	2	3.2
3	UG184911	Pancasila	2	3.2
4	SB184161	Biology	2	3.2
5	SF184101	Physics I	4	6.4
6	SK184101	Chemistry I	3	4.8
7	KM184101	Mathematics I	3	4.8
		Total Credits	18	28.8
		2nd SEMESTER		
1	UG184912	Indonesian	2	3.2
2	UG184913	Civics	2	3.2
3	SF184202	Physics II	3	4.8
4	SK184202	Chemistry II	3	4.8
5	SK184203	Modern Physics	2	3.2
6	SK184204	Mathematical and Computational Chemistry	3	4.8
7	KM184201	Mathematics II	3	4.8
		Total Credits	18	28.8
		3rd SEMESTER		
1	SK184301	Introduction to Statistical Methods	2	3.2
2	SK184302	Chemistry Literature	2	3.2
3	SK184311	Measurement Methods in Chemistry	4	6.4
4	SK184341	Atomic and Molecular Structures	3	4.8

5	SK184342	Chemical Thermodynamics	5	8
6	SK184351	Basic Organic Chemistry	3	4.8
		Total Credits	19	30.4
		4th SEMESTER		
1	SK184412	Separation and Purification Methods	4	6.4
2	SK184421	Structure, Properties and Reativity of Inorganic Compounds	5	8
3	SK184443	Chemical Dynamincs	6	9.6
4	SK184452	Organic Reactions and Mechanisms	4	6.4
		Total Credits	19	30.4
		5th SEMESTER		
1	SK184513	Instrumental Measurement Methods	4	6.4
2	SK184522	Elements and Inorganic Compound	4	6.4
3	SK184531	Biochemistry	4	6.4
4	SK184544	Molecular Spectroscopy	3	4.8
5	SK184553	Synthesis in Organic Chemistry	4	6.4
		Total Credits	19	30.4
		6th SEMESTER		
1	UG184916	Concept of Technology	3	4.8
2	SK184614	Chemometrics	2	3.2
3	SK184615	Chemical Analysis Laboratory	2	3.2
4	SK184623	Synthesis and Characterization of Inorganic Materials	5	8
5	SK184632	Bioprocess	4	6.4
6	SK184654	Identification in Organic Chemistry	3	4.8
		Total Credits	19	30.4
		7th SEMESTER		
1	SK184705	Colloquium	2	3.2
2	UG184915	Technopreneurship	2	3.2
3	SK184706	Chemistry Case Study	2	3.2
4	XXXXXX	Enrichment Course	3	4.8
5	SK1847xx	Elective Courses	7	11.2
		Total Credits	16	
		8th SEMESTER		
1	SK184807	Final Project	8	12.8
2	SW184801	Laboratory Management	2	3.2
3	SK1848XX	Elective Courses	6	9.6
4		SKEM	2	3.2
5		POMITS	2	3.2
6		TOEFL	2	3.2
		Total Credits	22	35.2
	TOTAL CREDITS		**144**	**240**

B. RELIGION STUDIES

No.	Course Code	Course Name	Credits
1	UG184901	Islamic Studies	2
2	UG184902	Christian Studies	2
3	UG184903	Catholic Studies	2
4	UG184904	Hinduism Studies	2
5	UG184905	Buddhism Studies	2
6	UG184906	Khonghucu Studies	2

C. ELECTIVE COURSES

No.	Course Code	Name of Optional Course	Credits
1	SK184711	Environmental Chemistry	2
2	SK184712	Electrometry	2
3	SK184713	Radiometry	2
4	SK184714	Applied Analysis	3
5	SK184721	Complex Compounds	2
6	SK184722	Catalysis	3
7	SK184723	Colloid Chemistry	2
8	SK184724	Surface Chemistry	3
9	SK184725	Polymers	2
10	SK184726	Building Materials Chemistry	2
11	SK184731	Genetics Engineering	2
12	SK184732	Bioremediation	2
13	SK184741	Phytochemistry	3
14	SK184742	Fragrance and Flavour Chemistry	2
15	SK184751	Organic Stereochemistry	2
16	SK184752	Coal Geochemistry	2
17	SK184761	On Job Training	2
18	SK184762	Marine Chemistry	2
19	SK184763*	Introduction to Fragrance and Dye Chemistry	3
20	SK184764*	Geochemistry and Mineralogy	3
21	SK184765*	Business Chemistry	3
22	SK184766*	Food Chemistry	3
23	SK184767*	Energy Storage	3
24	SK184811	Chemo-Biosensor	2
25	SK184812	Forensic Chemistry	2
26	SK184821	Organometallic Compounds	2
27	SK184822	Bioinorganic	2
28	SK184823	Solid State Chemistry	2
29	SK184824	Industrial Chemistry	2
30	SK184825	Basic Molecular Computational	3
31	SK184733	Microbiology Chemistry	2
32	SK184831	Fermentation	2
33	SK184832	Enzymology	2
34	SK184833	Bioactivity	2
35	SK184841	Chemical Systematics of Plant	2
36	SK184842	Drug Chemistry	2
37	SK184851	Introduction to Organic Geochemistry	3
38	SK184852	Biomarkers Analysis	2
39	SK184861	Capita Selecta	2
40	SK184862*	Hazardous and Dangerous Materials	3
41	SK184863*	Corrosion Analysis Methods	3
42	SK184864*	Chemical Analysis	3
43	SK184865*	Ceramics	3
44	SK184866*	Plastic Chemistry	3
45	SK184867*	Membrane Chemistry	3
46	SK184868*	Upstream Oil and Gas Chemistry	3
		Total Credits	**96**

*Note: * = Enrichment course (for other departments in ITS)*

All Teaching and Learning Plan of courses can be seen in Appendix 1.

CHAPTER 4
COLLOQUIUM

4.1 Introduction

Colloquium in the curriculum of BoC F-SCIENTICS ITS 2018-2021 is a curricular activityexpertise /profession in the field covered by the laboratory/research group in the BoC by students under the guidance of lecturer (as advisor) in the form of scientific seminars. The activity of Colloquium is literature searching, indirect data collection and application of how to prepare a scientific reports in the form of papers in a particular topic and present and maintain the paper in a seminar. At the end of the seminar, advisor and examiners can provide an explanation and summary of the subject of the colloquium that took place.

4.2 Colloquium Report

Colloquium report are compiled based on articles in English-language scientific magazines as the main reference article (publishing maximum of 5 years before), which must be supported by related references Papers are not a translation of one scientific article and should not all data from the main reference article be used. The paper is written in standard Indonesian with the same format as the writing procedure for the Final Project report of the BoC. The report to be equipped with data and information yang less than the main reference article with other references so that it becomes a perfect paper. Colloquium papers consist of: Preface (title page, authentication page, introduction, table of contents), Body papers (introduction, literature review, metodology, results and discussion, conclusion) and closing (references). The topics covered in this colloid should be new topics.

1. Colloquium is 2 (two) credits with a duration of activities 1 (one) semester.
2. Colloquium's supervisor is a teaching staff in the Department of Chemistry FSCIENTICS – ITS. For one Colloquium title there is only 1 (one) supervisor. All teaching staff in Department of Chemistry are obliged to guide the Colloquium with a maximum limit of 4 (four) titles for each teaching staff per semester.
3. The Colloquium Examiner is a teaching staff in the Department of Chemistry FSCIENTICS – ITS which is held in a seminar. The seminar was conducted openly and assessed by a team of Colloquium examiners. This team of Colloquium examiners amounted to 3(three) teaching staff with an arrange:
   - One lecturer as seader
   - One lecturer as Supervisor
   - One lecturer as member
4. The seminar/pres can be held if attended by a whole team of colorium examiners.
5. Students can take Colloquium after passed 96 credits (this is required in the curriculum system)

Procedure for Collloquial Retrieval (adapted to the new)

a. Students can take Colloquium at the beginning of each semester filling study plan form and signed by the academic supervisor (online form through MyITS).
b. The coordinator (Secretary of Department 1) distributes a list of Colloquium participants to the appropriate research group or laboratory.
c. The head of the laboratory then arranged the schedule of the Colloquium seminar and announced it in the fifth week of lectures and submitted to administration to make invitations and

grading form of the presentation of each student.

d. Colloquium students must attend a Colloquium seminar (in their respective research laboratories) and fill in the attendance list. The examiner team (team leader) isobliged to control the attendance list.
e. The Colloquium paper has been approved and signed by the supervisor and then submitted in as much as 3 (three) copy to the administration (no later than 5 working days before the due date of the seminar schedule). Submission of papers accompanied by a monitoring card at least 10 (ten) times mentoring with supervisor.
f. The seminar was examined by a team of examiners. The seminar can be held if attended by a whole team of colorium examiners. Seminars are managed as : 15-minute presentations, discussions of each examiner 15 minutes.
g. While delivering his paper in the seminar, students have to use formal attire (white shirt and black skirt/trouser)
h. During the seminar, participants (speakers and listeners) are not allowed to leave the seminar room until the seminar finished.
i. For students who take Colloquium courses, the evaluation is valid if the attendance in the seminar is at least 90% of the entire Colloquium presentation of each research group or laboratory.
j. The Colloquium grade is issued at the end of the semester, if the student of the Colloquium participant has submitted a revised paper, signed by the supervisor and submitting to administration office.

Colloquium Evaluation

Colloquium is evaluated based on students' proficiency in preparing papers, presenting and discussing them in front of examiners.

a. Colloquium is evaluated with the formula:

Final Grade = [0.4 (0.4 A + 0.6 B)+0.6(0.3 C +0.7 D)]

Final Grade = 0.16 A + 0.24 B + 0.18 C + 0.42 D

where:

A = Literature search and live data collection (Supervisor)
B = Preparation of scientific reports (Supervisor)
C = the average grade of all presentations /manners provided bythe testing team (All examiner)
D = average grade of all discussion/Q&A (All examiner)

b. The criteria for assessment ofdiscussion / Q&A are (With grade distribution):

86–100 : if the question is answered properly and correctly directly and is able to answer questions that are advanced from the initial question.
76– 85 : if the question dijawab well and correctly directly.
66–75 : if the question is answered properly and correctly with the direction of the questioner or other examiner.
61–65 : when the question is answered and most of the answers are good and correct.
56–60 : when the question is answered and a small number of answers are good and correct.
< 55 : if the question is answered incorrectly or unanswered.

c. The criteria for presentation assessment

Presentations are graded by students' ability in presentation techniques, time use, language, grammar and ethics during the presentation. Assessment criteria are regulated as follows:

1. Systematics in presentations (30)
2. Presentation slides (30)
3. Language (15)
4. Utilization of time (10)
5. Attitudes and ethics (15)

d. The grade of discussion/question and answer andpresentation /manners are given by the entire assessment team shortly after the seminar takes place while the grade of the paper is only given by the supervisor and delivered as soon as the seminar will begin.

e. Colloquium is declared passed when the price of $N \geq 56$.

The criteria for Colloquium graduation is divided into 2 groups, namely:

1. Pass
2. Didn't pass.

If there is any correction of the paper, this correction is entirely and became responsibility of the supervisor. Students who do not passed of colloquium must repeat the Colloquium with different titles and supervisor in the next semester.

CHAPTER 5
FINAL PROJECT

Final project is a requirement for student to graduate from BoC. The regulation of final project have been arranged by ITS as mandated in the Regulation of theMinister of Research, Technology and Higher Education Number 62 of 2016. The student of BoC can take final project in the 7^{th} semester or 8^{th} semester with workload s much as 8 credits, depend on their planning and grade of course. The student who take final project will be guided by at least 1 (one) supervisor from BoC. The other supervisor may come from other department in ITS or outside ITS, national or international. The complete guidance for final project can be seen in Appendix 2.

CHAPTER 6
ON JOB TRAINING

On Job Training is an elective course in BoC. The regulation of final project have been arranged by ITS according Rector Regulatio No. 12/2019 about Standard Quality of Internship and On Job Training (OJT). The objetive of OJT is to get and to apply the knowledge, general skill, and special skills. The student who take OJT are expected to be able to internalize professional character and work culture that is appropriate and necessary for the job market.

The student of BoC can take OJT with requiement have been passed 76 of credits. They will be guided by 1 (one) supervisor from BoC and 1 (one) supervisor from site/company. They will do a project that have ben designed by site/company. After finished the OJT, the have to write an report an submitted into department and site/company. Te grade will be giving by BoC supervisor and site supervisor. The complete proedure for OJT can be seen in Appendix 3.

RPS - GENERIC STUDIES

(*Lesson Plan*)

INSTITUT TEKNOLOGI SEPULUH NOPEMBER
KANTOR PENJAMINAN MUTU
2020

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER		
	RPS Generic Studies		
	Document Number	Revision Number	Endorsed by:
	2.3.3.3.3		Wakil Rektor 1

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1. RPS Pendidikan Agama Islam / *Semester Study Plan of Islam Religion*

Nama Program Studi / *Prpgram Name*	(Semua Program Studi) / (*All Program*)
Nama Mata Kuliah / *Course Name*	Pendidikan Agama Islam / *Islamic Religious Education*
Kode MK / *Course Code*	UG18 49 01 /UG18 19 01 /UG18 09 01
Semester	I / II
SKS / *Credit*	2
Nama Dosen Pengampu / *Lecturer Name*	Tim Dosen Agama Islam ITS

Pokok Bahasan ***Main Subject***	1. Etika dan kepribadian 2. Nilai-nilai kebangsaan (perspektif Agama) 1. *Attitude and personality* 2. *National values (religious perspective)*
Capaian Pembelajaran Lulusan Yang Dibebankan Mata Kuliah ***Learning Outcome***	1. Bertaqwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius (S.1); 2. Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral dan etika (S.2); 3. Menginternalisasi nilai, norma, dan etika akademik (S.8); 4. Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya (KU.1); 5. Mampu menunjukkan kinerja mandiri, bermutu, dan terukur (KU.2); 6. Mampu mengambil keputusan secara tepat dalam konteks penyelesaian masalah di bidang keahliannya, berdasarkan hasil analisis informasi dan data (KU.5);

	7. Mampu mengimplementasikan prinsip keberlanjutan *(sustainability)* dalam mengembangkan pengetahuan (KU.11). 1. *Believe in God Almighty and able to show a religious attitude (S.1);* 2. *Upholding human values in carrying out duties based on religion, morals and ethics (S.2);* 3. *Internalizing values, norms, and academic attitude (S.8);* 4. *Able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with their field of expertise (KU.1);* 5. *Able to show independent, quality, and measurable performance (KU.2);* 6. *Able to make decisions appropriately in the context of problem solving in their area of expertise, based on the results of information and data analysis (KU.5);* 7. *Able to implement the principles of sustainability in developing knowledge (KU.11).*
Capaian Pembelajaran Mata Kuliah ***Course Learning Outcome***	1. Menjelaskan esensi relasi manusia dengan Allah, dengan sesama manusia dan dengan lingkungan alam dalam paradigma Qur'ani (KK.1); 2. Menyajikan hasil penelaahan konseptual dan/atau empiris terkait esensi dan urgensi nilai-nilai spiritualitas Islam sebagai salah satu determinan dalam pembangunan bangsa yang berkarakter (KK.2); 3. Mampu bersikap secara konsistensi terhadap koherensi pokok-pokok ajaran Islam sebagai implementasi Iman, Islam, dan Ihsan, serta menghadirkan Islam *rahmatan lil alamin* (KK.3); 4. Terampil menyajikan hasil kajian individual maupun kelompok mengenai suatu kasus (studi kasus) terkait kontribusi Islam dalam perkembangan peradaban dunia (KK.4); 5. Terampil menganalisis permasalahan optimalisasi peran masjid sebagai pusat pengembangan budaya islam, dan wadah perwujudan kesejahteraan umat (KK.5).

	6. Memahami esensi Pendidikan Agama Islam sebagai komponen Mata Kuliah Wajib Umum dan urgensinya sebagai nilai-nilai spiritualitas yang menjadi salah satu determinan dalam pembangunan karakter bangsa (P.1); 7. Menguasai substansi agama sebagai salah satu komponen dasar persatuan dan kesatuan bangsa dalam wadah Negara Kesatuan Republik Indonesia (P.2); 8. Memahami korelasi sumber ajaran Islam dan kontekstualisasinya dalam kehidupan modern sebagai *rahmatan lil alamin* (P.3); 9. Menguasai aplikasi konsep Islam tentang IPTEK, seni, sosial-budaya, politik, ekonomi, dan masalah kesejahteraan umat (P.4); 10. Memahami kontribusi Islam dalam perkembangan peradaban dunia, dan menguasai strategi optimalisasi peran dan fungsi masjid sebagai pusat pengembangan budaya Islam (P.5). 1. *Explaining the essence of human relations with Allah, with fellow humans and with the natural environment in the Qur'anic paradigm;* 2. *Presenting the results of conceptual and / or empirical studies related to the essence and urgency of Islamic spirituality values as one of the determinants in building a nation with character;* 3. *Able to be consistent with the coherence of the principles of Islamic teachings as the implementation of Iman, Islam and Ihsan, and to present Islam rahmatan lil alamin;* 4. *Skilled in presenting the results of individual or group studies regarding a case (case study) related to the contribution of Islam to the development of world civilization;* 5. *Skilled in analyzing the problem of optimizing the role of the mosque as a center for the development of Islamic culture and a place for the realization of the welfare of the people.* 6. *Understand the essence of Islamic Religious Education as a component of the General Compulsory Course and its urgency as spiritual values which are one of the determinants in the nation's character building.* 7. *Mastering the substance of religion as one of the basic components of national unity and integrity within the Unitary State of the Republic of Indonesia.*

	8. *Understand the correlation of sources of Islamic teachings and their contextualization in modern life as rahmatan lil alamin.* 9. *Mastering the application of Islamic concepts regarding science and technology, arts, socio-culture, politics, economics, and issues of the welfare of the people.* 10. *Understand the contribution of Islam to the development of world civilization, and master the strategy of optimizing the role and function of mosques as centers of developing Islamic culture.*

Mg ke/ *Week*	**Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)***	**Materi Pembelajaran [Pustaka] / *Learning Material [Reference]***	**Metode Pembelajaran / *Learning Method***	**Estimasi Waktu / Duration**	**Pengalaman Belajar Mahasiswa / *Form of Learning***	**Kriteria dan Indikator Penilaian / Criteria and *ndicator Assessment***	Bobot Penilaian (%)
1-2	P.1, KK.1	• Pendahuluan • Membangun Paradigma Qur'ani • *Preliminary* • *Building a Qur'anic Paradigm*	Pemberian materi Pembahasan *Material and Discussion*	200 menit *200 minutes*	Diskusi *Discussion*	Penguasaan Ketepatan jawaban	5
3-4	P.1, KK.2, KK.3	• Bagaimana Manusia Bertuhan	Pembahasan Diskusi	200 menit	Presentasi Diskusi	Penguasaan	10

		• Integrasi Iman, Islam dan Ihsan • *How humans acknowledge the existence of God* • *Integration of Faith, Islam and Ihsan*	*Discussion*	*200 minutes*	Analisis *Presentation Discussion Analysis*	Keterampilan presentasi Ketepatan jawaban	
5-6	P.2, KK.3	• Bagaimana Agama Menjamin Kebahagiaan • Membumikan Islam di Indonesia • *How Religion Ensures Happiness* • *Ground Islam in Indonesia*	Pembahasan Diskusi *Discussion*	200 menit *200 minutes*	Presentasi Diskusi Analisis *Presentation Discussion Analysis*	Penguasaan Keterampilan presentasi Ketepatan jawaban	10
7	P.2, P.3, KK.3	Moderasi Beragama dalam Islam (Deradikalisasi) *Religious Moderation in Islam (Deradicalization)*	Pembahasan Diskusi *Discussion*	100 menit *100 minutes*	Presentasi Diskusi Analisis *Presentation Discussion Analysis*	Penguasaan Keterampilan presentasi Ketepatan jawaban	10
8	**Evaluasi tengah semester / *Midterm Exam***			100 menit	Ujian	Penguasaan Ketepatan jawaban	

				100 minutes	*Examination*		
9	P.2, P.3, KK.3	Islam Membangun Persatuan dalam Keberagaman *Islam Builds Unity in Diversity*	Pembahasan Diskusi *Discussion*	100 menit *100 minutes*	Presentasi Diskusi Analisis *Presentation* *Discussion* *Analysis*	Penguasaan Keterampilan presentasi Ketepatan jawaban	10
10	P.3, P.5, KK.4	Islam tentag Zakat, Shadaqah, dan Pajak (Filantropi Islam) *Islam about Zakat, Sadaqah, and Taxes (Islamic Philanthropy)*	Pembahasan Tugas studi kasus Presentasi tugas Diskusi *Discussion* *Case study assignments* *Presentation of assignments* *Discussion*	150 menit *150 minutes*	Survey Analisis Presentasi Diskusi *Survey* *Analysis* *Presentation* *Discussion*	Penguasaan Ketepatan jawaban Ketepatan analisis Keterampilan presentasi	15
11	P.5, KK.5	Peran dan Fungsi Masjid untuk Kesejarteraan Umat	Pembahasan Tugas studi kasus Presentasi tugas Diskusi	150 menit *150 minutes*	Survey Analisis Presentasi Diskusi	Penguasaan Ketepatan jawaban Ketepatan analisis Keterampilan presentasi	15

		The Role and Function of a Mosque for the Welfare of the Ummah	*Discussion* *Case study assignments* *Presentation of assignments* *Discussion*		*Survey* *Analysis* *Presentation* *Discussion*		
12	P.5, KK.4, KK.5	Islam Menghadapi Tantangan Modernisasi (Islam dan IPTEKS) *Islam Faces the Challenge of Modernization (Islam and Science and Technology)*	Pembahasan Tugas studi kasus Presentasi tugas Diskusi *Discussion* *Case study assignments* *Presentation of assignments* *Discussion*	150 menit *150 minutes*	Survey Analisis Presentasi Diskusi *Survey* *Analysis* *Presentation* *Discussion*	Penguasaan Ketepatan jawaban Ketepatan analisis Keterampilan presentasi	15
13-14	P.4, P.5, KK.4	Kontribusi Islam dalam Pengembangan Peradaban Dunia *Contribution of Islam in the Development of World Civilization*	Pembahasan Tugas studi kasus Presentasi tugas Diskusi *Discussion* *Case study assignments*	150 menit *150 minutes*	Survey Analisis Presentasi Diskusi *Survey* *Analysis* *Presentation*	Penguasaan Ketepatan jawaban Ketepatan analisis Keterampilan presentasi	10

			Presentation of assignments Discussion		*Discussion*		
15	**Review hasil tugas / Review assignment results**			100 menit *100 minutes*	Ujian *Examination*	Kecakapan menjalankan tugas	
16	**Evaluasi Akhir Semester / *Final Exam***			100 menit *100 minutes*	Ujian *Examination*	Ketepatan jawaban dan argumentasi	

Pustaka / References : (maks. 5)

1. Wahyuddin, dkk., *Pendidikan Agama Islam Membangun Karakter Mahasiswa di Perguruan Tinggi,* Surabaya, Penerbit Litera Jannata Perkasa, 2019.
2. Dirjen Pembelajaran dan Kemahasiswaan Kemenristekdikti, *Pendidikan Agama Islam untuk Perguruan Tinggi,* Jakarta, Dirjen Belmawa, 2016.
3. Muhibbin, Zainul, dkk, *Pendidikan Agama Islam Membangun Karakter Madani*,Surabaya, ITS Press, 2012.
4. Razaq, Nasruddin, *Dinnul Islam*, Bandung, Al-Ma,arif, 2005.
5. Iberani, Jamal Syarif dkk, *Mengenal Islam*, Jakarta: eL-Kahfi, 2003.
6. Imarah, Muhammad, *Islam dan Pluralitas Perbedaan dan Kemajemukan dalam Bingkai Persatuan*, Jakarta, Gema Insani, 1999.

Catatan / *notes*:

*Tugas studi kasus, studi lapangan, makalah literer, presentasi hasil tugas, diskusi, baca dan hafalan Al-Qur'an.

* *Assignment of case studies, field studies, literary papers, presentations of assignments, discussions, reading and memorizing the Al-Qur'an.*

2. RPS Pendidikan Agama Hindu/ *Semester Study Plan of Hindu Religion*

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **SDKB**	**Kode Dokumen** ***Document code***

RENCANA PEMBELAJARAN SEMESTER
Semester Learning Plan

MATA KULIAH (MK) *Course*	**KODE** *Code*	**Rumpun MK** *Course Cluster*	**BOBOT (sks)** *Credits*		**SEMESTER** *Semester*	**Tgl Penyusunan** *Compilation Date*
Pendidikan Agama Hindu ***Hindu Religion Education***	*UG184904*	Mata Kuliah Wajib Nasional *National Compulsory Courses*	*2 SKS*		*I / II*	*Tuliskan tanggal penyusunan RPS*
OTORISASI / PENGESAHAN ***AUTHORIZATION / ENDORSEMENT***	**Dosen Pengembang RPS** ***Developer Lecturer of Semester Learning Plan***		**Koordinator RMK** ***Course Cluster Coordinator***		**Ka Prodi** ***Head of Department***	
	Dra.Ni Wayan Suarmini, M.Sc		Aurelius Ratu			

Capaian Pembelajaran	**CPL-PRODI yang dibebankan pada MK** ***PLO Program Charged to The Course***	
	CPL 1	Bertaqwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius (S.1);

Learning Outcomes	*PLO 1*	*Pious to God Almighty and able to show a religious attitude (S.1);*
	CPL2 *PLO 2*	Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral dan etika (S.2); *Upholding human values in carrying out duties based on religion, morals and ethics (S.2);*
	CPL3 *PLO 3*	Bekerjasama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan (S.6) *Being cooperative and having social sensitivity and concern for society and the environment (S.6).*
	CPL4 *PLO 4*	Mampu memelihara dan mengembangkan jaringan kerjasama dan hasil kerjasama di dalam maupun di luar lembaganya (KU.6) *Being able to maintain and develop cooperation networks and cooperation results within and outside the institution (KU.6).*
	Capaian Pembelajaran Mata Kuliah (CPMK) ***Course Learning Outcome (CLO)***	
	CPMK1 *CLO 1*	Memahami Filsafat (Tattwa) Hindu dalam membangun sraddha dan bhakti (iman dan taqwa) kepada Tuhan Yang Maha Esa (Sanghyang Widdhi Wasa). *Understanding Hindu Philosophy (Tattwa) in building sraddha and bhakti (faith and taqwa) to the Almighty God (Sanghyang Widdhi Wasa).*
	CPMK2 *CLO 2*	Memahami ajaran Etika Hindu untuk menjunjung tinggi nilai-nilai kemanusiaan dalam membentuk kepribadian yang jujur, taat hukum, kreatif, sehat dan adaptif.

		Understand the teachings of Hindu Ethics to uphold human values in forming an honest, law-abiding, creative, healthy and adaptive personality.
	CPMK3 *CLO 3*	Mampu mengamalkan Nilai-nilai Acara untuk meningkatkan moralitas dan spiritualitas Hindu. *Able to practice Event Values to enhance Hindu morality and spirituality.*
	CPMK4 *CLO 4*	Mampu mewujudkan nilai-nilai Hindu dalam pergaulan global. *Able to actualize Hindu values in global society.*
Peta CPL – CP MK ***Map of PLO - CLO***		

	CPL1	**CPL2**	**CPL3**	**CPL4**
CP MK 1 / SUB CP MK 1	√			
CP MK 2 / SUB CP MK 2	√	√		√
CP MK 3 / SUB CP MK 3			√	√
CP MK 4 /SUB CP MK 4		√	√	√

Deskripsi Singkat MK ***Short Description of Course***	Mata kuliah Pendidikan Agama Hindu membahas dan mendalami materi-materi dengan substansi relasi manusia dengan Hyang Widdhi (Tuhan yang Maha Esa) untuk peningkatan iman dan taqwa (Sraddha dan bhakti); relasi manusia dengan sesama manusia dalam membangunan peradaban yang humanis; serta relasi manusia dengan lingkungannya dalam mewujudkan kesejahteraan (jagadhita), sehingga mampu membentuk insan Hindu dan manusia Indonesia yang humanis mandiri, bertanggung jawab dan memiliki kepedulian. *The Hindu religion course discusses and explores materials with the substance of human relations with Hyang Widdhi (God Almighty) for increased faith and Taqwa (Sraddha and bhakti); human relations with fellow humans in building a humanist civilization; as well as human relations with their environment in creating welfare (jagadhita), so as to be able to form Hindu and Indonesian human beings who are independent, responsible and caring.*
Bahan Kajian: Materi pembelajaran	1. Tujuan dan Fungsi Pendidikan Agama Hindu 2. Sejarah agama Hindu 3. Brahmavidya/Teologi Hindu

Course Materials:	4. Veda 5. Manusia dalam perspektif Hindu 6. Etika/susila Hindu 7. Panca Maha Yadnya 8. Seni keagamaan 9. Kerukunan Beragama 10. Deradikalisasi Dalam Persepektif Hindu 1. *Purpose and function of Hindu religion course* 2. *History of Hinduism* 3. *Brahmavidya/Hindu Theology* 4. *Veda* 5. *Humans in Hindu perspective* 6. *Hindu ethics/morals* 7. *Yadnya* 8. *Religious art* 9. *Harmony* 10. *Deradicalization in Hindu perspective*
Pustaka ***References***	**Utama:** ***Main:*** **Utama** : ***Main:*** **Direktorat Jenderal Pembelajaran dan Kemahasiswaan, 2016, Pendidikan Agama Hindu untuk Perguruan Tinggi, Kemenristek Dikti RI**

	Pendukung: ***Supporting:*** 1. Singer, Wayan, 2012. Tattwa (Ajaran Ketuhanan Agama Hindu, Surabaya, Paramita 2. Tim Penyusun, 1997, Pendidikan Agama Hindu Untuk Perguruan Tinggi, Hanuman Sakti 3. Wiana, 1994, Bagaimana Hindu Menghayati Tuhan, Manikgeni . 4. Wiana, 1982, Niti Sastra, Ditjen Hindu dan Budha. 5. Titib, 1996, Veda Sabda Suci Pedoman Praktis Kehidupan, Paramita. 6. Pudja, 1997, Teologi Hindu, Mayasari
Dosen Pengampu ***Lecturers***	Ni Wayan Suarmini
Matakuliah syarat ***Prerequisites***	-

Mg Ke -/ ***Week***	**Kemampuan akhir tiap tahapan belajar (Sub-CPMK) /** ***Final ability of each learning stage (LLO)***	**Penilaian /** ***Assesment***		**Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] /** ***Form of Learning; Learning Method; Student Assignment; [Estimated Time]***	**Materi Pembelajaran [Pustaka] /** ***Learning Material [Estimated Time]***	**Bobot Penilaian (%) /** ***Assesment Load (%)***
		Indikator / ***Indicator***	**Kriteria & Teknik /** ***Criteria & Techniques***			

(1)	(2)	(3)	(4)	**Tatap Muka (5) / *Face to face (5)***	**Daring (6) / *Online***	(7)	(8)
1-2	CP MK1/Sub CP MK 1 Memahami Filsafat (Tattwa) Hindu dalam membangun sraddha dan bhakti (iman dan taqwa) kepada Tuhan Yang Maha Esa (Sanghyang Widdhi Wasa) *CLO 1/LLO 1: Understanding Hindu Philosophy (Tattwa) in building sraddha and bhakti (faith and taqwa) to the Almighty God (Sanghyang Widdhi Wasa).*	Memahami sejarah Unjuk Kerja Ketepatan waktu mengumpulkan berkas *Understanding history* *Performance* *Files submission punctuality*	Instrumen : Rubrik Teknik : Non Test (observasi sikap), Penilaian Essay penilaian teman *Instrument: Rubric* *Technique: Non Test (attitude observation)* *Essay assesmentl* *Peer assesmentl*	*Kuliah* *Kontrak kuliah* Ceramah bervariasi Tanya - jawab Tugas Individu: meresume tahap-tahap perkembangan Agama Hindu dari India samapai ke Indonesia 2x50 menit *Lecture* *Course contract* *Varying lecture* *Question and answer* *Individual assignment:*	Syncronous Learning Link : https://classroom.its.ac.id / 4x50 menit *Synchronous Learning Link:* https://classroom.its.ac.id / *4x50 minutes*	• Kontrak Kuliah • Pembentukan Kelompok • Pendahuluan Tujuan dan fungsi pendidikan agama Hindu, dalam membangun basis kepribadian humanis • Peran sejarah perkembangan agama Hindu dalam memberi pembelajaran yang positif. (Direktorat Jenderal Pembelajaran dan Kemahasiswaan, 2016, Pendidikan	7

				Make a summary about the stages of development of Hinduism from India to Indonesia *2x50 minutes*		Agama Hindu untuk Perguruan Tinggi, Kemenristek Dikti RI) • *Course Contract* • *Group formation* • *Introduction The purpose and function of Hindu religious education, in building the basis of a humanist personality* • *The historical role of Hinduism development in providing positive learning.* *(Direktorat Jenderal Pembelajaran dan*	

						Kemahasiswaan, 2016, Pendidikan Agama Hindu untuk Perguruan Tinggi, Kemenristek Dikti RI)	
3-5	CP MK1/Sub CP MK 1 Memahami Filsafat (Tattwa) Hindu dalam membangun sraddha dan bhakti (iman dan taqwa) kepada Tuhan Yang Maha Esa (Sanghyang Widdhi Wasa). *CLO 1/LLO 1:*	Ketepatan mengemukakan konsep, kemampuan menarik nilai Sloka berkaitan dengan membangun Sraddha dan Bhakti Ketepatan dalam mendeskripsikan *Accuracy in expressing concepts,*	Instrumen: Rubrik Teknik: Non Test (Tanya Jawab), Presentasi, Diskusi, penilaian essay, penilaian teman, Kuis *Instrument: Rubric*	Kuliah Ceramah bervariasi Tanya Jawab **Tugas Kelompok: Menganalisis sloka-sloka dalam Weda yang terkait dengan konsep Ketuhanan dalam rangka membangun Sraddha dan Bhakti**	Syncronous Learning Link : https://classroom.its.ac.id/ (8x50 mnt) *Link :* https://classroom.its.ac.id/	• Peran studi Veda dalam membangun pemahaman tentang eksistensi Veda sebagai kitab suci dan sumber hukum Hindu; kajian: konsep dan urgen studi Veda; sumber historis, sosiologis, politik dan filosofis studi	**12**

	Understanding Hindu Philosophy (Tattwa) in building sraddha and bhakti (faith and taqwa) to the Almighty God (Sanghyang Widdhi Wasa).	*the ability to draw Sloka values related to building Sraddha and Bhakti* *Descriptions accuracy*	*Technique: Non Test (question and answer), Presentation, Discussion, essay assesment, peer assesmentl, quiz*	**Tugas Individu: Mendeskripsikan konsep ajaran Brahmavidya (teologi) dalam membangun Sraddha dan Bhakti (Iman dan Taqwa)** **Kuis** ***Lecture*** ***Varying lecture*** ***Question and answer*** ***Group Assignment: Analyzing the verses in Veda related to the concept of Divinity in order to develop Sraddha and Bhakti***	*(8x50 minutes)*	Veda dan esensi dan urgensi studi Veda • Ajaran Brahmavidya dalam membangun sraddha dan bhakti (iman dan takwa); konsep ajaran Brahma Widya; sumber historis dan filosofis serta argumen pentingnya ajaran Brahma Widya • *The role of Vedic studies in building an understanding of the existence of the Veda as a holy book and source of Hindu*	

				Individual Assignment: Describing the concept of Brahmavidya teaching (theology) in developing Sraddha and Bhakti (Faith and Taqwa) ***Quiz***		*law;* *study: the concept and urgency of Vedic studies; historical, sociological, political and philosophical sources of Vedic studies and the essence and urgency of Vedic studies* • *Brahmavidya teachings on building sraddha and bhakti (faith and taqwa); the concept of Brahma Widya teachings; historical and philosophical sources as well as arguments for the*	

						importance of the teachings of Brahma Widya	
6/7	**CP Mk 2/Sub CP MK2 Memahami ajaran Etika Hindu untuk menjunjung tinggi nilai-nilai kemanusiaan dalam membentuk kepribadian yang jujur,taat hukum, kreatif, sehat dan adatif** ***CLO 2/LLO 2: Understand the teachings of Hindu Ethics to uphold human values in forming an honest, law-abiding, creative, healthy and adaptive personality.***	Bersikap taat, jujur dan kreatif Laporan (paper) sesuai dengan format Kemampuan analisis *Be obedient, honest and creative* *Report (paper) according to the format* *Analytical skills*	Instrumen : Rubrik Teknik: Non Tes (Observasi sakap), Presentasi, Diskusi, penilaian essay *Instrument: Rubric* *Technique: Non Test (attitude observation) Presentation, Discussion, essay assesmentl*	Kuliah **Ceramah bervariasi** **Tugas Kelompok: menganalisis Kepemimpinan dalam perspektif Nitisastra dengan teori kepemimpinan modern** *Lecture* ***Varying lecture*** ***Group Assignment: Analyzing leadership in the perspective of Nitisastra with modern leadership theory***	Syncronous /unsyncronousLearning Link : https://classroom.its.ac.id/ (4x50 menit) *Synchronous/ unsynchronous learning Link:* https://classroom.its.ac.id/ *(4x50 minutes)*	• Konsep manusia Hindu dalam membangun kepribadian yang berjiwa pemimpin, taat hukum, sehat, kreatif dan adatif; kajian: urgensi dan menggali sumber filosofis, teologis dan sosiologis tentang konsep manusia Hindu dalam membangun kepribadian Hindu • Manusia sebagai mahkluk sosial.	**8**

						• Membangun kesadaran mahasiswa sebagai makhluk sosial sesuai ajaran Hindu, bentuk kajian: konsep dan urgensi, sumber historis, sosiologis dan filosofis, cara membangun kesadaran mahasiswa sebagai makhluk sosial sesuai ajaran Hindu • *The Hindu human concept in building a personality that is leadership, law abiding, healthy,*	

						creative and adaptive; study: urgency and explore philosophical, theological and sociological sources of the Hindu human concept in building Hindu personality • *Humans as social creatures* • *Build student awareness as social beings according to Hindu teachings, study forms: concepts and urgency, historical, sociological and philosophical sources, how to build student awareness as*	

						social beings according to Hindu teachings	
8	CP MK 1 dan 2 / *CLO 1 and 2*	**Ujian Tengah Semester / *Midterm Exam***					**20**
9-10	**CP Mk 2/Sub CP MK2 Memahami ajaran Etika Hindu untuk menjunjung tinggi nilai-nilai kemanusiaan dalam membentuk kepribadian yang jujur,taat hukum, kreatif, sehat dan adatif** ***CLO 2/LLO 2:*** ***Understand the teachings of Hindu Ethics to uphold human values in forming an honest, law-abiding, creative, healthy and adaptive personality.***	berpendapat / bertanya sesuai konten Kemampuan mengeksplor nilai-nilai persahabatan dalam sloka *Argue / ask according to content Ability to explore friendship values in verse*	Instrumen: Rubrik Teknik: Non Test (Tanya Jawab), Diskusi, Penilaian essay, unjuk kerja *Instrument: Rubric Technique: Non Test (question and answer), Discussion, essay assesmentl, performance*	Kuliah **Ceramah bervariasi** **Tugas Individu ; mengidentifikasi dan menganalisis sloka-sloka dalam Weda yang membahas tentang persahabatan.** *Lecture* ***Varying lecture*** ***Individual Assignment: identify and analyze the Vedic verses that discuss friendship***	Syncronous /unsyncronousLearning Link : https://classroom.its.ac.id/ (4x50 menit) *Synchronous/ unsynchronous learning Link:* https://classroom.its.ac.id/ *(4x50 minutes)*	• Ajaran Etika/ susila Hindu dalam membangun moralitas manusia Hindu, kajian menelusuri konsep dan urgensi, menggali sumber teologi dan filosofis; dinamika dan tantangan ajaran susila Hindu dalam membangun moralitas Hindu • *Hindu ethics / ethics in*	**8**

						building Hindu morality, studies exploring concepts and urgency, exploring theological and philosophical sources; dynamics and challenges of Hindu morality in building Hindu morality	
11-13	**CP MK3/Sub CP MK3 Mampu mengamalkan Nilai-nilai Ritual Hindu untuk meninggkatkan moralitas dan spiritualitas Hindu**	Ketrampilan bertanya/menjawab Laporan (paper) sesuai dengan format Kemampuan analisis Laporan/paper Ketepatan Hasil analisis	Instrumen: Rubrik Teknik: Non Test (Tanya Jawab), Presentasi, Diskusi, penilaian essay, unjuk kerja	kuliah Ceramah bervariasi Diskusi **Tugas Kelompok: (Analisis kasus estetika yang terjadi dalam masyarakat)**	Syncronous /Asyncronous Learning Link : https://classroom.its.ac.id/ **[6X50 mnt]**	• Yadnya sebagai salah satu unsur keimanan (Sraddha) dalam Hindu dan juga merupakan ritus pembentukan kepribadian manusia Hindu • Yadnya dalam Weda	**12**

	CLO 3/LLO 3: ***Able to practice Hindu Ritual Values to enhance Hindu morality and spirituality***	*Asking / answering skills* *Report (paper) according to the format* *Analytical skills* *Report / paper* *Accuracy* *Analysis results*	*Instrument: Rubric* *Technique: Non Test (question and answer), Discussion, essay assesmentl, performance*	**Tugas Individu: identifikasi dan menganalisis seni sacral dan profan dalam membentuk kepribadian yang estetis** *Lecture* *Varying lecture* *Discussion* ***Group Assignment: (analysis of aesthetic cases in society)*** ***Individual Assignment: identify and analyze the sacred and profane arts in shaping an aesthetic personality***	*Synchronous/ unsynchronous learning* *Link:* https://classroom.its.ac.id/ ***[6x50 minutes]***	• Peran seni keagamaan dalam membentuk kepribadian yang estetis, kajian: konsep dan urgensi, sumber historis, sosiologis dan filosofis; dinamika dan tantangan seni keagamaan dalam membentuk kepribadian yang estetis • *Yadnya as one of the elements of faith (Sraddha) in Hinduism and is also a ritual for the formation*	

						of the Hindu human personality • *Yadnya in Veda* • *The role of religious art in shaping an aesthetic personality, studies: concepts and urgency, historical, sociological and philosophical sources; dynamics and challenges of religious art in shaping an aesthetic personality*	

14-15	CP MK4 / Sub CP MK4 **Mampu mewujudkan nilai-nilai Hindu dalam pergaulan global** ***CLO 4/LLO 4:*** ***Able to actualize Hindu values in global society.***	Laporan, kemampuan mendapatkan sumber Paper, kemampuan analisis *Reports, ability to obtain resources* *Paper, analytical skills*	Instumen: Rubrik Teknik: Test (Kuis), Presentasi, Diskusi, penilaian essay *Instrument: Rubric* *Technique: Non Test (question and answer), Presentation, Discussion, essay assesmentl*	kuliah Ceramah bervariasi Diskusi **Tugas Kelompok: mengidentifikasi konsep ajaran toleransi pada masing-masing agama** **Tugas Individu : menganalisis Fenomena yang terjadi dimasyarakat (militansi beragama yang sempit justru terjadi pada orang yang dikenal menguasai teologi agama)** *Lecture* *Varying lecture*	Syncronous /asyncronus Learning Link : https://classroom.its.ac.id/ **[**4X50 mnt**]** *Synchronous/ unsynchronous learning Link:* https://classroom.its.ac.id/ *[4x50 minutes]*	• Membangun kerukunan sesuai ajaran Hindu, bentuk kajian: konsep dan urgensi kerukunan dalam membangun masyarakat yang damai, sumber historis, sosiologi, politik dan filosofis; dinamika dan tantangan dalam membangun kerukunan • Membangunan kehidupan yang harmonis menurut Hindu, bentuk kajian konsep, urgensi keharmonisan	**8**

				Discussion ***Group Assignment: identify the concept of tolerance in each religion*** ***Individual Assignment: analyzing the phenomena that occur in society (narrow religious militancy actually occurs in people who are known to master religious theology)***		dalam membangun sikap deradikalisasi dalam masyarakat. • *Building harmony according to Hindu teachings, the form of study: the concept and urgency of harmony in building a peaceful society, historical, sociological, political and philosophical sources; dynamics and*	

						• *challenges in building harmony* • *Building a harmonious life according to Hinduism, the form of conceptual studies, the urgency of harmony in building a deradicalization attitude in society.*	
16	**CP MK 2, 3 dan 4 /** ***CLO 2, 3 and 4***	**Ujian Akhir Semester /** ***Final Exam***					**25**
	Jumlah / *Total*						**100**

Catatan sesuai dengan SN Dikti Permendikbud No 3/2020:

1. Capaian Pembelajaran Lulusan PRODI (CPL-PRODI) adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. CPL yang dibebankan pada mata kuliah adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, ketrampulan umum, ketrampilan khusus dan pengetahuan.

3. CP Mata kuliah (CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. Sub-CP Mata kuliah (Sub-CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. Indikator penilaian kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. Kreteria Penilaian adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kreteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kreteria dapat berupa kuantitatif ataupun kualitatif.
7. Teknik penilaian: tes dan non-tes.
8. Bentuk pembelajaran: Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. Metode Pembelajaran: *Small Group Discussion*, *Role-Play & Simulation*, *Discovery Learning*, *Self-Directed Learning*, *Cooperative Learning*, *Collaborative Learning*, *Contextual Learning*, *Project Based Learning*, dan metode lainnya yg setara.
10. Materi Pembelajaran adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. Bobot penilaian adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. **TM**=Tatap Muka, **PT**=Penugasan Terstuktur, **BM**=Belajar Mandiri.

3. RPS Pendidikan Pancasila/ *Semester Study Plan of Pancasila*

Rencana Pembelajaran Semester Pancasila

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **SUBDIREKTORAT KOORDINASI PERKULIAHAN BERSAMA**					**Kode Dokumen**
RENCANA PEMBELAJARAN SEMESTER / *SEMESTER LEARNING PLAN*						
MATA KULIAH (MK) ***COURSE***	**KODE** ***CODE***	**Rumpun MK** ***Course Cluster***	**BOBOT (sks)** ***Credits***		**SEMESTER** ***Semester***	**Tgl Penyusunan** ***Compilation Date***
Pancasila	UG. 184911	SKPB	2 sks	0	I/ II	3 Juni 2020
OTORISASI / PENGESAHAN ***AUTHORIZATION / ENDORSEMENT***	**Dosen Pengembang RPS** ***Developer Lecturer of Semester Learning Plan***		**Koordinator RMK** ***Course Cluster Coordinator***		**Ka DEPARTEMEN** ***Head of Department***	
Capaian Pembelajaran ***Learning Outcomes***	**CPL-PRODI yang dibebankan pada MK** ***PLO Program Charged to The Course***					
	CPL 1 (S3)	Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila *Contributing to improving the quality of life in society, nation, state, and advancement of civilization based on Pancasila*				
	CPL 2 (S5)	Menghargai keanekaragaman budaya, pandangan, agama dan kepercayaan serta pendapat atau temuan orisinal orang lain				

		Respect the diversity of cultures, views, religions and beliefs as well as the original opinions or findings of others
	CPL 3 (S6)	Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan *Work together and have social sensitivity and care for the community and the environment*
	CPL 4 (KU3)	Mampu mengkaji implikasi pengembangan atau implementasi ilmu pengetahuan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan keahliannya berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, gagasan, desain atau kritik seni *Able to study the implications of developing or implementing science technology that pays attention to and applies humanities values according to their expertise based on scientific principles, procedures and ethics in order to produce solutions, ideas, designs or art criticism.*

	Capaian Pembelajaran Mata Kuliah (CPMK) */ Course Learning Outcome (CLO)* Bila CP MK sbg penjabaran kemampuan setiap Tahap Pembelajaran dalam MK maka CPMK = Sub CPMK *If CLO as description capability of each Learning Stage in the course, then CLO = Lesson Learning Outcome (LLO)*	
	CP MK 1/Sub CPMK 1 *CLO1/LLO1*	Mampu memahami arti penting sejarah untuk memperkuat jati diri bangsa dan identitas nasional Indonesia *Able to understand the importance of history to strengthen national identity and Indonesian national identity*
	CP MK 2/Sub CPMK 2 *CLO2/LLO2*	Mampu menganalisis problem-problem faktual kebangsaan berdasarkan perspektif Pancasila *Able to analyze factual national problems based on the Pancasila perspective*
	CP MK 3/Sub CPMK 3 *CLO3/LLO3*	Mampu menganalisis konsep pengembangan sains dan teknologi berbasis nilai-nilai Pancasila *Able to analyze the concept of developing science and technology based on the values of Pancasila*
	CP MK 4/Sub CPMK 4 *CLO4/LLO4*	Mampu mempraktekkan kepekaan sosial, kepedulian lingkungan dan cinta tanah air *Able to practice social sensitivity, environmental awareness and love for the country*

Peta CPL – CP MK

Map of PLO - CLO

CPMK	CPL1	CPL2	CPL3	CPL4
CPMK 1		X	X	X
CPMK 2	X		X	X
CPMK 3	X	X		X
CPMK 4	X	X	X	

Diskripsi Singkat MK ***Short Description of Course***	Mata Kuliah Pancasila merupakan salah satu mata kuliah wajib umum/nasional. Dalam perkuliahan ini mahasiswa akan mendapatkan pengetahuan dan pengalaman belajar untuk meningkatkan pemahaman dan kesadaran tentang: rasa kebangsaan dan cinta tanah air melalui wawasan tentang Pancasila sehingga menjadi warganegara yang memiliki daya saing, serta berdisiplin tinggi dan berpartisifasi aktif dalam membangun kehidupan yang damai berdasarkan sistem nilai Pancasila. Setelah perkuliahan ini diharapkan mahasiswa mampu mewujudkan diri menjadi warga negara yang baik yang mampu mendukung bangsa dan negaranya. Warga negara yang cerdas, berkeadaban dan bertanggung jawab bagi kelangsungan hidup negara Indonesia dalam mengamalkan kemampuan ilmu pengetahun, teknologi dan seni yang dimilikinya. *This course provides knowledge of Pancasila, understand and examine experiences related to application of Pancasila into human lives. This course uses a various range of teaching methods, including classroom and practical learning, learning through community engagement, seminars, interactive discussion and group works. It aims to equip students with capacities to understand Pancasila from multi-perspectives: Pancasila within Indonesia historical context, Pancasila as national ideology, Pancasila as national principle, Pancasila viewed from ethical and philosophical contexts and Pancasila as the basis of science, technology and art development. This topic is also designed to improve students' ethical behaviour and personality as well as grow and build nationalism values and sense of patriotism*
Bahan Kajian: Materi pembelajaran ***Course Materials:***	1. Urgensi Pendidikan Pancasila di Indonesia 2. Pancasila dalam Perspektif Sejarah Bangsa Indonesia 3. Pancasila sebagai Dasar Negara Republik Indonesia 4. Pancasila sebagai Filsafat dan Ideologi negara 5. Pancasila sebagai Sistem Etika serta implementasi sila-sila Pancasila 6. Pancasila sebagai Nilai Dasar Pengembangan Sains dan teknologi di Indonesia 1. *The urgency of Pancasila in higher education* 2. *Pancasila and Indonesia history* 3. *Pancasila as the Indonesia national principle and national ideology* 4. *Pancasila as philosophy system*

	5. *Pancasila as ethic system* 6. *Pancasila as the foundation of science, technology and art development*
Pustaka ***References***	**Utama / *main*:** 1. Kemenristekdikti. 2016. *Pendidikan Pancasila Untuk Perguruan Tinggi.* Jakarta: Dirjen Belmawa Kementerian Dikti **Pendukung / *supporting*:** 1. Bahar, Saafroedin (ed). 1992. *Risalah Sidang Badan Penyelidik Usaha-Usaha Persiapan Kemerdekaan Indonesia (BPUPKI): Panitia Persiapan Kemerdekaan Indonesia (PPKI) 29 Mei – 19 Agustus 1945*. Jakarta: Sekretariat Negara Republik Indonesia. 2. Bertens, Kees. 2004. *Etika.* Jakarta: Gramedia. 3. Friedman, Thomas. 2006. The World is Flat: Sejarah Ringkas Abad ke 21. Jakarta: Dian Rakyat 4. Kattsof, Louis O. 1992. *Pengantar Filsafat.* Yogyakarta: Tiara Wacana. 5. Latif, Yudi. 2011. *Negara Paripurna*, Jakarta: PT. Gramedia Pustaka Utama. 6. Latif, Yudi. 2018. *Wawasan Pancasila: Bintang Penuntun Untuk Pembudayaan.* Jakarta: Mizan. 7. Magnis-Suseno, Franz. 2006. *Etika Politik: Prinsip-prinsip Moral Dasar Kenegaraan Modern*. Jakarta: Penerbit Gramedia Pustaka Utama. 8. Schwab, Klaus. 2016. The Fourth Industrial Revolution. New York: Crown Business. 9. Sukarno. 2001. *Tjamkan Pancasila Dasar Falsafah Negara*. Jakarta: Panitia Nasional Peringatan Lahirnya Pancasila 1 Juni 1945 – 1 Juni 1964. 10. Soedarso. 2014. *Filsafat Pancasila Identitas Indonesia*. Surabaya: Pustaka Radja.
Dosen Pengampu ***Lecturers***	Tim Dosen Pancasila ITS
Matakuliah syarat ***Prerequisite***	-

Mg ke/ ***Week***	**Kemampuan akhir tiap tahapan belajar (Sub-CPMK) /**	**Penilaian / *Assessment***		**Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] /** ***Form of Learning; Learning Method;***	**Materi Pembelajaran [Pustaka] /**	**Bobot Penilaian**
		Indikator / ***Indicator***	**Kriteria & Teknik /**			

	Final ability of each learning stage (LLO)		***Criteria & Techniques***	***Student Assignment; [Estimated Time]***		***Learning Material [Reference]***	***/Ass ess-ment Load (%)***
(1)	**(2)**	**(3)**	**(4)**	**Tatap Muka (5)**	**Daring (6)**	**(7)**	**(8)**
1,3	CPMK1: Memahami arti penting sejarah nasional dan Identitas Nasional bangsa Indonesia *CLO1: Understand the importance of national history and the National Identity of the Indonesian nation*	1.Komperhensif dalam identifikasi bentuk-bentuk kearifan lokal yang ada di Indonesia 2.Ketepatan dalam menjelaskan kronologi pengusulan, penyusunan, pengesahan Pancasila dan UUD 1945 *1. Comprehensive in identifying forms of local wisdom that exist in Indonesia* *2. Accuracy in explaining the chronology of the proposal,*	• **Instrumen Penilaian:** Rubrik • **Teknik Nontes:** Observasi (Sikap) Unjuk Kerja (Tugas) • ***Assessment Instruments:*** *Rubric* • ***Non-test technique****: Observation (Attitude) Performance (Duties)*	• **Bentuk:** Kuliah • **Metode** Diskusi [(TM: 1 minggu x (2sks x 50 menit)] • **Tugas 1:** Merangkum dan mensarikan proses Pengusulan, Perumusan, dan Pengesahan Pancasila dari Buku Sejarah BPUPKI • ***Form:*** *Lecture* • ***Method*** *Discussion*	• **Bentuk:** Kuliah tatap muka maya (via Zoom) • **Metode** Diskusi, Tanya Jawab [(TM: 1 minggu x (2sks x 50 menit)] • **Tugas 1:** Merangkum dan mensarikan proses Pengusulan, Perumusan, dan Pengesahan Pancasila dari Buku Sejarah BPUPKI • ***Form:*** *Face-to-face virtual lectures (via Zoom)*	• **Sumber Pustaka / *references*:** 1. Kemenristekdikti. 2016. *Pendidikan Pancasila Untuk Perguruan Tinggi.* Jakarta: Dirjen Belmawa Kementerian Dikti. • **Materi Pembelajaran :** Pancasila dalam perspektif sejarah Bangsa Indonesia • ***Learning materials:***	**10**

		preparation, ratification of the Pancasila and the 1945 Constitution		*[(TM: 1 week x (2sks x 50 minutes)]* • ***Task 1:*** *Summarize and summarize the process of Proposing, Formulating, and Ratifying Pancasila from the BPUPKI History Book*	• ***Method*** *Discussion, Question and Answer [(TM: 1 week x (2sks x 50 minutes)]* • ***Task 1:*** *Summarize and summarize the process of Proposing, Formulating, and Ratifying Pancasila from the BPUPKI History Book*	*Pancasila in the perspective of the history of the Indonesian nation*	
4-7	CPMK2: Mampu menganalisis problem-problem aktual kebangsaan *CLO2: Able to analyze actual national problems*	1. Ketepatan dalam menjelaskan konsep Pancasila sebagai ideologi dan dasar negara 2. Ketepatan dalam menyebutkan hubungan Pancasila dan UUD 1945 Keakuratan dalam menyebutkan dan memberikan solusi	• **Instrumen Penilaian:** Rubrik • **Teknik Tes:** Unjuk Kerja (Tugas) • ***Assessment Instruments:*** *Rubric* • ***Test technique****:*	• **Bentuk:** 1. Kuliah 2. Responsi • **Metode** 1. Diskusi 2. *Discovery Learning* [(TM: 2 minggu x (2sks x 50 menit)] • **Tugas 1:** Membuat kajian film “71 Into the	• **Bentuk:** Kuliah tatap muka maya (via Zoom) Responsi (via Classroom) [(TM: 2 minggu x (2sks x 50 menit)] • **Tugas 1:** Membuat kajian film “71 Into the	• **Sumber Pustaka / *references*:** 1. Kemenristek dikti. 2016. *Pendidikan Pancasila Untuk Perguruan Tinggi.* Jakarta: Dirjen Belmawa	**15**

		persoalan-persoalan SARA di Indonesia *1. Accuracy in explaining the Pancasila concept as the ideology and basis of the state* *2. Accuracy in mentioning the relationship between Pancasila and the 1945 Constitution* *Accuracy in mentioning and providing solutions to SARA problems in Indonesia*	*Performance (Assigment)*	Fire" dalam perspektif ideologi • **Tugas 2:** Presentasi kelompok dengan tema "Pancasila sebagai Ideologi" [(PT+BM: (2+2) x (2sks x 60 menit)] •***Form*:** *1. Lecture* *2. Responsiveness* •***Method*** *1. Discussion* *2. Discovery Learning* *[(TM: 2 weeks x (2sks x 50 minutes)]* •***Task 1:*** *Making a study of the film "71 Into the Fire" from an ideological perspective* • ***Task 2:*** *Group presentation with the theme "Pancasila as an Ideology"*	Fire" dalam perspektif ideologi • **Tugas 2:** Presentasi kelompok dengan tema "Pancasila sebagai Ideologi" [(PT+BM: (2+2) x (2sks x 60 menit)] •***Form:*** *1. Face-to-face virtual lectures (via Zoom)* *2. Responsiveness (via Classroom)* *[(TM: 2 weeks x (2sks x 50 minutes)]* •***Task 1:*** *Making a study of the film "71 Into the Fire" from an ideological perspective* • ***Task 2:*** *Group presentation with the theme "Pancasila as an Ideology"*	Kementerian Dikti. 2. Bahar, Saafroedin (ed). 1992. *Risalah Sidang (BPUPKI): (PPKI)* Jakarta: Sekretariat Negara Republik Indonesia. • **Materi Pembelajaran:** 1. Pancasila sebagai Dasar Negara Republik Indonesia 2. Pancasila sebagai Ideologi •***Learning materials:***	

				[(PT + BM: (2 + 2) x (2sks x 60 minutes)]	*[(PT + BM: (2 + 2) x (2sks x 60 minutes)]*	*1. Pancasila as the basis of the Republic of Indonesia* *2. Pancasila as ideology*	
8	Evaluasi tengah semester / *Midterm Exam*						**20**
9-12	CPMK3: Mampu menganalisis persoalan-persoalan sains dan teknologi berbasis nilai-nilai Pancasila *CLO3: Able to analyze science and technology issues based on Pancasila values*	1. Ketepatan dalam menganalis pengertian sains 2.Kelengkapan dan keakuratan dalam menganilisis problematika teknologi dan sains berbasis nilai-nilai Pancasila *1. Accuracy in analyzing the understanding of science* *2. Completeness and accuracy in analyzing technology and science*	• **Instrumen Penilaian:** Rubrik • **Teknik Nontes:** Observasi Unjuk Kerja • ***Assessment Instruments:*** *Rubric* • ***Non-test technique****: Observation Performance*	• **Bentuk:** Kuliah • **Metode** 1. Diskusi 2. *Small Group Disussion* 3. *Contextual Learning* [(TM: 2 minggu x (2sks x 50 menit)] • **Tugas 1:** Mengkaji video dalam perspektif etika https://www.youtube.com/watch?v=8dnVZibrV6g • **Tugas 2:** Presentasi kelompok dengan tema “Pancasila	• **Bentuk Kuliah** • **Metode:** 1. Diskusi 2. *Small Group Disussion* 3. *Contextual Learning* [(TM: 2 minggu x (2sks x 50 menit)] • **Tugas 1:** Mengkaji video dalam perspektif etika https://www.youtube.com/watch?v=8dnVZibrV6g • **Tugas 2:** Presentasi kelompok dengan tema “Pancasila	• **Sumber Pustaka / *references*::** 1. Kemenristek dikti. 2016. *Pendidikan Pancasila Untuk Perguruan Tinggi.* Jakarta: Dirjen Belmawa Kementerian Dikti. 2. Latif, Yudi. 2018. *Wawasan Pancasila: Bintang*	**10**

		problems based on Pancasila values		sebagai sistem Etika" [(PT+BM: (2+2) x (2sks x 60 menit)] • ***Form:*** *Lecture* • ***Method*** *1. Discussion 2. Small Group Discussion 3. Contextual Learning [(TM: 2 weeks x (2sks x 50 minutes)]* • ***Task 1:*** *Reviewing videos from an ethical perspective https://www.youtube.com/watch?v=8dnVZibrV6g* • ***Task 2:*** *Group presentation with the theme "Pancasila as an Ethical System"* ***[(PT + BM: (2 + 2) x (2sks x 60 minutes)]***	sebagai sistem Etika" (via zoom) [(PT+BM: (2+2) x (2sks x 60 menit)] • ***Form:*** *Lecture* • ***Method*** *1. Discussion 2. Small Group Discussion 3. Contextual Learning [(TM: 2 weeks x (2sks x 50 minutes)]* • ***Task 1:*** *Reviewing videos from an ethical perspective https://www.youtube.com/watch?v=8dnVZibrV6g* • ***Task 2:*** *Group presentation with the theme "Pancasila as an*	*Penuntun Untuk Pembudayaan.* Jakarta: Mizan. 3. Kattsof, Louis O. 1992. Pengantar Filsafat. Yogyakarta: Tiara Wacana. 4. Bertens, Kees. 2004. *Etika.* Jakarta: Gramedia. **Materi Pembelajaran:** 1. Pancasila sebagai sistem Filsafat 2. Pancasila sebagai sistem Etika Pancasila sebagai dasar	

					Ethical System" (via zoom) ***[(PT + BM: (2 + 2) x (2sks x 60 minutes)]***	Pengembangan Ilmu *Learning materials:* *1. Pancasila as a system of philosophy* *2. Pancasila as an Ethics system* *Pancasila as the basis for Science Development*	
13-15	CPMK4: Memiliki kepekaan sosial, kepedulian lingkungan dan cinta tanah air *CLO4: Have social sensitivity, care for the environment and love the country*	1. Keakuratan dalam menjelaskan implementasi 2. Kelengkapan dan keakuratan dalam mengimplementasikan sikap cinta tanah air dan kepedulian lingkungan yang dituangkan dalam *project*	• **Instrumen Penilaian:** Rubrik • **Teknik Nontes:** Observasi Unjuk Kerja • ***Assessment Instruments:*** *Rubric* • ***Non-test technique****: Observation Performance*	• **Bentuk:** Kuliah • **Metode** 1. Diskusi 2. *Contextual Learning* [(TM: 1 minggu x (2sks x 50 menit)] • **Tugas 1:** Penugasan kelompok dengan membuat video berdasarkan tema kelompok dengan jenis: reportase, *short movie, documenter.*	• **Kuliah tatap muka maya (via Zoom):** 1. Diskusi 2. *Small Group Disussion* 3. *Contextual Learning* [(TM: 2 minggu x (2sks x 50 menit)] • **Tugas 1:** Penugasan kelompok dengan membuat video berdasarkan tema kelompok dengan jenis:	• **Sumber Pustaka / references:** 1. Kemenristek dikti. 2016. *Pendidikan Pancasila Untuk Perguruan Tinggi.* Jakarta: Dirjen Belmawa Kementerian Dikti.	**20**

		1. *Accuracy in explaining implementation* 2. *Completeness and accuracy in implementing the love of the country and environmental care as outlined in the project*		[(PT+BM: 1+1) x (1sks x 60 menit)] • ***Form:*** *Lecture* • ***Method*** *1. Discussion* *2. Contextual Learning* *[(TM: 2 weeks x (2sks x 50 minutes)]* • ***Task 1:*** *Assignment of groups by making videos based on group themes by type: reportage, short movie, documentary.* ***[(PT + BM: (2 + 2) x (2sks x 60 minutes)]***	reportase, *short movie, documenter.* https://www.youtube.com/watch?v=Xo2VjprfgEU [(PT+BM: 1+1) x (1sks x 60 menit)] • ***Face-to-face virtual lectures (via Zoom):*** *1. Discussion* *2. Small Group Discussion* *3. Contextual Learning* *[(TM: 2 weeks x (2sks x 50 minutes)]* •***Task 1****:* *Assignment of groups by making videos based on group themes by type: reportage, short movie, documentary. https://www.youtube.com/watch?v=Xo2VjprfgEU*	2. Bertens, Kees. 2004. *Etika.* Jakarta: Gramedia. 3. Friedman, Thomas. 2006. *The World is Flat: Sejarah Ringkas Abad ke 21*. Jakarta: Dian Rakyat 4. Schwab, Klaus. 2016. The Fourth Industrial Revolution. New York: Crown Business. • **Materi Pembelajaran:** 1. Pancasila sebagai	

					[(PT + BM: 1 + 1) x (1sks x 60 minutes)]	sistem Etika Pancasila sebagai dasar Pengembangan Ilmu ***Learning materials:*** *1.. Pancasila as an Ethics system Pancasila as the basis for Science Development*	
15, 16	**Evaluasi Akhir Semester / *Final Exam***						**25**

4. RPS Bahasa Indonesia/ *Semester Study Plan of Indonesian Languange*

<table>
<tr><td></td><td colspan="6">INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
SUBDIREKTORAT KOORDINASI PERKULIAHAN BERSAMA</td><td>Kode Dokumen</td></tr>
<tr><td colspan="8">RENCANA PEMBELAJARAN SEMESTER / SEMESTER LEARNING PLAN</td></tr>
<tr><td colspan="2">MATA KULIAH (MK)
COURSE</td><td>KODE
CODE</td><td>Rumpun MK
Course Cluster</td><td colspan="2">BOBOT (sks)
Credits</td><td>SEMESTER
Semester</td><td>Tgl Penyusunan
Compilation Date</td></tr>
<tr><td colspan="2">Bahasa Indonesia
Indonesian language</td><td>UG 184912</td><td>SKPB</td><td>2</td><td>0</td><td>I / II</td><td>13 Juli 2020</td></tr>
<tr><td colspan="2" rowspan="2">OTORISASI / PENGESAHAN
AUTHORIZATION / ENDORSEMENT</td><td colspan="2">Dosen Pengembang RPS
Developer Lecturer of Semester Learning Plan</td><td colspan="2">Koordinator RMK
Course Cluster Coordinator</td><td colspan="2">Ka DEPARTEMEN
Head of Department</td></tr>
<tr><td colspan="2">Eka Dian Savitri, S.Hum., M.A.
Drs. Edy Subali, M.Pd.
Drs. Marsudi, M.PD.
Dra. Enie Hendrajati, M.Pd.
Dra. Siti Zahrok, M.Pd.</td><td colspan="2">Eka Dian Savitri, S.Hum., M.A.</td><td colspan="2"></td></tr>
<tr><td rowspan="3">Capaian Pembelajaran

Learning Outcomes</td><td colspan="2">CPL-PRODI yang dibebankan pada MK
PLO Program Charged to The Course</td><td colspan="5"></td></tr>
<tr><td>S8</td><td colspan="6">Menginternalisasi nilai, norma, dan etika akademik;

Internalizing values, norms, and academic attitude</td></tr>
<tr><td>KU9</td><td colspan="6">Mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi</td></tr>
</table>

		Documenting, storing, securing, and recovering data to ensure validity and prevent plagiarism
	KU1	Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya *Able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with their field of expertise*
	Capaian Pembelajaran Mata Kuliah (CPMK) */ Course Learning Outcome (CLO)* Bila CP MK sbg penjabaran kemampuan setiap Tahap Pembelajaran dalam MK maka CPMK = Sub CPMK *If CLO as description capability of each Learning Stage in the course, then CLO = Lesson Learning Outcome (LLO)*	
	CPMK1/SubCPMK 1 *LLO1*	Mampu menjelaskan dan menerapkan etika akademik dengan benar dalam menyusun KTI; *Able to explain and apply academic ethics correctly in preparing KTI;*
	CPMK2/ SubCPMK2 *LLO2*	Mampu menemukan, menyimpan, dan mengolah referensi melalui aplikasi mendeley untuk menghindari plagiasi; *Able to find, store, and process references through the Mendeley application to avoid plagiarism;*
	CPMK3/ SubCPMK3 *LLO3*	Mampu menjelaskan dan/atau memberikan contoh sistematika, formulasi bahasa Indonesia yang digunakan dalam KTI dengan memperhatikan kaidah gramatika, PUEBI, dan KBBI; *Able to explain and / or provide systematic examples, Indonesian language formulations used in KTI with due observance of grammatical rules, PUEBI, and KBBI;*

	CPMK4/ SubCPMK4 *LLO4*	Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam penyusunan KTI bagian pendahuluan dengan menggunakan bahasa Indonesia yang baik dan benar *Able to apply logical, critical, systematic, and innovative thinking in the preparation of the introductory KTI using good and correct Indonesian.*
	CPMK4/ SubCPMK5 *LLO5*	Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam penyusunan KTI bagian hasil dan pembahasan dengan menggunakan bahasa Indonesia yang baik dan benar *Able to apply logical, critical, systematic, and innovative thinking in the compilation of the KTI results and discussion sections using good and correct Indonesian.*
	CPMK4/ SubCPMK6 *LLO6*	Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam penyusunan KTI bagian kesimpulan dengan menggunakan bahasa Indonesia yang baik dan benar *Able to apply logical, critical, systematic, and innovative thinking in the preparation of KTI conclusions using good and correct Indonesian.*
	CPMK5/ SubCPMK7	Mampu mempresentasikan hasil penyusunan KTI secara lisan sesuai prinsip komunikasi efektif *Able to present the results of the preparation of KTI orally according to the principles of effective communication*.
Peta CPL – CP MK *Map of PLO - CLO*		

	S8	KU1	KU9
Sub-CPMK1	√		
Sub-CPMK2	√		√
Sub-CPMK3	√		√
Sub-CPMK4	√	√	√
Sub-CPMK5	√	√	√
Sub-CPMK6	√	√	√

	Sub-CPMK7 | √ | √ | √
Diskripsi Singkat MK *Short Description of Course*	Mata kuliah bahasa Indonesia termasuk salah satu mata kuliah wajib umum/nasional. Mahasiswa akan mendalami materi perkuliahan meliputi: (a) etika akademik; (b) teknik pereferensian; (c) sistematika KTI dan formulasi bahasa Indonesia yang digunakan dalam KTI dengan memperhatikan kaidah gramatika, PUEBI, dan KBBI; (d) penyusunan KTI secara logis, kritis, sistematis, dan inovatif dengan menggunakan bahasa Indonesia yang baik dan benar; (e) teknik presentasi efektif. Materi yang dipelajari bermanfaat dalam menyusun karya tulis ilmiah baik berupa tugas perkuliahan, laporan penelitian, maupun karya tulis ilmiah yang dikompetisikan. *The Indonesian language course is one of the general / national compulsory courses. Students will explore lecture materials including: (a) academic ethics; (b) referencing techniques; (c) Systematics of Scientific Writing (KTI) and Indonesian language formulations used in KTI with due observance of grammar, PUEBI, and KBBI principles; (d) structuring KTI logically, critically, systematically, and innovatively by using good and correct Indonesian; (e) effective presentation techniques. The material studied is useful in compiling scientific papers in the form of lecture assignments, research reports, as well as competed scientific papers.*
Bahan Kajian: Materi pembelajaran *Course Materials:*	1. Etika akademik penulisan karya ilmiah. 2. Teknik pereferensian dan aplikasi mendeley untuk sistem pereferensian. 3. Sistematika, gaya selingkung, dan kaidah gramatika bahasa Indonesia dalam KTI. 4. Presentasi efektif. *1. Academic writing of scientific papers.* *2. Reference techniques and Mendeley applications for reference systems.* *3. Systematics, selingkung style, and grammatical rules for the Indonesian language in KTI.* *4. Effective presentation.*
Pustaka *References*	Utama / *main*:

	1. Alwi, Hasan, 2007, *Tata Bahasa Baku Bahasa Indonesia*, Edisi Ketiga, Balai Pustaka: Jakarta. 2. Dirjen Pembelajaran dan Kemahasiswaan Kemenristekdikti, *Bahasa Indonesia untuk Perguruan Tinggi*, 2016, Jakarta, Dirjen Belmawa. 3. *Kamus Besar Bahasa Indonesia* (daring atau luring), Kemdikbud RI, https://kbbi.kemdikbud.go.id/ 4. *Pedoman Umum Ejaan Bahasa Indonesia* (PUEBI), 2016, http://badanbahasa.kemdikbud.go.id/lamanbahasa/sites/default/files/PUEBI.pdf Pendukung/ *supporting*: 1. Pratapa, Suminar, 2018, *Etika ilmiah, Hak cipta, dan Plagiarisme*. *2.* Rosmawaty, 2017, *Menulis Karya Ilmiah, 2017.* 3. The Structure, Format, Content, and Style of a Journal-Style Scientific Paper, Bates Collage, http://jrtdd.com/wp-content/uploads/2018/05/How-to-Write-a-Paper-in-Scientific-Journal-Style-and-Format.pdf
Dosen Pengampu ***Lecturers***	Tim Dosen Bahasa Indonesia ITS
Matakuliah syarat *Prerequisite*	-

Mg ke/ *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / *Final ability of each learning stage (LLO)*	Penilaian / *Assessment*		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / *Form of Learning; Learning Method; Student Assignment; [Estimated Time]*		Materi Pembelajaran [Pustaka] / *Learning Material [Reference]*	Bobot Penilaian */Assess-ment Load* (%)
		Indikator / *Indicator*	Kriteria & Teknik / *Criteria & Techniques*				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1-2	Sub-CPMK1: Mampu menjelaskan secara tepat	1.1 Ketepatan menjelaskan konsep	Kriteria:	Kuliah: Diskusi kelompok,	Kuliah tatap muka maya. MyITS-	• Kontrak perkuliahan	10

	konsep etika akademik dalam menyusun KTI; *LLO1: Able to explain accurately the concept of academic ethics in preparing KTI;*	etika ilmiah, hak cipta, dan plagiarisme 1.2 Ketepatan menjelaskan jenis-jenis kutipan beserta contohnya untuk menghindari plagiarisme *1.1 Accuracy in explaining the concepts of scientific ethics, copyright, and plagiarism* *1.2 Accuracy explains the types of citations and examples to avoid plagiarism*	Rubrik pemahaman etika akademik dan plagiarisme Teknik nontes: Observasi dan unjuk kerja diskusi kelompok tentang etika llmiah dan plagiarisme Criteria: Rubric for understanding academic ethics and plagiarism Non-test technique: Observation and performance of group discussions on scientific ethics and plagiarism	[TM: 2mgx(2sksx50")] • Tugas 1: Menjawab soal materi etika ilmiah, hak cipta , dan plagiarisme. [PT+BM:(2+2)x(2x60")] • *Lectures:* • *Group discussion, [TM: 2weekx(2sksx50")]* • *Task 1: Answering questions about scientific ethics, copyright, and plagiarism* *[PT+BM:(2+2)x(2x60")]*	Classroom: sinkron dan asinkron; Diskusi kelompok; [TM: 2xmg(2x50")] • Tugas 1: Menjawab soal materi etika ilmiah, hak cipta , dan plagiarisme. [PT+BM:(2+2)x(2x60")] • *Virtual face-to-face lectures. MyITS-Classroom: synchronous and asynchronous;* •*Group discussion; [TM: 2xweek(2x50")]* •*Task 1: Answering questions about scientific ethics, copyright, and plagiarism.*	• Tujuan belajar KTI • artikel "Etika ilmiah, hak cipta, dan plagiarisme" oleh Prof. Suminar. • Jenis-jenis kutipan. (materi tersedia di myitsclassroom) • *Course contract* • *KTI learning objectives* • *the article "Scientific ethics, copyright, and plagiarism" by Prof. Suminar.* • *Types of citations. (material is available on myitsclassroom*	

					[PT+BM:(2+2)x(2x60")]		
3-4	Sub-CPMK 2: Mampu menemukan, menyimpan, dan mengelola referensi melalui aplikasi mendeley untuk menghindari plagiasi; *LLO2: Able to find, store and manage references through the Mendeley application to avoid plagiarism;*	1.1 Ketepatan menelusuri referensi kredibel 1.2 ketepatan mengelola referensi dengan menggunakan aplikasi mendeley *1.1 Accuracy of tracing credible references* *1.2 the accuracy of managing references using the Mendeley application*	Kriteria Rubrik praktik mengelola referensi dan kutipan menggunakan mendeley Teknik nontes Observasi dan unjuk kerja Menelusuri artikel penelitian yang kredibel Mengelola aplikasi mendeley *Criteria* *Practical rubric managing references and*	Kuliah Tutorial menggunakan mendeley [TM: 2mgx(2sksx50")] Tugas 2: Membuat video penelusuran referensi kredibel dan praktik mengelola referensi menggunakan mendeley. Tugas diunggah ke youtube. [PT+BM:(2+2)x(2x60")] • *Lectures* • *Tutorial using Mendeley* *[TM: 2mgx(2sksx50")]* • *Task 2:* *Create credible reference tracking videos and practice*	Kuliah tatap muka maya. MyITS-Classroom: sinkron dan asinkron Tutorial menggunakan mendeley [TM: 2mgx(2sksx50")] Tugas 2: Membuat video penelusuran referensi kredibel dan praktik mengelola referensi menggunakan mendeley. Tugas diunggah ke youtube [PT+BM:(2+2)x(2x60")] • *Virtual face-to-face lectures. MyITS-Classroom:*	Tutorial mendeley: • *Mendeley tutorial:* https://www.youtube.com/watch?v=Gv6_HuCYExM Link penelusuran referensi: *Reference search link:* http://gen.lib.rus.ec/scimag/ http://e-resources.perpusnas.go.id/ http://sinta.ristekbrin.go.id/journals	10

			citations using mendeley *Non-test technique* *Observation and performance* *Browse credible research articles* *Manage Mendeley applications*	*managing references using mendeley. Tasks are uploaded to youtube.* *[PT+BM:(2+2)x(2x60")]*	*synchronous and asynchronous* • *Tutorial using Mendeley* *[TM: 2weekx(2sksx50")]* • *Task 2:* *Create credible reference tracking videos and practice managing references using mendeley. Tasks are uploaded to youtube* *[PT+BM:(2+2)x(2x60")]*		
5-6	Sub-CPMK3: Mampu menjelaskan dan/atau memberikan contoh sistematika, formulasi bahasa Indonesia yang digunakan dalam artikel jurnal ilmiah dengan memperhatikan kaidah gramatika, PUEBI, dan KBBI;	Ketepatan mengidentifikasi sistematika KTI (artikel jurnal ilmiah) Ketepatan mengidentifikasi gaya penulisan KTI (artikel jurnal ilmiah)	Kriteria: Rubrik Teknik nontes: Observasi & unjuk kerja Mengidentifikasi sistematika KTI	Kuliah: Diskusi kelompok, [TM: 2mgx(2sksx50")] • Tugas 3: Review artikel penelitian berdasarkan	Kuliah tatap muka maya. MyITS-Classroom: sinkron dan asinkron; Diskusi kelompok, [TM: 2x(2x50")] Tugas 3: Review artikel penelitian	Materi "Menulis Karya Ilmiah" oleh Prof. Rosmawati (tersedia di MyITSClassroom) Link penulisan artikel jurnal ilmiah:	10

	LLO3: Able to explain and / or provide systematic examples, Indonesian language formulations used in scientific journal articles by paying attention to the rules of grammar, PUEBI, and KBBI;	Keaktifan kerja kelompok; *Accuracy in identifying the systematics of KTI (scientific journal articles)* *Accuracy in identifying the writing style of KTI (scientific journal articles)* *Active group work;*	(artikel jurnal ilmiah). Mengidentifikasi gaya selingkung penulisan KTI (artikel jurnal ilmiah). *Criteria:* *Rubric* *Non-test technique:* • *Observation & performance* *Identifying the systematics of KTI (scientific journal articles).* *Identify the style of writing KTI (scientific journal articles).*	sistematika dan gaya selingkungnya [PT+BM:(2+2)x(2x60")] *Lectures:* *Group discussion,* *[TM: 2weekx (2sksx50 ")]* • *Task 3:* - *Review research articles based on the systematics and styles of the environment* *[PT + BM: (2 + 2) x (2x60 ")]*	berdasarkan sistematika dan gaya selingkungnya [PT+BM:(2+2)x(3x60")] • *Virtual face-to-face lectures. MyITS-Classroom: synchronous and asynchronous;* • *Group discussion,* *[TM: 2wekx(2x50")]* *Task 3:* - *Review research articles based on the systematics and styles of the environment* *[PT+BM:(2+2)x(3x60")]*	*Material "Writing Scientific Papers" by Prof. Rosmawati (available at MyITSClassroom)* *Links to writing scientific journal articles:* https://www.youtube.com/watch?v=MTYcPNQzBCg Penelurusan artikel jurnal ilmiah di *Search for scientific journal articles at* www.sciencedirect.com , www.sagepublication.com ,	

						www.springer.com , http://sinta.ristekbrin.go.id/journals	
7-8	Sub-CPMK4: Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam penyusunan KTI bagian judul dan pendahuluan dengan menggunakan bahasa Indonesia yang baik dan benar *LLO4: Able to apply logical, critical, systematic, and innovative thinking in the preparation of the KTI section title and introduction by using good and correct Indonesian*	1.1 Ketepatan menyusun judul dan pendahuluan berisi latar belakang, tujuan, dan metode 1.2 Ketepatan menggunakan formulasi bahasa Indonesia sesuai prinsip bahasa Indonesia ilmiah *1.1 Accuracy in preparing the title and introduction to the background, objectives and methods* *1.2 Accuracy in using Indonesian formulations according to scientific Indonesian principles*	Kriteria Rubrik penyusunan artikel jurnal ilmiah bagian judul dan pendahuluan Teknik nontes Observasi dan unjuk kerja Menyusun judul dan bab pendahuluan *Criteria* *Rubric for the preparation of scientific journal*	Kuliah, Diskusi kelompok, [TM: 2mgx(2sksx50")] • Tugas 4: Menyusun karangan berupa judul, latar belakang, tujuan, tinjauan pustaka/studi literatur, dan metode [PT+BM:(2+2)x(2x60")] • *Lectures,* • *Group discussion,* *[TM: 2weekx (2sksx50 ")]* • *Task 4:* *- Compile an essay in the form of a title,*	Kuliah tatap muka maya. MyITS-Classroom: sinkron dan asinkron; Diskusi kelompok, [TM: 2x(2x50")] Tugas 4: Menyusun karangan berupa judul, latar belakang, tujuan, tinjauan pustaka/studi literatur, dan metode [PT+BM:(2+2)x(3x60")] • *Virtual face-to-face lectures. MyITS-Classroom:*	Materi: -Kamberlis *Handout* (tersedia di MyITSClassroom) *Materi:* *-Kamberlis Handout (tersedia di MyITSClassroom)*	10

			articles, the title and introduction *Non-test technique Observation and performance* *Prepare an introductory title and chapter*	*background, objectives, literature review / literature study, and methods* *[PT + BM: (2 + 2) x (2x60 ")]*	*synchronous and asynchronous;* • *Group discussion,* *[TM: 2x(2x50")]* *Task 4:* *Compiling essays in the form of titles, backgrounds, objectives, literature reviews / literature studies, and methods* *[PT+BM:(2+2)x(3x60")]*		
9-10	Sub-CPMK5: Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam penyusunan KTI bagian hasil dan pembahasan dengan menggunakan bahasa Indonesia yang baik dan benar *LLO5: Able to apply logical, critical, systematic, and innovative thinking in the*	1.1 Ketepatan menyusun hasil dan pembahasan 1.2 Ketepatan menggunakan formulasi bahasa Indonesia sesuai prinsip bahasa Indonesia ilmiah *1.1 Accuracy in compiling results and discussion*	Kriteria Rubrik penyusunan artikel jurnal ilmiah bagian hasil dan pembahasan Teknik nontes Observasi dan unjuk kerja	Kuliah, Diskusi kelompok, [TM: 2mgx(2sksx50")] • Tugas 5: Menyusun karangan bab hasil dan pembahasan [PT+BM:(2+2)x(2x60")] • *Lectures,*	Kuliah tatap muka maya. MyITS-Classroom: sinkron dan asinkron; Diskusi kelompok, [TM: 2x(2x50")] Tugas 4: Menyusun karangan bab hasil dan pembahasan [PT+BM:(2+2)x(3x60")]	PPT review contoh artikel jurnal bagian hasil dan pembahasan (tersedia di MyITSClassroom) *PPT review sample journal article results and discussion section*	10

	preparation of KTI for the results and discussion sections by using good and correct Indonesian	*1.2 Accuracy in using Indonesian formulations according to scientific Indonesian principles*	Menyusun bab hasil dan pembahasan *Criteria* *Rubric for the preparation of scientific journal articles for the results and discussion section* *Non-test technique* *Observation and performance* *Arrange the results and discussion chapters*	• *Group discussion,* *[TM: 2weekx (2sksx50 ")]* • *Task 5:* *- Compiling an essay on the results and discussion chapters* *[PT + BM: (2 + 2) x (2x60 ")]*	• *Virtual face-to-face lectures. MyITS-Classroom: synchronous and asynchronous;* • *Group discussion,* *[TM: 2x(2x50")]* *Task 4:* *Compile an essay on the results and discussion chapters[PT+BM:(2+2)x(3x60")]*	*(available at MyITSClassroom)*	
11	Sub-CPMK6: Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam penyusunan	1.1 Ketepatan menyusun kesimpulan 1.2 Ketepatan menggunakan	Kriteria Rubrik penyusunan artikel jurnal	Kuliah, Diskusi kelompok, [TM: 1mgx(2sksx50")]	Kuliah tatap muka maya. MyITS-Classroom: sinkron dan asinkron;	PPT review contoh artikel jurnal bagian kesimpulan	10

	KTI bagian kesimpulan dengan menggunakan bahasa Indonesia yang baik dan benar *LLO6: Able to apply logical, critical, systematic, and innovative thinking in the preparation of the KTI conclusion by using good and correct Indonesian*	formulasi bahasa Indonesia sesuai prinsip bahasa Indonesia ilmiah *1.1 Accuracy in drawing conclusions* *1.2 Accuracy in using Indonesian formulations according to scientific Indonesian principles*	ilmiah bagian kesimpulan Teknik nontes Observasi dan unjuk kerja Menyusun bab kesimpulan *Criteria* *The rubric for the preparation of scientific journal articles for the conclusion* *Non-test technique* *Observation and performance* *Develop a conclusion chapter*	• Tugas 6: Menyusun karangan bab kesimpulan [PT+BM:(1+1)x(2x60")] • *Lectures,* • *Group discussion,* *[TM: 1weekx (2sksx50 ")]* • *Task 6:* *- Compile a concluding chapter essay* *[PT + BM: (1 + 1) x (2x60 ")]*	Diskusi kelompok, [TM: 1x(2x50")] Tugas 5: Menyusun karangan bab kesimpulan [PT+BM:(1+1)x(3x60")] • *Virtual face-to-face lectures. MyITS-Classroom: synchronous and asynchronous;* • *Group discussion,* *[TM: 1x(2x50")]* *Task 5:* *Compile a concluding chapter essay [PT+BM:(1+1)x(3x60")]*	(tersedia di MyITSClassroom) *PPT review sample journal article conclusion section (available at MyITSClassroom)*	

12-14	Sub-CPMK7: Mampu mempresentasikan hasil penyusunan KTI melalui presentasi sesuai prinsip komunikasi efektif; *LLO7: Able to present the results of the preparation of KTI through presentations according to the principles of effective communication;*	1.1. Ketepatan dalam menjelaskan hasil penyusunan karya tulis ilmiah sesuai kaidah gramatika, kohesi dan koherensi, sistematis, dan menarik. 1.2 Keefektifan komunikasi lisan 1.3 Keaktifan kerja kelompok *1.1. Accuracy in explaining the results of the preparation of scientific papers according to the rules of grammar, cohesion and coherence, systematic, and interesting.* *1.2 The effectiveness of oral communication* *1.3 Active group work*	Kriteria Rubrik presentasi Teknik nontes Observasi dan unjuk kerja Melakukan presentasi sesuai prinsip komunikasi efektif *Criteria* *Presentation rubric* *Non-test technique* *Observation and performance* *Make presentations according to the*	Kuliah, Diskusi kelompok, [TM: 3mgx(2sksx50")] • Evaluasi melalui presentasi: Menyampaikan hasil penyusunan artikel ilmiah [PT+BM:(3+3)x(2x60")] • *Lectures,* • *Group discussion,* *[TM: 3weekx (2sksx50 ")]* • *Evaluation through presentation: Delivering the results of the preparation of scientific articles* *[PT + BM: (3 + 3) x (2x60 ")]*	Kuliah tatap muka maya. MyITS-Classroom: sinkron dan asinkron; Diskusi kelompok, [TM: 3x(2x50")] Presentasi: Menyampaikan hasil penyusunan artikel ilmiah, presentasi diunggah ke youtube [PT+BM:(3+3)x(3x60")] • *Virtual face-to-face lectures. MyITS-Classroom: synchronous and asynchronous;* • *Group discussion,* *[TM: 3x(2x50")]* *Presentation: Delivering the results of the preparation of scientific articles, the*	Link presentasi menarik: *Interesting presentation link:* https://www.youtube.com/watch?v=bbz2boNSeL0 https://www.youtube.com/watch?v=NSuJ-L6xN-I	20

			principles of effective communication		*presentation is uploaded to YouTube [PT+BM:(3+3)x(3x60")]*		
15, 16	Evaluasi Akhir Semester / *Final exam*						20

5. RPS Pendidikan Kewarganegaraan/ *Semester Study Plan of Citizenship*

<table>
<tr><td></td><td colspan="6">INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
SDKB</td><td>Kode Dokumen

Document code</td></tr>
<tr><td colspan="8">RENCANA PEMBELAJARAN SEMESTER
Semester Learning Plan</td></tr>
<tr><td colspan="2">MATA KULIAH (MK)
Course</td><td>KODE
Code</td><td>Rumpun MK
Course Cluster</td><td colspan="2">BOBOT (sks)
Credits</td><td>SEMESTER
Semester</td><td>Tgl Penyusunan
Compilation Date</td></tr>
<tr><td colspan="2">Pendidikan Kewarganegaraan
Civics</td><td>UG. 184913</td><td>Mata Kuliah Wajib Nasional
National Compulsory Courses</td><td>2 SKS</td><td></td><td>I/II</td><td></td></tr>
<tr><td colspan="2" rowspan="2">OTORISASI / PENGESAHAN
AUTHORIZATION / ENDORSEMENT</td><td colspan="2">Dosen Pengembang RPS
Developer Lecturer of Semester Learning Plan</td><td colspan="2">Koordinator RMK
Course Cluster Coordinator</td><td colspan="2">Ka Prodi
Head of Department</td></tr>
<tr><td colspan="2">TIM Dosen</td><td colspan="2">(Jika ada)
Tanda tangan</td><td colspan="2">Tanda tangan</td></tr>
<tr><td>Capaian Pembelajaran</td><td colspan="3">CPL-PRODI yang dibebankan pada MK
PLO Program Charged to The Course</td><td colspan="4"></td></tr>
</table>

Learning Outcomes	CPL 1 (S3) PLO 1 (S3)	Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan peradaban berdasarkan Pancasila . Contribute to improving the quality of life in society, nation, state and civilization based on Pancasila.
	CPL 2 (S4) PLO 2 (S4)	Berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa . Acting as citizens who are proud and love the country, have nationalism and a sense of responsibility to the state and nation.
	CPL 3 (S7) PLO 3 (S7)	Taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara. Obeying the law and discipline in social and state life.
	CPL 4 (KU7) PLO 4 (KU7)	Mampu bertanggung jawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggung jawabnya. Being responsible for the achievement of group work and supervise and evaluate the completion of work assigned to workers under their responsibility.
	Capaian Pembelajaran Mata Kuliah (CPMK) – Bila CP MK sebagai kemampuan pada tiap tahap pembelajaran CP MK = Sub CP MK Course Learning Outcome (CLO) – If CLO as capability of each Learning Stage in the course, then CLO = Lesson Learning Outcome (LLO)	
	CP MK 1/Sub – CPMK1	Memahami substansi pendidikan kewarganegaraan untuk memiliki kepribadian Indonesia , membangun rasa kebangsaan dan mencintai tanah air, sehingga menjadi warga negara yang baik dan terdidik (smart and good citizen) dalam kehidupan masyarakat, bangsa dan negara yang demokratis.

	CLO 1/LLO1	Mastering the substance of citizenship education to have an Indonesian personality, build a sense of nationality and love the country, so that they become good and educated citizens (smart and good citizen) in the life of a democratic society, nation and state.
	CP MK 2/Sub – CPMK2 CLO 2/LLO2	Memahami korelasi pendidikan kewarganegaraan dengan nilai-nilai kehidupan sehingga menjadi warganegara yang berkepribadian Indonesia memiliki daya saing, berdisiplin dan berpartisifasi aktif dalam membangun kehidupan yang damai berdasarkan sistem nilai Pancasila Understand the correlation of civic education with the values of life so that becoming a citizen with an Indonesian personality is competitive, disciplined and actively participates in building a peaceful life based on the Pancasila value system.
	CP MK 3/Sub-CPMK3 CLO 3/LLO3	Memahami aplikasi konsep kewarganegaraan, untuk menjadikan warga negara yang baik yang mampu mendukung bangsa dan negara, warga negara yang demokratis yaitu warga negara yang cerdas, berkeadaban dan dan bertanggung jawab bagi kelangsungan hidup negara Indonesia dalam mengamalkan kemampuan ilmu pengetahun, teknologi dan seni yang dimilikinya. Mastering the application of the concept of citizenship, to make good citizens who are able to support the nation and state, democratic citizens, namely citizens who are intelligent, civilized and responsible for the survival of the Indonesian state in exercising the skills of science, technology and arts it has.
	CPMK 4/ Sub-CPMK 4 CLO 4/LLO4	Memahami kontribusi kewarganegaraan dalam membentuk tata sikap dan tata nilai: menghargai ke-bhinekaan, mampu bekerjasama, memiliki sifat amanah, kepekaan social dan kecintaan yang tinggi terhadap masyarakat, bangsa dan negara Indonesia. Understanding the contribution of citizenship in shaping attitudes and values: respecting diversity, being able to work together, having a trustworthy nature, social sensitivity and a high love for the people, nation and state of Indonesia.
Peta CPL – CP MK Map of PLO - CLO	Tuliskan peta matriks antara CPL dengan CPMK (Sub CP MK) Write out the matrix mapping between PLO and CLO (Sub CLO)	

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>CPL1</td><td>CPL2</td><td>CPL3</td><td>CPL4</td></tr>
<tr><td>CPMK 1 / SUB CPMK 1</td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>CPMK 2 / SUB CPMK 2</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>CPMK 3 / SUB CPMK 3</td><td>√</td><td></td><td>√</td><td>√</td></tr>
<tr><td>CPMK 4 / SUB CPMK 4</td><td></td><td>√</td><td></td><td>√</td></tr>
</table>
</td></tr>
<tr><td>Deskripsi Singkat MK

Short Description of Course</td><td>Kewarganegaraan (Kwn) pada dasarnya membahas tentang ke-Indonesiaan yakni: menjadi warga negara yang berkepribadian Indonesia, membangun rasa kebangsaan dan mencintai tanah air Indonesia, dengan demikian akan dapat menjadi warga negara yang baik dan terdidik (Smart and good citizen) dalam kehidupan masyarakat, bangsa dan negara yang demokratis

Civics (Kwn) basically discusses Indonesianness, namely: becoming a citizen with an Indonesian personality, building a sense of nationality and loving the Indonesian homeland, thereby becoming a good and educated citizen (Smart and good citizen) in people's lives, a democratic nation and state.</td></tr>
<tr><td>Bahan Kajian: Materi pembelajaran

Course Materials:</td><td>Hakikat dan tantangan KWN
Negara: Konstitusi dan Demokrasi
Penegakan Hukum: Hak dan Kewajiban Warga Negara, Kepastian dan Keadilan Hukum
Identitas dan Integrasi Nasional
Wawasan Nusantara dan Otonomi Daerah
Ketahanan Nasional Dan Bela Negara
Pendidikan Anti Korupsi

The nature and challenges of KWN
State: Constitution and Democracy
Law Enforcement: Rights and Obligations of Citizens, Legal Certainty and Justice
National Identity and Integration
Archipelagic Insight and Regional Autonomy</td></tr>
</table>

	National Resilience and State Defense Anti-Corrupotion Education
Pustaka References	Utama: Main: Kemenristekdikti. 2016. Modul Pendidikan Kewarganegaraan Untuk Perguruan Tinggi. Jakarta: Dirjen Belmawa Kemenristekdikti Pendukung: Supporting: Armaidy Armawi, Geostrategi Indonesia, Jakarta, Direktorat jenderal Pendidikan Tinggi, 2006 Azyumardi Azra, paradigma Baru Pendidikan Nasional dan Rekrontruksi dan Demokratisasi, Penerbit Kompas, Jakarta, 2002 Bahar, Dr. Saefrodin, "Konteks Kenegaraan, Hak Asasi Manusia, Pustaka Sinar Harapan, Jakarta, 2000. Kaelan, Pendidikan Kewarganegaraan, UGM Press, Yogyakarta 2005. Slamet Soemiarno, Geopolitik Indonesia, Jakarta, Direktorat Jenderal Pendidikan Tinggi, 2006
Dosen Pengampu Lecturers	Tim : Dyah Satya Yoga,Niken Prasetyawati,Ni Wayan Suarmini, Windiani, Tri Widyastuti,Tony Hanoraga,Banu Prastyo, Aurel Ratu, Julius F. Nagel, Agung Kurniawan,Helmy Boemiya,Ida Wahyuliana, John Sinartra Wolo, Badruli Martati.
Matakuliah syarat Prerequisites	

Mg Ke--/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assesment		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]	Materi Pembelajaran [Pustaka]] / Learning Material [Estimated Time]	Bobot Penilaian (%)/ Assesment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques			

(1)	(2)	(3)	(4)	Tatap Muka (5) / Face to face (5)	Daring (6) / Online	(7)	(8)
1-4	CP MK 1 : Memahami substansi pendidikan kewarganegaraan untuk memiliki kepribadian Indonesia , membangun rasa kebangsaan dan mencintai tanah air, sehingga menjadi warga negara yang baik dan terdidik (smart and good citizen) dalam kehidupan masyarakat, bangsa dan negara yang demokratis. CLO 1: Mastering the substance of citizenship education to have an Indonesian personality, build a sense of nationality and love the country, so that they become good and educated citizens (smart	Memahami hakekat negara,konstitusi dan demokrasi Unjuk kerja, ketepatan mengumpulkan tugas Understanding the essence of the state, the constitution and democracy	Instrumen Rubrik Teknik: Non Tes (observasi), Tugas Penilaian essay/ penilaian teman Instrument: Rubric Technique: Non test (observation),	TM: (10x50 mnt) Kontrak Kuliah Pembentukan kelompok Ceramah bervariasi Tgs Individu: (mereviw jurnal,persepsi,eksplorasi) FF: (10x50 minutes) Course Contract Group formation Varying Lectures Individual Assignment: (journal	Syncronous /Unsyncronus Learning Link : https://classroom.its.ac.id/ Synchronous /Unsynchronous Learning Link : https://classr	Kontrak Kuliah: Jenis-jenis evaluasi dan referensi,Pembentukan kelompok. Hakekat dan Tantangan KWN untuk masa depan bangsa Negara dan Konstitusi, nilai dan norma konstitusional UUD RI 1945 dan konstitusionalitas per UU dibawah UUD 1945 Lembaga dan hubungan antar lembaga negara pemerintahan negara dan Sistem pemerintahan daerah. Demokrasi Indonesia berlandaskan Pancasila dan UUD 1945. Hakikat demokrasi sebagai sistem nilai dan sistem politik, partai politik, pemilu dan sistem	15

	and good citizen) in the life of a democratic society, nation and state	Performance, assignments submission accuracy	Assignment Essay assessment/peer assessment	review, perception, exploration)	oom.its.ac.id /	perwakilan, pendidikan demokrasi Lecture Contract: Types of evaluation and reference, forming groups. The essence and challenges of KWN for the future of the nation State and Constitution, constitutional values and norms of the 1945 Constitution of the Republic of Indonesia and constitutionality per law under the 1945 Constitution Institutions and relationships between state government agencies and local government systems. Indonesian democracy based on Pancasila and the 1945 Constitution.	

						The essence of democracy as a value system and political system, political parties, elections and representative systems, democratic education	
5-7	CP MK 3 : Memahami kontribusi kewarganegaraan dalam membentuk tata sikap dan tata nilai: menghargai ke-bhinekaan, mampu bekerjasama, memiliki sifat amanah, kepekaan social dan kecintaan yang tinggi terhadap masyarakat, bangsa dan negara Indonesia	Bentuk kerjasama, kepekaan sosial. Unjuk kerja, kesesuaian hasil kerja dengan tema	Instrumen Rubrik Teknik : Non Test (Tanya jawab, sikap) Diskusi Penilaian projek ,presentasi, Penilaian Essay	TM; (6x50 mnt) Kuliah: Ceramah bervariasi Problem solving Tugas Klp : (membuat makalah, Video, podcast dengan Tema sesuai dengan materi).	Syncronous /Unsyncronus Learning Link : https://classroom.its.ac.id/	Penegakan Hukum yang berkeadilan Hak Dan Kewajiban Negara dan Warga Negara, Dinamika, Tantangan hak dan kewajiban Negara Dan Warga Negara Pengakuan Atas Martabat Dan Hak-Hak Yang Sama (HAM) Kepastian dan Keadilan Hukum	15

	CLO 3: Understanding the contribution of citizenship in shaping attitudes and values: respecting diversity, being able to work together, having a trustworthy nature, social sensitivity and a high love for the people, nation and state of Indonesia	Forms of cooperation, social sensitivity. Performance, compatibility between work results and the given theme	Instrument: Rubric Technique: Non test (question and answer, attitude), Discussion, project assessment, presentation, Essay assessment	FF: (6x50 minutes) Lecture: Varying lectures Problem solving Group Assignment: (make papers, video, podcast with themes according to the material)	Synchronous /Unsynchronous Learning Link : https://classroom.its.ac.id/	Justice enforcement Rights and Duties of the State and Citizens, Dynamics, Challenges of the rights and obligations of the State and Citizens Recognition of Dignity and Equal Rights (HAM) Legal certainty and justice	
8	CP MK 1 dan 3 CLO 1 and 3	Ujian Tengah Semester / Midterm Exam					20
9-11	CP MK 2: Memahami korelasi pendidikan kewarganegaraan dengan nilai-nilai kehidupan sehingga menjadi warganegara yang berkepribadian	Memahami keberagaman Unjuk kerja, kerja sama Memahami konten	Instrumen: Rubrik Teknik: Observasi Diskusi, Presentasi	TM; (6x50 mnt) Kuliah; ceramah bervariasi Problem solving	Syncronous /unsyncronous Learning Link : https://classroom.its.ac.id/ (2x 50 mnt)	identitas nasional sebagai salah satu determinan pembangunan bangsa dan karakter bangsa Urgensi Integrasi nasional sebagai salah satu	10

	Indonesia memiliki daya saing, berdisiplin dan berpartisifasi aktif dalam membangun kehidupan yang damai berdasarkan sistem nilai Pancasila CLO 2: Understand the correlation of civic education with the values of life so that becoming a citizen with an Indonesian personality is competitive, disciplined and actively participates in building a peaceful life based on the Pancasila value system	Understanding diversity Performance, cooperation Understanding content	Penilaian essay, penilaian projek Instrument: Rubric Technique: Observation, Discussion, presentation, essay assessment, project assessment	Tgs Klp: (Studi Kasus, Projek, dengan Tema sesuai dengan materi) FF: (6x50 minutes) Lecture: Varying lectures Problem solving Group Assignment: (Case study, Project with themes according to the material)	Synchronous /Unsynchronous Learning Link : https://classroom.its.ac.id/ (2x50 minutes)	parameter persatuan dan kesatuan bangsa wawasan nusantara sebagai konsepsi dan pandangan kolektif kebangsaan Indonesia dalam konteks pergaulan dunia otonomi daerah dalam konteks persatuan dan kesatuan bangsa Indonesia National identity as one of the determinants of national development and national character The urgency of national integration as one of the parameters of national unity and integrity Indonesian archipelago insight as a collective conception and viewpoint of the Indonesian nationality in the context of world relations	

						regional autonomy in the context of the unity of the Indonesian nation	
12-15	CP MK 4 : Mampu mengaplikasikan konsep kewarganegaraan, untuk menjadikan warga negara yang baik yang mampu mendukung bangsa dan negara, warga negara yang demokratis yaitu warga negara yang cerdas, berkeadaban dan dan bertanggung jawab bagi kelangsungan hidup negara Indonesia dalam mengamalkan kemampuan ilmu pengetahun, teknologi dan seni yang dimilikinya CLO 4: Mastering the application of the concept of citizenship, to make good citizens who	Memahami konten Unjuk kerja Kerjasama Role play Understanding content Performance Cooperation Role play	Instrumen Rubrik Teknik: Non test (tanya jawab, sikap) Presentasi, Debat, role play , Problem & Solving	TM; (6x50 mnt) Kuliah; Ceramah Diskusi Tugas (debat, simulasi, study kasus) FF: (6x50 minutes)	Syncronous /Unsyncronus Learning Link : https://classroom.its.ac.id/ (6X50 mnt)	Ketahanan nasional dan bela negara dalam membangun komitmen kolektif kebangsaan. Posisi negara dalam Eara Global. Dinamika , Tantangan Tannas dan Bela Negara pendidikan anti korupsi untuk mewujudkan warga negara yang berkeadaban dan bertanggungjawab bagi kelangsungan hidup bangsa dan negara Indonesia. Tindakan pidana Korupsi dan peraturan perundang-undangan. National resilience and state defense in building a collective national commitment.	15

	are able to support the nation and state, democratic citizens, namely citizens who are intelligent, civilized and responsible for the survival of the Indonesian state in exercising the skills of science, technology and arts it has		Instrument: Rubric Technique: Non test (question, answer), presentation, debate, roleplay, problem & solving	Lecture; Lecture Discussion Assignment (debate, simulation, case study)	Synchronous /Unsynchronous Learning Link : https://classroom.its.ac.id/ (6x50 minutes)	Country position in Eara Global. Dynamics, Challenges of Tannas and State Defense Anti-corruption education to create civilized and responsible citizens for the survival of the Indonesian nation and state. Corruption laws and regulations.	
16	CP MK 2 dan 4 CLO 2 and 4	UJIAN AKHIR SEMESTER FINAL EXAM					25
		JUMLAH / TOTAL					100

6. RPS Wawasan dan Aplikasi Teknologi/ *Semester Study Plan of insights and technology applications*

Bahan Kajian: *Course Materials:*	Adapun materi dari mata kuliah Wawasan dan Aplikasi Teknologi adalah 1. Pengantar, RPS, Sillabus WASTEK, Teori Sistem dan Berpikir Sistemik 2. Pengetahuan Roadmap Riset ITS dan Nasional 3. Konsep SDGs (Sustainable Development Goals) 4. Pengantar dan Pengetahuan Science Technopark (STP) 5. Konsep dan Pengetahuan Kreatif, Inovatif 6. Teknologi Open Source 7. Konsep Proposal Program Kreatif Mahasiswa (PKM) The material from the Technology Insights and Applications course are *1. Introduction, RPS, Sillabus WASTEK, Systems Theory and Systemic Thinking* *2. ITS and National Research Roadmap Knowledge* *3. The concept of SDGs (Sustainable Development Goals)* *4. Introduction to Science and Technopark Knowledge (STP)* *5. Creative, Innovative Concepts and Knowledge* *6. Open Source Technology* *7. Concept of Student Creative Program Proposal (PKM)*
Learning Outcomes	1. Mampu bekerjasama dan memiliki kepekaan sosial, serta kepedulian terhadap masyarakat dan lingkungan, 2. Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahliannya

	3. Mampu menggunakan Aplikasi Teknologi untuk pengembangan atau implementasi ilmu pengetahuan teknologi berdasarkan kaidah, tata cara dan etika ilmiah dalam rangka menghasilkan solusi, dan gagasan 4. Mampu menyusun Laporan akhir/Proposal atau proyek riset/inovasi/Program Kreatifitas Mahasiswa (PKM). 1. *Able to cooperate and have social sensitivity, as well as concern for the community and the environment,* 2. *Able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with their field of expertise* 3. *Able to use Technology Applications for the development or implementation of scientific technology based on scientific principles, procedures and ethics in order to produce solutions and ideas.* 4. *Able to compile final reports / proposals or research / innovation projects / Student Creativity Program (PKM).*
Capaian Pembelajaran Mata Kuliah (CPMK) *Course Learning Outcome (CLO)*	1. Mampu Berfikir secara Sistematis dalam menyelesaikan permasalahan umum dengan baik dan benar 2. Mahasiswa Mampu mendayagunakan Pusat-Pusat penelitian baik lokal maupun nasional dengan Aplikasi Teknologi 3. Mampu memiliki wawasan konservasi terhadap sumber daya alam dan manusia dalam menerapkan ilmu pengetahuan dan teknologi untuk kepentingan Pembangunan Berkelanjutan dengan Teori dan Konsep SDG's.

	4. Mampu menyelesaikan pembuatan Proposal Program Kreativitas Mahasiswa (PKM) dan program sejenis dalam menyiapkan project based inovasi beserta Luaran Proposal PKM (Artikel , Poster dan Video). 1. *Able to think systematically in solving general problems properly and correctly* 2. *Students Able to utilize research centers both local and national with technology applications* 3. *Able to have insight into the conservation of natural and human resources in applying science and technology for the benefit of Sustainable Development with SDG Theory and Concept.* 4. *Able to complete the making of Student Creativity Program (PKM) Proposals and similar programs in preparing innovation-based projects along with PKM Proposal Outputs (Articles, Posters and Videos).*

RPS - BASIC SCIENCE

(*Lesson Plan*)

INSTITUT TEKNOLOGI SEPULUH NOPEMBER
KANTOR PENJAMINAN MUTU
2020

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER		
	RPS Basic Science		
	Document Number	Revision Number	Endorsed by:
	2.3.3.3.4		Wakil Rektor 1

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1. RPS Fisika Dasar I / *Semester Study Plan of Basic Physics I*

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FAKULTAS ….. DEPARTEMEN …..	Kode Dokumen *Document code*
RENCANA PEMBELAJARAN SEMESTER *Semester Learning Plan*		

MATA KULIAH (MK) *Course*	KODE *Code*	Rumpun MK *Course cluster*	BOBOT (sks) *Credits*	SEMESTER *Semester*	Tgl Penyusunan *Compilation Date*
Fisika Dasar I *Physics I*	SF184101	SKPB	3	1	1 Januari 2021

OTORISASI / PENGESAHAN *AUTHORIZATION / ENDORSEMENT*	Dosen Pengembang RPS *Developer Lecturer of Semester Learning Plan*	Koordinator RMK *Course Cluster Coordinator*	Ka PRODI *Head of Department*

Capaian Pembelajaran	CPL-PRODI yang dibebankan pada MK *PLO Program Charged to The Course*	
	KU1	Menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan/atau teknologi sesuai dengan bidang keahliannya

Learning Outcomes		Applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and / or technology in accordance with their field of expertise
	KU2	mampu menunjukkan kinerja mandiri, bermutu, dan terukur; Able to demonstrate independent, quality, and measurable performance
	S9	menunjukkan sikap bertanggung jawab atas pekerjaan di bidang keahliannya secara mandiri; Show an attitude of responsibility for work in their field of expertise independently
	Capaian Pembelajaran Mata Kuliah (CPMK) – Bila CP MK sebagai kemampuan pada tiap tahap pembelajaran CP MK = Sub CP MK *Course Learning Outcome (CLO) - If CLO as an ability of each learning stage, then CLO = Lesson Learning Outcome (LLO)*	
	CPMK1	mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam menyelesaikan masalah dan implementasi ilmu fisika I. Applying logical, critical, systematic, and innovative thinking to solve problems and implementing Physics I
	CPMK2	mampu menunjukkan kinerja mandiri, bermutu, dan terukur; able to demonstrate independent, quality, and measurable performance
	CPMK3	menunjukkan sikap bertanggung jawab atas pekerjaan di bidang keahliannya secara mandiri; show an attitude of responsibility for work in their field of expertise independently
Peta CPL – CP MK *Map of PLO - CLO*	Tuliskan peta matriks antara CPL dengan CPMK (Sub CP MK) Write out the matrix mapping between PLO and CLO (Sub PLO)	

	KU1	KU2	S9
Sub-CPMK1	√		
Sub-CPMK2	√	√	√

		Sub-CPMK3	√	√	√
		Sub-CPMK4	√	√	√
		Sub-CPMK5	√	√	√
		Sub-CPMK6	√	√	√
		Sub-CPMK7	√	√	√
		Sub-CPMK8	√	√	√
Deskripsi Singkat MK *Short Description of Course*	Pada mata kuliah ini mahasiswa akan belajar memahami hukum-hukum dasar fisika, Kinematika partikel; Dinamika partikel; Kerja dan energi; Gerak rotasi ; Getaran dan Mekanika fluida, melalui uraian matematika sederhana serta memperkenalkan contoh pemakaian konsep, dan melakukan analisa materi dalam bentuk praktikum. Praktikum yang dilakukan meliputi:(1)bandul fisis, (2)bandul matematis, (3)konstanta pegas, (4)viskositas cairan, (5)gerak peluru, (6)koefisien gesek, (7) momen inersia. 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 descriptions and introducing examples of the use of concepts, and analyzing material in the form of practicum. The practicum includes: (1) physical pendulum, (2) mathematical pendulum, (3) spring constant, (4) liquid viscosity, (5) bullet motion, (6) friction coefficient, (7) moment inertia			
Bahan Kajian: Materi pembelajaran *Course Materials:*	Besaran danvektor: Besaran dasar, besaran turunan, satuan, konversi satuan, besaran skalar dan vektor, operasi matematika pada vektor secara geometris dan analitis Kinematika partikel: Pergeseran posisi, kecepatan, percepatan, gerak lurus, gerak lengkung (parabola dan melingkar); gerak relatif. Dinamika partikel: Hukum Newton I, II dan III, macam-macam gaya (gaya gravitasi, gaya berat, gaya tegang tali, gaya normal, gaya gesek dan gaya pegas), kesetimbangan gaya, penerapan hukum Newton I,II dan III ; Kerja dan energi: konsep kerja, energi kinetik, energi potensial (gravitasi dan pegas), teorema kerja energi, hukum kekekalan energi mekanik, Impuls dan Momentum: impuls, momentum, tumbukan (elastis dan tidak elastis),; Dinamika rotasi: Pergeseran sudut, kecepatan sudut dan percepatan sudut, momen gaya (torsi), pusat massa,kesetimbangan momen gaya, momen inersia, energi kinetik rotasi, gerak menggelinding, hukum kekekalan energi (translasi dan rotasi) Getaran: gerak harmonis sederhana, energi gerak harmonis sederhana, bandul matematis, bandul fisis, bandul puntir, gabungan getaran selaras (sejajar dan tegak lurus);			

	Mekanika fluida:tekanan hidrostatika, prinsip Pascal, prinsip Archimedes, tegangan permukaan, persamaan kontinuitas, persamaan Bernoulli,viskositas. Quantities and vectors: base quantities, derived quantities, units, units conversion, scalar and vector quantities, mathematical operations on vectors geometrically and analytically Particle kinematics: displacement, velocity, acceleration, linear motion, angular motion (parabolic and circular); relative motion. Particle dynamics: Newton's Laws I, II and III, various forces (gravitational force, gravity, rope tension, normal force, friction and spring force), force balance, application of Newton's laws I, II and III; Work and energy: the concept of work, kinetic energy, potential energy (gravity and spring), work energy theorem, the law of conservation of mechanical energy, Impulse and Momentum: impulse, momentum, collision (elastic and inelastic), center of mass; Rotational dynamics: Angular displacement, angular velocity and angular acceleration, force moment (torque), force moment equilibrium, moment of inertia, rotational kinetic energy, rolling motion, energy conservation law (translation and rotation) Vibration: simple harmonic motion, energy of simple harmonic motion, mathematical pendulum, physical pendulum, torsional pendulum, combination of harmonious vibrations (parallel and perpendicular); Fluid mechanics: hydrostatic pressure, Pascal's principle, Archimedes principle, surface tension, continuity equation, Bernoulli's equation, viscosity.
Pustaka *References*	Utama: *Main:*
	1. Sears & Zemanky,"University Physics", Pearson Education, 14thed, USA, 2016 2. Douglas C. Giancoli, 'Physics for Scientists and Engineers, Pearson Education, 4th ed, London, 2014 3. Tim Dosen, " Fisika I", Fisika FMIPA-ITS 4. "Petunjuk Praktikum Fisika Dasar", Fisika, MIPA-ITS
	Pendukung: *Supporting:*
	5. Halliday, Resnic, Jearl Walker; 'Fundamental of Physics'. John Wiley and Sons, 10th ed, New York, 2014 6. Tipler, PA, 'Physics for Scientists and Engineers ‘,6th ed, W.H. Freeman and Co, New York, 2008
Dosen Pengampu *Lecturers*	

Matakuliah syarat *Prerequisites*	-

Mg Ke- / *Week*	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)/ *Final ability of each learning stage (LLO)*	Penilaian/ *Assesment*		Bantuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa;/ *Form of Learning; Learning Method; Student Assignment;*		Materi Pembelajaran / *Learning Material*	Bobot Penilaian (%)/ *Assesment Load (%)*
		Indikator/ *Indicator*	Kriteria &Teknik/ *Criteria & Techniques*				
(1)	(2)	(3)	(4)	Tatap Muka(5)	Daring (6)	(7)	(8)

1	Sub-CPMK1: Mampu menjelaskan dan menggunakan besaran, satuan, dan vektor, serta mampu menerapkan operasi matematika pada vektor secara geometris dan analitis untuk menyelesaikan permasalahan vektor.
	
	LLO1:
	Able to explain and use quantities, units and vectors, and be able to apply mathematical operations on vectors geometrically and analytically to solve vector problems.
		Ketepatan menjelaskan besaran fisis dan sistem satuan
		Ketepatan menjelaskan ciri besaran skalar dan besaran vektor serta menerapkan dan menggunakan aljabar vektor
		
		Accuracy in explaining physical quantities and unit systems
		Accuracy in describing the features of scalar quantities and vector quantities and applies and uses vector algebra
			Kriteria:
			Menggunakan rubrik analitik dan pedoman penskoran (*Marking Scheme*)
			
			Teknik non-test:
			Meringkas materi kuliah;
			
			Teknik test:
			Tanya jawab lisan
			Latihan menyelesaikan soal-soal mengenai besaran fisika,
				Kuliah:
				Diskusi,
				[TM: 1x(2x50")]
				• Tugas-1:
				Menyusun ringkasan kuliah dan mengerjakan contoh latihan soal yang diberikan dalam kuliah
				[PT+BM:(1+1)x(2x60")]
				Latihan soal
				Latihan menyelesaikan soal-soal aplikasi besaran fisika, satuan, besaran skalar, besaran vektor serta aljabar vektor
				[PT+BM:(1+1)x(2x60")]
					Kuliah tatap muka maya (Zoom);
					MyITS-Classroom:
					Sumber belajar:
					https://www.youtube.com/watch?v=GtOGurrUPmQ;
					https://www.youtube.com/watch?v=0na1JdPE_JY;
					https://www.youtube.com/watch?v=CtysVq9eO-0;
					https://www.youtube.com/watch?v=xEHZArgLlUo&list=PLyQSN7X0ro23IUORJBSDBH8AUWZ1mQBna&index=4&t=0s;
					https://www.youtube
						Besaran dan vektor:
						Sistem Satuan Internasional (SI), perubahan satuan, besaran dasar, besaran turunan, vektor dan skalar, komponen vektor, vektor satuan, penambahan vektor, perkalian vektor
							10%

			satuan, besaran skalar, besaran vektor serta aljabar vektor (Tugas-1: Problem & Solving) *Criteria:* *Using analytical rubrics and scoring guidelines (Marking Scheme)* *Non-test technique:* *Summarize the lecture material;* *Test technique:* *Oral questions and answers* *Exercises on physical quantities, units, scalar quantities, vector quantities*	*Lectures:* *Discussion,* *[TM: 1x(2x50")]* •*Assignment-1:* *Compile a lecture summary and work on sample practice questions given in the lecture* *[PT+BM:(1+1)x(2x60")]* *Exercise* *Exercise on application of physical quantities, vector quantities and vector algebra* *[PT+BM:(1+1)x(2x60")]*	.com/watch?v=ZAeLlaFxR_o&list=PLyQSN7X0ro23IUORJBSDBH8AUWZ1mQBna&index=5&t=0s; https://www.youtube.com/watch?v=ZCFPNl-Ved4&list=PLyQSN7X0ro23IUORJBSDBH8AUWZ1mQBna&index=6&t=0s Diskusi; [TM: 1x(2x50")] Tugas-1: Menyusun ringkasan kuliah dan mengerjakan contoh latihan soal yang diberikan dalam kuliah[PT+BM:(1+1)x(2x60")] Latihan soal Latihan menyelesaikan soal-soal aplikasi besaran fisika, satuan, besaran skalar, besaran vektor serta aljabar vektor [PT+BM:(1+1)x(2x60")]	*Quantities and vectors: International Systems of Units (SI), unit conversion, base quantities, derived quantities, scalar and vector, vector components, unit vector, vector addition, vector multiplication* Pustaka : *References* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004 Tim Dosen Fisika ITS	

			and vector algebra (Assignment-1: Problem & Solving)		*Face-to-Face virtual lectures (Zoom); MyITS-Classroom: Learning resources:* https://www.youtube.com/watch?v=GtOGurrUPmQ; https://www.youtube.com/watch?v=0na1JdPE_JY; https://www.youtube.com/watch?v=CtysVq9eO-0; https://www.youtube.com/watch?v=xEHZArgLlUo&list=PLyQSN7X0ro23IUORJBSDBH8AUWZ1mQBna&index=4&t=0s; https://www.youtube.com/watch?v=ZAeLlaFxR_o&list=PLyQSN7X0ro23IUORJBSDBH8AUWZ1mQBna&index=5&t=0s; https://www.youtube.com/watch?v=ZCFPNl-		

					Ved4&list=PLyQSN7X0ro23IUORJBSDBH8AUWZ1mQBna&index=6&t=0s *Discussion;* *[TM: 1x(2x50")]* *Assignment-1:* *Compile a lecture summary and work on sample practice questions given in the lecture[PT+BM:(1+1)x(2x60")]* *Excersise* *Exercise on the application of physical quantities, vector quantities and vector algebra* *[PT+BM:(1+1)x(2x60")]*		
2,3	Sub-CPMK2: Mampu mendefinisikanPergeseran posisi, kecepatan, percepatan gerak lurus dan melengkung secara grafis dan matematis serta mendemontrasikannya (P).	Ketepatan menjelaskan prinsip Pergeseran posisi, kecepatan, percepatan Ketepatan menjelaskan prinsip gerak lurus, gerak lengkung (parabola dan meling-kar); gerak relatif	Kriteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-test: Meringkas materi kuliah	Kuliah: Diskusi, [TM: 2x(3x50")] • Kuis-1: Menyelesaikan soal-soal posisi, kecepatan, percepatan Latihan soal: menghitung	Kuliah tatap muka maya; [TM: 2x(3x50")] MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=RIGMaw8gsic;	Kinematika partikel: Pergeseran posisi, kecepatan, percepatan, gerak lurus, gerak lengkung	2%

	LLO2: *Be able to define position shift, velocity, straight and curved motion acceleration graphically and mathematically and demonstrate it (P).*	*Accuracy in explaining the principle of displacement, velocity and acceleration* *Accuracy in explaining the principle of linear motion, angular motion (parabolic and circular); relative motion*	Tanya-jawab lisan Menyalin contoh soal Teknik test: Latihan soal *Criteria*: *Scoring guidelines*(*Marking Scheme*) *Non-test technique:* *Summarize the lecture material* *Oral questions and answers* *Transcribe exercise* *Test technique:* *Exercise*	percepatan suatu benda yang dipengaruhi oleh resultan gaya. Latihan soal menguraikan persamaan gerak lurus, gerak lengkung (parabola dan meling-kar); gerak relatif. [PT+BM:(2+2)x(3x60")] *Lecture:* *Discussion,* *[TM: 2x(3x50")]* •*Quiz-1: Exeercise on position, speed and acceleration* *Exercise:* *calculate the acceleration of an object which is affected by the resultant of force* *Exercise* *describe equations of linear motion, angular motion (parabola and*	Kuis-1: Daring dg MyITS Classroom; Latihan soal: menghitung posisi, kecepatan dan percepatan benda berdasar komponen vektor . Latihan soal menguraikan persamaan gerak lurus, gerak lengkung (paraboladan meling-kar); gerak relatif. [PT+BM:(2+2)x(3x60")] *Face-to-face virtual lectures;* *[TM: 2x(3x50")]* *MyITS-Classroom:* *Learning resources:* https://www.youtube.com/watch?v=RIGMaw8gsic; *Quiz-1: Online with MyITS Classroom;*	(paraboladan melingkar); gerak relatif. *Position, speed, acceleration, straight motion, curved motion (parabola and circular); relative motion.*	

				circular); relative motion. *[PT+BM:(2+2)x(3x60")]*	*Exercise: calculate position, speed and acceleration of an object based on vector component.* *Exercise describe equations of linear motion, angular motion (parabola and circular); relative motion.* *[PT+BM:(2+2)x(3x60")]*		
		Ketepatan menghitung penyelesaian soal-soal yang berhubungan. Pergeseran posisi, kecepatan, percepatan, gerak lurus, gerak lengkung (parabola dan melingkar); gerak relatif *Accuracy in calculating the problem solutions related to displacement, velocity, acceleration, linear motion, angular motion*	Kriteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-test: Tanya-jawab lisan Menyalin jawaban soal-soal yang dibahas selama perkuliahan Teknik test: Quis 1	Kuliah: Diskusi, [TM: 2x(3x50")] • Kuis-1: Menyelesaikan soal-soal tentang posisi, kecepatan dan percepatan. Latihan soal: Menghitung kecepatan rata – rata dan sesaat, percepatan rata – rata dan sesaat. Latihan soal: Menghitung	Kuliah tatap muka maya; [TM: 2x(3x50")] MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=Po7li9JbEs; Kuis-1: Daring dg MyITS Classroom; Latihan soal: Menghitung kecepatan rata – rata dan sesaat, percepatan rata – rata dan sesaat.	Kinematika partikel: Pergeseran posisi, kecepatan, percepatan, persamaan gerak lurus berubah beraturan, gerak lurus, gerak lengkung (parabola dan melingkar); gerak relatif.	7%

		(parabolic and circular); relative motion	Latihan soal Tugas Rumah *Criteria*: *Scoring guidelines* (*Marking Scheme*) *Non-test technique: Oral questions and answers Transcribe exercises discussed during lectures* *Test technique: Quiz 1 Exercise Home assignment*	permasalahan gerak lurus beraturan (GLB) dan gerak lurus berubah beraturan (GLBB) Latihan soal Menghitung gerak lurus, gerak lengkung (parabola dan meling-kar); gerak relatif [PT+BM:(2+2)x(3x60")] *Lecture: Discussion, [TM: 2x(3x50")]* • *Quiz-1: Solve problems about position, velocity and acceleration.* *Exercise: Calculate average and instantaneous velocity, average and instantaneous acceleration*	Latihan soal: Menghitung permasalahan gerak lurus beraturan (GLB) dan gerak lurus berubah beraturan (GLBB) Latihan soal Menghitung gerak lurus, gerak lengkung (parabola dan meling-kar); gerak relatif *Face-to-face virtual lecture; [TM: 2x(3x50")] MyITS-Classroom: Learning resources*: https://www.youtube.com/watch?v=Po7li9JbEs; *Quiz-1: Online with MyITS Classroom;* *Exercise: Calculate the average and instantaneous velocity, average and*	*Particle kinematics: Displacement, velocity, acceleration, uniformly accelerated motion equation, linear motion, angular rotation (parabolic and circular); relative motion*	

				Exercise Calculating the problem of uniform motion (GLB) and uniformly accelerated motion (GLBB) *Exercise Calculate linear motion, angular motion (parabolic and circular); relative motion [PT+BM:(2+2)x(3x60")]*	*instantaneous acceleration* *Exercise:Calculating the problem of uniform motion (GLB) and uniformly accelerated motion (GLBB)* Exercise *Calculate linear motion, angular motion (parabolic and circular); relative motion*		
	Praktikum Sub-CPMK3: Mampu menggunakan konsep dan teori pergeseran posisi, kecepatan, percepatan gerak lurus dan melengkung sertamendemontrasikanny a (M-4) *Practicum* *LLO3: Able to use the concepts and theories of displacement, velocity, linear and angular*	Ketepatan menghitung dan mendemonstrasikan pergeseran posisi, kecepatan, percepatan *Accuracy in calculating and demonstrating displacement, velocity and acceleration.*	Kriteria: Rubrik Modul praktikum Fisika Dasar 1 Teknik non-test: Praktikum di dampingi oleh asisten lab. Mencatat Data hasil praktikum, acc asisten. Teknik test:	Praktikum: Modul M-..: Gerak, kecepatan dan percepatan 7 jam: Tutorial / Pre-test, Persiapan, Pelaksanaan Praktikum, Penyusunan laporan, Presentasi hasil. *Practicum:*	Mengakses demonstrasi praktimum secara real time yang dilakukan oleh asisten, melalui live streaming Melakukan praktikum Mandiri Menggunakan program animasi yang telah disiapkan oleh TIM ITS		5%

	acceleration and demonstrate it (M-4)		Tes pendahuluan lisan. Laporan akhir presentasi *Criteria:* *Rubric Physics 1 Practicum module* *Non-test technique: Practicum assisted by laboratory assistant* *Record data on practicum results, acc assistant* *Test technique: Oral preliminary test* *Final report Presentation*	*Module week - : Motion, velocity and acceleration* *7 hours: Tutorial / Pre-test, Preparation, Practicum implementation, Report preparation, Result presentation.*	*Accessing real-time practicum demonstration by the assistant through live streaming* *Doing practicum independently using animation programs prepared by ITS Team*		
	Asistensi Sub-CPMK3: Mampu menggunakan konsep dan	Ketepatan menghitung penyelesaian soal-soal yang berhubungan	Kriteria: Pedoman Penskoran	Pembahasan soal – soal terkait posisi, kecepatan,	Kuliah oleh asisten melalui tatap muka maya;	Kinematika partikel: Pergeseran	2%

	teori pergeseran posisi, kecepatan, percepatangerak lurus dan melengkung sertamendemontrasikannya (P). *Assistance* *LLO3*: *Able to use the concepts and theories of displacement, velocity, linear and angular acceleration and demonstrate it* (P).	dengan posisi, kecepatan, percepatan, gerak lurus, gerak lengkung (parabola dan melingkar); gerak relative *Accuracy in calculating the problem solutions related to position, velocity, acceleration, linear motion, angular motion (parabolic and circular); relative motion*	(*Marking Scheme*) Teknik non-test: Tanya-jawab lisan Menyalin jawaban soal-soal yang dibahas oleh asisten selama perkuliahan. Teknik test: Keaktifan dan ketepatan jawaban atas pertanyaan yang diajukan oleh asisten *Criteria*: *Scoring guidelines*(*Marking Scheme*) *Non-test technique:*	percepatan, gerak lurus, gerak lengkung (parabola dan meling-kar); gerak relatif Diskusi, [TM: 1x(3x50")] *Discussing questions related toposition, velocity, acceleration, linear motion, angular motion (parabolic and circular); relative motion Discussion, [TM: 1x(3x50")]*	Pembahasan soal melalui myITS Classroom, group Wa, Line, dll. [TM: 1x(3x50")] MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=Po7li9JbEs; *Face-to-face virtual lecture by the assistant; Discussing questions through myITS Classroom, Wa group, Line, dll. [TM: 1x(3x50")] MyITS-Classroom: Learning resources:* https://www.youtube.com/watch?v=Po7li9JbEs;	posisi, kecepatan, percepatan, persamaan gerak lurus berubah beraturan, gerak lurus, gerak lengkung (parabola dan melingkar); gerak relatif. *Particle kinematics: Displacement, velocity,acceleration,uniformly accelerated motion equation, linear motion, angular rotation (parabolic and circular);*	

			Oral questions and answers *Transcribe exercises discussed with the assistant during lectures* *Test technique:* *Originality and accuracy of answering questions asked by the assistant*			*relative motion*	
4,5	Sub-CPMK3: Mampu menggunakan konsep dan teori Newton I, II, dan III untuk menguraikan gaya-gaya pada berbagai sistem benda, serta mendemontrasikannya (P). *LLO3:* *Able to use Newton I, II and III concepts and theories to describe forces in various systems of objects, and demonstrate it (P)*	Ketepatan menjelaskan prinsip Hukum Newton I, Hukum Newton II, dan Hukum Newton III Ketepatan menjelaskan prinsip macam-macam gaya (gaya gravitasi, gaya berat, gaya apung, gaya berat, gaya tegangan tali, gaya normal, gaya gesek, gaya pegas). *Accuracy in describing the principles of*	Kriteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-test: Meringkas materi kuliah Tanya-jawab lisan Menyalin contoh soal Teknik test: Latihan soal	Kuliah: Diskusi, [TM: 1x(3x50")] • Kuis-1: Menyelesaikan soal-soal Hukum Newton Latihan soal: menghitung percepatan suatu benda yang dipengaruhi oleh resultan gaya. Latihan soal menguraikan komponen-komponen	Kuliah tatap muka maya; [TM: 1x(3x50")] MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=g550H4e5FCY Kuis-1: Daring dg MyITS Classroom; Latihan soal: menghitung percepatan suatu benda yang dipengaruhi oleh resultan gaya.	Dinamika partikel: Hukum Newton I, II dan III, macam-macam gaya (gaya gravitasi, gaya berat, gaya tegang tali, gaya normal, gaya gesek dan gaya pegas), kesetimbanga	2%

		Newton's first, second and third law *Accuracy in describing the principles of various forces (gravitational force, weight force, buoyant force, tension force, normal force, friction force, spring force)*	*Criteria:* *Scoring guidelines (Marking Scheme)* *Non-test technique:* *Summarize the lecture material* *Oral questions and answers* *Transcribe exercise* *Test technique:* *Exercise*	gaya yang dimiliki oleh suatu benda pada bidang horizontal , bidang miring, dan katrol. [PT+BM:(2+2)x(3x60")] *Lecture:* *Discussion,* *[TM: 1x(3x50")]* • *Quiz-1:* *Solve problems on Newton's laws* *Exercise* *calculate the acceleration an object which is affected by the resultant force* *Exercise* *describes the force components of an object in the horizontal plane, inclined plane and pulley* *[PT+BM:(2+2)x(3x60")]*	Latihan soal menguraikan komponen-komponen gaya yang dimiliki oleh suatu benda pada bidang horizontal , bidang miring, dan katrol. [PT+BM:(2+2)x(3x60")] *Face-to-face virtual lecture;* *[TM: 1x(3x50")]* *MyITS-Classroom:* *Learning resources:* https://www.youtube.com/watch?v=g550H4e5FCY *Quiz-1: Online with MyITS Classroom;* *Exercise:* *calculate the acceleration an object which is affected by the resultant force.* *Exercise* *describes the force components of an*	n gaya, penerapan hukum Newton I,II dan. *Particle dynamics:* *Newton's first, second and third law, types of forces (forces (gravitational force, weight force, buoyant force, tension force, normal force, friction force, spring force), equilibrium of forces, Newton's laws application.*	

					object in the horizontal plane, inclined plane and pulley *[PT+BM:(2+2)x(3x60")]*		
		Ketepatan menghitung penyelesaian soal-soal yang berhubungan dengan Hukum Newton I, Hukum Newton II, dan Hukum Newton III *Accuracy in calculating the problem solutions related to Newton's first, second and third law*	Kreteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-test: Tanya-jawab lisan Menyalin jawaban soal-soal yang dibahas selama perkuliahan Teknik test: Quis 1 Latihan soal Tugas Rumah *Criteria*: *Scoring guidelines*	Kuliah: Diskusi, [TM: 2x(3x50")] • Kuis-1: Menyelesaikan soal-soal Hukum Newton Latihan soal: Menghitung kecepatan /gaya gesek benda, pada bidang horizontal karena adanya pengaruh resultan gaya. Latihan soal: Menghitung kecepatan /gaya gesek benda, pada bidang miring karena adanya pengaruh resultan gaya. Latihan soal	Kuliah tatap muka maya; [TM: 2x(3x50")] MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=RDwXQeWWbz0 Kuis-1: Daring dg MyITS Classroom; Latihan soal: Menghitung kecepatan /gaya gesek benda, pada bidang horizontal karena adanya pengaruh resultan gaya. Latihan soal: Menghitung kecepatan /gaya gesek benda, pada bidang miring karena	Dinamika partikel: Hukum Newton I, II dan III, macam-macam gaya (gaya gravitasi, gaya berat, gaya tegang tali, gaya normal, gaya gesek dan gaya pegas), kesetimbangan gaya, penerapan hukum Newton I,II dan.	7 %

			(*Marking Scheme*) *Non-test technique:* *Oral questions and answers* *Transcribe exercises discussed during lectures* *Test technique:* *Quiz 1* *Exercise* *Home assignment*	Menghitung tegangan tali pada katrol, akibat adanya gaya berat benda. [PT+BM:(2+2)x(3x60")] *Lecture:* *Discussion,* *[TM: 2x(3x50")]* • *Quiz-1:* *Solve problems on Newton's laws* *Exercise:* *Calculate velocity/friction force of an object on horizontal plane due to the effect of the resultant force* *Exercise:* *Calculate velocity/friction force of an object on inclined plane due to the effect of the resultant force*	adanya pengaruh resultan gaya. Latihan soal Menghitung tegangan tali pada katrol, akibat adanya gaya berat benda. *Face-to-face virtual lecture;* *[TM: 2x(3x50")]* *MyITS-Classroom:* *Learning resources:* https://www.youtube.com/watch?v=RDwXQeWWbz0 *Quiz-1: Online with MyITS Classroom;* *Exercise:* *Calculate velocity/friction force of an object on horizontal plane due to the effect of the resultant force* *Exercise:* *Calculate velocity/friction force*	*Particle dynamics: Newton's first, second and third law, types of forces (forces (gravitational force, weight force, buoyant force, tension force, normal force, friction force, spring force), equilibrium of forces, Newton's laws application.*	

				Exercise *Calculate the rope tension on the pulley due to the object's weight force* *[PT+BM:(2+2)x(3x60")]*	*of an object on inclined plane due to the effect of the resultant force* *Exercise* *Calculate the rope tension on the pulley due to the object's weight force*		
	Praktikum Sub-CPMK3: Mampu menggunakan konsep dan teori Newton I, II, dan III untuk menyelesaikan masalah gaya-gaya dalam fisika, serta mendemontrasikannya (M-4). *Practicum* *LLO3: Able to use Newton I, II and III concepts and theories to describe forces in various systems of objects, and demonstrate it (M-4).*	Ketepatan menghitung dan mendemonstrasikan koefisien gesek statis dan kinetis *Accuracy in calculating and demonstrating static and kinetic friction coefficient*	Kriteria: Rubrik Modul praktikum Fisika Dasar 1 Teknik non-test: Praktikum di dampingi oleh asisten lab. Mencatat Data hasil praktikum, acc asisten. Teknik non-test: Tes pendahuluan lisan. Laporan akhir Presentasi	Praktikum: Modul M-4: Gaya gesek 7 jam: Tutorial / Pre-test, Persiapan, Pelaksanaan Praktikum, Penyusunan laporan, Presentasi hasil. *Practicum:* *Module week - 4: Friction force* *7 hours: Tutorial / Pre-test, Preparation, Practicum implementation, Report preparation, Result presentation.*	Mengakses demonstrasi praktimum secara real time yang dilakukan oleh asisten, melalui live streaming Praktikum Mandiri Menggunakan program animasi yang telah disiapkan oleh TIM ITS *Accessing real-time practicum demonstration by the assistant through live streaming* *Doing practicum independently using*		5%

			Criteria: *Rubric Physics 1 Practicum module* *Non-test technique: Practicum assisted by laboratory assistant* *Record data on practicum results, acc assistant* *Test technique: Oral preliminary test* *Final report Presentation*		*animation programs prepared by ITS Team*		
	Asistensi Sub-CPMK3: Mampu menggunakan konsep dan teori Newton I, II, dan III untuk menyelesaikan masalah gaya-gaya dalam fisika, serta mendemontrasikannya (P).	Ketepatan menghitung penyelesaian soal-soal yang berhubungan dengan Hukum Newton I, Hukum Newton II, dan Hukum Newton III	Kreteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-test: Tanya-jawab lisan	Pembahasan soal – soal terkait Hukum Newton I, Hukum Newton II, dan Hukum Newton III Diskusi, [TM: 2x(3x50")]	Kuliah oleh asisten melalui tatap muka maya; Pembahasan soal melalui group Wa, Line, dll. [TM: 1x(3x50")] MyITS-Classroom: Sumber belajar:	Dinamika partikel: Hukum Newton I, II dan III, macam-macam gaya (gaya gravitasi, gaya	2%

	Assistance *LLO3*: *Able to use Newton I, II and III concepts and theories to describe forces in various systems of objects, and demonstrate it* (P).	*Accuracy in calculating the problem solutions related to Newton's first, second and third law*	Menyalin jawaban soal-soal yang dibahas oleh asisten selama perkuliahan. Teknik test: Keatifan dan ketepatan jawaban atas pertanyaan yang diajukan oleh asisten *Criteria*: *Scoring guidelines* (*Marking Scheme*) *Non-test technique: Oral questions and answers Transcribe exercises discussed with the assistant during lectures*	*Discussing questions related toNewton's first, second and third law* *Discussion,* *[TM: 2x(3x50")]*	https://www.youtube.com/watch?v=wrhT5xGS-f8 *Face-to-face virtual lecture by the assistant;* *Discussing questions through myITS Classroom, Wa group, Line, dll.* *[TM: 1x(3x50")]* *MyITS-Classroom:* *Learning resources:* https://www.youtube.com/watch?v=wrhT5xGS-f8	berat, gaya tegang tali, gaya normal, gaya gesek dan gaya pegas), kesetimbangan gaya, penerapan hukum Newton I,II dan III. *Particle dynamics: Newton's first, second and third law, types of forces* (*forces (gravitational force, weight force, buoyant force, tension force, normal force, friction force, spring force),*	

			Test technique: Originality and accuracy of answering questions asked by the assistant			*equilibrium of forces, Newton's laws application.*	
6,7	Sub-CP MK-4: Mahasiswa memahami azas kerja dan energi mekanik, hukum kekekalan energi mekanik, impuls, momentum, kekekalan momentum, dan menerapkannya kedalam penyelesaian soal *LLO4:* *Students understand the principles of work and mechanical energy, the law of conservation of mechanical energy, impulses, momentum, conservation of momentum, and apply them to solving problems*	Ketepatan Menjelaskan kerja dan energi: konsep kerja, energi kinetik, energi potensial (gravitasi dan pegas) (TM 12) *Accuracy in describing work and energy: Ketepatan Menjelaskan kerja dan energi: concept of work, kinetic energy, potential energy (gravity and spring) (TM 12)*	Kriteria: Pedoman Penilaian Teknik non-test: Penjelasan materi kuliah Diskusi dan tanya-jawab Mengerjakan latihan soal bersama-samadi buku tentang konsep kerja dan energi Teknik test: Latihan soal& Tugas *Criteria:* *Scoring guidelines*	Kuliah: Diskusi, [TM: 1x(2x50")] • Tugas: Menyelesaikan soal-soal konsep kerja, Energi Potensial Gravitasi dan Energi Potensial Pegas Latihan soal:Menghitung Kerja Oleh Gaya konservatif dan non konsevatif BM:2x(2x60")] *Lecture:* *Discussion,* *[TM: 1x(2x50")]*	Kuliah tatap muka daring (zoom); [TM: 1x(2x50")] MyITS-Classroom: https://www.youtube.com/watch?v=zVRH9d5PW8g Tugas: Daring dg MyITS Classroom; Latihan soal: menghitung kerja oleh gaya konservatif dan non konservatif, menghitung energi kinetik, potensial gravitasi dan potensial pegas BM:2x(2x60")] *Face-to-face virtual lecture (zoom);* *[TM: 1x(2x50")]*	Kerja dan Energi: Menjelaskan Konsep kerja Energi Kinetik Energi Potensial Gravitasi Energi Potensial Energi Kinetik *Work and Energy:* *Explain the concept of work kinetic energy potential energy gravity energy kinetic*	3%

			Non-test technique: *Explanation of course material* *Discussions and questions and answers* *Practice the problems about the concept of work and energy in the book together* *Test technique:* *Exercise & assignment*	• *Assignment:* *Solve problems on the concept of work, potential gravity energy and potential spring energy* *Exercise:* *Calculate the work by conservative and nonconservative forces* *BM:2x(2x60")]*	*MyITS-Classroom:* https://www.youtube.com/watch?v=zVRH9d5PW8g *Assignment: Online with MyITS Classroom;* *Exercise:* *Calculate the work by conservative and nonconservative forces, calculate kinetic energy, potential gravity and potential spring* *BM:2x(2x60")]*	*potential energy* Pustaka: *References:* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004 Tim Dosen Fisika ITS	
		Ketepatan menjelaskan kerja dan energi: teorema kerja energi, hukum kekekalan energi mekanik(TM 13) *Accuracy in describing work and energy; work-energy theorem, the law of conservation of mechanical energy (TM 13)*	Kriteria: Pedoman Penilaian Teknik non-test: Penjelasan materi kuliah Diskusi dan tanya-jawab Mengerjakan latihan soal bersama-samadi buku tentang hukum	Kuliah: Diskusi, [TM: 1x(2x50")] • Tugas: Mengitung tentang hukum kekekalan energi Latihan soal:Mengitung tentang hukum kekekalan energi	Kuliah tatap muka daring (zoom); [TM: 1x(2x50")] MyITS-Classroom:https://www.youtube.com/watch?v=HR5iEX3Sy1k Tugas: Daring dg MyITS Classroom; Latihan soal:Mengitung tentang hukum kekekalan energi	Kerja dan Energi: menjelaskan kerja dan energi: teorema kerja energi, hukum kekekalan energi mekanik	3%

			kekekalan energi Teknik test: Latihan soal& Tugas *Criteria: Scoring guidelines* *Non-test technique: Explanation of course material Discussions and questions and answers Practice the problems about the law of conservation of energy* *Test technique: Exercise & assignment*	[BM:2x(2x60")] *Lecture: Discussion, [TM: 1x(2x50")]* • *Assignment: Calculate the law of conservation of energy* *Exercise: Calculate the law of conservation of energy* *BM:2x(2x60")]*	[BM:2x(2x60")] *Face-to-face virtual lecture (zoom); [TM: 1x(2x50")]* *MyITS-Classroom:* https://www.youtube.com/watch?v=HR5iEX3Sy1k *Assignment: Online with MyITS Classroom;* *Exercise: Calculate law of conservation of energy* *BM:2x(2x60")]*	*Work and Energy: Explain about work and energy; work-energy theorem, the law of conservation of mechanical energy* Pustaka: *References:* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004 Tim Dosen Fisika ITS	
		Ketepatan menjelaskan Impuls dan Momentum : impuls, momentum,	Kriteria: Pedoman Penilaian	Kuliah: Diskusi, [TM: 1x(2x50")]	Kuliah tatap muka daring (zoom); [TM: 1x(2x50")]	Kerja dan Energi: menjelaskan	3%

		tumbukan (elastis dan tidak elastis), pusat massa;(TM 14) *Accuracy in describing impulse and momentum: impulse, momentum, collision (elastic and inelastic), center of mass; (TM 14)*	Teknik non-test: Penjelasan materi kuliah Diskusi dan tanya-jawab Mengerjakan latihan soal bersama-samadi buku tentang Impuls dan momentum (tumbukan) Teknik test: Latihan soal& Tugas *Criteria:* *Scoring guidelines* *Non-test technique:* *Explanation of course material* *Discussions and questions and answers* *Practice the problems*	• Tugas: Menyelesaikan soal-soal impuls dan momentum, tumbukan lenting sempurna, lenting sebagian dan tidak lenting sama sekali Latihan soal:Menghitung impuls dan momentum, kecepatan benda setelah tumbukan lenting sempurna, sebagian dan tidak lenting sama sekali [BM:2x(2x60")] *Lecture:* *Discussion,* *[TM: 1x(2x50")]* *Assignment:* *Solve problems on impulse and momentum, perfectly*	MyITS-Classroom: https://www.youtube.com/watch?v=pHJQTtEEX4M Tugas: Daring dg MyITS Classroom; Latihan soal:Menghitung impuls dan momentum, kecepatan benda setelah tumbukan lenting sempurna, sebagian dan tidak lenting sama sekali [BM:2x(2x60")] *Face-to-face virtual lecture (zoom);* *[TM: 1x(2x50")]* *MyITS-Classroom:* https://www.youtube.com/watch?v=pHJQTtEEX4M *Assignment: Online with MyITS Classroom;*	Impuls dan Momentum : impuls, momentum, tumbukan (elastis dan tidak elastis), pusat massa *Work and energy: describing impulse and momentum: impulse, momentum, collision (elastic and inelastic), center of mass* Pustaka: *References:* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004	

			impulse and momentum (collision) *Test technique: Exercise & assignment*	*elastic collision, inelastic collision and perfectly inelastic collision* *Exercise: Calculate impulse and momentum, object's velocity after perfectly elastic collision inelastic collision and perfectly inelastic collision* *BM:2x(2x60")]*	*Exercise: Calculate impulse and momentum, object's velocity after perfectly elastic collision inelastic collision and perfectly inelastic collision* *BM:2x(2x60")]*	Tim Dosen Fisika ITS	
	Asistensi (3) Sub-CP MK-3: Mahasiswa memahami azas kerja dan energi mekanik, hukum kekekalan energi mekanik impuls, momentum, kekekalan momentum, dan menerapkannya kedalam penyelesaian soal *Assistance (3)*	Ketepatan dalam meyelesaikan dan menghitung soal-soal tentang kosep kerja dan energi, impuls dan mometum(TM 15) *Accuracy in solving and calculating problems about the concept of work and energy, impulse and momentum (TM 15)*	Kriteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-test: Tanya-jawab lisan Menyalin jawaban soal-soal yang dibahas oleh	Pembahasan soal – soal terkait Kerja dan Energi, Impuls dan Momentum Diskusi, [TM: 1x(2x50")] Discussing questions related to work and energy, impulse and momentum Discussion,	Kuliah oleh asisten melalui tatap muka secara daring; Pembahasan soal melalui zoom, group WA dll [TM: 1x(2x50")] *Face-to-face online lecture by the assistant;*	Kerja dan Energi: Membahas soal-soal terkait Menjelaskan kerja dan energi: konsep kerja, energi kinetik, energi potensial (gravitasi dan	2%

	LLO3:Students understand the principles of work and mechanical energy, the law of conservation of impulse mechanical energy, momentum, conservation of momentum, and apply them to solving problems.		asisten selama perkuliahan. Teknik test: Keaktifan dan ketepatan jawaban atas pertanyaan yang diajukan oleh asisten *Criteria*: *Scoring guidelines* (*Marking Scheme*) *Non-test technique: Oral questions and answers Transcribe exercises discussed with the assistant during lectures* *Test technique:*	[TM: 1x(2x50")]	*Discussing questions through zoom, WA group, etc* [TM: 1x(2x50")]	pegas), teorema kerja energi, hukum kekekalan energi mekanik, Impuls dan Momentum, *Work and energy: Discussing questions about Explaining about work and energy; concept of work, kinetic energy, potential energy (gravity and spring), work-energy theorem, the law of conservation*	

			Originality and accuracy of answering questions asked by the assistant			*of mechanical energy, impulse and momentum* Pustaka: *References:* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004 Tim Dosen Fisika ITS	
8	EVALUASI TENGAH SEMESTER / *MIDTERM EXAM*						
9,10	Sub-CPMK5: Mahasiswa mampu memahami konsep benda pejal, menghitung momen inersia, torsi, serta mendemontrasikannya (P). Mahasiswa mampu menggunakan konsep dan teori, dan hukum kekekalan energi untuk menyelesaikan masalah-masalah dinamika rotasi pada sistem katrol, gerak menggelinding, kekekalan momentum sudut	Ketepatan menjelaskan konsep dan teori dinamika rotasi, pusat massa, dan momen inersia, serta penggunaannya Ketepatan menerapkan prinsip benda tegar dan gerak menggelinding dalam penyelesaian soal-soal dinamika rotasi	Kriteria: Menggunakan rubrik analitik dan pedoman penskoran (*Marking Scheme*) Teknik non-test: Meringkas materi kuliah; Teknik test:	Kuliah: Diskusi, [TM: 1x(3x50")] • Tugas-5: Menyusun ringkasan kuliah dan menghitung penyelesaian soal dinamika rotasi dengan kasus dalam fisika. [PT+BM:(1+1)x(3x60")] Latihan soal	Kuliah tatap muka maya (Zoom); MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=fDJeVR0o w Diskusi; [TM: 1x(3x50")] Tugas-1: Menyusun ringkasan kuliah dan dan menghitung penyeleaian soal dinamika rotasi	Dinamika rotasi: Pergeseran sudut, kecepatan sudut dan percepatan sudut, momen gaya (torsi), pusat massa, kesetimbangan momen gaya, momen	12%

	LLO5: *Students are able to understand the concept of solid objects, calculate the moment of inertia, torque, and demonstrate it (P)* *Students are able to use concepts and theories, and the law of conservation of energy to solve problems of rotational dynamics in pulley systems, rolling motion, conservation of angular momentum*	*Accuracy in describing the concept and theory of rotational dynamics, centre of mass and moment of inertia, as well as the application* *Accuracy in applying the principles of rigid body and rolling motion in solving rotational dynamics problems*	Tanya jawab lisan Latihan menyelesaikan soal-soal dinamika rotasi dan aplikasinya (Tugas-5: Problem & Solving) *Criteria:* *Using analytic rubric and scoring guidelines (Marking Scheme)* *Non-test technique:* *Summarize the lecture material* *Test technique*: *Oral questions and answers* *Exercises on rotational*	Latihan menyelesaikan soal-soal dinamika rotasi [PT+BM:(1+1)x(3x60")] *Lectures:* *Discussion,* *[TM: 1x(3x50")]* *•Assignment-5:* *Compile a lecture summary and calculate the solutions of rotational dynamics problems with cases in physics.* *[PT+BM:(1+1)x(2x60")]* *Exercise* *Exercise on rotational dynamics* *[PT+BM:(1+1)x(2x60")]*	dengan kasus dalam fisika.[PT+BM:(1+1)x(3x60")] Latihan soal Latihan menyelesaikan soal-soal dinamika rotasi [PT+BM:(1+1)x(3x60")] *Face-to-Face virtual lectures (Zoom);* *MyITS-Classroom:* *Learning resources:* https://www.youtube.com/watch?v=fDJeVR0o w Discussion; [TM: 1x(3x50")] Assignment-1: *Compile a lecture summary and calculate the solutions of rotational dynamics problems with cases in physics.* [PT+BM:(1+1)x(3x60")]	inersia, energi kinetik rotasi, gerak menggelinding, hukum kekekalan energi (translasi dan rotasi) *Rotational dynamics: Angular displacement, angular velocity and angular acceleration, moment of force (torque), centre of mass, balance of force moment, moment of inertia,*	

			dynamics and its application (Assignment-5: Problem & Solving)		*Exercise* *Exercise on rotational dynamics* [PT+BM:(1+1)x(3x60")]	*rotational kinetic energy, rolling motion, energy conservation law (translation and rotation)*	
		Ketepatan menghitung dan mendemonstrasikan dinamika rotasi *Accuracy in calculating and demonstrating rotational dynamics*	Kriteria: Menggunakan rubrik holistik Teknik non-test: Menyusun tahapan metode praktikum M5 (Momen Inersia) Praktikum M5 (Momen inersia) yang di dampingi oleh asisten laboratorium Fisika Dasar. Mencatat data hasil praktikum sesuai dengan variabel yang dijelaskan oleh asisten.	Praktikum: Modul-5 (M5): Momen Inersia, 7 jam: Tutorial/ Pre-test, Persiapan, Pelaksanaan Praktikum, Penyusunan laporan, Presentasi hasil. *Practicum:* *Module-5 (M%): Moment of inertia, 7 hours: Tutorial / Pre-test, Preparation, Practicum implementation, Report preparation, Result presentation*.	Praktikum Mandiri Memanfaatkan virtual laboratory untuk mempelajari konsep gerak rotasi dari suatu benda, sebagai contohnya penggunaanaplikasi PhET (https://phet.colorado.edu/ *Independent Practicum* *Use virtual laboratory to learn the concept of rotational motion of an object, for example using PhET application*(https://phet.colorado.edu/	Pustaka: *References:* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004 Tim Dosen Fisika ITS	5%

			Teknik test: Tes pendahuluan lisan. Membuat laporan akhir Presentasi hasil *Criteria:* *Using holistic rubric* *Non-test technique:* *Arranging the stages of practicum method M5 (Moment of Inertia)* *Practicum M5 (Moment of inertia) assisted by the Physics laboratory assistant.* *Record data on practicum results*				

			according to the variables explained by the assistant				
	Asisten *Assistance*	Ketepatan menghitung penyelesaian soal-soal dinamika rotasi melalui asistensi *Accuracy in calculating the solutions of rotational dynamics problems through assistance*	Kriteria: Menggunakan rubrik analitik dan pedoman penskoran (*Marking Scheme*) Teknik non-test: Tanya-jawab lisan Latihan soal yang dibahas dengan asisten Teknik test: Keaktifan dan ketepatan jawaban atas pertanyaan yang diajukan oleh asisten *Criteria*:	Diskusi, [TM: 1x(3x50")] • Latihan soal Latihan dan pembahasan penyelesaian soal-soal dinamika rotasi [PT+BM:(1+1)x(3x60")] *Discussion,* *[TM: 1x(3x50")]* • *Exercise* *Exercise and discussing the solution of rotational dynamics problems* *[PT+BM:(1+1)x(3x60")]*	Kuliah dengan asisten melalui tatap muka maya (Zoom); Diskusi Online (Chatting) pembahasan soal melalui email, group WA, Line, dll. [TM: 1x(3x50")] Latihan soal Latihan dan pembahasan penyelesaian soal-soal dinamika rotasi[PT+BM:(1+1)x(3x60")] *Face-to-face virtual lecture with the assistant (Zoom);* Online discussion (Chatting) on solving problems by email, WA group, Line, etc[TM: 1x(3x50")]		4

			Using analytic rubric and scoring guidelines(*Marking Scheme*) *Non-test technique:* *Oral questions and answers* *Discuss exercise with the assistant* *Test technique:* *Originality and accuracy of answering questions asked by the assistant*		Exercise *Exercise and discussing the solution of rotational dynamics problems* [PT+BM:(1+1)x(3x60”)]		
11,12	Sub-CPMK 6:Mahasiswa memahami dan mampu menerapkan konsep gerak harmonis sederhana, energi gerak harmonis sederhana, bandul matematis, bandul fisis, bandul punter dan mampu mendemonstrasikannya,	Ketepatan dalam menerangkan secara tulisan dan verbal dengan tepat terhadap konsep energi pada gerak harmonis sederhana, bandul matematis, bandul fisis, bandul puntir,	Kriteria: Menggunakan rubrik analitik dan pedoman penskoran (*Marking Scheme*) Teknik non-test:	Kuliah: Diskusi, [TM: 1x(2x50”)] • Tugas-1: Menyusun ringkasan kuliah dan mengerjakan contoh latihan soal yang diberikan dalam kuliah	Kuliah tatap muka maya (Zoom); MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=pKKfmthLNmQ	Getaran:harmonis sederhana, bandul matematis, bandul fisis, bandul puntir, gabungan	12

	serta mampu menghitung gabungan getaran selaras(sejajar dan tegak lurus) *LLO6:* *Students understand and are able to apply the concept of simple harmonic motion, simple harmonic motion energy, mathematical pendulum, physical pendulum, punter pendulum and are able to demonstrate them, and are able to calculate the combination of harmonious vibrations (parallel and perpendicular)*	gabungan getaran selaras (sejajar dan tegak lurus) Kemampuan memberikan contoh penerapan konsep harmonis sederhana, bandul matematis, bandul fisis, bandul puntir, gabungan getaran selaras (sejajar dan tegak lurus) dalam kehidupan sehari-hari *Accuracy in describing in writing and verbally concept of energy in simple harmonic motion, mathematical pendulum, physical pendulum, torsional pendulum, combination of harmonious vibrations (parallel and perpendicular)* *Ability to provide examples on the application of the concept of simple*	Meringkas materi kuliah; Memberikan ide sederhana aplikasi Teknik test: Tanya jawab lisan Latihan menyelesaikan soal-soal mengenai harmonis sederhana, bandul matematis, bandul fisis, bandul puntir, gabungan getaran selaras (sejajar dan tegak lurus) (Tugas-1: Problem & Solving) *Criteria*:	[PT+BM:(1+1)x(2x60")] Latihan soal menyelesaikan soal-soal aplikasi harmonis sederhana, bandul matematis, bandul fisis, bandul puntir, gabungan getaran selaras (sejajar dan tegak lurus)[PT+BM:(1+1)x(2x60")] *Lecture:* *Discussion,* *[TM: 1x(2x50")]* • *Assignment-1: Summarize the lecture material and working on sample practice questions given in lecture[PT+BM:(1+1)x(2x60")]* *Exercise* *Exercises on simple harmonic motion, mathematical pendulum, physical*	https://www.youtube.com/watch?v=aMas-Z8K2-I https://www.youtube.com/watch?v= o0 lJ CnMQE https://www.youtube.com/watch?v=NN--nwtXrsw https://www.youtube.com/watch?v=X6Hz0rPzxvc https://www.youtube.com/watch?v=cj4XTyW6ums Diskusi; [TM: 1x(2x50")] Tugas-1: Menyusun ringkasan kuliah dan mengerjakan contoh latihan soal yang diberikan dalam kuliah[PT+BM:(1+1)x(2x60")] Latihan soalmenyelesaikan soal-soal aplikasi harmonis sederhana, bandul matematis, bandul fisis, bandul puntir, gabungan getaran selaras (	getaran selaras(sejajar dan tegak lurus) *Vibrations: simple harmonic motion, mathematical pendulum, physical pendulum, torsional pendulum, combination of harmonious vibrations (parallel and perpendicular)* Pustaka: *References:* Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014	

		harmonic motion, mathematical pendulum, physical pendulum, torsional pendulum, combination of harmonious vibrations (parallel and perpendicular) in everyday life.	*Using analytic rubric and scoring guidelines (Marking Scheme)* *Non-test technique: Summarize the lecture material Provide simple application idea* *Test technique: Oral questions and answers Exercises on simple harmonic motion, mathematical pendulum, physical pendulum, torsional pendulum, combination of harmonious vibrations*	*pendulum, torsional pendulum, combination of harmonious vibrations (parallel and perpendicular)[PT+BM :(1+1)x(2x60")]*	sejajar dan tegak lurus)[PT+BM:(1+1)x(2x60")] *Face-to-face virtual lecture (Zoom); MyITS-Classroom: Learning resources*: https://www.youtube.com/watch?v=pKKfmthLNmQ https://www.youtube.com/watch?v=aMas-Z8K2-I https://www.youtube.com/watch?v=_o0_IJCnMQE https://www.youtube.com/watch?v=NN--nwtXrsw https://www.youtube.com/watch?v=X6Hz0rPzxvc https://www.youtube.com/watch?v=cj4XTyW6ums *Discussion, [TM: 1x(2x50")]* • *Assignment-1: Summarize the lecture material and working*	Serway, 2004 Tim Dosen Fisika ITS	

			(parallel and perpendicular) (Assignment-1: Problem &Solving)		*on sample practice questions given in lecture[PT+BM:(1+1)x (2x60")]* *Exercise* *Exercises on simple harmonic motion, mathematical pendulum, physical pendulum, torsional pendulum, combination of harmonious vibrations (parallel and perpendicular)[PT+BM:(1+1)x(2x60")]*		
	Praktikum Mampu menggunakan getaran, hukum Hooke pada konsep bandul matematis dan bandul fisis. *Practicum* *Able to use vibrations, Hooke law on the concepts of mathematical and physical pendulum.*	Ketepatan menghitung dan mendemonstrasikan terkait perbedaan sistem bandul matematis dan bandul fisis. *Accuracy in calculating and demonstrating differences between*	Kriteria: Rubrik Modul praktikum Fisika Dasar 1 Teknik non-test: Praktikum di dampingi oleh asisten lab. Mencatat Data hasil praktikum, acc asisten. Teknik non-test:	Praktikum: ModulG1 dan G2 : Bandul matematis dan Bandul Fisis 7 jam: Tutorial / Pre-test, Persiapan, Pelaksanaan Praktikum, Penyusunan laporan, Presentasi hasil. *Practicum:*	Praktikum Mandiri Menggunakan program animasi yang telah disiapkan oleh TIM ITS *Independent practicum using animation programs prepared by ITS Team*		5%

		mathematical and physical pendulum.	Tes pendahuluan lesan. Laporan akhir Presentasi *Criteria:* *Rubric* *Physics 1 Practicum module* *Non-test technique:* *Practicum assisted by laboratory assistant* *Record data on practicum results, acc assistant* *Test technique:* *Oral preliminary test* *Final report* *Presentation*	*Module G1 and G : Mathematical and physical pendulum* *7 hours: Tutorial / Pre-test, Preparation, Practicum implementation, Report preparation, Result presentation*.			
	Asistensi mampu menerapkan konsep gerak harmonis	Ketepatan menghitung penyelesaian soal-soal berkenaan dengan	Kriteria: Pedoman Penskoran	Pembahasan soal – soal berkenaan energi osilasi dan gabungan	Pembahasan soal – soal tatap maya (Zoom, melalui group		3%

	sederhana, energi gerak harmonis sederhana, bandul matematis, bandul fisis, bandul puntir serta mampu menghitung gabungan getaran selaras (sejajar dan tegak lurus) *Assistance* *able to apply the concept of simple harmonic motion, simple harmonic motion energy, mathematical pendulum, physical pendulum, torsional pendulum and able to calculate combined harmonious vibrations (parallel and perpendicular)*	konsep gabungan dua getaran selaras dan tegak lurus. *Accuracy in calculating the problem solutions related to the concept of combining two harmonious and perpendicular motion*.	(*Marking Scheme*) Teknik non-tes: Tanya-jawab lisan Menyalin jawaban soal-soal yang dibahas oleh asisten selama perkuliahan. Teknik tes: Keatifan dan ketepatan jawaban atas pertanyaan yang diajukan oleh asisten *Criteria*: *Scoring guidelines* (*Marking Scheme*) *Non-test technique:*	dua getaran baik selaras maupun tegak lurus. Diskusi, [TM: 1x(3x50")] *Discussing questions related to oscillation energy and combination of two vibrations both harmonious and perpendicular* *Discussion,* *[TM: 1x(3x50")]*	WA, LINE, dll.) berkenaandengan energi osilasi dan gabungan dua getaran [TM: 1x(3x50")] MyITS-Classroom: Sumber belajar: *Discussing questions virtually (Zoom, through WA group, Line, etc) about oscillation energy and combination of two vibrations* *[TM: 1x(3x50")]* MyITS-Classroom: *Learning resources:*		

			Oral questions and answers *Transcribe exercises discussed with the assistant during lectures* *Test technique: Originality and accuracy of answering questions asked by the assistant*				
13,14	Sub-CPMK7: Mampu menggunakan konsep elastisitas, teori hidrostatis yang meliputi:tekanan hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan dan Kapilaritas. Mampu menggunakan konsep hidrodinamika yang meliputi: persamaan kontinyuitas dan Bernoulli. *LLO7:* *Able to use the concept of elasticity, hydrostatic*	Ketepatan menjelaskan tentang konsep elastisitas, teori hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan dan Kapilaritas Ketepatan menghitung penyelesaian soal-soal berkenaan dengan elastisitas,hidrostatis, prinsip Pascal, Archimedes, dan Tegangan Permukaan Ketepatan menghitung dan	Kriteria: Pedoman Penskoran (*Marking Scheme*) Teknik non-tes: Meringkas materi kuliah Tanya-jawab lisan Menyalin contoh soal Teknik tes: Latihan soal	Kuliah: Diskusi, [TM: 1mgx(3sksx50")] • Tugas: Menyusun ringkasan kuliah dan menghitung berhubungan dengan elastisitas, teori hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan dan Kapilaritas [PT+BM:(1+1)x(3x50")]	Kuliah tatap muka maya (Zoom); Diskusi; [TM: 1x(3x50")] Tugas: Menyusun ringkasan kuliah dan menghitung berkenaan teori elastisitas, hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan, dan Kapilaritas [PT+BM:(1+1)x(3x50")]	Mekanika fluida: elastisitas, tekanan hidrostatika, prinsip Pascal, prinsip Archimedes, tegangan permukaan dan kapilaritas *Fluid mechanics:el*	5 %

	theory which includes: hydrostatic pressure, Pascal's principle, Archimedes, Surface Tension and Capillary. Able to use hydrodynamic concepts which include: continuity and Bernoulli equations	mendemonstrasikan viskositas cairan *Accuracy in explaining the concept of elasticity, hydrostatic theory, Pascal principle, Archimedes, surface tension and capillarity* *Accuracy in calculating the problems solutions related to elasticity, hydrostatic theory, Pascal principle, Archimedes, and surface tension* *Accuracy in calculating and demonstrating fluid viscosity*	Kriteria: Rubrik Modul praktikum Fisika Dasar 1 Teknik non-tes: Praktikum di dampingi oleh asisten lab. Mencatat Data hasil praktikum, acc asisten. Teknik non-tes: Tes pendahuluan lisan. Laporan akhir Presentasi *Criteria:* *Scoring guidelines (Marking Scheme)* *Non-test technique:*	Modul: Viskositas cairan 7 jam: Tutorial / Pre-tes, Persiapan, Pelaksanaan Praktikum, Penyusunan laporan, Presentasi hasil. *Lecture:* *Discussion,* *[TM: 1mgx(3sksx50")]* • *Assignment: Compile a lecture summary and doing calculation related to elasticity, hydrostatic theory, Pascal principle, Archimedes, surface tension and capillarity* *[PT+BM:(1+1)x(3x50")]* *Modul: Fluid viscosity* *7 hours: Tutorial / Pre-test, Preparation, Practicum implementation,*	Praktikum Mandiri Menggunakan program animasi tentang viskositas cairan yang telah disiapkan oleh TIM ITS *Face-to-face virtual lecture (Zoom);* *Discussion;* *[TM: 1x(3x50")]* *Assignment: Compile a lecture summary and doing calculation related to elasticity, hydrostatic, Pascal principle, Archimedes, surface tension and capillarity* *[PT+BM:(1+1)x(3x50")]* *Independent practicum using animation programs about viscosity prepared by ITS Team*	*asticity, hydrostatic pressure, Pascal principle, Archimedes, surface tension and capillarity*	

			Summarize the lecture material *Oral questions and answers* *Transcribe exercise* *Test technique:* *Exercise* *Criteria:* *Rubric* *Physics 1 Practicum module* *Non-test technique:* *Practicum assisted by laboratory assistant* *Record data on practicum results, acc assistant* *Test technique:* *Oral preliminary test* *Final report Presentation*	*Report preparation, Result presentation.*			

	Asistensi Mampu menggunakan konsep dan teori hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan, Bernoulli dalam menyelesaikan masalah-masalah mekanika fluida Assistance Able to use hydrostatic concept and theory, Pascal's principle, Archimedes, Bernoulli in solving fluid mechanics problems	Ketepatan menghitung penyelesaian soal-soal berkenaan dengan konsep dan teori hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan, Bernoulli Accuracy in calculating the problem solutions related to hydrostatic concept and theory, Pascal's principle, Archimedes, Bernoulli	Kriteria: Pedoman Penskoran (Marking Scheme) Teknik non-tes: Tanya-jawab lisan Menyalin jawaban soal-soal yang dibahas oleh asisten selama perkuliahan. Teknik tes: Keatifan dan ketepatan jawaban atas pertanyaan yang diajukan oleh asisten Criteria: Scoring guidelines(Marking Scheme)	Pembahasan soal – soal berkenaan teori elastisitas, hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan, Bernoulli dalam menyelesaikan masalah-masalah mekanika fluida Diskusi, [TM: 1x(3x50")] Discussing questions related toelasticity theory, hydrostatic, Pascal's principle, Archimedes, Surface Tension, Bernoulli in solving fluid mechanics problems Discussion, [TM: 1x(3x50")]	Pembahasan soal – soal tatap maya (Zoom, melalui group WA, LINE, dll.) berkenaandengan teori hidrostatis, prinsip Pascal, Archimedes, Tegangan Permukaan, Bernoulli dalam menyelesaikan masalah-masalah mekanika fluida [TM: 1x(3x50")] MyITS-Classroom: Sumber belajar: https://www.youtube.com/watch?v=UJ3-Zm1wbIQ Discussing questions virtually (Zoom, through WA group, Line, etc) about hydrostatic concept and theory, Pascal's principle, Archimedes, Bernoulli in solving fluid	Mekanika fluida: elastisitas, tekanan hidrostatika, prinsip Pascal, prinsip Archimedes, tegangan permukaan, persamaan kontinuitas, persamaan Bernoulli, viskositas Fluid mechanics:elasticity, hydrostatic pressure, Pascal principle, Archimedes, surface tension, continuity equation, Bernoulli	2%

			Non-test technique: Oral questions and answers Transcribe exercises discussed with the assistant during lectures Test technique: Originality and accuracy of answering questions asked by the assistant		mechanics problems [TM: 1x(3x50")] MyITS-Classroom: Learning resources: https://www.youtube.com/watch?v=UJ3-Zm1wbIQ	equation and viscosity	
15,16	EVALUASI AKHIR SEMESTER FINAL EXAM						100 %

Catatan sesuai dengan SN Dikti Permendikbud No 3/2020:
Capaian Pembelajaran Lulusan PRODI (CPL-PRODI) adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
CPL yang dibebankan pada mata kuliah adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, ketrampulan umum, ketrampilan khusus dan pengetahuan.
CP Mata kuliah (CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
Sub-CP Mata kuliah (Sub-CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

Indikator penilaian kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
Kreteria Penilaian adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kreteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kreteria dapat berupa kuantitatif ataupun kualitatif.
Teknik penilaian: tes dan non-tes.
Bentuk pembelajaran: Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
Metode Pembelajaran: *Small Group Discussion*, *Role-Play & Simulation*, *Discovery Learning*, *Self-Directed Learning*, *Cooperative Learning*, *Collaborative Learning*, *Contextual Learning*, *Project Based Learning*, dan metode lainnya yg setara.
Materi Pembelajaran adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
Bobot penilaian adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
TM=Tatap Muka, **PT**=Penugasan Terstuktur, **BM**=Belajar Mandiri.

2. RPS Fisika Dasar II /*Semester Study Plan of Basic Physics II*

<table>
<tr><td></td><td colspan="6">INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FAKULTAS SAINS dan ANALITIKA DATA
DEPARTEMEN FISIKA</td><td>Kode
Dokumen</td></tr>
<tr><td colspan="8">RENCANA PEMBELAJARAN SEMESTER
Semester Learning Plan</td></tr>
<tr><td colspan="2">MATA KULIAH (MK)
COURSE</td><td>KODE
CODE</td><td>Rumpun MK
Course Cluster</td><td colspan="2">BOBOT (sks)
Credits</td><td>SEMESTER
Semester</td><td>Tgl Penyusunan
Compilation Date</td></tr>
<tr><td colspan="2">Fisika II
Physics II</td><td>SF184202</td><td>SPKB</td><td>3</td><td>3/0</td><td>2</td><td>10 Desember 2021</td></tr>
<tr><td colspan="2" rowspan="2">OTORISASI / PENGESAHAN
AUTHORIZATION / ENDORSEMENT</td><td colspan="2">Dosen Pengembang RPS
Developer Lecturer of Semester Learning Plan</td><td colspan="2">Koordinator RMK
Course Cluster Coordinator</td><td colspan="2">Ka DEPARTEMEN
Head of Department</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Capaian Pembelajaran

Learning Outcomes</td><td colspan="2">CPL-PRODI yang dibebankan pada MK
PLO Program Learning Outcome</td><td colspan="5"></td></tr>
<tr><td>KU1</td><td colspan="6">Menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan/atau teknologi sesuai dengan bidang keahliannya

Applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and / or technology in accordance with their field of expertise</td></tr>
<tr><td>KU2</td><td colspan="6">mampu menunjukkan kinerja mandiri, bermutu, dan terukur;</td></tr>
</table>

		able to demonstrate independent, quality, and measurable performance;
	S9	menunjukkan sikap bertanggung jawab atas pekerjaan di bidang keahliannya secara mandiri; show an attitude of responsibility for work in their field of expertise independently;
	Capaian Pembelajaran Mata Kuliah (CPMK) / Course Learning Outcome (CLO) Bila CP MK sbg penjabaran kemampuan setiap Tahap Pembelajaran dalam MK maka CPMK = Sub CPMK If CLO as description capability of each Learning Stage in the course, then CLO = Lesson Learning Outcome (LLO)	
	CPMK1 CLO1	mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam menyelesaikan masalah dan implementasi ilmu fisika I. able to apply logical, critical, systematic, and innovative thinking in solving problems and implementing physics I.
	CPMK2 CLO2	mampu menunjukkan kinerja mandiri, bermutu, dan terukur; able to demonstrate independent, quality, and measurable performance;
	CPMK3 CLO3	menunjukkan sikap bertanggung jawab atas pekerjaan di bidang keahliannya secara mandiri; show an attitude of responsibility for work in their field of expertise independently;
Peta CPL – CP MK Map of PLO - CLO	Tuliskan peta matriks antara CPL dengan CPMK (Sub CP MK)	

	KU1	KU2	S9
Sub-CPMK1	√		

		Sub-CPMK2	√	√	√
		Sub-CPMK3	√	√	√
		Sub-CPMK4	√	√	√
		Sub-CPMK5	√	√	√
		Sub-CPMK6	√	√	√
Diskripsi Singkat MK Short Description of Course	Pada mata kuliah ini mahasiswa akan belajar memahami hukum-hukum dasar fisika, Medan Listrik; Potensial Listrik;Arus Listrik; Medan magnet; Gaya Gerak Listrik (EMF) Induksi dan Arus Bolak Balik, melalui uraian matematika sederhana serta memperkenalkan contoh pemakaian konsep. In this course, students will learn to understand the basic laws of physics, the Electric Field; Electric Potential; Electric current ; Magnetic field; Electric Motion Force (EMF) Induction and Alternating Current, through simple mathematical descriptions and introducing examples of the use of concepts.				
Bahan Kajian: Materi pembelajaran Course Materials:	Gaya dan medan listrik: Muatan listrik, Hukum Coulomb; Medan listrik: kuat medan listrik, garis gaya, perhitungan kuat medan listrik untuk muatan titik, muatan garis, cincin, piringan, silinder; Hukum Gauss: fluks, garis gaya, Hukum Gauss dan aplikasinya untuk muatan silinder dan bola; Potensial listrik:Energi potensial, beda potensial listrik, hubungan potensial listrik dan medan listrik, perhitungan potensial listrik untuk muatan titik, muatan garis, cincin, piringan, silinder dan bola; Kapasitor: Kapasitansi, perhitungan kapasitansi untuk kapisitor keping sejajar, kapasitor silinder dan kapasitor bola, rangkaian kapasitor seri dan paralel, bahan dielektrik, energi kapasitor; Arus listrik: Arus dan gerak muatan, hukum Ohm, resistivitas, resistansi, daya listrik; Rangkaian arus searah: rangkaian resistor seri dan paralel, hukum Kirchoff; Medan magnet: fluks dan induksi magnet, gaya Lorentz, hukum Biot Savard-Ampere, perhitungan medan magnet untuk kawat lurus berarus, cincin, solenoida dan toroida; GGL Induksi : Hukum Faraday, Hukum Lenz, GGL induksi, Induktansi diri dan induktansi gandeng; energi pada induktor; Arus bolakbalik: arus bolak-balik dalam resistor, induktor, kapasitor, Impedansi, rangkaian R-L dan R-C untuk seri dan pararel, R-L-C seri, Daya, Resonansi. Force and Electric field				

	Electric charge, Coulomb's Law; Electric field: electric field strength, line force, calculation of electric field strength for point charge, line charge, ring, disk, cylinder; Gauss's Law: flux, lines of force, Gauss's Law and its application to cylindrical and spherical charges; Electric potential: potential energy, electric potential difference, relationship between electric potential and electric field, calculation of electric potential for point charges, line charges, rings, plates, cylinders and spheres; Capacitors: Capacitance, capacitance calculations for strip capacitors, cylindrical and ball 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 fields: magnetic flux and induction, Lorentz forces, Biot Savard-Ampere law, computation of magnetic fields for straight-current wires, rings, solenoids and toroides; Induced EMF: Faraday's Law, Lenz's Law, Induced EMF, Self-Inductance and Coupled Inductance; energy in the inductor; Transient Symptoms: calculation of change in current with time for series RC and CL circuits 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.
Pustaka References	Utama / main: 1. Sears & Zemanky,"University Physics", Pearson Education, 14thed, USA, 2016 2. Douglas C. Giancoli, 'Physics for Scientists and Engineers, Pearson Education, 4th ed, London, 2014 3. Tim Dosen, " Fisika II", Fisika FMIPA-ITS Pendukung/ supporting: 4. Halliday, Resnic, Jearl Walker; 'Fundamental of Physics'. John Wiley and Sons, 10th ed, New York, 2014 5. Tipler, PA, 'Physics for Scientists and Engineers ‘,6th ed, W.H. Freeman and Co, New York, 2008
Dosen Pengampu Lecturers	

Matakuliah syarat Prerequisite	

Mg ke/ Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) / Final ability of each learning stage (LLO)	Penilaian / Assessment		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; [Estimasi Waktu] / Form of Learning; Learning Method; Student Assignment; [Estimated Time]		Materi Pembelajaran [Pustaka] / Learning Material [Reference]	Bobot Penilaian /Assess-ment Load (%)
		Indikator / Indicator	Kriteria & Teknik / Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka / In-class (5)	Daring / Online (6)	(7)	(8)
1,2,3	Sub-CPMK1: Mahasiswa memahami butir-butir penyusun materi serta sifat kelistrikannya, hakekat konduktor dan dielektrik. Sub-CPMK2:Mahasiswa Memahami kuat medan listrik berdasarkan gaya coulomb dan hukum gauss LLO1: Students understand the constituent points of the material as well as its electrical properties, the nature of conductors and dielectrics.	Mampu menghitung gaya Coulomb Mampu menghitung medan listrik sistem diskrit Mampu menghitung medan listrik sistem diskrit Mampu mengguna-kan hukum Gauss Be able to calculate Coulomb force Able to calculate the electric field of a discrete system Able to calculate the electric field of a discrete system	Kriteria: Menggunakan rubrik analitik dan pedoman penskoran (Marking Scheme) Teknik non-test: Meringkas materi kuliah; Teknik test: Criteria: Using analytical rubrics and scoring guidelines	Kuliah: Diskusi, [TM: 1mgx(3sksx50")] • Tugas-1: Menyusun ringkasan kuliah dan mengerjakan contoh latihan soal yang diberikan dalam kuliah [PT+BM:(1+1)x(2x60")] Latihan soaldan Asistensi Latihan menyelesaikan soal. [TM: 1mgx(1sksx50")] • Lectures:	Kuliah tatap muka maya (Zoom); MyITS-Classroom: Sumber belajar: Diskusi; [TM: 1mgx(3sksx50")] Tugas-1: Menyusun ringkasan kuliah dan mengerjakan contoh latihan soal yang diberikan dalam kuliah Face-to-face virtual lectures (Zoom); • MyITS-Classroom: Learning Resources:	Bab 1: Hukum Coulomb dan medan listrik (Ref.Utama no.2) Chapter 1: Coulomb's laws and electric fields (Main ref. 2)	15%

	LLO2: Students Understand electric field strength based on coulomb force and Gauss law	Able to use Gauss's law	(Marking Scheme) Non-test technique: • Summarize the lecture material; Test technique:	• Discussion, [TM: 1weekx (3sksx50 ")] • Task-1: Compile a lecture summary and work on sample practice questions given in the lecture [PT + BM: (1 + 1) x (2x60 ")] • Exercise questions and assistance Practice solving problems. [TM: 1weekx (1sksx50 ")]	• Discussion; [TM: 1weekx(3sksx50")] • Task-1: Compile a lecture summary and work on sample practice questions given in the lecture		
4,5	Sub-CPMK3: Mahasiswa mampu memahami berbagai bentuk potensial listrik pada konduktor bermuatan dan konsep kapasitor LLO3: Students are able to understand various forms of electric potential in charged conductors and the concept of capacitors	Ketepatan menjelaskan Integral garis kuat medan listrik, Ketepatan Menjelaskan potensial listrik dan energi potensial listrik Ketepatan menghitung persoalan potensial listrik yang diantaranya adalah potensial listrik oleh muatan diskrit, cincin bermuatan, dan bola bermuatan.	Kriteria: Pedoman Penilaian Teknik non-test: Penjelasan materi kuliah Diskusi dan tanya-jawab Mengerjakan latihan soal bersama-sama di buku tentang integral garis	Kuliah: Diskusi, [TM: 1mgx(3sksx50")] • Tugas-1: Menyusun ringkasan kuliah dan menyelesaiakan soal – soal konsep integral garis kuat medan listrik, potensial listrik, energi potensial listrik, kapasitor [PT+BM:(1+1)x(2x60")]	Kuliah tatap muka daring (Zoom); Diskusi; [TM: 1mgx(3sksx50")] Tugas-1: Menyusun ringkasan ringkasan kuliah dan menghitung potensial listrik oleh muatan diskrit dan bola bermuatan [PT+BM:(1+1)x(2x60")]	Potensial Listrik Potensial Listrik pada konduktor bermuatan Electric Potential Electric potential in	17,5%

		Ketepatan Menjelaskan konsep kapasitor dan enghitung nilai kapasitansi Accuracy describes the line integral to the electric field, Accuracy Describe electric potential and electric potential energy Accuracy in calculating electric potential problems which include electric potential by discrete charges, charged rings and charged spheres. Accuracy Explain the concept of capacitor and calculate the value of capacitance	kuat medan listrik, potensial listrik, dan energi potensial listrik, kapasitor Teknik test: Latihan soal& Tugas Criteria: assessment Guidelines Non-test technique: • Explanation of course material • Discussion and questions and answers • Doing practice problems together in books on the integral of electric field lines, electric potential, and electric	Asistensi: Menghitung potensial listrik oleh muatan diskrit, cincin bermuatan, dan bola bermuatan [TM: 1mgx(1sksx50")] • Lectures: • Discussion, [TM: 1weekx(3sksx50")] • Task-1: Compile a lecture summary and complete questions on the concept of integral lines of electric field strength, electric potential, electric potential energy, capacitors [PT+BM:(1+1)x(2x60")] • Assistance: Calculates the electric potential by discrete	Asistensi: [TM: 1mgx(1sksx50")] • Face-to-face online lectures (Zoom); • Discussion; [TM: 1weekx(3sksx50")] • Task-1: Compile a lecture summary summary and calculate the electric potential by discrete charges and charged balls [PT+BM:(1+1)x(2x60")] Assistance: [TM: 1mgx (1sksx50")]	charged conductors Pustaka / references: Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004 Tim Dosen Fisika ITS	

			potential energy, capacitors Test technique: Practice questions & Assignments	charges, charged rings, and charged spheres[TM: 1weekx(1sksx50")]			
6,7	Sub-CPMK 4: Mahasiswa mampu memahami konsep arus dan mampu menghitung besaran-besaran dalam rangkaian arus searah. LLO4: Students are able to understand the concept of current and be able to calculate quantities in a direct current circuit.	Ketepatan menjelaskan konsep arus dan hukum ohm; Ketepatan menjelaskan arus dan tegangan dalam rangkaian terbuka ataupun tertutup; Ketepatan menjelaskan Hukum kirchoff Ketepatan menghitung penyelesaian soal-soal yang berkaitan dengan arus searah; Accuracy explains the concept of current and ohms law; Accuracy describes currents and voltages in open or closed circuits;	Kriteria: Pedoman Penilaian Teknik non-test: Penjelasan materi kuliah Diskusi dan tanya-jawab Mengerjakan latihan soal bersama-sama di buku tentang konsep arus, hukum ohm, hukum kirchoff arus dan tegangan dalam rangkaian terbuka/tertutup	Kuliah: Diskusi, [TM: 1mgx(3sksx50")] • Tugas-1: Menyusun ringkasan kuliah dan menyelesaiakan soal – soal konsep arus, hukum ohm, hukum kirchoff. [PT+BM:(1+1)x(2x60")] Latihan Soal dan Asistensi: Menghitung arus dan tegangan dalam rangkaian terbuka ataupun tertutup	Kuliah tatap muka daring (Zoom); Diskusi; [TM: 1mgx(3sksx50")] Tugas-1: Menyusun ringkasan ringkasan kuliah dan menghitung besaran dalam konsep arus searah [PT+BM:(1+1)x(2x60")] Asistensi [TM: 1mgx(1sksx50")] • Face-to-face online lectures (Zoom); • Discussion; [TM: 1mgx (3sksx50")]	Arus Searah Arus searah, hukum ohm dan hukum kirchoff Direct current Direct current, Ohms law and Kirchoff's law Pustaka / references : Halliday,R.,et all, 2014 Douglas C. Giancoli, 2014 Serway, 2004	17,5%

		Accuracy explaining Kirchoff's Law The accuracy of calculating the solving of problems related to direct current;	Teknik test: Latihan soal& Tugas Criteria: assessment Guidelines Non-test technique: • Explanation of course material • Discussion and questions and answers • Doing practice problems together in books on the concept of current, ohms law, current kirchoff law and voltage in open / closed circuits Test technique:	[TM: 1mgx(1sksx50")] • Lectures: • Discussion, [TM: 1weekx (3sksx50 ")] • Task-1: Compile a lecture summary and solve problems on the concept of currents, Ohm's law, Kirchoff's law. [PT + BM: (1 + 1) x (2x60 ")] • Exercise and Assistance: Calculates current and voltage in open or closed circuits [TM: 1weekx (1sksx50 ")]	Task-1: Prepare a lecture summary summary and calculate the quantity in the concept of direct current [PT + BM: (1 + 1) x (2x60 ")] • Assistance [TM: 1mgx (1sksx50 ")]	Tim Dosen Fisika ITS	

			Practice questions & Assignments				
8	Evaluasi tengah semester / Midterm Exam						
9,10	Sub-CPMK5: Mampu menggunakan rumus gaya magnet dan medan magnet terhadap arus listrik dan muatan bergerak Sub-CPMK6: menganalisa peranan magnetisasi dalam material magnetik dan hysteresis loop LLO5: Able to apply magnetic force formulas and magnetic fields to electric currents and moving charges LLO6: analyzes the role of magnetization in magnetic materials and hysteresis loops	4.1 Ketepatan menjelaskan tentang gaya magnet serta gerak partikel-bermuatan dan kumparan dalam medan magnet; Ketepatan memformulasikan dan menggunakan rumus induksi magnet oleh arus listrik; Ketepatan menjelaskan peranan magnetisasi dalam material magnetik dan kurva histeresis Accuracy describes the magnetic force and motion of charged-particles and coils in a magnetic field; Accuracy in formulating and using the formula	Kreteria: Menggunakan rubrik Teknik non-test: Menyelesaikan tugas (essay); Meringkas materi kuliah Teknik test: Quiz-2 (dengan sub-CPMK 5) EAS (dengan sub-CPMK 5 & 6) Criteria: Using a rubric Non-test technique: • Complete assignments (essays); • Summarize the course material	Kuliah; Diskusi; [TM: 1mgx(3sksx50")] • Tugas-1: Menyelesaikan soal essay perhitungan induksi magnet dan gaya magnet Tugas-2: Menyusun ringkasan peranan induksi magnetik dalam teknologi [PT+BM:(1+1)x(3x60")] Asistensi [TM: 1mgx(1sksx50")] • Lectures; • Discussion; [TM: 1weekx (3sksx50 ")] • Task-1: Complete an essay problem for calculating magnetic	Kuliah tatap muka maya dan diskusi melalui Zoom [TM: 1mgx(3x50")] • MyITS classroom: Kuliah asinkronus dan forum diskusi Assignement/ Tugas [PT+BM:(1+1)x(3x60")] Quiz-2 dan EAS: daring melalui myITS classroom (bersama dengan sub-CPMK 5 & 6) Asistensi [TM: 1mgx(1sksx50")] • Face-to-face virtual lectures and discussions via Zoom [TM: 1weekx (3x50 ")]	Gaya Magnet & Medan Magnet: gaya magnet pada partikel bermuatan dan kumparan dalam pengaruh medan magnet, induksi magnet oleh arus listrik, serta aplikasinya dalam teknologi Magnetic Force & Magnetic Field: magnetic	15%

		for magnetic induction by electric currents; Accuracy explains the role of magnetization in magnetic materials and hysteresis curves	Test technique: • Quiz-2 (with sub-CPMK 5) EAS (with sub-CPMK 5 & 6)	induction and magnetic force • Task-2: Summarize the role of magnetic induction in technology [PT + BM: (1 + 1) x (3x60 ")] Assistance [TM: 1weekx (1sksx50 ")]	• MyITS classroom: Asynchronous lectures and discussion forums Assignement / Task [PT + BM: (1 + 1) x (3x60 ")] Quiz-2 and EAS: online via myITS classroom (together with sub-CPMK 5 & 6) Assistance [TM: 1weekx (1sksx50 ")]	force on charged particles and coils under the influence of magnetic fields, magnetic induction by electric currents, and their application in technology	
11,12	Sub-CPMK7: Memahami prinsip timbunya gaya gerak listrik, dan arus dalam resistor, kapasitor dan induktor LLO7: Understand the principle of electromotive force, and currents in resistors, capacitors and inductors	4.1 Ketepatan menjelaskan tentang Hukum Faraday, Hukum Lenz dan timbulnya GGL induksi; Ketepatan memformulasikan dan menggunakan rumus GGL Induksi, iduktansi diri, induktansi silang dan energi yang tersimpan pada induktor	Kreteria: Menggunakan rubrik Teknik non-test: Menyelesaikan tugas (essay); Meringkas materi kuliah Keaktifan Teknik test:	Kuliah; Diskusi; [TM: 1mgx(3sksx50")] • Tugas-1: Menyelesaikan soal essay perhitungan mengenaiGGL Induksi Latihan soal dan Asistensi: Latihan soal-soalGGL Induksi [TM: 1mgx (1sksx50")]	Kuliah tatap muka maya dan diskusi melalui Zoom [TM: 1mgx(3sksx50")] • MyITS classroom: Kuliah asinkronus dan forum diskusi Assignement/ Tugas [PT+BM:(1+1)x(3x60")]	GGL Induksi: Hukum Faraday, Hukum Lenz, GGL induksi, Induktansi diri dan induktansi gandeng; energi pada induktor;	17,5%

		Accuracy explains Faraday's Law, Lenz's Law and the emergence of induced EMF; Accuracy to Accuracy to formulate and use the formula EMF Induction, self-iductance, cross inductance and energy stored in the inductor	Quiz-2 (dengan sub-CPMK 4) EAS (dengan sub-CPMK 5 & 6) Criteria: Using a rubric Non-test technique: • Complete assignments (essays); • Summarize the course material • Activeness Test technique: • Quiz-2 (with sub-CPMK 4) • EAS (with sub-CPMK 5 & 6)	• Lectures; • Discussion; [TM: 1weekx(3sksx50")] • Task-1: Complete a computation essay on induced emf • Exercise and Assistance: Practice Induction GGL questions [TM: 1weekx (1sksx50")]	Quiz-2 dan EAS: daring melalui myITS classroom (bersama dengan sub-CPMK 5 & 6) Asistensi: Latihan soal-soalGGL Induksi [TM: 1mgx (1sksx50")] • Face-to-face virtual lectures and discussions via Zoom [TM: 1weekx (3sksx50")] • MyITS classroom: Asynchronous lectures and discussion forums Assignement / Task [PT + BM: (1 + 1) x (3x60 ")] Quiz-2 and EAS: online via myITS classroom (together with sub-CPMK 5 & 6) • Assistance: Practice Induction GGL questions	Induced EMF: Faraday's Law, Lenz's Law, Induced EMF, Self-Inductance and Coupled Inductance; energy in the inductor;	

					[TM: 1weekx (1sksx50")]		
13,14	Sub-CPMK 6: mampu menjelaskan konsep arus bolak-balik, gejala transient, menganalisa dan memecahkan permasalahan tentang rangkaian RLC LLO6: able to explain the concept of alternating current, transient symptoms, analyze and solve problems about the RLC circuit	Ketepatan menjelaskan konsep arus bolak-balik; Ketepatan menjelaskan gejala transien; Ketepatan menghitung penyelesaian soal-soal yang berkaitan dengan rangkaian RLC; Accuracy explains the concept of alternating current; Accuracy in describing transient symptoms; Accuracy in calculating the solving of problemsrelated to the RLC circuit;	Kriteria: Menggunakan rubrik Teknik test: Tugas mandiri/kelompok Teknik non-test: Meringkas materi kuliah; Kehadiran Keaktifan Criteria: Using a rubric Test technique: Independent / group assignments Non-test technique:	Kuliah: Diskusi, [TM: 1mgx(3sksx50")] • Tugas: Menyusun ringkasan kuliah dan menghitung besaran dalam rangkaian RLC (impedansi, sudut fasa, harga arus efektif, frekuensi resonansi) [PT+BM:(1+1)x(2x60")] Latihan soal dan Asistensi: Latihan soal rangkaian arus bolak-balik [TM: 1mgx(1sksx50")] • Lectures: • Discussion, [TM: 1mgx (3sksx50")]	Kuliah tatap muka online (Zoom); Diskusi; [TM: 1mgx(3sksx50")] Tugas-1: Menyusun ringkasan ringkasan kuliah dan menghitung dan mencari penyelesaian soal-soal rangkaian RLC (impedansi, sudut fasa, harga arus efektif, frekuensi resonansi) [PT+BM:(1+1)x(2x60")] Asistensi: Latihan soal rangkaian arus bolak-balik [TM: 1mgx(1sksx50")] • Face-to-face online lectures (Zoom); • Discussion;	Arus Bolak-Balik Arus bolak-balik; gejala Transien;rangkaian RLC Alternating Current Alternating current; symptoms Transients; RLC circuits Pustaka / references : Buku Diktat Tim Dosen Fisika ITS Halliday,R.,et all, 2014	17,5%

			• Summarize the lecture material; • Attendance • Activeness	• Task: Compile a lecture summary and calculate the quantities in the RLC circuit (impedance, phase angle, effective current value, resonant frequency) [PT + BM: (1 + 1) x (2x60 ")] • Practice questions and Assistance: Exercise problems with alternating current circuits [TM: 1mgx (1sksx50 ")]	[TM: 1weekx (3sksx50 ")] Task-1: Compile a lecture summary and calculate and solve RLC circuit problems (impedance, phase angle, effective current value, resonant frequency) [PT + BM: (1 + 1) x (2x60 ")] • Assistance: Exercise circuit problems alternating current [TM: 1weekx (1sksx50 ")]	Douglas C. Giancoli, 2014 Serway, 2004	
15,16	Evaluasi Akhir Semester / Final exam						100 %

Catatan sesuai dengan SN Dikti Permendikbud No 3/2020:
Capaian Pembelajaran Lulusan PRODI (CPL-PRODI) adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
CPL yang dibebankan pada mata kuliah adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, ketrampulan umum, ketrampilan khusus dan pengetahuan.

CP Mata kuliah (CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
Sub-CP Mata kuliah (Sub-CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
Indikator penilaian kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.

3. RPS Chemistry/ *Semester Study Plan of Chemistry*

Minggu Ke Week	Pertemuan ke Meeting	Materi Kuliah Course Material	
1	1	Rencana Pembelajaran/Kontrak Kuliah Proses Analisis Materi (unsur,senyawa,sifat Kimia,Fisika) Lesson Plan / CourseContract Material Analysis Process (elements, compounds, chemical and physics properties)	Mahasiswa mampu menjelaskan prinsip-prinsip dasar kimia, meliputi Konsep Dasar Kimia Students are able to explain the basic principles of chemistry, including the basic concepts of chemistry
	2	Hukum dasar penggabungan unsur (Proust, Lavoisier, Dalton)/ Perkembangan model dan struktur atomi Basic law of elements compounding (Proust, Lavoisier, Dalton) / atomic models and structures development	

2	3	Lanjutan Perkembangan model atom dan percobaan yang mendasarinya (Dalton, Thompson, Rutherford, Bohr dan Spektrum Atom H2. Continued development of the atomic model and the experiments that underlied (Dalton, Thompson, Rutherford, Bohr and H2 atom spectrum)	Mahasiswa mampu menjelaskan prinsip-prinsip dasar kimia, meliputi Model dan Struktur Atom Students are able to explain the basic principles of chemistry, including Atomic Model and Structure
	4	Konfigurasi elektron suatu unsur dan ion Sistem dan Sifat Periodik Unsur Latihan / diskusi Elements and ions electron configuration The Periodic System and Properties of the Elements Exercise / discussion	
3	5	Satuan Konsentrasi (M, m, N, F, %, ppm, ppb) Perhitungan konsep mol Rumus empiris dan rumus molekul Latihan soal Concentration units (M, m, N, F, %, ppm, ppb) Mole concept calculation Empirical and molecular formula	Mahasiswa mampu menjelaskan prinsip-prinsip dasar kimia, meliputi Konfigurasi Elektron dan sifat sistem periodik unsur Students are able to explain the basic principles of chemistry, including Electron Configuration and the properties of the periodic system of elements

		Exercise	
	6	Stoikhiometri dalam Larutan Latihan soal Stoichiometry in solutions Exercise	Konsep Mol, Stoikhiometri dan Sifat Koligatif Larutan Mole concept, Stoichiometry and solution colligative properties
4	7	Ikatan Kimia, ionic, kovalen momen dipol, ikatan logam, ikatan hidrogen, dan ikatan Van der Walls Latihan Soal Chemical bonds, ionic, dipole moment covalent, metallic bonding, hydrogen bonding, and Van der Walls bonding Exercise	Mahasiswa mampu menjelaskan prinsip-prinsip dasar kimia, meliputi Ikatan Kimia Students are able to explain the basic principles of chemistry, including Chemical Bonds
	8	Ikatan Kovalen koordinasi Struktur dan bentuk geometri molekul (struktur Lewis, dan hibridisasi) Latihan Soal Covalent bonds, coordination structure and molecular geometry (Lewis structure and hybridization) Exercise	
5	9	QUIZ Materi sd minggu ke-3/4 Quis Materials to 3/4th week	

	10	Teori orbital molekul Latihan soal Molecular orbital theory Exercise	
6	11	Wujud Gas (Hukum-hukum gas dan sifat fisiknya) Latihan soal Gas state (Gas laws and its physical properties) Exercise	Mahasiswa mampu menjelaskan prinsip-prinsip Students are able to explain the principles
	12	Wujud Cair (sifat fisik cairan: tekanan uap, titik didih, tegangan permukaan, viskositas, wujud padat kisi kristal kubus sederhana simple cube, kubus berpusat muka face centered cube, kubus berpusat badan body centered cube, indeks Miller, persamaan Bragg) Liquid state (liquid physical properties: vapor pressure, boiling point, surface tension, viscosity, crystal lattice solid state, simple cube, face centered cube, body centered cube, Miller index, Bragg equation).	dasar kimia meliputi Wujud Zat dan Perubahan Fasa chemistry base including state of matters and phase changes

7	13	Larutan. Teori Asam Basa (Teori Arrhenius, Brønsted-Lowry,Teori Lewis) Derajat ionisasi dan Tetapan Kekuatan Asam Basa Solution Acid Base Theory (Arrhenius Theory, Brønsted-Lowry, Lewis Theory) Degree of ionization and Acid Base Strength Constant	Mahasiswa mampu menjelaskan prinsip-prinsip dasar kimia, meliputi Kesetimbangan Ionik dalam Larutan Students are able to explain the basic principles of chemistry, including Ionic Equilibrium in Solutions
	14	Latihan soal-soal Exercises	
8	15 16	ETS Materi minggu ke-4 – ke-6 Mid Term Evaluation Material week 4 – 6	
9	17	Larutan Buffer, Ksp, Kesetimbangan ionik antara zat padat dan larutan Buffer solution, Ksp, Ionic equilibrium between solids and solutions	Mahasiswa mampu menjelaskan prinsip-prinsip dasar kimia, meliputi Kesetimbangan Kimia Students are able to explain the basic principles of chemistry, including Chemical Equilibrium
	18	Latihan soal Exercise	

10	19	Konsep termodinamika (prinsip, keadaan dan proses) Hukum I Termodinamika: energi dalam, kerja dan kalor Kapasitas panas, kalorimetri dan entalpi latihan soal Thermodynamics concept (principles, states and processes) The first law of Thermodynamics: internal energy, work and heat Heat capacity, calorimetry and enthalpy Exercise	Mahasiswa mampu menjelaskan prinsip-prinsip dasar ilmu kimia meliputi, Students are able to explain the basic principles of chemistry including,
	20	Hukum II Termodinamika dan spontanitas Termokimia serta penggunaannya untuk menjelaskan kespontanan reaksi kimia, Energi bebas Gibbs, Entropi The second law of Thermodynamics and spontaneity thermochemistry and its use to explain chemical reactions, Gibbs free energy, Entropy	Termodinamika Kimia dan Termokimia Chemistry Thermodynamics and Thermochemistry
11	21	Perhitungan yang berkaitan dengan aplikasi mesin Carnot Latihan soal Calculations related to the Carnot engine application Exercise	

	22	Konsep kinetika kimia Laju dalam reaksi kimia Penentuan laju reaksi, orde dan konstanta laju reaksi Chemical kinetics concept Rate of chemical reaction Determine reaction rate, order and reaction rate constant	
12	23	Pengaruh suhu pada laju reaksi Reaksi elementer Katalis Effect of temperature on reaction rate Elementary reaction Catalyst	
	24	Latihan soal Exercise	
13	25	QUIZ Quiz	
	26	Konsep reaksi redoks Sel elektrokimia (elektroda dan larutan elektrolit dalam sel elektrokimia) Latihan soal Redox reactions concepts Electrochemical cell (electrode and electrolyte solution in electrochemical cell) Exercise	

14	27	Pengaruh konsentrasi dan persamaan Nerst Penggunaan konsep elektrokimia untuk aplikasi sel volta (baterei dan Fuel Cells) serta elektrolisis Aktivitas dan Latihan soal-soal Concrentation effect and Nerst equation Use of electrochemical concepts for voltaic cell aplications (battery and fuel cells) as well as electrolysis Activity and exercises		Penilaian *Assessment*
	28	Latihan soal Exercise		
XV	29,30	EAS Final Term Evaluation		
XVI	31,32	EAS Final Term Evaluation		

No No	Macam Evaluasi Types of Evaluation	Bobot penilaian Assessment Load
1.	Tugas-tugas (distribusi per bab) Assignments (distribution per chapter)	20 %
2.	Q u i z I Quiz I	15 %
3.	Evaluasi Tengah Semester Mid Term Evaluation	25 %
4.	Q u i z. II Quiz II	15 %

5.	Evaluasi Akhir Semester Final term	25 %

Daftar Pustaka
References

Tim Dosen Departemen Kimia ITS. 2019. Kimia 1. edisi kedua. Penerbit Media Bersaudara.

TEACHING AND LEARNING PLAN

DEPARTMENT OF CHEMISTRY - FACULTY OF SCIENCE AND DATA ANALYTICS

COMPULSORY COURSES

1. **ENGLISH**
2. **RELIGION**
3. **PANCASILA**
4. **BIOLOGY (SERVICE)**
5. **PHYSICS I**

6. **CHEMISTRY I**

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**				**Document Code**	
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMISTRY I	**SK 184101**	General	3		I	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dr. Hendro Juwono, M.Si		Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**					
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners				
	B.3 (LO 5)	Able to take responsibility for his/her own work and to give the responsibility of the achievement of anorganization				

<table>
<tr><td></td><td>D.1 (LO 8)</td><td>Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that arefaced.</td></tr>
<tr><td></td><td colspan="2">Course Learning Outcomes (CLO)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>CLO 1</td><td>The students should be able to use the principles of basic chemistry knowledge as a basis to learn chemistry inwhich they will learn further throughout their whole studies.</td></tr>
<tr><td></td><td>CLO 2</td><td>The students should be able to do the basic chemistry calculations.</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td>√</td><td></td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="2">This subject study the principles of the fundamental chemistry knowledge that covers the theory of atoms, the electron configurations, the different phases and, phase transitions, chemical reactions and stoichiometry, Acid-Base Theories, Ionic Equilibrium in Substances (Acid-Base, Solubility, Complex and Precipitation), Chemistry Thermodynamics, Chemical Kinetics and, Electrochemistry.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="2">The Basic Concepts of Chemistry, Atom Structures and Models, Electron Configurations and Chemical Bonds, Stoichiometric and Chemical Reactions, Chemical Solutions, Concentrations and, Colligative Chemical Properties, Chemistry Equilibrium, TheStates of Matters and Phase Transformations, Acid-Base Theory, Ionic Equilibrium in Substances (Acid-Base, Solubility, Complex and Precipitation), Chemistry Thermodynamics, Chemical Kinetics, Electrochemistry.</td></tr>
<tr><td>Reference</td><td colspan="2">Primary:

1. Oxtoby, D.W., Gillis, H.P. and Campion, A.,” Principles of Modern Chemistry”, 7th Edition, Brooks/Cole, 2012.
2. Chang, R. and Goldsby, K., “Chemistry”, 11th Edition, McGraw-Hill, USA, 2012.
3. Goldberg, D. E., “Fundamental of Chemistry”, 4th Edition, McGraw-Hill Companies, 2007.
4. I. Ulfin, I. K. Murwani, H. Juwono, A. Wahyudi and F. Kurniawan, “Kimia Dasar”, ITS Press, Surabaya, 2010.

Secondary:</td></tr>
<tr><td>Lecturer</td><td colspan="2">Lecturer Team for Fundamental Chemistry</td></tr>
<tr><td>Pre-Requisite Courses</td><td colspan="2">-</td></tr>
</table>

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	The students should be able to explain the fundamental principles of chemistry, including the basic concepts of chemistry.	• Accuracy in explaining the basic concepts of chemistry • Accuracy in the calculation (formulas and units) relevant examples		Lecture (Face to face) [1×(3×50')]	Lecture [1×(3×50')]	• Course contract • Material analysis process (elements, compounds, physical properties, chemical properties) • Laws of chemical combination (Proust, Lavoisier, Dalton)	
2	The students should be able to explain the fundamental principles ofchemistry, including atomstructures and models.	• Accuracy in explaining theconcepts • Accuracy incalculation	Assignment	Lecture (Face toface) [1×(3×50')]	Lecture [1×(3×50')]	• The development of atom structures and model • The underlying experiments (Dalton, Thompson, Rutherford,Bohr and The Atomic Spectrum of Hydrogen)	**5**
3	The students should be able to explain the fundamental principles ofchemistry,	Accuracy in explaining the concepts	Assignment	Lecture (Face to face) [1×(3×50')]	Lecture [1×(3×50')]	• Electron configurations of elements and ions • Periodic system	**10**

	including electron configurations					ofelements • The periodicity of elements • Ionic bond	
4	The students should be able to explain the fundamental principles ofchemistry, including chemical bonds.	• Accuracy in explaining the concepts • Accuracy in explaining and differentiating a different kind of chemical bonds	Quiz	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Polar covalent and covalent bonds, dipole moment, metal bonds, hydrogen bonds, andVan der Walls bonds • Molecular structures and geometrics (Lewis structures and hybridizatio n)	
5	The students should be able to explain the fundamental principles ofchemistry, including the state of matters and phasetransformations.	• Accuracy in explaining theconcepts • Accuracy inthe calculation	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Gaseous state (Gas laws and its physical properties) • Liquid state(Liquid physical properties: vapor pressure, boiling point, surface tension, viscosity)	**5**
6	The students should be able to explain the fundamental principles ofchemistry, including the state of matters and phasetransformations.	• Accuracy in explaining theconcepts • Accuracy inthe calculation	Assignment	Lecture (Face toface) **[1×(3×50')]**	Lecture **[1×(3×50')]**	Solid-state (Crystal lattice, simple cube, face- centered cube, body-centered cube, Miller index, Bragg's equation)	**5**

7	The students should be able to explain the fundamental principles ofchemistry, including chemical solutions, concentrations, and colligative chemical properties.	• Accuracy of calculation related to the concentration of a solute, stoichiometry, and colligative properties of asolution	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Mole concept's calculation • Empiricaland molecular formula • Concentration units (M, m, N, F, %, ppm,ppb) • Stoichiometry in solution • Colligativeproperties of a solution	**5**
8	**Mid-semester Evaluation**						**20**
9	The students should be able to explain the fundamental principles ofchemistry, including chemical equilibrium	• Accuracy in explaining theconcepts • Accuracy inthe calculation	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Concept of chemical equilibriumand equilibrium constant (Reaction Quotient, the equilibrium constant, Kp and Kc) • Le Chatelier's principles • Factors thataffect chemical equilibrium	**5**
10	The students should be able to explain the fundamental principles ofchemistry,	• Accuracy in explaining theconcepts	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Acid-base theory (Arrhenius, Bronsted- Lowry theory, Lewis	**10**

	including ionicequilibrium in substances	• Accuracy inthe calculation				theory) • Degree of ionizationand ionization constant • Acid-basestrength	
11	The students should be able to explain the fundamental principles of chemistry, including ionicequilibrium in substances	• Accuracy in explaining the concepts • Accuracy inthe calculation	Assignment Quiz	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Ionic equilibrium between solid and liquid	
12	The students should be able to explain the fundamental principles ofchemistry, including chemical thermodynamics and thermochemistry	• Accuracy in explaining theconcepts • Accuracy incalculation	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• Thermodyn amic concepts (principles,states, and processes) • First Law of Thermodyn amics: internal energy, work, and heat • Heat capacity, calorimetry,and enthalpy • The secondlaw of thermodyna mics and spontaneity • Thermochemistry and its use to explain the spontaneityof chemicalreactions • Calculations	**5**

						related to the Application of Carnot engine	
13	The students should be able to explain the fundamental principles ofchemistry, including chemical kinetics	• Accuracy in explaining theconcepts • Accuracy incalculation	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• The concept of chemical kinetics • Rate of chemical reactions • Determination of reaction rates, orders, and rate constants • Effect of temperatureon reaction rates • Elementary reactions • Catalyst	**5**
14	The students should be able to explain the fundamental principles ofchemistry, including electrochemistry	• Accuracy in explaining theconcepts • Accuracy inthe calculation	Assignment	Lecture (Face to face) **[1×(3×50')]**	Lecture **[1×(3×50')]**	• The concept of the redox reaction • Electroche mical cells (electrodes and electrolyte solutions in electroche mical cells) • Effect of concentration and Nernst equation • Use of electroche	**5**

						mical concepts for voltaic cell applications (batteries and Fuel Cells) and electrolysis • Corrosion and corrosion prevention	
15-16	**Final Semester Evaluation**						**20**

7. **MATHEMATICS I**
8. **INDONESIAN**
9. **CIVICS**
10. **PHYSICS II**

11. **CHEMISTRY II**

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMISTRY II	**SK 184202**	General	4		II	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Dr. Hendro Juwono, M.Si</td><td>Djarot Sugiarso S., M.Si.</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="3">Able to report his/her own work in a good and discipline manners</td></tr>
<tr><td>B.3 (LO 5)</td><td colspan="3">Able to take responsibility for his/her own work and to give the responsibility of the achievement of an organization</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">The students should be able to use the principles of basic chemistry knowledge as a basis to learn the chemistryknowledge further.</td></tr>
<tr><td>CLO 2</td><td colspan="3">The students should be able to use the glass apparatus correctly.</td></tr>
<tr><td>CLO 3</td><td colspan="3">The students should be to perform the basic chemistry laboratory experiments correctly.</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td>√</td><td></td><td></td><td></td><td>√</td><td></td><td>√</td><td></td><td></td></tr>
<tr><td>CLO 3</td><td>√</td><td></td><td></td><td></td><td>√</td><td></td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">This subject teaches the students about the basic principles of chemistry knowledge that covers acid-base theory, ionic equilibrium in a solution, chemical elements, chemical nucleus, and classifications of organic compounds. In addition, the students will be giventhe chance to perform basic chemistry laboratory experiments and relate their observations from the experiments with the basic theories of chemistry and their applications.</td></tr>
<tr><td>Study Material: Subject Matter</td><td colspan="4">Acid-Base Theory, Ionic equilibrium in a solution (acid-base, solubility complex, and precipitation), chemical elements, NucleusReactions, and Organic Compounds.</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:

1. Oxtoby, D.W., Gillis, H.P. and Campion, A.,” Principles of Modern Chemistry”, 7th Edition, Brooks/Cole, 2012.
2. Chang, R. and Goldsby, K., “Chemistry”, 11th Edition, McGraw-Hill, USA, 2012.
3. Goldberg, D. E., “Fundamental of Chemistry”, 4th Edition, McGraw-Hill Companies, 2007.</td></tr>
</table>

	4. I. Ulfin, I. K. Murwani, H. Juwono, A. Wahyudi and F. Kurniawan, "Kimia Dasar", ITS Press, Surabaya, 2010. **Secondary:**
Lecturer	Lecturer Team for Fundamental Chemistry
Pre-Requisite Courses	Chemistry I

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	The students should be able to use the fundamental principles of chemistry, including Ionic equilibrium in a solution	• Accuracy in explaining the concepts • Accuracy in the calculation	Assignment	Lecture **[2×(2×50')]** **[Practical training: 2 x 170']**	Lecture **[2×(2×50')]** **[Practical training: 2 x 170']**	• Course contract • Acid-base reaction • Weak acid-base equilibrium • Buffer solution • Acid-base titration's curves and principles • Polyproticacid • Organic acid-base	**10**
3,4	The students should be able to use the fundamental principles ofchemistry,	• Accuracy in explaining the concepts	• Assignment • Practical training 1 (Laboratory	Lecture [**2×(2×50')** **[Practical training: 2 x 170']**	Lecture [**2×(2×50]** **[Practical training:**	• Oxidation-reduction equilibrium • The empirical	**10**

	including solubility and precipitation equilibria	• Accuracy incalculation	technique) • Practical training 2 (Solutions)		**2x170']**	law of mass • Equilibriumof solution • Ionic Equilibria between Solids and Solutions • The effectof pH on solubility • Complex Ions and Solubility	
5,7	The students should be able to use the fundamental principles ofchemistry, including chemical elements	• Accuracy in explaining the concepts • Accuracy in the calculation	• Assignment • Practical training 3 (Acid- base titration) • Practical training 4 (Chemical element)	Lecture **[2×(2×50')]** **[Practical training: 2 x 170']**	Lecture **[2×(2×50')]** **[Practical training: 2 x170']**	• Elements and compoundsin everydaylife	**10**
8	**Mid-semester Evaluation**						**20**
9-11	The students should be able to use the fundamental principles ofchemistry, including Nucleus Reaction's theory	• Accuracy in explaining the concepts • Accuracy incalculation	• Assignment • Quiz • Practical training 5 (Chemica l Kinetics) Practical training 6 (Chemistry Thermodynamics)	Lecture **[3×(2×50')]** **[Practical training: 2 x 170']**	Lecture **[3×(2×50]** **[Practical training:2 x170']**	• The conceptof the nucleus • Radioactivity • The relationship between the neutron- proton ratioand the stability ofthe nucleus • The core structure and	**15**

						coredecay process • Core reaction equation • The mass- energy relationship • Kinetics of Core Decay • Nuclear fission	
12-14	The students should be able to use the fundamental principles ofchemistry, including the classification theory of organic compounds	• Accuracy in explaining the concepts • Accuracy incalculation	• Assignment • Practical training 7 (Electroc hemistry) Practical training 8 (Organic Compounds)	Lecture **[3×(2×50')]** **[Practical training: 2 x 170']**	Lecture **[3×(2×50)]** **[Practical training: 2 x 170']**	• The conceptof bonding in organic compounds (C-C single bonds, ethene, ethyne) • Resonance • Nomenclature of organic compounds • Isomers • Saturated hydrocarbons • Unsaturated hydrocarbo ns • Aromatic hydrocarbons • Functionalgroups • Basic reactions of organic compounds	**15**
15-16	**Final Semester Evaluation**						**20**

12. MODERN PHYSICS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**								**Document Code**
TEACHING AND LEARNING PLAN									
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**				**SEMESTER**	**Compilation Date**	
MODERN PHYSICS	**SK 184203**	Physical Chemistry	2				2		
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**				**Head of Study Program (PRODI)**		
	Nurul Widiastuti, M.Si., Ph.D., Drs. Lukman Atmaja, M.Si., Ph.D, Prof. Dr. Syafsir Akhlus, M.Sc., Dr. Triyanda Gunawan, S.Si., Drs. Eko Santoso, M.S., M.Si., Dr. Hendro Juwono, M.Si		Drs. Eko Santoso, M.S.,M.Si.				Dr. rer. nat. Fredy Kurniawan, M. Si		

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	C.1 (LO 6)	Able to apply the concepts of structure, character, and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances
	Course Learning Outcomes (CLO)	
	CLO 1	The students should be able to explain the relations of classic and modern physics and also relate them to their atomicstructures and energy characteristics.
	CLO 2	The students should be able to explain the basic concepts of atom structures based on quantum theories.
	CLO 3	The students should be able to solve wavelength equations to determine the energy.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1						√	√		
CLO 2						√	√		
CLO 3						√	√		

Course Short Description	This subject covers the basic ideas of the evolution of the modern theories of atoms based on non-classical physics, starting with the theories of relativities and quantummechanics.

Study Material: Subject Matter	The theory of relativities, Mass and Energy, Electrical and Magnetic Fields, The Theories of Gas Kinetics, Photos, Black Body Radiations,Photoelectric Effects, The Spectrum of Atoms, Bohr's Theories of Atoms, Particles, and Waves, De Broglie's Waves, The Principles of Uncertainties, The Schrodinger Equation, The Wavelength Equations, and Modern Atomic Structures.
Reference	**Primary:** 1. K.S. Krane, "Modern Physics", 3rd edition, Wiley, 2012. 2. N. Ashby and S.C. Miller, "Modern Physics", Holden-day Inc., 1970. **Secondary:**
Lecturer	Nurul Widiastuti, M.Si., Ph.D., Drs. Lukman Atmaja, M.Si., Ph.D, Prof. Dr. Syafsir Akhlus, M.Sc., Dr. Triyanda Gunawan, S.Si., Drs. EkoSantoso, M.S., M.Si., Dr. Hendro Juwono, M.Si
Pre-Requisite Courses	Mathematics I and Physics I

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students can explain the failures of classical physics, namely in the concepts of space and time, the theory of particle statistics, as wellas the relationship between classical physics and modern physics and its relationship to atomic structure and energy properties.	• The accuracy in explaining the failure theory of classical physics and relating it to modern physics regarding the structure of the atom and its energy properties.	Reading, listening, practicingquestions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, anddemo [1×(2×50')]	Classical physics failures: - Failures in the concept of space and time - Failures in the theory ofparticle	**10**

						statistics	
2	Students can explain the classical theory of relativity, Michelson- Morley's experiment, andEinstein's postulates and their consequences.	• Accuracy, logic, correct calculations in solving chemical problems related to the classical theory of relativity, Michelson-Morley's experiment, and Einstein's postulate	Reading, listening, practicing questions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	Specific relativity theory: - Classical relativity - Michelson-Morley's experiment - Einstein's postulates and their consequences	**5**
3	Students can explain Lorentz transformations and relativistic dynamics	Accuracy, logic sequence, correct calculations in solvingchemical problems related to Lorentz transformations and relativistic dynamics	Reading, listening, practicing questions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	The theory of specialrelativity: - Lorentz transformation - Relativistic dynamics	**5**

4-5	Students can explain the properties of electromagnetic waves which include photoelectriceffects, thermal radiation, Compton effects, and photon processes, as well astheir relation to atomic structure and energy properties.	Students can explain the properties of electromagnetic waves which include photoelectric effects, thermal radiation, Compton effects, and photon processes, as well as their relation toatomic structure and energy properties.	Reading, listening, practicing questions	Lecture, practice,and demo [2×(2×50')]	Lecture, practice, and demo [2×(2×50')]	Particle properties ofelectromagnetic waves: - Photoelectric effect - Thermal radiation - Compton effect Photon process	**10**
6-7	Students can explain the wave-particle's properties which include de Broglie's hypothesis, Heisenberg's	• Accuracy, logic sequence, correct calculations in solving	Reading, listening, practicing questions	Lecture, practice,and demo [2×(2×50')]	Lecture, practice, anddemo [2×(2×50')]	The wave-particle's properties: - de Broglie's hypothess - Heisenberg's uncertainy - Wave packets - Probability and randomnes	**15**
8	**Mid-semester Evaluation**						**7,5**

9	Students can solve the Schrodinger equation and determine the energy.	• Accuracy, logic sequence, correct calculations in solving chemical problems related to the Schrodinger equation	Reading, listening, practicing questions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	Schrodinger' sequation: - The behaviorof waves at the boundary - Particle confinemen t	**10**
10, 11	Students can solve the Schrodinger equation and apply it	• Accuracy, logic sequence, correct calculations in solving chemical problems related to the Schrodinger equation and applying them in life.	Reading, listening, practicing questions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	Schroding er equation: - Schrödinger equation and its applications	**15**
12	Students can explain the Rutherford-Bohr atomic model and the concept of the Hydrogen atom which includes one-dimensional atoms, angular momentumin the Hydrogen atom, andthe wave function of the Hydrogen atom, and its relation to its energy properties.	Accuracy, logic sequence, correct calculations in solving chemical problems related to the Rutherford-Bohr atomic model and the Hydrogen atom model.	Reading,listening, practicing questions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	Rutherford-Bohr model of the atom Hydrogen atom: - One-dimension alatom - Angular momentu min the hydrogen	**5**

						atom • The atomichydrogen wave function	
13	Students can explain probability density, angular probability density, and intrinsic spin on the Hydrogen atom	• Accuracy in explaining probability density, angular probability density, and intrinsic spin of the Hydrogen atom	Reading, listening, practicingquestions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	Rutherford-Bohr model of the atomHydrogen atom: - probabili tydensity - angular probabili tydensity - intrinsic spin	**5**
14	Students can explain energy levels and spectroscopic notations, the theory of the Zeeman effect, and Hydrogen fine structure	• Accuracy in explaining energy levels and spectroscopic notations,the Zeeman effect theory, and the fine structure of the Hydrogen atom.	Reading, listening, practicingquestions	Lecture, practice,and demo [1×(2×50')]	Lecture, practice, and demo [1×(2×50')]	Rutherford-Bohr model of the atomHydrogen atom: - Energy levelsand spectrosco picnotation - Zeeman effect - Hydrogen fine structure	**5**
15-16	**Final Semester Evaluation**						**7,5**

13. MATHEMATICAL AND COMPUTATIONAL CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
MATHEMATICAL AND COMPUTATIONAL CHEMISTRY	**SK184204**	Physical Chemistry	2		II	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dr. Yuly Kusumawati, S.Si., M.Si., Drs. Eko Santoso, M.S., M.Si., Drs. Lukman Atmaja,M.Si., Ph.D., Dr. Hendro Juwono, M.Si		Drs. Eko Santoso, M.S.,M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity, and communication ability
	C.1 (LO 6)	Able to apply the concepts of structure, character, and change of substance according to the aspects of dynamics andenergetics
	C.2(LO 7)	Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances
	Course Learning Outcomes (CLO)	
	CLO 1	The students should be able to use mathematics that has been taught to solve problems involving dynamics,thermodynamics, and molecule structures.
	CLO 2	The students should be able to solve problems involving dynamics, thermodynamics, and molecule structures by usingnumerical and computational methods.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1				√			√	√	
CLO 2				√			√	√	

Course Short Description	During this course, the students are being taught the basics of mathematics which can be used to solve problems involving chemistry dynamics, thermodynamics, and molecule structures. The students are also taught to solve mathematical problems in the related fieldsusing computational methods.
Study Material: Subject Matter	Co-ordinate systems, Graphs, and Functions, Differential Calculus, Integral Calculus, Differential Equations, Sequences, Operators,Vectors, Numerical and Computational Methods.
Reference	**Primary:** 1. J. R. Barrante, "Applied Mathematics for Physical Chemistry", 3rd Edition, Prentice-Hall, New Jersey, 2004. 2. Rogers, D. W, "Computational Chemistry using PC, 3rd ed, 2003 **Secondary:**
Lecturer	Dr. Yuly Kusumawati, S.Si., M.Si., Drs. Eko Santoso, M.S., M.Si., Drs. Lukman Atmaja, M.Si., Ph.D., Dr. Hendro Juwono, M.Si
Pre-Requisite Courses	Have taken Mathematics I and Mathematics II, and obtained a minimum grade of D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	- Students can identify (C1) and differentiate (P1) several kinds of coordinate systems - Students can interpret a graph (C2) - Students can perform	Graphing accuracy With Cartesian coordinate system and polar coordinate system. The accuracy in interpreting the maximum point / minimum point of a function from the		Lecture, Exercises, Demo **[2×(2×50')]**	Lecture, Exercises ,Demo **[2×(2×50')]**	• Co-ordinate systems, graphs, and functions	2%

	linear regression using MS. Excel	graph. Ability to perform a linear regression of the curve obtained					
2	Students can explain logarithmic functions and provide examples in chemical problems (C2, P2)	• Accuracy, logic sequence, the correct calculation in solving chemical problems using logarithmic functions		Case studies (various questions that can be solved using logarithms are presented) **[2×(2×50')]**	Case studies (various questions thatcan be solved using logarithms are presented) **[2×(2×50')]**	• Logarithmic Functions	3%
3	Students can explain the concept of differential calculus and provideexamples in chemical problems (C2, P2)	Accuracy, logic sequence, correct calculations in solvingchemical problems using differential calculus		Lecture, exercise, and Assignment **[2×(2×50')]**	Lecture, exercise, and Assignment **[2×(2×50')]**	• DifferentialCalculus	3%
4-5	Students can explain the concept of integral calculus and provide examples in chemical problems (C2, P2)	• Accuracy, logic sequence, correct calculations in solving chemical problems using integral calculus		Lecture, exercise, and Assignment **[1×(2×50')]**	Lecture, exercise, and Assignment **[1×(2×50')]**	• Integral Calculus	3%
5-6	Students can explain the concept of differential equations and provide examples in chemical problems (C2, P2)	• Accuracy, Logic Sequence, Correct calculations in solving chemical problems		Lecture, exercise, and Assignment **[2×(2×50')]**	Lecture, exercise, and Assignment	Differential Equations, • Introduction to numerical methods:Euler's	3%

		using differential equations			[2×(2×50')]	method for solving differential equations in excel	
6	Students can explain the concepts of scalar and vector quantity and provide examples in chemical problems (C2,P2)	• Accuracy, Logic Sequence, Correct calculations in solving chemical problems using scalar and vector quantity		Lecture, exercise, and Assignment [1×(2×50')]	Lecture, exercise, and Assignment [1×(2×50')]	Scalar quantity and vector quantity	3%
7	Students can explain the concept of matrices and determinants (C2) Students can calculate matrix and determinant questions (P2) Students can use matrices and determinants to solve the determinant slater in solving the Schrodinger equation	• Accuracy, Logic Sequence, Correct calculations in solving chemical problems using matrices and determinants		Lecture, exercise, and Assignment [2×(2×50')]	Lecture, exercise, and Assignment [2×(2×50')]	• Matrices and Determinants	3%
8	**Mid-semester Evaluation**						**30%**
9	Students can explain how to calculate with the Iterative / Numerical Method and its applicationin solving chemical problems	• Accuracy in explaining how to calculate with the Iterative / Numerical Method andits application in solving chemical problems		Lecture, exercise, and Assignment [1×(2×50')]	Lecture, exercise, and Assignment [1×(2×50')]	• Iterative method	3%

9	Students can use QBasic / visual basic software to solve Wien's displacementand Planck's radiation law(C2, P2)	• Accuracy, in the use of commands in Qbasic for subject material completion		Lecture, exercise, and Assignment **[2×(2×50')]**	Lecture, exercise, and Assignment **[2×(2×50')]**	• Computer Practice1: Wien's displacement and Planck's radiation law	**3%**
10	Students can use QBasic / visual basic software for solving numerical integration in thermodynamic applications (C2, P2)	• Accuracy, in the use ofcommands in Qbasic for subject material completion				• Computer Practice 2: A numerical Integration Shift for thermodynamic applications	**4%**
11	Students can use QBasic / visual basic software for matrix completion in the application of determinant slater (C2, P2)	• Accuracy, in the use of commands in Qbasic for subject material completion.		**Exercise** **[2×(2×50')]**	**Exercise** **[2×(2×50')]**	• Computer Practice 2: A numerical Integration Shift for thermodynamic applications	**4%**
12	Students can explain the concept of an operator (C2) Students can calculate questions related to operators for chemical applications	• Accuracy, Logic Sequence, Correct calculations in solving chemical problems using operators				• Operator	**2%**
13-14	Students understand the concepts of operators for solving chemical problems (C2). Students can make molecular orbitals graphs using origin / LabView.	• Accuracy, Logic Sequence, Correct calculation in solving chemical problems using the concept of operators		Lecture, exercise, and assignment **[2×(2×50')]**	Lecture, exercise, and assignment **[2×(2×50')]**	• Molecular orbital's Drawing Practice	**4%**
15-16	**Final Semester Evaluation**						**30%**

14. MATHEMATICS II

15. INTRODUCTION TO STATISTICAL METHODS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**				**Document Code**	
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
Introduction to StatisticalMethods	**SK 184301**	General	2		III	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Drs. Muhammad Nadjib M., MS., Djarot Sugiarso S., M.Si., Suprapto, M. Si., Ph. D		Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	C.2 (LO 7)	Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	The students should understand the terms used in statistics, as well as presenting data accordingly to statistical rules.
	CLO 2	The students should be able to do a hypothesis test, correlation analyses, and single regression.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1							√	√	
CLO 2	√						√	√	

Course Short Description	After taking part in this subject, the students know data sampling, presenting the data and describing them, analyze the data accurately andprecisely, comparing the data, and next correlating the data and predicting the relations between the data.
Study Material: Subject Matter	Understanding the terms and the basics of statistics, the different types of uncertainties, data presentation, the significant figures, the rulesof rounding up, accuracy and precision, the errors in recurring measurements, the hypothesis tests, the similarity tests of two variants, thesimilarity test of two averages, quality control, deviation measurements (variation/dispersion, range, standard deviation), population and sample, single correlation and single regression analysis.
Reference	**Primary:** 1. H. Usman and R. P. S. Akbar, "Pengantar Statistika", edisi ke 2, Bumi Aksara, Jakarta, 2008. 2. J. C. Miller and J. N. Miller, "Statistic and Chemometrics for Analytical Chemistry", 5th edition, Pearson Education, Canada,2005. 3. E. Morgan, "Chemometrics: Experimental Design", Thames Polytechnic, London, 1991. 4. B. Darmawan, "Teori Ketidak Pastian", ITB, Bandung, 1984 **Secondary:**
Lecturer	Drs. Muhammad Nadjib M., MS., Djarot Sugiarso S., M.Si., Suprapto, M. Si., Ph. D
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Understand some of the terms and basics of statistics and the differenttypes of uncertainties		Assignment	Face to face			
2	Understand datapresentation		Assignment	Face to face			10

3	Well-aware of the significant figures as well as the rules of rounding up			Face to face			
4	Can determine accuracy and precision		Assignment	Face to face			
5	Understand the existence of errors in recurring measurements		Assignment	Face to face			
6-7	Able to do the hypothesis tests, the similarity tests of two variants, and the similarity test of two averages		Assignment, Presentation	Face to face			20
8	**Mid-semester Evaluation**						**30**
9	Understand how to doquality control			Face to face			
10	Can define deviation measurements (variation/dispersion, range, standard deviation)			Face to face			
11-12	Understand the concept of population and sample		Assignment	Face to face			
13-15	Able to do the single correlation and single regression analysis		Presentation	Face to face			20
15-16	**Final Semester Evaluation**						**30**

16. CHEMICAL LITERATURE

SEMESTER LEARNING PROGRAMME

COURSE (MK)	CODE	Course Diciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
CHEMICAL LITERATURE	SK 184302	Mandatory Courses	2	0	III	21 February 2021
AUTHORIZATION / LEGALIZATION	TLP Editor		Course Group Coordinator		Head of Study Program	
	Prof. Mardi Santoso, Ph.D.; Sri Fatmawati, Ph.D.,		Drs. R. Djarot S.K.S., M.S.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	LO-PRODI Charged to the Courses	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity and communication ability
	Course Learning Outcomes (LO MK)	
	LO MK 1	Able to trace chemistry literatures
	LO MK 2	Able to write scientific articles (research proposal, article or scientific report) and understand the techniques of presentation

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1	√		√	√					

Course Description

References and/or Literatures is a comprehension that students must have in order to learn and develop a knowledge, in particular chemistry and its application. Literatures and/or References is a main source of information and consists of a lot of types of literatures.

Literatures grow at a fast rate. As an example, a scientific journal published by PubMed could increase by one article per minute. Furthermore, according to research, it shows that there are 50 million scientific articles available in the current scientific publishers. This growth needs to be balanced with the effective ways in obtaining and filtering information with the aim of developing and applying the knowledge effectively. Therefore, knowledge on literatures and implementing them would very much contribute in developing the knowledge itself and its applications.

	This course discusses literatures, in particular chemistry, that covers the sources of chemistry literatures, how to find chemistry literatures efficiently and effectively, and use them in writing research proposals, planning research methods and reporting the research results in the form of scientific articles, final assignment reports and popular scientific articles. Moreover, during the course, the students will also learn the right manners of writing and presenting a scientific article.
Study Material: Subject matter	1. Benefits of chemistry literatures 2. Types of chemistry literatures 3. Problems in searching chemistry literatures. 4. Varieties of chemistry literatures 5. Chemistry literatures and references 6. Updating to the present literatures and searching references using literatures in according to the correct manners. 7. Planning research methods according to the literature studies. 8. Writing scientific reports/articles (popular scientific article, research report, and final assignment report), and also presentation techniques.
References	**Primary:** 1. A. G. Fink, "Conducting Research Literature Reviews: From the Internet to Paper", 3rd edition, 2010. **Secondary:** 1. C. R. Kothari, "Research Methodology: Methods and Techniques", 2nd edition, New age international (P) limited, 2004.
Lecturer	Prof. Mardi Santoso, Ph.D.; Sri Fatmawati, Ph.D.,
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**

1,2	The students should be able to undestand the benefit of chemistry literature, the problem of searching chemistry literatures, technique of reading the chemistry literature and acquire the necessary information.	• Able to trace the chemistry literature • The problem in searching chemistry literature • Understand the technique of reading the chemistry literature • Able to acquire the necessary information	**Technical:** Asssignment 1 **Criteria:** • Writing the report of chemistry literature	**Lecture** **[TM: 2×(2×50')]**		• Benefit of chemistry literature • Sources of chemistry literatures • Problems in searching chemistry literatures. • Technique of reading the chemistry literature • Technique of acquire the necessary information	**5**
3,4	The students should be able to trace literature, writing the report of tracing literature, the ethics of writing and plagiarism	• Able to do the tracing literature • Able to writing the report of tracing literature • Understand the ethics of writing and plagiarism	**Technical:** Assignment 2 **Criteria** • Writing the scientific report of some literature review	**Lecture** **[TM: 1×(2×50')]** **Library visit** **[1x(2x50')]**		• How to tracing the literature review in scientific report • The ethics of writing and plagiarism • Visiting the library	**10**
5	The students should be able to understand and explain the type of literature and tracing literature, writing the bibliography and library	• Able to explain the type of literature correctly • Able to do the tracing literature, writing the bibliography and library correctly	**Technical:** **Quiz 1** **Criteria:**	**Lecture** **[TM: 1×(2×50')]**		• Type of literature • Tracing of literature review • Writing the bibliography and library	**10**

6,7	The students should be able to use the information technology for writing the bibliography : EndNote and Zotero	• Able to implement the information technology for writing the bibliography: EndNote and Zotero	**Technical :** **Criteria:**	**Lecture** **[TM: 2×(2×50')]**		• Implementation of information technology for writing the bibliography : EndNote and Zotero	
8	**Mid Semester Evaluation**						**25**
9-11	The students should be able to arrange the problem and goals, propose the hypothesis and design the experiment	• Able to arrange the problems and goals, propose the hypothesis and design the experiment	**Technical:** Assignment 3 **Criteria:** • Writing the research proposal	**Lecture** **[TM: 3×(2×50')]**		• Research methodology : arrange the research problem and goals, propose the hypothesis and design the experiment	**15**
12-15	The students should be able to writing the scientific report i.e popular research article, experiment report (essay, thesis, dissertation), scientific paper (article in conference and scientific magazine), technical of presentation	• Able to writing the writing the scientific report i.e popular research article, experiment report (essay, thesis, dissertation), scientific paper (article in conference and scientific magazine), technical of presentation	**Technical:** Assignment 4 **Criteria:** • Writing the popular scientific article for newspaper/magazine	**Lecture** **[TM: 4×(2×50')]**		• Writing of scientific report i.e popular research article, experiment report (essay, thesis, dissertation), scientific paper (article in conference and scientific magazine), technical of presentation	**10**
16	**End Semester Evaluation**						**25**

17. MEASUREMENT METHODS IN CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**					**Document Code**
SEMESTER LEARNING PROGRAMME						
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
MEASUREMENT METHODS IN CHEMISTRY	SK 184311	Analytical Chemistry	4	0	III	21 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	
	Dra. Ita Ulfin, M.Si.; Drs. M. Nadjib M., M.S.; Dr. Yatim Lailun Ni'mah, M.Si.; Drs. R. Djarot S.K.S., M.S.; Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.; Suprapto, M.Si., Ph.D.		Suprapto, M.Si., Ph.D.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	
Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**					
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making				
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances				
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.				
	Course Learning Outcomes (LO MK)					
	LO MK 1	Able to find the correlations between the knowledge of structures, characteristics, and reactivities with identifications and measurements based on mass and volumes.				
LO – LO MK Map						

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1			√				√	√	

Course Description	Measuring Methods is a course that introduces the ways to analyse compounds in samples using simple conventional methods using titration and gravimetric methods. During The Methods of Measurements lectures, the students are being taught how to use the chemistry apparatus according to their appropriate functions which are visualized through videos. By doing so, the students are expected to know and understand further on how to use the chemical apparatus (particularly the glass chemical apparatus) in the correct manners. Some of these methods are visualized, in particular the basic methods of performing titration in the correct manners, and choosing and using the right indicators to reach the point of equivalent, with the addition of experiments used in volumetric and gravimetric methods. By doing so, it is expected that it can minimize the number of experiments that are performed inside the laboratoriums, however, the students can still have the understanding of performing titrations in the correct manners.
Study Material: Subject matter	1. Solution Equilibrium 2. Calibrating glass apparatus. 3. The effects of electrolyte salts on equilibrium conditions. 4. Qualitative element analysis. 5. Volumetric Analysis (acid-base titration, Argentometry, Complexometry, Iodometry and Permanganometry). 6. Gravimetry. 7. Crystallization
References	**Primary:** 1. Skoog, D.A, West, Donal M and Holler, F.James"Analytical Chemistry: An Introduction", Sixth edition, Saunders Golden Sunburst series, USA, 1994. **Secondary:** 1. Skoog, Douglas A., et al. " Principles of Analysis chemistry", 5th ed. Saunders College Publishing, USA, 1998 2. Vogel, Arthur Israel, " A text book of Macro and Semimicro Qualitative Inorganic Analysis", 1989 3. Harris Andiel C, "Quantitative Chemical Analysis",ed 8, Clancy Marshall, 2010
Lecturer	Dra. Ita Ulfin, M.Si.; Drs. M. Nadjib M., M.S.; Dr. Yatim Lailun Ni'mah, M.Si.; Drs. R. Djarot S.K.S., M.S.; Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.; Suprapto, M.Si., Ph.D.
Pre-Requisite Courses	Have taken the courses Chemistry Fundamentals I and II

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**	**Learning Design; Learning Method;**	**Learning Material [Reference]**	

		Indicator	Criteria and Technical	Student Assignment; [Time Estimation]			Assesment portion (%)
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1,2	The students should be able to implement concept of solution equilibrium (C3, A2)	• Able solve the problem related to chemical equilibrium i.e. acid-base equilibrium and heterogen equilibrium	**Technical:** Exercise **Criteria:**	**Lecture** **[TM: 1×(2×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **[TM: 1×(2×50')]**		• Lecture contract • Solution Equilibrium	**2.5**
3,4	The students should be able to apply the concept of electrolyte salt to chemical equilibrium (C3, A2)	• Able to do calculate the effect of electrolyte salt to chemical equlibrium • Able to calculate the activity and coefficient activity with Debye-Huckel equation or by table of ion strength.	**Technical:** Student activity Exercise Test **Criteria**	**Lecture** **[TM: 1×(2×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **[TM: 1×(2×50')]**		• Effect of salt electrolyte to water equilibrium	**2.5**
5	The students should be able to do calibration and choose the correct chemical glass (C2, A2)	• Able to do calibration glass • Able to choose the correct chemical glass	**Technical:** **Criteria:**	**Lecture** **[TM: 1×(2×50')]**		• Calibration and choosing chemical glass	

6-8	The students should be able to identify cation and anion (C2, A2)	• Able to identify cation and anion	**Technical : Quiz** **Criteria:**	**Lecture** **[TM: 3×(2×50')]**			
9		• Understand the solution equilibrium and effect of salt electrolyte	**Technical : Quiz** Quiz **Criteria:** • Given 5 essay problem	**Quiz** **[TM: 1×(2×50')]**		• Quiz 1	**15**
10	The students should be able to implement the concept of quantitative analysis and choosing indicator (C3, A2)	• Able to explain the basic concept of titimetri • Able to implement the indicator equilibrium concept and choosing the correct indicator for titimetri analysis	**Technical :** Assignment activity	**Lecture** **[TM: 1×(2×50')]**		• Theory of titimetri-volumetri	
11-14	The students should be able to implement the basic concept of acid-base titration	• Able to determine the correct acid-base indicator • Able to calculate pH and determine the composition of mono buffer solution and poly acid-base	**Technical :** Student activity Assignment Test **Criteria:**	**Lecture** **[TM: 3×(2×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **[TM: 1×(2×50')]**		• Acid-base Titration	

		• Able to implement the concept od acid base for material analysis					
15-16	**Mid Semester Evaluation**						
17,18	The students should be able to implement the basic concept of precipitation titration (C3, P3, A2)	• Able to explain the basic concept of precipitation titration • Able to distinguish the type of precipitation titration • Able to implement the concept of precipitation titration	**Technical:** Student activity Exercise **Criteria:**	**Lecture** **[TM: 1×(2×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **[TM: 1×(2×50')]**		• Argentometry	
19,20	The students should be able to implement the basic concept of argentometry	• Able to explain the basic concept of precipitation formation • Able to distinguish the type of precipitation • Able to calculate substance level by gravimetry	**Technical:** Student activity Exercise **Criteria:** •	**Lecture** **[TM: 1×(3×50')]** **Responsi** **[TM: 1×(2×50')]**		• Gravimetry	**2.5**
21,22	The students should be able to explain the crystalization process (C3, A2)	• Able to explain the basic concept of crystallization	**Technical:** Student activity Exercise **Criteria:**	**Lecture** **[TM: 1×(3×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **TM: 1×(2×50')]**		• Crystallization	**2.5**

23			**Technical:** Quiz **Criteria:** • Given 5 essays problem				**15**
24-26	The students should be able to implement the basic concept of complexometry titration	• Able to explain the basic reaction of complex formation and choose the correct indicator • Able to explain the pH effect and the other complexing agent in titration • Able to implement the basic concept of titration	**Technical:** Student activity Exercise Assignment **Criteria:**	**Lecture** **[TM: 2×(2×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **[TM: 1×(2×50')]**		• Complexometry	**2.5**
27-30	The students should be able to implement the basic concept of redox titration	• Able to explain the basic concept of redox reaction • Able to distinguish the type of redox titration • Able to implement the basic concept of redox titration	**Technical:** Student activity Exercise Assignment **Criteria:**	**Lecture** **[TM: 3×(2×50')]** **Responsi** **[TM: 1×(2×50')]** **Assignment** **[TM: 1×(2×50')]**		• Redox titration	**2.5**
31-32	**End Semester Evaluation**						**25**

18. ATOMIC AND MOLECULAR STRUCTURES

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**					**Document Code**
SEMESTER LEARNING PROGRAMME						
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
ATOMIC AND MOLECULAR STRUCTURES	SK 184341	Physical Chemistry	3	0	III	21 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	
	Nurul Widiastuti, S.Si., M.Si., Ph.D. Dr. Yuly Kusumawati, S.Si., M.Si., Drs. Lukman Atmaja, M.Si., Ph.D.; Dr. Drs. Eko Santoso, M.Si.; Dr. Hendro Juwono, M.Si.; Prof. Dr. Syafsir Akhlus, M.Sc.		Dr. Drs. Eko Santoso, M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	LO MK 1	Able to trace chemistry literaturesThe students are able to use the basic concepts of structures of atoms and molecules to predict the characteristics of atoms and molecules.

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1	√					√		√	

Course Description	The Molecule Structures as a subject covers the basic concepts of structures of atoms and molecules. The lecture starts from the applications of Schrodinger Equation for translational, vibrational and rotational movements to determine the energy levels of each of the movements. The topic is then continued with one electron atoms (hydrogen atoms) in order to visualize orbital and the energy levels based on the Schrodinger Equation. The topic of atoms with more than one electrons are discussed by using the approach of the atoms interference theory and the variation methods to determine the energy level, the structures of atoms and their characteristics. After learning the structures of atoms, the topics on the molecules are started with the Born-Oppenheimer approach to explain the formatioojn of molecules, the valence bond theory, the orbital molecule theory, orbital molecules for polyatomic systems in order to predict the characteristics of the molecules by using the Huckel approach and chemistry computational.
Study Material: Subject matter	Reviews on the discussions of hydrogen atoms, the approach methods used to explain atoms with more than one electrons, orbits and their contents, penetrations and shieldings, and the configurations of electrons and the periodicities of elements. The interactions between atoms : (a) The Chemical Bonds: The empirical approach on chemical bonds : The ionic and covalent bonds, metallic bondings and the weak intermolecular forces (van der Waals, the hydrogen bonds, etc.); (b) The theories of valence bonds and the molecule shapes : The interactions of valence electrons between the atoms, the diatomic molecules, the polyatomic molecules and molecule structures (an approach by using the VSEPR methods), (c) The theories of orbital molecules : LCAO; orbital bonds, non bonding and anti bonding; the σ and π bonds; the structures of electronic molecules; the polarities of molecules; The Huckel methods; the introduction to computational calculations.
References	**Primary:** • P. W. Atkins and J. de Paula, "Physical Chemistry", 9th edition, W.H. Freeman & Co, New York, 2009. **Secondary:** 2. D. A. McQuarrie, "Quantum Chemistry", 2nd edition, University Science Books, California, 2007.
Lecturer	Nurul Widiastuti, S.Si., M.Si., Ph.D. Dr. Yuly Kusumawati, S.Si., M.Si., Drs. Lukman Atmaja, M.Si., Ph.D.; Dr. Drs. Eko Santoso, M.Si.; Dr. Hendro Juwono, M.Si.; Prof. Dr. Syafsir Akhlus, M.Sc.
Pre-Requisite Courses	Have taken the courses Modern Physics, Calculus I and Calculus II

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**

1	The students should be able to undestand the use the Schrodinger equation for vibration motion and rotation to determine the level of each energy vibration	• Able to solve the chemical problem related with vibration and rotation motion with a correct accuracy and logic	**Technical:** Quiz **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Vibration motion • Rotation motion	**5**
2	The students should be able to understand and use the Schrodinger equation of atom with one electron (aton hydrogen) to visualization the orbital and level of energy	• Able to solve the chemical problem related to atom with one electron and visualization the orbital and level energy with a correct accuracy and logic	**Technical:** Assignment **Criteria**	**Lecture and exercise [TM: 2×(2×50')]**		• Structure of hydrogen atom, atomic orbital and energy	**5**
3	The students should be able to understand and use the concept of spectroscopy transition and selection rule, atomic structure with multiple electron using the disorder theory approach and variation method to determine the level energy and atomic structure	• Able to solve the chemical problem related to concept of spectroscopy transition and selection rule, atomic structure with multiple electron using the disorder theory	**Technical:** **Quiz 1** **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Spectroscopy transition and selection rule • Atomic structure for multiple electron	**5**

		approach and variation method to determine the level energy and atomic structure					
4	The students should be able to understand and use the concept of complex atomic spectra (linewidth, singlet and triplet quantum defect) to predict the characteristic of atom	• Able to solve the chemical problem related to complex atomic spectra with a correct accuracy and logic	**Technical :** Quiz **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Complex atomic spectra : linewidth, singlet and tripley quantum defect	**10**
5	The students should be able to understand and use the theory of spin-orbit coupling, term symbol and selection rule to predict the characteristic of atom	• Able to solve the chemical problem related to spin-orbit coupling, term symbol and selection rule with a correct accuracy and logic	**Technical :** Assignment **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Spin-orbit coupling, term symbol and selection rule	**5**
6	The students should be able to understand and use Born-Oppenheimer Approximation theory and Molecular Orbital theory to predict the characteristic of molecule	• Able to solve the chemical problem related to Born-Oppenheimer Approximation theory and Molecular Orbital theory with a correct accuracy and logic	**Technical :** Quiz **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Born-Oppenheimer Approximation theory and Molecular Orbital theory : Ion hydrogen molecule, diatomic molecule with a single core	**10**

7	The students should be able to understand and use the concept of diatomic heteronuclear molecule to predict the characteristic of molecule	• Able to solve the chemical problem related to concept of diatomic heteronuclear molecule and chemical interaction with a correct accuracy and logic	**Technical :** Assignment **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Diiatomic heteronuclear molecule	**5**
8	**Mid Semester Evaluation**						**7.5**
9-10	The students should be able to understand and use the molecular orbital theory for polyatom and the implementation for computational chemistry to predict the characteristic of molecule	• Able to solve the chemical problem related to concept of molecular orbital theory for polyatom and computational chemistry with a correct accuracy and logic	**Technical:** Assignment **Criteria:**	**Lecture and exercise [TM: 4×(2×50')]**		• Molecular orbital theory for polyatom: Huckel Approximation Theory • Computational chemistry and prediction of molecule properties	**10**
11	The students should be able to understand and use operation and elemental symmetry and classification of molecular symmetry to predict the characteristic of molecule	• Able to solve the chemical problem related to operation and elemental symmetry and classification of molecular symmetry with a correct accuracy and logic	**Technical:** Assignment **Criteria:** •	**Lecture and exercise [TM: 2×(2×50')]**		• Operation and elemental symmetry, classification of molecular symmetry	**10**

12, 13	The students should be able to understand and use the implication concept of symmetry, characteristic table and label symmetry, integral negates and overlap orbital to predict characteristic of atom and molecule	• Able to solve the chemical problem related to implication concept of symmetry, characteristic table and label symmetry, integral with a correct accuracy and logic	**Technical:** Quiz **Criteria:**	**Lecture and exercise [TM: 4×(2×50')]**		• Implication concept of symmetry • Table character and label symmetry, integral and overlap integral	**15**
14	The students should be able to understand and use the integral concept and selection rule to predict the atom and molecule characteristic	• Able to solve the chemical problem related to integral concept and selection rule with a correct accuracy and logic	**Technical:** Quiz and assignment **Criteria:**	**Lecture and exercise [TM: 2×(2×50')]**		• Interal concept and selection rule	**15**
15-16	**End Semester Evaluation**						**7.5**

19. CHEMICAL THERMODYNAMICS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**	**Document Code**

SEMESTER LEARNING PROGRAMME

COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMICAL THERMODYNAMICS	SK 184342	Physical Chemistry	5	0	III	22 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	

<table>
<tr><td colspan="2"></td><td>Drs. Lukman Atmaja, M.Si., Ph.D.; Dr. Drs. Eko Santoso, M.Si.; Dr. Hendro Juwono, M.Si.; Dr. Ir. Endah Mutiara M.P., M.Si.; Ir. Endang Purwanti S., M.T.; Dra. Harmami, M.S.</td><td>.
Dr. Drs. Eko Santoso</td><td>Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="7">Program Learning Outcomes (LO)</td><td colspan="3">LO-PRODI Charged to the Courses</td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="2">Able to report his/her own work in a good and discipline manners</td></tr>
<tr><td>B.2 (LO 4)</td><td colspan="2">Able to give alternative solutions with the characters of leadership, creativity and communication ability</td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="2">Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="2">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td colspan="3">Course Learning Outcomes (LO MK)</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td></td><td>LO MK 1</td><td colspan="2">Able to implement the knowledge of structures, characteristics and reactivities to predict the substance and energy changes that follow.</td></tr>
<tr><td></td><td>LO MK 2</td><td colspan="2">Able to demonstrate the substrance and energy changes in daily life</td></tr>
<tr><td>LO – LO MK Map</td><td colspan="3"><table><tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr><tr><td>CP MK 1</td><td>√</td><td></td><td></td><td>√</td><td></td><td>√</td><td>√</td><td></td><td></td></tr></table></td></tr>
<tr><td>Course Description</td><td colspan="3">In this subject the students learn about the effects of thermal energy towards various characteristics change of substances and their mixtures, both physically and chemically, and predict and observe their characteristics change inside a laboratorium.</td></tr>
<tr><td>Study Material:
Subject matter</td><td colspan="3">1. The universe (the system, environment and the barrier wall), the wall characteristics (diathermal and isolative walls), the system characteristics (open systems, closed systems and isolated systems), the forms of systems (solids, liquids, gas), the types of systems (pure and mixed), the system variables (temperatures, pressures, and concentrations), the equations of the state of the system, the system magnitudes (intensive and extensive).
2. The thermodynamics concepts (the zero law, first law, second law and third law).
3. The applications of thermodynamics (the phase equilibrium of pure substances, the phase equilibrium in mixtures, the equilibrium of chemical reactions, electrochemical equilibirums, and the equilibrium in a life system).</td></tr>
<tr><td>References</td><td colspan="3">Primary:</td></tr>
</table>

	1. P. W. Atkins and J. de Paula, "Physical Chemistry", 9th edition, W.H. Freeman and Company, New York, 2010. **Secondary:**
Lecturer	Drs. Lukman Atmaja, M.Si., Ph.D.; Dr. Drs. Eko Santoso, M.Si.; Dr. Hendro Juwono, M.Si.; Dr. Ir. Endah Mutiara M.P., M.Si.; Ir. Endang Purwanti S., M.T.; Dra. Harmami, M.S.
Pre-Requisite Courses	Have taken the courses Chemistry Fundamentals I and II, or currently taking Mathematical Chemistry.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1-3	The students should be able to implement the knowledge of structures, characteristics and reactivities to predict the substance and energy changes that follow.	• Accuracy in distinguish the thermal function • Accuracy to calculate the thermodynamic parameter • Able to give correct conclusion	**Technical:** • Assignment • Quiz 1 **Criteria:**	**Lecture, exercise, group discussion, demonstration [TM: 2×(2×50')] [200 min]**		• Characteristic of ideal gas and real gas • Universe (system and environment) the forms of systems, the types of systems, the system variables, the equations of the state of the system, the system magnitudes	**5** **15**
4-7	The students should be able to implement the knowledge of structures, characteristics and reactivities to predict the	• Able to calculate the thermodynamic parameter • Able to give correct conclusion	**Technical:** Assignment Practical	**Lecture, exercise, group discussion, practice, demonstration [TM: 2×(2×50')] [200 min]**		• Thermodynamic II : direction of constant change • Helmholtz and Gibb's free energy	**5** **5**

	substance and energy changes that follow.	• Accuracy in laboratory measurement	**Criteria**			• Correlation between Thermodynamic I and II	
8	**Mid Semester Evaluation**						**15**
9-11	Able to demonstrate the substrance and energy changes in daily life	• Accuracy in explaining the substrance changes • Calculate the degree of freedom in phase diagram and composition of phase component • Measurement in laboratory	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice** **[TM: 2×(2×50')]** **[200 min]**		• Phase diagram and aspect of phase transition thermo • Thermodynamics of mixing • Properties of solution	**15** **5** **10**
12-14	Able to demonstrate the substrance and energy changes in daily life	• Accuracy of concept • Accuracy in calculation • Accuracy in measurement • Accuracy in argumentation and give examples	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice** **[TM: 2×(2×50')]** **[200 min]**		• Binary phase diagram • Activity • Spontaneous reaction equilibrium • Electrochemistry equilibrium	**5** **5**
16	**End Semester Evaluation**						**15**

20. BASIC ORGANIC CHEMISTRY

SEMESTER LEARNING PROGRAMME

COURSE (MK)	CODE	Course Diciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
BASIC ORGANIC CHEMISTRY	SK 184351	Organic Chemistry	3	0	III	22 February 2021
FAUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	
	Prof. Dr. Taslim Ersam, MS., Prof. Dr. R.Y Perry Burhan, M.Sc.., Zjahra Vianita Nugraheni, M.Si.; Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.; Drs. Agus Wahyudi, M.Si.; Dr. Yulfi Zetra, M.S.		Drs. Agus Wahyudi, MS.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**	
	B.3 (LO 5)	Able to take responsibility for his/her own work and to be give the responsibility of the achievement of an organization
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	LO MK 1	Able to explain the characteristic and reactivity of organic molecule with the basic concept of molecular structure and functional group

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1					√	√		√	

Course Description

Organic compounds are groups of important compounds which are spread widely throughout the nature and are mostly used in the industrial world. Plastics, medicines, petrochemical products, food, explosive materials, and paints are products that contain chemical organic compounds that we easily find in our everyday life. Hence, the structures and the characteristics of organic compounds is an interesting study to predict their reactivities and their stabilities in every reactions that occur and in every products being formed.

This course is a basic survey of the structures of organic compounds that emphasizes on bonds, electronic structures, conformations and stereochemistry. The concepts and the principles developed are used to build the student's intuitions on the stabilities and the reactivities of organic compounds based on the molecules and functional groups, so after taking this course, the students are expected to be able to explain the characteristics and the reactivities of organic molecules based on the basic concepts of molecule stuctures and functional groups. These concepts are used to prepare the students for the

	mechanistic learnings based on the organic reactivities. The activities of learning are carried out synergically between the theory classroom lectures and laboratorium experiments that runs simultaneously. This course also develops the student's abilities to solve unique problems that involve organic chemistry.
Study Material: Subject matter	1. Bonds (organic reviews), hybrid orbitals, the intramolecular interactions. 2. Stereochemistry. 3. Electrophile-nucleophile, the acid-base organics (strength identifications based on the structures). 4. The introduction to functional groups and their reactivities 5. The introduction to reaction mechanisms (hemolytic heterolytic ruptures), reactive intermediates (carbocation, carbanion, radical). 6. The introduction to organic compounds functional groups based on the spectroscopy data and their separation techniques.
References	**Primary:** 1. T.W.G. Solomons, "Organic Chemistry", John Wiley & Sons, New York, 2004. **Secondary:** 1. M. A. Fox and J. K. Whitesell, "Organic Chemistry", Jones and Barlett Publishers, Boston, 2001. 2. J. March, "Advanced Organic Chemistry", 4th edition, John Wiley & Sons, New York, 1992. 3. E. L. Eliel, "Stereochemistry of Organic Compounds", McGraw-Hill, Singapore, 1975. 4. H. Kagan, "La Stereochimie organique", Press Universite de France, Paris, 1973.
Lecturer	Prof. Dr. Taslim Ersam, MS., Prof. Dr. R.Y Perry Burhan, M.Sc.., Zjahra Vianita Nugraheni, M.Si.; Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.; Drs. Agus Wahyudi, M.Si.; Dr. Yulfi Zetra, M.S.
Pre-Requisite Courses	Have taken Chemistry Fundamentals I and II, and passed with a minimum grade D.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**

1,2	**[C2, A3]** The students should be able to explain the process of bond formation and hibrida orbital in molecule	• Accuracy in explaining the bond formation and formation of hibrida orbital	**Technical:** Asssignment 1 **Criteria:**	**Introduction Lecture & Brainstorming** **[TM: 1x(2x50")]** **Lecture and Discussion** **[TM: 3x(2x50")]** **Assignment 1** **[BT+BM:(1+1)x(4x60")]**		• Bonding • Formation of carbon hibrida orbital and other atom	**10**
3,4	**[C2, A3]** The students should be able to explain the phenomena of molecular interaction	• Accuracy in explaining the molecular interaction (bond length, bond angle, bond energy, dipole moment, polar-non polar, resonance, induction, hyperconjugation and mesomeric)	**Technical:** Asssignment 1 **Criteria:**	**Lecture, group discussion** **[TM: 4x(2x50")]**		• Molecular interaction (bond length, bond angle, bond energy, dipole moment, polar-non polar, resonance, induction, hyperconjugation and mesomeric) •	
5-7	**[C2, A3]** The students should be able to explain the concept of acid-base, electrophile and nucleophile	• Accuracy in explaining the acid-base concept and electrophile-nucleophile • Accuracy in identifying the acid-base	**Technical:** Quiz **Criteria:**	**Lecture, group discussion** **[TM: 6x(2x50")]** [BT+BM:(1+1)x(4x60")]		• Acid-base and electrophile-nucleophile • Acid-base (identification of acidity and basicity	**10**

	The student able to identify the acid-base characteristic from molecular structure	characteristic from molecular structure				from molecular structure)	
8	**Mid Semester Evaluation**						**30**
9-10	**[C3, A3]** The students should be able to mention the type of functional group in molecule and explain the reactivity	• Able to mention the type of functional group in molecule and explain the reactivity	**Technical:** **Criteria:** •	**Lecture, group discussion** **[TM: 4x(2x50")]**		• Introduction to functional group and its reactivity	**10**
11,12	**[C3, A3]** The students should be able to mention the type of functional group in molecule based on spectroscopic data and explain the separation technique	• Able to mention the type of functional group in molecule based on spectroscopic data and explain the separation technique	**Technical:** Assignment 2 **Criteria:**	**Lecture, group discussion** **[TM: 4x(2x50")]**		• Introduction to functional group based on spectroscopic data and the separation technique	**10**
13-15	**[C3, A3]** The students should be able to explain the stereochemistry principal in organic molecule and explain a simple organic reaction	• Accuracy in explaining the stereochemistry phenomena in organic molecular structure and conjugation in unsaturated compounds • Identify the type of reaction in organic molecule	**Technical:** Presentation **Criteria:**	**Lecture, group discussion** **[TM: 6x(2x50")]** **[BT+BM:(1+1)x(4x60")]**		• Organic stereochemistry • Introduction of organic reaction mechanism	**10**
16	**End Semester Evaluation**						**30**

21. SEPARATION AND PURIFICATION METHODS

S	**INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)** **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Kode Dokumen**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
SEPARATION AND PURIFICATION METHODS	SK 184412	Analytical Chemistry	4	0	IV	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Lecturer teams of Analytical Chemistry		Suprapto, M.Si., Ph.D.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity and communication ability
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	CP MK 1	Able to correlate between the knowledge of structures, characteristics, reactivities during the process of temperature based separation and purification, solubility, polarity and size/mass.

LO – LO MK Map

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CP MK 1				√		√	√	√	

Course Short Description	The Methods of Separation and Purification as course counts as mandatory in which the course is normally available during the 4th semester. This course teaches the students the methods of carrying out the processes of separation and purification of compounds in samples, separating pollutants from samples and purification of compounds in samples, by using methods such as distillation, extraction, adsorption, ion exchange, electrodeposition, floatation and membranes. Each topic is given in the form of class lectures and the topics being discussed can also be accessed via the ITS website, complete with video for illustrations. By doing so, the students are expected to understand further the aims of learning the Methods of Separation and Purification Course. A couple of topics that will be presented are examples of journals that are related to the topics being discussed in the course. At the end of the course, the students are given a study case, where the students are expected to complete the study case by choosing one of the methods being taught. The solutions to the study case will be in the form of written papers and presentations presented in the front of the class at the end of the course
Study Material: Subject matter	9. Distillations (the fundamentals and their types). 10. Extractions (simple extraction, continue, counter-current, SPE, critical super fluid). 11. Chromatography (the basic concepts, the types of chromatography, PC, TLC, GC, LC, IC). 12. Adsorption and Ion Exchanger (the basic concepts, the types of ion exchangers, the resin ion exchanger). 13. Electrodeposition and electrocoagulation. 14. Flotation 15. Speciation 16. Membranes
Reference	**Main :** 2. **Supporting :** 1. Meloan, Clifton E.,"Chemical Separation: Principles, Techniques and Experiments", John Woley, Canada, 1999. 2. Pawliszyn, James and Lord, Heather.L,"Handbook of sample preparation", John Wiley, USA, 2101. 3. Inglezakis.Vjssilis J and Poulopoulus, Stravros G, "Adsorption, Ion Exchange and Catalysis", Elsevier, 2006. 4. Mc Nair, Harold M and Miller, James.M, " Basic Gas Chromatography",John Wiley,1998. 5. Articles or journals with related topics
Supporting Lecturer	Lecturer teams of Analytical Chemistry

Pre-Requisite Courses	Have taken the courses Chemistry Fundamentals II and Measuring Methods.

Session	Learning outcome of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1				**Lecture [2x50”]**		• Learning contract	
2-5	Students are able to explain the extraction process and kinds of extractions	• Able to explain the basic concept of extraction • Able to explain the affecting factors of extraction • Able to explain the basic concept of solid-liquid extraction • Able to explain the basic concept of	**Technical :** Exercises	**Lecture [6x50”]** **Problem base learning [2x50”]**		Extractions : 1. Simple, continued, counter current extractions 2. Solid state extraction 3. Supercritical fluid extraction	**2.5**

		supercritical fluid extraction • Well-skilled to perform liquid-liquid extraction and solid-liquid extraction					
6-10	Students are able to define and explain the basic concept of chromatography	• Able to explain the basic concept of chromatography • Well-skilled to perform the separation of compounds by column chromatography (CC) and thin layer chromatography (TLC) in the right manner	**Technical :** Exercises Journal reviewing **Criteria:** •	**Lecture** **[6x50"]** **Problem base learning** **[2x50"]** **Laboratory work** **[2x50"]**		• Basic chromatography	**2.5**
11		QUIZ 1	**Technical :** **Quiz** **Criteria:**	**Quiz** **[2x50"]**		• Extractions and concept of chromatography	**15**
12-15	Students are able to explain the process of ion exchange	• Able to explain the basic concept of adsorption and ion exchange • Able to choose and differ kinds of	**Technical :** Exercises Arranging an experimental procedure **Criteria:**	**Lecture** **[5x50"]** **Group discussion** **[3x50"]**		• Adsorption and ion exchange	**2,5**

		adsorption process and ion exchange • Able to arrange an experimental procedure based on an graphic taken from a scientific journal					
16	**Mid-term evaluation**						**25**
17-18	Students are able to explain the basic concept of separation based on boiling point	• Able to explain the basic concept of separation based on differences in boiling point	**Technical:** **Criteria:**	**Lecture [2x50"]**		• Distillation (simple, fractionation, continued, azeotrope, extractive, steam, vacuum)	
19-20	Students are able to define and explain the electric field-based separation	• Able to explain the separation process by electrodeposition and electrocoagulation	**Technical:** **Criteria:** •	**Lecture [4x50"]**		• Electrodeposition • Electrocoagulation	
21	Students are able to define and explain the separation by membranes	• Able to explain the separation process by membranes, and know the applications	**Technical:** **Criteria:**	**Lecture [2x50"]**		• Membranes	
22		QUIZ 2	**Technical:** **Quiz** **Criteria:**			• Distillation • Membranes • Electrodeposition • Electrocoagulation	**15**

23-24	Students are able to define and explain the separation by floatation	• Able to explain the floatation process in the right manner	**Technical:** **Criteria:**	**Lecture [4x50”]**		• Flotation	
25-27	Students are able to define and explain a few of missel techniques for the separation process	• Able to explain the separation process by speciation	**Technical:** **Criteria:**	**Lecture [4x50”]** **Exercises [2x50”]**		• Speciation	**2.5**
28-29	Case study		**Technical:** **Criteria:**	**Individual project [2x50”]** **Presentation [2x50”]**			**10**
30-32	**End-term evaluation**						**25**

22. STRUCTURE, PROPERTIES AND REACTIVITY OF INORGANIC COMPOUNDS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Kode Dokumen**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
STRUCTURE, PROPERTIES AND REATIVITY OF INORGANIC COMPOUNDS	SK 184421	Inorganic Chemistry	5	0	IV	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Lecturer teams of Inorganic Chemistry</td><td>Dra. Ratna Ediati, M.S., Ph.D.</td><td>Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="7">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>B.3 (LO 5)</td><td colspan="3">Able to take responsibility for his/her own work and to be give the responsibility of the achievement of an organization</td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="3">Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (LO MK)</td><td colspan="2"></td></tr>
<tr><td>CP MK 1</td><td colspan="3">The students are able to correlate the structures, characteristics and reactivities of inorganic molecules based on the basic concepts of kinetics-thermodynamics of structures and molecules</td></tr>
<tr><td>CP MK 2</td><td colspan="3">The students have the experience to correlate structures, characteristics and reactivities of inorganic molecules</td></tr>
<tr><td>LO – LO MK Map</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CP MK 1</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>CP MK 2</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">In this course, the students will learn about the physical forms of the inorganic compound structures based on the theories of chemical bond and correlate the structures of inorganic compounds with their inorganic molecule characteristics and reactivities based on the basic concepts of molecule thermodynamics-kinetics structures and characteristics.</td></tr>
<tr><td>Study Material:
Subject matter</td><td colspan="4">1. The Introduction to Chemical Structures: properties, ionic strengths, and bond angles in covalent compounds, polycation
2. Calculating Electronegativities in bonds and dipole moments.
3. Point groups on inorganic molecules.
4. The correlation between polarity and symmetric molecules.
5. The Acid-Base Concepts of Acid Periodicities, oxo acid, anhydrous and polymerization, the acid-base strengths, the acid-base solvents.
6. Ionic solids, structures, properties, applications, covalent bonds in ionic solids.
7. Metallic compounds, metal alloys, organometallic
8. Coordination compounds, spectroscopy of complex compounds (term symbol, The Tanabe Sugano Diagram)
9. Potential reduction, redox stability, the pH Dependence Latimer Diagram.</td></tr>
</table>

	10. The Principles of Inorganic Compound Reactions: octahedral substitutions, rectangular planar, the reactions of complex compounds, redox.
Reference	**Main:** 1. D. D. Shriver and P. W. Atkins, "Inorganic Chemistry", 5th Edition, W.H. Freeman and Company, Oxford, 2010. 2. E. Huheey, E. A. Keiter and R. L. Keiter, "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Edition, Harper Collins College Publishers, London 1997. 3. G. L. Miessler, P. J. Fischer and D. A. Tarr, "Inorganic Chemistry", 5th Edition, Prentice Hall, London, 2013. 4. C. E. Housecroft and A.G. Sharpe, "Inorganic Chemistry", 2nd Edition, Pearson Education Limited, 2005 **Supporting:** 1.
Supporting Lecturer	Lecturer teams of inorganic Chemistry
Pre-Requisite Courses	Have taken the courses Chemistry Fundamentals I and II, and passed with a minimum grade D.

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain the termination and formation of bonds, as well as the energy change that occur in a chemical reaction	• The accuracy in explaining the process of breaking and forming bonds in chemical reactions • The accuracy in explaining the energy changes in a chemical reaction	**Technical :** **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]** **Discussion [TM: 1x(2x50")]**		• Chemical reaction aspects in inorganic compounds, including the termination and formation of bonds along with its energy changes	

2	Students are able to explain the characteristics of bonds and the polarity of inorganic compounds	• The accuracy in explaining bond characterizations and ionic and covalent strengths in inorganic molecules • The accuracy in calculating the electronegativity and dipole moment and explaining the polarity of a molecule as well as its dipole-dipole interaction	**Technical :** Non test (Assignment 1, a brief report) **Criteria :** Having a calculation of bond characteristic and dipole moment in inorganic molecule	**Lecture, group discussion** [TM: 2x(2x50")]		• Bond characteristics • Calculation of ionic and covalent bond characteristics • Polycation • Electronegativity • Dipole moment and bond polarity • Dipole-dipole interactions • Hydrogen bond and Van der Walls bond and its applications in daily life	**10**
3,4	Students are able to determine the symmetry of an inorganic compound and the relationship between polarity and symmetry	• The accuracy in determining the symmetry of an inorganic molecule • The accuracy in explaining the relationship between polarity and symmetry of inorganic molecule	**Technical :** Quiz 1 **Criteria :** •	**Lecture, group discussion** **[TM: 3x(2x50")]** **Quiz** **[TM: 1x(2x50")]**		• The symmetry of molecule : plane symmetry, rotation symmetry, translation symmetry • Point group • The relationship between polarity and symmetry of inorganic molecule	**15**
5,6	Students are able to explain acid-base concept from various definitions and to	• The accuracy in explaining the concept of acid-base	**Technical :** **Criteria :**	**Lecture, group discussion** **[TM: 4x(2x50")]**		• The concept of acid-base : Arrhenius, Lewis, Bronsted-Lowry, Lux-Flood,	

	determine the strength of acid-base	• The accuracy in explaining the strength of acid-base of inorganic compounds				Solvent, Usanovish, Lavoisier	
7	Students are able to demonstrate the application of the concept of acid-base hardness to the formation of inorganic compounds in nature	• The accuracy in demonstrating the concept of acid-base hardness to the formation of inorganic compounds in nature	**Technical :** **Criteria :**	**Lecture, group discussion [TM: 2x(2x50")]**		• The concept of Hard-soft acid base • The examples of hard acid and soft acid • The tendency of hard and soft acids in nature • The application of hard acid and soft acid	
8	**Mid-term evaluation**						**20**
9,10	Students are able to relate the structure of ionic solids to the properties and reactivity it produces	• The accuracy in describing the structure of ionic solids • The accuracy in predicting the structure and properties of ionic solids • The accuracy in relating the structure of ionic solids to their properties and reactivity	**Technical:** Non test (assignment 2, a brief report) **Criteria:** Estimating the structure, determining the arrangement of the atoms and the crystal structure formed and relating it to the properties	**Lecture, group discussion [TM: 4x(2x50")]**		• The structure of ionic solids and the basis for their determination • Properties and reactivity of ionic solids • Effects of structure and properties on ionic solid applications • The structure and properties of the metal alloy	**10**

			and reactivity of the solid resulting from a determined ionic solid			• Ionic solids and metal alloy applications	
11,12	Students are able to relate the structure and the reactivity of coordination compounds and organometallic compounds	• The accuracy in explaining the concept of the organometallic compounds • The accuracy in determine the structure of the coordination compounds • The accuracy in relating the structure of the coordination compound formed to its chemical properties and reactivity	**Technical:** Non test (assignment 3, a brief report) **Criteria:** • Determining the structure of coordination compound and the splitting energy of d-orbitals in the coordination compounds. • Determining the characteristics of the known structure of coordination compounds	**Lecture, group discussion [TM: 3x(2x50")]** **Quiz [TM: 1x(2x50")]**		• Introduction to organometallic compounds • The formation and structure of coordination compounds • Nomenclature of coordination compounds • Electronic spectra of coordination compounds • Tanabe-Sugano diagram • Calculating the energy of d orbitals	**15**
13,14	Students are able to explain the concept of reduction potential, redox stability and pH dependence on inorganic compounds and estimate the properties and reactivity of a	• The accuracy in understanding Latimer diagram, Purboix diagram, and Frost diagram	**Technical:** **Criteria:**	**Lecture, group discussion [TM: 4x(2x50")]**		• Reduction potential • Redox stability • Latimer diagram • pH dependence	

	compound based on the information given.	• Able to use diagram in determining the characteristics and the reactivities of an inorganic compound					
15	Students are able to predict the types of reactions that occur in an inorganic compound based on its properties and reactivity	• The accuracy of estimating the types of reactions of inorganic compound based on its properties and reactivity	**Technical:** **Criteria:**	**Lecture, group discussion [TM: 2x(2x50")]**		• Octahedral substitution and tetrahedral planar substitution • Reactions of complex compounds • Redox reactions	
16	**End-term evaluation**						**20**

23. CHEMICAL DYNAMICS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**						**Kode Dokumen**
TEACHING AND LEARNING PLAN							
COURSE (MK)		**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
CHEMICAL DYNAMICS		SK 184443	Physical Chemistry	6	0	IV	07 Januari 2020
AUTHORIZATION / LEGALIZATION		**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
		Prof. Dr. Syafsir Akhlus, M.Sc., Drs. Eko Santoso, M. Si., Dra. Harmami, M.S., Dr. Hendro Juwono, M.Si., Lukman Atmaja, Ph.D.		Dr. Drs. Eko Santoso, M. Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**						
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics					

<table>
<tr><td></td><td>C.2 (LO 7)</td><td>Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td></td><td>D.1 (LO 8)</td><td>Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Course Learning Outcomes (LO MK)</td></tr>
<tr><td></td><td>CP MK 1</td><td>Able to apply the principles of dynamics to predict substance changes.</td></tr>
<tr><td></td><td>CP MK 2</td><td>Able to gather data and information, analyze them in the correct manners, and use qualitative findings to compile a scientific arguments and make decisions that such reactions could take place.</td></tr>
<tr><td>LO – LO MK Map</td><td colspan="3">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CP MK 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td>√</td><td></td></tr>
<tr><td>CP MK 2</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="3">This course discusses two aspects of chemical dynamics which are the transport phenomena, and the phenomena of electrokinetic and reaction kinetics. The topic on transport phenomena cover molecules, ions, and heat, and continued by discussing electrokinetic phenomena, the electrode processes, and the electrode reaction mechanisms. The second topic is the reaction kinetics which discusses the different types of reaction, starting from the very simple reactions up to the most complicated reactions, such as chain reaction enzymatic reactions, catalysis reactions and polymerization reactions. In this course, the methods of learning, besides from being given as lectures inside a classroom, it is also being done inside a laboratory to gather data and information, and to calculate and analyze the data obtained. A small project of a simple type of reaction is also given to introduce the students to the abilities of predicting the changes in substances and determine that the particular reactions could or could not occur.</td></tr>
<tr><td>Study Material:
Subject matter</td><td colspan="3">1. Transport phenomena: molecules, ions and heat.
2. Electrokinetic phenomena, The Electrode Processes, and The Mechanisms of Electrode Reactions.
3. Reaction Kinetics : The simple rate laws for homogenous reactions and their data treatment, the kinetic modeling of chemical reactions, the mechanisms of simple homogenous reactions, the principles of reversible reactions and the equilibrium concepts, the unimolecular, bimolecular and termolecular reactions, The Theory Approach : the surface potential energy, the theory of momentum, transition state, comparing the calculated results with the experimental results for a reaction, The Non-Elementary Reactions (numbers that are not whole numbers/fraction numbers) : chain reaction, enzymatic reactions, catalysis reactions and polymerization reactions.</td></tr>
<tr><td>Reference</td><td colspan="3">Main:
1. P. W. Atkins and J. de Paula, “Physical Chemistry”, 9th edition, W.H. Freeman and Company, New York, 2010.</td></tr>
</table>

	Suppoerting: 2.
Supporting Lecturer	Prof. Dr. Syafsir Akhlus, M.Sc., Drs. Eko Santoso, M. Si., Dra. Harmami, M.S., Dr. Hendro Juwono, M.Si., Lukman Atmaja, Ph.D.
Pre-Requisite Courses	Have taken Fundamentals Chemistry 1 and 2, and Calculus I and 2 courses.

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1-3	Students are able to apply the principles of dynamics to predict substance changes.	• The accuracy in explaining the kinetic model of the gas. • The accuracy in describing the motion of molecules in a gas form • The accuracy in calculating wall collisions, and effusion rates • The accuracy in describing the motion of molecules in a liquid form • Able to explain diffusion in a correct manner • The accuracy in explaining diffusion probability and its statistical aspects • The accuracy in determining reaction rates	**Technical :** Assignment or problem based learning Quiz 1 **Criteria :**	**Lecture and exercise** **[TM: 3x(2x50”]** **Or 300 minutes**		• Movement of molecules in gases: Kinetics models of gases • Movement of molecules in gases: 1. Astrophysical impact 2. Wall and surface collisions • Movement of molecules in gases: 1. Effusion rate 2. Ideal gas transport properties • Movement of molecules in liquid: 1. Experimental results 2. The conductivity of the electrolyte solution	**20**

						• Movement of molecules in liquid: 1. Diffusion 2. Biochemical impact • Diffusion: 1. Thermodynamic aspects 2. Diffusion equation • Diffusion: 1. Diffusion probability 2. Statistical aspects • Diffusion: 1. Experimental Techniques 2. Reaction Rate	
4-7	Students are able to collect data and information, perform proper analysis, use qualitative evidence to formulate scientific arguments and make decisions that reactions may occur.	• The accuracy in explaining chemical kinetics and calculating reaction rates and equilibria • The accuracy in describing the laws of rates and elementary reactions. • The accuracy in explaining the reaction mechanism	**Technical :** Assignment or problem based learning **Criteria :**	**Lecture, exercise, lab work** **[TM: 3x(2x50”]** **Or 300 minutes**		• Chemical Kinetics 1. Experimental Techniques 2. Reaction rate 3. The law of the rate of integration 4. Equilibrium reactions 5. Effect of temperature on reaction rate • Law of Rate: 1. Elementary reaction 2. Consecutive elementary reactions • Examples of reaction mechanisms:	**10**

						1. Unimolecular reactions 2. Polymerization kinetics 3. Photochemistry 4. Plant photosynthesis	
8	**Mid-term evaluation**						**20**
9-11	Students are able to collect data and information, perform proper analysis, use qualitative evidence to formulate scientific arguments and make decisions that reactions may occur	• The accuracy in explaining reactive encounters • The accuracy in calculating Eyring's equation and thermodynamic aspects • The accuracy in explaining the dynamics of molecular collisions and electron transfer, and their applications in daily life.	**Technical :** Assignment or problem based learning **Criteria :**	**Lecture, exercise, lab work [TM: 3x(2x50")] Or 300 minutes**		• Reactive encounters: 1. Collision theory 2. Controlled diffusion reaction 3. Equation of material balance • Transition state theory: 1. The Eyring Equation 2. Thermodynamic aspects • Dynamics of molecular collision: 1. Reactive collisions 2. Potential energy surface 3. Examples of experiments and calculations • Electron transfer dynamics: 1. Transfer of electrons in a homogeneous system	**10**

						2. The process of transferring electrons to the electrodes 3. Impact on energy: fuel cells	
12-15	Students are able to collect data and information, perform proper analysis, use qualitative evidence to formulate scientific arguments and make decisions that reactions may occur	• The accuracy in explaining the definition of catalyst • The accuracy in explaining the difference between homogeneous and heterogeneous catalyst • The accuracy in explaining the catalyst mechanism in a reaction • The accuracy in explaining the applications of catalyst in industrial aspect	**Technical :** Assignment or problem based learning • **Criteria :**	**Lecture, exercise, lab work** **[TM: 3x(2x50")]** **Or 300 minutes**		• Discussion and exercise • Catalyst : 1. Homogeneous catalyst 2. Enzyme • Heterogeneous catalyst : 1. Growth and surface structure of solids 2. Adsorption 3. Heterogeneous catalysis mechanism 4. Catalytic activity on the surface 5. Impact on technology: catalysis in the chemical industry	**15**
16	**End-term evaluation**						**20**

24. ORGANIC REACTIONS AND MECHANISMS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Kode Dokumen**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
ORGANIC REACTIONS AND MECHANISMS	SK 184452	Organic Chemistry	4	0	IV	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Prof. Dr. Mardi Santoso, Arif Fadlan D.Sc, Dr. Yulfi Zetra, MS., Prof. Dr. R.Y. Perry Burhan, M.Sc., Zjahra Vianita Nugraheni, S.Si., M.Si., Drs. Agus Wahyudi, M.Si.		Drs. Agus Wahyudi, M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	CP MK 1	Able to demonstrate a wide range of reaction mechanism based on the structure and functional groups of organic molecules

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1			√			√	√	√	

Course Short Description

Burning fossil fuels and making soaps are organic reactions which have been known for a long time. Producing products with organic compound contents such as medicines, plastics, food additives, and cotton are also well known to rely on organic reactions. Organic reactions that cover addition reaction, elimination reaction, substitution reaction and rearrangement reaction have also taken a couple of scientists to achieve a Noble Price in the

	field of chemistry. Based on these factors, organic compound reactions become an interesting and a challenging subject to study. The organic compound reactions lecture is a survey of organic compound reactions by emphasizing on the reaction mechanisms based on the structures and functional group reactivities of organic molecules. The concepts and models being developed are useful for developing intuitions on the reactivities of organic compounds. The concepts are used to study and approach the mechanisms of organic reactions based on the structures and reactivities of organic molecule function groups. The activities of learning are carried out synergically between the theory classroom lectures and laboratory experiments that runs simultaneously. Hence at the end of the courses, the students are expected to be able to show a variety of organic reaction mechanisms based on their structures and organic molecule function groups.
Study Material: Subject matter	1. Addition : electrophilic (hydrohalogenation, hydration, halogenation, halohydration, Diels-Alder, hydroboration/oxidation, epoxidation, ozonolysis); nucleophilic (Grignard reaction, Wittig reaction, aldol condensation, Claisen condensation, benzoin condensation, addition of ammonia derivatives, Mannich reaction, monosaccharide cyclisation (hemiacetal-acetal cyclic carbohydrates)) 2. Substitution: SN1, SN2, SNi, participation of neighboring groups, SN of carboxylic acid and its derivatives, SN of alcohol (formation of glycoside bonds), Aromatic SN, Aromatic SE. 3. Elimination: E1, E2, competition of (E1 / E2) with SN1 / SN2 (solvent effect, nucleophile), Hoffmann elimination. 4. Rearrangement: electron-deficient system, electron-rich system, double or triple bond migration, thermal-impacted rearrangement, rearrangement of aromatic nuclei.
Reference	**Main:** 1. T.W.G. Solomons, “Organic Chemistry”, John Wiley & Sons, New York, 2004. 2. J. March, “Advanced Organic Chemistry”, 4th edition, John Wiley & Sons, New York, 1992. 3. E. L. Eliel, “Stereochemistry of Organic Compounds”, McGraw-Hill, Singapore, 1975. 4. J. S. Nimitz, “Experiments in Organic Chemistry”, Prentice Hall Inc., Englewood Cliffs, 1991. 5. C. F. Wilcox Jr. and M. F. Wilcox, “Experimental Organic Chemistry”, 2nd edition, Prentice-Hall, Englewood Cliffs, 1995. **Supporting:**
Supporting Lecturer	Prof. Dr. Mardi Santoso, Arif Fadlan D.Sc, Dr. Yulfi Zetra, MS., Prof. Dr. R.Y. Perry Burhan, M.Sc., Zjahra Vianita Nugraheni, S.Si., M.Si., Drs. Agus Wahyudi, M.Si.
Pre-Requisite Courses	Have taken the course Fundamentals of Organic Chemistry and passed with a minimum grade D.

Session	Learning outcome of each learning stage (Sub-LOMK)	Assessment	Learning Design; Learning Method;	Learning Material [Reference]	Assessment (%)

		Indicator	Criteria and Technical	Student Assignment; [Time Estimation]			
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	Students are able to show nucleophilic substitution reactions in alkyl halides and alcohols	• The accuracy in writing down organic reaction mechanisms • The accuracy in writing down the mechanism of nucleophilic substitution reactions for alkyl halides and alcohols	**Technical :** Assignment 1 **Criteria :** Nucleophilic substitution reactions in alkyl halides and alcohols	**Introduction lecture and brainstroming [TM: 2x(2x50")]** **Lecture and discussion [TM: 2x(2x50")]** **Assignment about reaction example [BT+BM:(1+1)x(4x60")]**		• S_N2 reaction in alkyl halides and alcohols • S_N1 reaction, ion-pair criteria in the S_N1 reaction mechanism, • S_Ni mechanism • Rearrangement reaction mechanism in substitution reaction	**10**
3,4	Students are able to show nucleophilic and electrophilic substitution reactions in benzene	• The accuracy in writing down the mechanisms of nucleophilic and electrophilic substitution reaction in benzene	**Technical :** **Criteria :**	**Lecture and group discussion [TM: 4x(2x50')] [BT+BM:(1+1)x(4x60")]**		• The reaction mechanisms of aromatic SE: halogenation, nitration, sulfonation and hydroxylation • The Friedel-Crafts alkylation mechanism, rearrangement during Friedel-Crafts reaction, Friedel-Crafts acylation • Effects of substituents and electronic effects (ortho drive, meta,	**10**

						para) on SE in aromatic compounds • SN mechanism on benzene, substituent effect and electronic effect on SN in aromatic compounds	
5	Students are able to show nucleophilic substitution reactions in carboxylic acid and its derivatives, as well as in amines	• The accuracy in writing down the mechanisms of nucleophilic and substitution reaction in carboxylic acid and its derivatives, as well as in amines	**Technical :** Quiz **Criteria :**	**Lecture and group discussion** **[TM: 2x(2x50")]** **[BT+BM:(2+2)x(4x60")]**		• Nucleophilic substitution reactions of carboxylic acid: esterification, formation of amides, reactions with hydrides • the anhydrous formation of carboxylic acid derivatives, • Formation of peptide bonds, hydrolysis of carboxylic acid derivatives • Substitution reaction with amines, reaction of amines and nitric acid	**10**
6,7	Students are able to show elimination reactions in alkyl halides and other compounds	• The accuracy in writing down the mechanisms of elimination reactions in	**Technical :** **Criteria :**	**Lecture and group discussion** **[TM: 4x(2x50")]** **[BT+BM:(1+1)x(4x60")]**		• The reaction mechanisms of E1 and E2 in alkyl halides and alcohols • The relation between	**10**

		alkyl halides and other compounds				conformation and elimination mechanisms • The Hoffmann elimination • Coupling reactions of diazonium salts, reactions of amines with sulfonyl chlorides, elimination reactions involving ammonium compounds	
8	**Mid-term evaluation**						**20**
9	Students are able to show the possibility of a more dominant reaction mechanism (elimination reaction vs substitution reaction)	• The accuracy of writing down the predominant reaction mechanism (elimination vs substitution reactions)	**Technical :** Laboratory work 1 **Criteria :**	**Lecture and group discussion [TM: 2x(2x50")]** **Laboratory work [1x160"]**		• The reaction competition between S_N and elimination	**5**
10, 11	Students are able to demonstrate the mechanism of the addition reaction of alkenes and alkenes.	• The accuracy of writing down the mechanism of the addition reaction of alkenes and alkenes.	**Technical :** Assignment II Laboratory work II • **Criteria :**	**Lecture and group discussion [TM: 4x(2x50")]** **Laboratory work [1x160"]**		• Markovnikov addition (H-Z), electrophilic addition with H^+ catalyst, anti-Markovnikov addition • Halogenation, halogenation	**15**

						related to stereochemistry, epoxidation, oxidation, reaction of alkenes with carbocation • The reaction mechanism of carbocation rearrangement in addition reactions	
12, 13	Students are able to demonstrate the mechanism of nucleophilic addition reaction of aldehyde and ketones and the conjugated system in unsaturated compounds	• The accuracy of writing down the mechanism of nucleophilic addition reaction of aldehyde and ketones and the conjugated system in unsaturated compounds	**Technical :** Laboratory work III **Criteria :**	**Lecture and group discussion [TM: 4x(2x50")]** **Laboratory work [1x160"]**		• Structure of the aldehyde and ketone, keto-enol tautomer • Nucleophilic addition in aldehydes and ketones: reaction with water, alcohol (formation of hemiacetal-acetal, hemiketal-ketal) • Nucleophilic addition in aldehydes and ketones: ammonia and its derivatives	**5**

						(formation of 2,4-dinitrophenylhydrazone, semicarbazone, oxime, imines, and enemines, the Wolf-Kischner reduction) • Reaction with Grignard reagent, Wittig reaction, Reformatsky reaction • The stability of the conjugated diene, addition reaction of the conjugated 1,4-diene, the Diels-Alder reaction	
14, 15	Students are able to demonstrate the aldol condensation of aldehyde and keton	• The accuracy of writing down the reaction mechanism of the aldol condensation of aldehyde and keton	**Technical :** Presentation **Criteria :**	**Lecture and group discussion** **[TM: 4x(2x50")]**		• The aldol condensation, Claisen condensation (1,3-dicarbonyl) • Addition of 1,4- α, β unsaturated	**10**

						carbonyl compounds • The aldol condensation • Claisen condensation (1,3-dicarbonyl)	
16	**End-term evaluation**						**25**

25. INSTRUMENTAL MEASUREMENT METHODS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**						**Kode Dokumen**
TEACHING AND LEARNING PLAN							
COURSE (MK)		**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
INSTRUMENTAL MEASUREMENT METHODS		SK 184513	Analytical Chemistry	4	0	V	07 Januari 2020
AUTHORIZATION / LEGALIZATION		**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
		Drs. M. Nadjib M., M.S., Dr. Yatim Lailun Ni'mah, M.Si., Drs. R. Djarot S.K.S., M.S., Prof. Dr.rer.nat. Fredy Kurniawan, M.Si., Suprapto, M.Si., Ph.D.		Suprapto, M.Si., Ph.D.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**						
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners					
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity, and communication ability					
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances					
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.					

<table>
<tr><td></td><td>Course Learning Outcomes (LO MK)
CP MK 1 Be able to choose between qualitative and quantitative test methods based on the results of the interaction between electromagnetic waves and matter.</td></tr>
<tr><td>LO – LO MK Map</td><td>
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CP MK 1</td><td>√</td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
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</td></tr>
<tr><td>Course Short Description</td><td>In the Instrument Measurement Methods course, students learn qualitative and quantitative methods of analysis methods based on interactions between electromagnetic waves with materials on experiment tests. Examples of these tests are electron excitation on atoms (AAS, ICP), functional groups vibration (IR, Raman), nucleus spin resonance (NMR), crystal framework diffraction (XRD), and fluorescence.</td></tr>
<tr><td>Study Material:
Subject matter</td><td>1. Electromagnetic wave interactions with materials.
2. The basic components of spectroscopy instruments.
3. Tests based on electron excitation on atoms (AAS, AES, ICP).
4. Functional groups vibration (IR, Raman).
5. Nucleus spin resonance (NMR).
6. Crystal framework diffraction (XRD).
7. Spectroscopy (UV-VIS, fluorescence, and MS).
8. Electrometry methods (Amperometry, Potentiometry, Polarography, Voltametry, Coulometry, Conductometry).
9. Thermal Methods (Differential Thermal Analysis, Thermo Gravimetry Analysis, Differential Scanning Calorymetry).
10. Turbidimetry-nephelometry
11. Chromatography Method (Thin Layer Chromatography, Column, Liquid Chromatography, Gas Chromatography, Ion Exchange, Electrophoresis).</td></tr>
<tr><td>Reference</td><td>Main:
1. Skoog. Douglass, West and Holler, “ Principles of instrumental Analysis, “John Wilet and Sons, Brooks/Cole Pub Co, 2006.
2. Wang, J,” electroanalitical chemistry,” Wiley VCH, USA, 2000.

Suppoerting:</td></tr>
</table>

Supporting Lecturer	Drs. M. Nadjib M., M.S., Dr. Yatim Lailun Ni'mah, M.Si., Drs. R. Djarot S.K.S., M.S., Prof. Dr.rer.nat. Fredy Kurniawan, M.Si., Suprapto, M.Si., Ph.D.
Pre-Requisite Courses	Have taken the courses Measuring Methods, and Separation and Purification Methods.

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to perform measurement with spectroscopy-based instrument (C1, P3, A2)	• The accuracy in explaining spectroscopy method • The accuracy in explaining spectroscopy-based instrument	**Technical :** Non-test **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]**		• Spectroscopy method • Spectroscopy-based instrument • The interaction between electromagnetic waves and matter • The basic components of Spectroscopy-based instrument	**10**
2	Students are able to perform measurement with spectroscopy-based instrument (C1, P3, A2)	• The accuracy in explaining spectroscopy-based instrument based on adsorption	**Technical :** Non-test **Criteria :**	**Lecture and brainstorming [TM: 1x(1x50")]** **Laboratory work [TM: 1x(1x50")]**		• Conducting a test based on electron excitation on atoms (AAS, AES, ICP)	**10**
3, 4	Students are able to perform measurement with	• The accuracy in explaining the differences between UV Vis, IR, and	**Technical :** Non-test	**Lecture and brainstorming [TM: 1x(2x50")]**		Spectrophotometry: UV-Vis, IR, Raman, Turbidimetry,	**10**

	spectroscopy-based instrument (C1, P3, A2)	Raman spectrophotometry • The accuracy in explaining the differences between fluorescence spectrophotometry, turbidimetry, and nephelometry.	**Criteria :**	**Laboratory work [TM: 1x(2x50")]**		Nephelometry, Fluorescence.	
5,6	Students are able to perform measurement with spectroscopy-based instrument (C1, P3, A2)	• The accuracy in explaining the differences of absorption and emission spectrophotometry, NMR spectroscopy, and MS.	**Technical :** Non-test **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]** **Laboratory work [TM: 1x(2x50")]**		• NMR spectroscopy • Absorption-emission spectrophotometry • MS spectroscopy	**15**
7	Students are able to perform measurement with spectroscopy-based instrument (C1, P3, A2)	• The accuracy in explaining about XRD and its function	**Technical :** Non-test **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]** **Laboratory work [TM: 1x(2x50")]**		• X-ray Powder Diffraction (XRD)	**10**
8	**Mid-term evaluation**						**20**
9-11	Students are able to perform measurement techniques using electroanalytic methods (C3, P3, A2)	• The accuracy in explaining the differences of electrometric method and its use	**Technical :** Non-test **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]** **Laboratory work [TM: 1x(2x50")]**		• Electrometry method (Amperometry, Potentiometry, Polarograph, Voltammetry,	**15**

						Coulometry, conductometry)	
12, 13	Students are able to apply measurement by thermal analysis methods (C3, P3, A2)	• The accuracy of explaining about thermal analysis methods and their use	**Technical :** Non-test • **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]** **Laboratory work [TM: 1x(2x50")]**		• Thermal Methods (Differential Thermal Analysis, Thermogravimetric Analysis, Differential Scanning Calorimetry)	**15**
14, 15	Students are well-skilled to perform measurement techniques by chromatography methods	• The accuracy of explaining the kinds of chromatography methods and their use	**Technical :** Non-test **Criteria :**	**Lecture and brainstorming [TM: 1x(2x50")]** **Laboratory work [TM: 1x(2x50")]**		• Chromatography methods (TLC, column, LC, GC, GPC, ion exchange, electrophoresis)	**15**
16	**End-term evaluation**						

26. ELEMENTS AND INORGANIC COMPOUNDS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
ELEMENTS AND INORGANIC COMPOUND	SK 184522	Inorganic Chemistry	4	0	V	

<table>
<tr><td colspan="2">AUTHORIZATION / LEGALIZATION</td><td>TLP Editor</td><td>Course Group Coordinator</td><td>Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2"></td><td>Prof.Dr.Didik Prasetyoko S.Si., M.Sc.; Prof. Hamzah Fansuri, M.Si., Ph.D.; Prof. Dr. rer. nat. Irmina Kris M.Si; Dra. Ratna Ediati MS., Ph.D; Prof. Dr. Djoko Hartanto M.Si; Prof. Dr. Fahimak Martak, M. Si.; Dr. Afifah Rosyidah S.Si,M.Si</td><td>Dra. Ratna Ediati MS., Ph.D</td><td>Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>B.2 (LO 4)</td><td colspan="3">Able to give alternative solutions with the characters of leadership, creativity, and communication ability</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to master concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Able to explain the genesis of elements and determine the separation process</td></tr>
<tr><td>CLO 2</td><td colspan="3">Able to show important elements in their application in everyday life</td></tr>
<tr><td>CLO 3</td><td colspan="3">Able to estimate the correct elemental extraction method</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4"></td></tr>
<tr><td colspan="5">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 3</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">In this course, the students will learn about the genesis of elements until they can explain the correlations between the elements and their compounds (inorganic). Besides, this course also discusses the basic concepts of element extractions. During the lectures, illustrations on hydrogen and hydrogen compounds, extractions and purifications of block s, p, transitional and rare earth elements, and other important elements and their everyday applications will also be taught to the students. Hence the students will have the learning experience to think critically about the advantages of the elements and their compounds used in some sectors such as energy, environment, food, and health, and at the same time they can make the correct decisions about the uses of elements and their compounds</td></tr>
<tr><td>Study Material: Subject Matter</td><td colspan="4">The elemental genesis and the basic concepts of separation and extraction of elements, hydrogen, and hydrogen compounds as well as the genesis, reactions, extractions, and purifications of block s, p, transitional and rare earth elements, other important elements, and their everyday life applications</td></tr>
<tr><td>Reference</td><td>Primary:</td><td colspan="3"></td></tr>
</table>

	1. D. D. Shriver and P. W. Atkins, “Inorganic Chemistry”, 5th Edition, W.H. Freeman and Company, Oxford, 2010. 2. J. E. Huheey, E. A. Keiter and R. L. Keiter, “Inorganic Chemistry: Principles of Structure and Reactivity”, 4th Edition, Harper Collins CollegePublishers, London 1997. 3. G. L. Miessler, P. J. Fischer and D. A. Tarr, “Inorganic Chemistry”, 5th Edition, Prentice-Hall, London, 2013. 4. C. E. Housecroft and A.G. Sharpe, “Inorganic Chemistry”, 2nd Edition, Pearson Education Limited, 2005 **Secondary:**
Lecturer	Prof.Dr.Didik Prasetyoko S.Si., M.Sc.; Prof. Hamzah Fansuri, M.Si., Ph.D.; Prof. Dr. rer. nat. Irmina Kris M.Si; Dra. Ratna Ediati MS., Ph.D; Prof. Dr. Djoko Hartanto M.Si; Prof. Dr. Fahimak Martak, M. Si.; Dr. Afifah Rosyidah S.Si,M.Si
Pre-Requisite Courses	Have taken Structure, Properties and Reativity of Inorganic Compounds course, and passed with a minimum grade of D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	**[C2, A3, P1]:** Students can explain the genesis of elements	• The accuracy in explaining the process of formation of elements in the universe	**Technical:** **Criteria:**	**Introduction lecture[TM: 1×(2×50’’)]** **Lecture and discussion [TM: 1×(2×50’’)]**		• Elemental genesis:Big Bang Theory • Hydrogen burning,helium burning • Stability and abundance ofatom in the • universe	

2	**[C2, A3, P1]:** Students can explain the tendency of elemental properties and their compounds and the principle of elemental extraction	• The accuracy in explaining the tendencyof elemental properties in the periodic table of elements • The accuracy inexplaining the properties of a compound • The accuracy in explaining the fundamental principles of elemental extraction	**Technical:** **Criteria:**	**Lecture and discussion** **[TM: 2×(2×50'')]**		• The properties of elements in the periodic table: valence electron configuration, atomic parameters, elements formation, metallic properties, and oxidation number • The properties of compounds in theperiodic table: coordination number, bond enthalpy trends, anomalies, binary compounds, and other aspects of periodicity • Fundamental principles of elemental extraction	
3,4	**[C3, A3, P2]:** Students can show the properties, compounds,	The accuracy in explaining and showing	**Technical:** Non-test: Assignment 1	**Lecture** **[TM: 2×(2×50'')]**		• Hydrogen elements,simple hydrogen	**10**

	reactions, and synthesis of hydrogen compounds	the properties, compounds, reactions, and synthesis of hydrogen compounds	Search and explainexamples of reactions involving hydrogen compounds and the industrial manufacturing process for hydrogen compounds **Criteria:**	**Presentation, groupdiscussion [TM: 2×(2×50'')]**		compounds • The properties ofthe hydrogen nucleus • The production ofdihydrogen • Dihydrogen reaction • Hydrogen compounds • General methods for the synthesis of hydrogen compounds	
5,6	**[C5, A3, P2]:** Students can show the properties, compounds, reactions of s block elements and predict the appropriate method for extraction and refining process of s block elements	• The accuracy in showing the propertiesof s block elements and compounds • The accuracy in explaining and showing the s block elements, including predicting the appropriate method for the process	**Technical:** Test: Quiz 1 Quiz materials ranging from elemental genesis to s block elements **Criteria:**	**Lecture [TM: 3×(2×50'')]** **Quiz [TM: 1×(2×50'')]**		• S block elementsand compounds • The characteristic oflithium and beryllium • Genesis, extraction, and purification of s block elements • The usage of s blockelements and compounds • Forms of hydrides,	**15**

						halides, oxides, sulfides, selenides, tellurides, hydroxides • Compounds or saltsof oxyacid • Nitrides and carbides • Solubility and hydration • Organometallic and coordination compounds	
7	**[C5, A3, P2]:** Students can show the properties, compounds, and reactions of groups 13 and 14 of the p block elements and predict the appropriate method for their extraction and refining process	• The accuracy in showing the propertiesof the elements and compounds of groups 13 and 14 of the p block • The accuracy in showing compounds of groups 13 and 14 of the p block, including predicting the appropriate method for the process	**Technical:** **Criteria:**	**Lecture and group discussion[TM: 2×(2×50'')]**		• Elements and compounds of groups 13 and 14 • Genesis, extractions,and purification of groups 13 and 14 compounds • The characteristic ofboron and carbon • Oxo compounds • Organometa llic compounds • The usage of the	

						elements and compounds of groups 13 and 14	
8	**Mid-semester Evaluation**						**25**
9,10	**[C5, A3, P2]:** Students can show the properties, compounds, reactions of groups 15-18 of the p block elements and predict the appropriate method for their extraction and refining process	• The accuracy in showing the propertiesof elements and compounds of groups 15-18 of the p block • The accuracy in showing compounds of groups 15-18 of the p block, including predicting the appropriate method forthe process	**Technical:** Non-test Assignment 2 Show the genesis, properties, reactions, and purification of an element or compound of the pblock group (elements or compounds have been assigned differently for eachstudent) **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Elements and compounds of groups 15-18 of thep block • Genesis, extraction,and purification of groups 15-18 compounds • The characteristic ofnitrogen and oxygen: The reactivity of oxygen • Oxo compounds • Interhalog en compoun ds • Fluorocarbon • Organometa llic compounds • The usage of the elements and compounds of groups 15-18 of thep block	**10**

11,12, 13	**[C5, A3, P2]:** Students can show the properties, compounds, reactions, extraction, and predict the purification method of d block elements, as well as d block metal complex compounds	• The accuracy in showing the propertiesof elements and compounds of d block • The accuracy in showing compounds ofd block, including predicting their extraction and refiningprocess	**Technical:** Test: Quiz 2 Quiz materials ranging from groups 15-18 of the p block elements to d block elements **Criteria:**	**Lecture and discussion [TM: 5×(2×50'')]** **Quiz [TM: 1×(2×50'')]**		• The genesis of dblock elements • Extraction and purification of dblock elements • The oxidation number of d block elements • Structural trends and noble properties of d block • Metal halides, oxides, and complexoxides • Metal sulfides andcomplex sulfides • Complex nitridesand alkylidenes • Metal-metal bondedcluster compounds • The application of dblock elements	**20**
14,15	**[C5, A3, P2]:** Students can show the properties, compounds, reactions, extraction, and	• The accuracy in explaining the properties of	**Technical:Criteria:**	**lecture [TM: 4×(2×50'')]**		• The genesis of the fblock elements • Extraction and	

	predict the appropriate method for the refining process of rare earth elements (f block)	elements and compounds of the f block • The accuracy in explaining compounds of f block elements, including predicting the appropriate method fortheir extraction and refining process				purification of the fblock elements • Physical properties and application of the f block elements • Lanthanide Chemistry: General trends, electronic, optical, and magnetic properties,binary and ternary ionic compounds, coordination and organometallic compounds • Actinide Chemistry: General trends, electronic spectra	
16	**Final Semester Evaluation**						**20**

27. BIOCHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**
TEACHING AND LEARNING PLAN		

<table>
<tr><td colspan="2">COURSE (MK)</td><td>CODE</td><td>Course disiplines (RMK)</td><td colspan="2">Semester Credit Units</td><td>SEMESTER</td><td>Compilation Date</td></tr>
<tr><td colspan="2">BIOCHEMISTRY</td><td>SK 184531</td><td>Biochemistry</td><td>4</td><td>0</td><td>V</td><td></td></tr>
<tr><td colspan="2" rowspan="2">AUTHORIZATION / LEGALIZATION</td><td colspan="2">TLP Editor</td><td colspan="2">Course Group Coordinator</td><td colspan="2">Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2">Drs. Refdinal Nawfa, M.S.; Adi Setyo Purnomo, S.Si, M.Sc, Ph.D.; Herdayanto Sulistyo Putro, S.Si, M.Si; Hamdan Dwi Rizqi, M.Si.</td><td colspan="2">Herdayanto Sulistyo Putro, S.Si, M.Si</td><td colspan="2">Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="5"></td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="6">Able to master the concepts of structure, character, and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="6">Able to master concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="6">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="6">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="5"></td></tr>
<tr><td></td><td colspan="6"></td></tr>
<tr><td>CLO 1</td><td colspan="6">Able to explain the basic concepts of macromolecules and their characteristics</td></tr>
<tr><td>CLO 2</td><td colspan="6">Able to identify and isolate macromolecule compounds of living substances</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="7"><table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>CLO 2</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table></td></tr>
<tr><td>Course Short Description</td><td colspan="7">Biochemistry is an important course to learn for the students since it is very related to our own lives. After taking the course, students can understand the role of biomolecule compounds inside the cells that supports the lives of living creatures. The lesson to be learned from this subject is to correlate structures, reactivities, functions between biomolecules in supporting the chemical cell processes and performing synthesis, separation, and identifications from biomolecules.
This course covers the following: properties of living substances, the understanding of biochemistry in living substances, biomolecules, the functions of biomolecules in cells, structures and reactivities in amino acids, peptides, proteins, carbohydrates, lipids and nucleate acids, DNA biosynthesis (DNA replication), RNA biosynthesis (RNA transcriptions), protein biosynthesis (translation/genetic expressions), enzyme catalysts and their applications, classification methods, and biomolecule (DNA and RNA) isolations and purifications. The teaching methods used are lectures, discussions, assignments, and laboratory experiments.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="7">Properties of living substances, the understanding of biochemistry in living substances, biomolecules, the functions of biomolecules in cells, living cells, structures and reactivities in amino acids, peptides, proteins, carbohydrates, lipids and nucleate acids, DNA biosynthesis (DNA replication),</td></tr>
</table>

	RNA biosynthesis (RNA transcriptions), protein biosynthesis (translation/genetic expressions), enzyme catalysts and their applications, classification methods, and biomolecule (DNA and RNA) isolations and purifications.
Reference	**Primary:** 1. D. L. Nelson and M. M. Cox, "Lehninger Principles of Biochemistry", 6th edition, W.H. Freeman, New York, 2012. 2. L. Stryer, "Biochemistry", 3rd edition, W.H. Freeman and Company, New York, 1988. 3. D. Freifelder, "Recombinant DNA", W.H. Freeman and Company, San Fransisco, 1978 4. R. F. Boyer, "Modern Experimental Biochemistry", Addison-Wesley publishing company, California, 1986. **Secondary:**
Lecturer	Drs. Refdinal Nawfa, M.S.; Adi Setyo Purnomo, S.Si, M.Sc, Ph.D.; Herdayanto Sulistyo Putro, S.Si, M.Si; Hamdan Dwi Rizqi, M.Si.
Pre-Requisite Courses	Have taken the course Organic Reactions and Mechanisms

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1-4	Students can understand the characteristics of living beings,the understanding of biochemistry in living beings, the functions of biomolecules in a cell, living substances, structures and reactivities of amino acids	• The accuracy in explaining the characteristics of livingbeings, biomolecules and their functions in a cell • The accuracy in explaining the structures and reactivities of amino acids	**Technical:** Assignments **Criteria:**	**Lecture [TM: 8×(2×50'')]**		• The characteristics of living beings, the understanding of biochemistry in living beings • Biomolecules, thefunctions of biomolecules in acell • Living cell • Structures and	**5**

						reactivities of aminoacids: the structural characteristics and type of amino acids • Chemical properties (solubility, acidity, basicity) • Physical properties (isoelectric, optical active); characterization andidentification (chromatography, electrophoresis, titration)	
5-7	Students can predict the physical or chemical properties of peptides, proteins, carbohydrates, and lipids based on their structures	• The accuracy in explaining peptides • The accuracy in explaining proteins • The accuracy in explaining carbohydrates • Students can operate	**Technical:** Assignments; Quiz1; Laboratory experiments **Criteria:**	**Lecture [TM: 5×(2×50'')]** **Laboratory experiment [TM: 1×(2×50'')]**		• Synthesis of a peptide from aminoacids • Several biological activities of peptides • Structures and classifications ofproteins • Determination method of aminoacid sequences of	**25**

		centrifugation equipment				proteins • Structures of carbohydrates andlipids • Isolations and purifications of proteins (laboratory experiment)	
8	**Mid-semester Evaluation**						**20**
9,11	Students can predict the physical or chemical properties of enzymes based on their cellular and chemical structures	• The accuracy in explaining the discovery, nomenclature, and classification of enzymes • The accuracy in explaining the enzyme-catalyzed process • The accuracy in explaining the reactionrate of enzyme and their kinetic parameters • Students can operate Fermentor, homogenizer, and	**Technical:** Assignments; Quiz2; Laboratory experiment **Criteria:**	**Lecture [TM: 6×(2×50'')]** **Laboratory experiment [TM: 1×(2×50'')]**		• Enzymes are the main biomoleculesof life processes (history of discovery, nomenclature, and classification) • Catalysis process (molecular model,general reaction model, chemical reaction model, mechanism, regulation) • Enzyme reaction kinetics (reaction rate, kinetics model, inhibition model)	**20**

		centrifugation equipment				• Isolations and purifications of enzymes (laboratory experiment)	
12-15	Students can predict the physical or chemical properties of DNA and RNA based on their cellular and chemical structures	• The accuracy in predicting the properties of nucleicacids • The accuracy in predicting structuresand biosynthesis of nucleic acids • The accuracy in predicting amino acidsequences of proteins • Able to predict whenproteins are synthesized • Able to predict the nucleotide sequence of a DNA strand	**Technical:** Assignments; Quiz3 **Criteria:**	**Lecture [TM: 8×(2×50'')]**		• History of DNA and RNA discovery (virtual experiment), nucleotides as the building blocks of nucleic acids (physical and chemical properties) • The structure of DNA (Watson-Crick),the structure of RNA • DNA biosynthesis (DNA replication) and RNA biosynthesis (RNA transcriptions) • DNA as genetic codestorage (protein biosynthesis) • Arrangement of protein	**15**

						biosynthesis • Isolations and purifications of DNA Determination of the nucleotide sequence in DNA (determination of taxonomy tree)	
16	**Final Semester Evaluation**						**20**

28. MOLECULAR SPECTROSCOPY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
MOLECULAR SPECTROSCOPY	SK 184544	Physical Chemistry	3	0	V	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dr. Yuly Kusumawati, M.Si.; Dr. Hendro Juwono, M.Si.; Dr. Triyanda Gunawan, S.Si.; Prof. Dr. Syafsir Akhlus, M.Sc.; Lukman Atmaja, Ph.D.; Drs. Eko Santoso, M. Si.		Drs. Eko Santoso, M. Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**					
	A.1 (LO 1)	Has good moral, ethics, and personality in completing one's task				
	C.1 (LO 6)	Able to master the concepts of structure, character and change of substance according to the aspects of dynamics and energetics				
	C.2 (LO 7)	Able to master concepts, theory, and methods on analysis and synthesis of chemical substances				

	Course Learning Outcomes (CLO)	
	CLO 1	Able to predict the spectra of a simple molecule based on its molecular structure
	CLO 2	Able to determine simple molecular structure based on experimental spectra
LO - CLOMAP		

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√					√			
CLO 2	√						√		

Course Short Description	During this course, students will learn electromagnetic radiation interactions between materials, spectra, the correlation between structure and spectra, microwave spectroscopy, infrared spectroscopy, rotation-vibration spectra, molecule polarizability, and Raman effect, Raman spectroscopy, atom electronic spectroscopy, molecule electronic spectroscopy, and spin resonant spectroscopy
Study Material: Subject Matter	Electromagnetic radiation interactions between materials, spectra (energy, wavenumbers, intensities), the correlation between structure and spectra, molecule rotations and microwave spectroscopy (diatomic molecules, introduction to polyatomic molecules), vibration-rotation and vibration-rotation spectra, molecule polarizability and Raman effect, Raman spectra rotation and vibration, atom electronic spectroscopy, molecule electronic spectroscopy, and spin resonant spectroscopy (spin, hydrogen atom NMR, NMR other than hydrogen)
Reference	**Primary:** 1. P. W. Atkins and J. de Paula, "Physical Chemistry", 9th edition, W.H. Freeman and Company, New York, 2010. **Secondary:**
Lecturer	Dr. Yuly Kusumawati, M.Si.; Dr. Hendro Juwono, M.Si.; Dr. Triyanda Gunawan, S.Si.; Prof. Dr. Syafsir Akhlus, M.Sc.; Lukman Atmaja, Ph.D.; Drs. Eko Santoso, M. Si.
Pre-Requisite Courses	Have taken Atomic and Molecular Structures course

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to explain the fundamental concepts of spectroscopy and its various types	• State the differences between spectroscopy according to the principle of using transition energy	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• General schema oftools, types and features of the modern spectrometer, the moment of inertia, rotational energy levels	**2**
2	Students are able to determine the rotational energy level	• Calculate the rotational energy levels of a molecule	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• General scheme oftools, types and features of the modern spectrometer, the moment of inertia, rotational energy levels	**3**
3	Students are able to use the selection rule for rotational transition	Predict the shape of the rotational spectrum ofa molecule	**Technical:** Group discussion **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The rotational transition, rotational Raman spectra, nuclear statistics	**5**
4	Students are able to use the selection rule for rotational transition	• Predict the shape of the rotational Raman spectrum	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The rotational transition, rotational Raman spectra, nuclear statistics	**5**
5	Students are able to determine the vibrational energy levels	• Determine the vibrational active molecules	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The simple vibrations of diatomic molecules, vibrational selectionrule,	**4**

						anharmonicity – 1	
6	Students are able to determine the vibrational energy levels	• Determine the vibrational active molecules	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The simple vibrations of diatomic molecules, vibrational selectionrule, anharmonicity – 2	**4**
7	Students are able to determine the vibration-rotation energy levels	• Determine the vibrational-rotational active molecules	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Vibration-rotation spectrum, vibrational-rotational Raman spectrum – 1	**4**
8	Students are able to determine the vibration-rotation energy levels	• Determine the vibrational-rotational active molecules	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Vibration-rotation spectrum, vibrational-rotational Raman spectrum – 2	**4**
9	Students are able to read the vibrational spectrum of polyatomic molecules	• Determine the vibrational active polyatomic molecules	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Vibration mode of apolyatomic molecule, infrared spectra, Raman spectra, symmetry effects	**4**
10	Students are able to read the vibrational spectrum of polyatomic molecules	• Predicting symmetry effects for multiple molecules	**Technical:** Class discussion **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Vibration mode of apolyatomic molecule, infrared spectra, Raman spectra,	**4**

						symmetry effects	
11	Students are able to differentiate between a vibration-rotation spectrum and an electronic spectrum of diatomic molecules	• Determine the qualitative features ofelectronic transitions (molar absorption coefficient and term symbols)	**Technical:** Class discussion **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The fundamental concepts of the electronic spectra ofdiatomic molecules – 1	**5**
12	Students are able to differentiate between a vibration-rotation spectrum and an electronic spectrum of diatomic molecules	• Determine the qualitative features ofelectronic transitions (molar absorption coefficient and term symbols)	**Technical:** Class discussion **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The fundamental concepts of the electronic spectra ofdiatomic molecules – 2	**5**
13	Students are able to recognize the vibrational transitions and rotational transitions in the electronic spectra	• Calculate Franck-Condon factor	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The vibrational transitions and rotational transitions in the electronic transitions – 1	**3**
14	Students are able to recognize the vibrational transitions and rotational transitions in the electronic spectra	• Recognizing the characteristic of the R branch and P branch	**Technical:** Exercise **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The vibrational transitions and rotational transitions in theelectronic transitions – 1	**3**
15-16	**Mid-semester Evaluation**						**50**
17	Students are able to determine the electronic	• Recognizing the electronic transitions	**Technical:** Lesson	**Lecture [TM: 1×(2×50'')]**		• Electronic transitions of	**4**

	energy levels of polyatomic molecules	ofAH_2 system molecules	**Criteria:**			polyatomic molecules, electronic and vibronic selection rule, a chromophore – 1	
18	Students are able to determine the electronic energy levels of polyatomic molecules	• Recognizing the spectrum characteristics of chromophore compounds	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Electronic transitions of polyatomic molecules, electronic and vibronic selection rule, a chromophore – 2	**4**
19	Students understand several applications and benefits of electronic transitions	• Differentiate between nonradiative electronictransitions and common electronic transitions	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Nonradiative electronic transitions (fluorescence, phosphorescenc e, dissociation, and laser spectroscopy) – 1	**4**
20	Students understand several applications and benefits of electronic transitions	• Able to understandlaser applications	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• Nonradiative electronic transitions (fluorescence, phosphorescenc e, dissociation, and laser spectroscopy) – 2	**4**

21	Students are able to understand the external magnetic field effects on energy levels	• Determine the main transition features of electrons and nuclei energy level	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The separation of the energy level of electrons and nucleiin the magnetic field, the fundamental concepts of nuclear magnetic resonance spectroscopy – 1	**4**
22	Students are able to understand the external magnetic field effects on energy levels	• Determine the main transition features of electrons and nuclei energy level	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The separation of the energy level of electrons and nucleiin the magnetic field, the fundamental concepts of nuclear magnetic resonance spectroscopy – 2	**4**
23	Students are able to understand the external magnetic field effects on energy levels	• Determine the correlation between simple molecular structure and spectrum	**Technical:** Class discussion **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The chemical shift, shielding concepts, solvent effects, fine structure and coupling concepts, and conformational conversion – 1	**5**
24	Students are able to understand the external magnetic field effects on energy levels	• Determine the correlation between	**Technical:** Class discussion **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The chemical shift, shielding concepts, solvent effects, fine	**5**

		simple molecular structure and spectrum				structure and coupling concepts, and conformational conversion – 2	
25	Students are able to understand the Fourier-transform NMR (FT-NMR) method	• Recognizing the development process of the NMR spectroscopy technique	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The magnetization vector, relaxation and decoupling of spin, nuclear Overhauser effect, two-dimensional NMR – 1	**5**
26	Students are able to understand the Fourier-transform NMR (FT-NMR) method	• Recognizing the development process of the NMR spectroscopy technique	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The magnetization vector, relaxation and decoupling of spin, nuclear Overhauser effect,two-dimensional NMR – 2	**4**
27	Students are able to understand the special technique in special-featured spectroscopy	• Recognizing the spectroscopy applications for the specific analyzes purpose	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The fundamental concept of electron paramagnetic resonance, the fundamental concept of special types of	**4**

						spectroscopy – 1	
28	Students are able to understand the special technique in special-featured spectroscopy	• Recognizing the spectroscopy applications for the specific analyzes purpose	**Technical:** Lesson **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The fundamental concept of electron paramagnetic resonance, the fundamental concept of specialtypes of spectroscopy – 2	**3**
29-32	**Final Semester Evaluation**						**50**

29. SYNTHESIS IN ORGANIC CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
SYNTHESIS IN ORGANIC CHEMISTRY	SK 184544	Organic Chemistry	3	0	V	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Prof. Mardi Santoso, Ph.D.; Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.; Dr. Yulfi Zetra, M.S.; Prof. Dr. R.Y. Perry Burhan, M.Sc.; Drs. Agus Wahyudi, M.Si.; Zjahra Vianita Nugraheni, S.Si., M.Si.		Drs. Agus Wahyudi, M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	
	LO-PRODI Charged to The Course					

<table>
<tr><td rowspan="5">Program Learning Outcomes (LO)</td><td>B.2 (LO 4)</td><td>Able to give alternative solutions with the characters of leadership, creativity, and communication ability</td></tr>
<tr><td>C.2 (LO 7)</td><td>Able to master concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td>Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td></tr>
<tr><td>CLO 1</td><td>Able to compare the strategies of synthesis organic compound using a retrosynthesis approach based on the general organic chemistry reactions</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="2">Antibiotics, analgesics, anti-inflammations, and purple mauveine coloring agents are examples of organic synthesis industry products in pharmacy, and they have proven to contribute towards the welfare of human beings. Organic synthesis involves forming organic molecules from simple organic compounds, all of which are chemical molecule construction worth to be studied. Organic synthesis using organic reactions such as addition, condensation, cyclization, by emphasizing in-depth synthesis strategies and logics. Therefore by doing so, students are able to compare synthesis strategies when performing synthesis of organic compounds based on the general organic chemistry reactions. Synthesis laboratory experiments target simple molecules which are used as a measurement of how far the students understand the synthesis logics and strategies learned during the class lectures. Class lectures also give students the basic understanding of organic synthesis knowledge</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="2">1. Introduction, definitions, basic strategy concepts, disconnections, and functional groups exchange.
2. One group carbon-heteroatom bond disconnections (C-X; X= O, N, halogen), two groups C-X disconnections, amine synthesis through C-Xdisconnections, C-X on benzene derivatives.
3. Ungrouped carbon to carbon bonds (C-C) disconnection, the disconnection between C-C bonds in one group.
4. Two groups carbon to carbon bonds (C-C) disconnection, normal and umpolung.
5. Two groups carbon-carbon bonds (C-C), normal and umpolung.
6. Carboxylic compounds synthesis.
7. Synthesis strategies for particular compounds</td></tr>
<tr><td>Reference</td><td colspan="2">Primary:

1. Willis, C. H. and M. Wills, “Sintesis Organik”, Penerjemah Marcellino Rudyanto, Airlangga University Press, Surabaya, 2004.
2. Warren, S., “Organic Synthesis : The Disconnection Approach”, John Wiley & Sons, Brisbane, 1986.
3. J. S. Nimitz, “Experiments in Organic Chemistry”, Prentice Hall Inc., Englewood Cliffs, 1991.
4. C. F. Wilcox Jr. and M. F. Wilcox, “Experimental Organic Chemisty”, 2nd edition, Prentice-Hall, Englewood Cliffs, 1995.</td></tr>
</table>

	Secondary:
Lecturer	Prof. Mardi Santoso, Ph.D.; Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.; Dr. Yulfi Zetra, M.S.; Prof. Dr. R.Y. Perry Burhan, M.Sc.; Drs. Agus Wahyudi, M.Si.; Zjahra Vianita Nugraheni, S.Si., M.Si.
Pre-Requisite Courses	Have taken the courses Basic Organic Chemistry and Organic Reactions and Mechanisms, and passed with a minimum grade of D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain and show what is meant by synthon, reactant, functional group interconversion (FGI), and disconnection	• The accuracy in explaining what is meant by synthon, reactant, functional group interconversion (FGI), and disconnection	**Technical:** Assignment 1 **Criteria:**	**Introduction lectureand brainstorming [TM: 1×(2×50'')]** **Lecture and discussion[TM: 1×(2×50'')]** **Assignment 1 [BT+BM:(1+1)x(4x60'')]**		• The introduction ofthe synthesis • Synthon • Types of reactant • Functional group interconversion • Disconnection mechanism	**10**
2	Students are able to explain and show the process of one group carbon-heteroatom [C-X (X= O, N, Halogen)] disconnection	• The accuracy in explaining and showingthe process of one group carbon-heteroatom [C-X (X= O,N, Halogen)] disconnection	**Technical:Criteria:**	**Lecture and group discussion [TM: 2×(2×50'')]**		• Disconnection of one group carbon-heteroatom [C-X (X= O, N, Halogen)]	

3	Students are able to explain and show the disconnection process of two groups carbon-heteroatom [C-X (X= O, N, Halogen)] with a difunctional system of 1,1-; 1,2-; and 1,3-	• The accuracy in explaining and showingthe disconnection process of two groups carbon-heteroatom [C-X (X= O, N, Halogen)] with a difunctional system of 1,1-; 1,2-; and 1,3-	**Technical:Criteria:**	**Lecture and group discussion [TM: 2×(2×50'')]**		• Disconnection of two groups carbon-heteroatom [C-X (X= O, N, Halogen)] with a difunctional system of 1,1-; 1,2-; and 1,3-	
4	Students are able to explain and show the process of carbon-heteroatom [C-X (X= O, N, Halogen)] disconnection and amine synthesis from C-X	• The accuracy in explaining and showing the process of carbon-heteroatom [C-X (X= O, N, Halogen)] disconnection and amine synthesis from C-X	**Technical:Criteria:**	**Lecture and group discussion [TM: 2×(2×50'')]**		• Disconnection of carbon-heteroatom[C-X (X= O, N, Halogen)] Amine synthesisfrom C-X	
5	Students are able to explain and show the process of carbon-heteroatom [C-X (X= O, N, Halogen)] disconnection where C-X is benzene derivative	• The accuracy in explaining and showing the process of carbon-heteroatom [C-X (X= O, N, Halogen)] disconnection where C-X is benzene derivative	**Technical:** Quiz **Criteria:**	**Lecture and group discussion [TM: 1×(2×50'')]** **Quiz [TM: 1×(2×50'')]**		• Disconnection of carbon-heteroatom [C-X (X= O, N, Halogen)] where C-Xis benzene derivative	**10**
6,7	Students are able to explain and show the process of the ungroup carbon-carbon (C-C)	• The accuracy in explaining and showingthe process	**Technical:Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')]**		• Disconnection of theungroup carbon- carbon (C-C)	

	and one group carbon-carbon (C-C) disconnection	of the ungroup carbon-carbon(C-C) and one group carbon-carbon (C-C) disconnection				Disconnection of one group carbon-carbon (C-C)	
8	**Mid-semester Evaluation**						**20**
9	Students are able to explain and show the process of one group carbon-carbon (C-C) disconnection	• The accuracy in explaining and showingthe process of one group carbon-carbon (C-C) disconnection	**Technical:** Laboratory experiment 1 **Criteria:**	**Lecture and group discussion [TM: 1×(2×50'')]** **Laboratory experiment[TM: 1×160'']**		• Disconnection of one group carbon-carbon (C-C)	**3.75**
10,11	Students are able to explain and show the process of two groups carbon-carbon (C-C) disconnection by observing the normal carbonyl reactivity	• The accuracy in explaining and showingthe process of two groups carbon-carbon (C-C) disconnection by observing the normalcarbonyl reactivity	**Technical:** Assignment 2 Laboratory experiment 2-3 **Criteria:**	**Lecture and group discussion [TM: 2×(2×50'')]** **Assignment 2 [BT+BM:(1+1)x(4x60")]** **Laboratory experiment[TM: 2×160'']**		• Disconnection of two groups carbon-carbon (C-C)	**17.5**
12-15	Students are able to explain and show the process of two groups carbon-carbon (C-C) disconnection by observing the unnatural carbonyl reactivity and carbocyclic compounds synthesis	• The accuracy in explaining and showing the process of two groups carbon-carbon (C-C) disconnection by	**Technical:** Presentation Laboratory experiment 4	**Lecture and group discussion [TM: 7×(2×50'')] [BT+BM:(1+1)x (4x60")]**		• Disconnection of two groups carbon-carbon (C-C) • Reactivity of unnatural carbonyl	**13.75**

		observing the unnaturalcarbonyl reactivity • The accuracy in conducting carbocyclic compounds synthesis	**Criteria:**	**Laboratory experiment[TM: 1×160'']**		• Carbocyclic compounds synthesis	
16	**Final Semester Evaluation**						**25**

30. CONCEPT OF TECHNOLOGY

31. CHEMOMETRICS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMOMETRICS	SK 184614	Analytical Chemistry	2	0	VI	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Suprapto, M.Si., Ph.D.; Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.		Suprapto, M.Si., Ph.D.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics and personality in completing one's task
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity, and communication ability
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced
	Course Learning Outcomes (CLO)	

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>CLO 1</td><td>Able to prove the data validity obtained from the chemistry analysis (C3)</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td></td><td>√</td><td></td><td></td><td></td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="2">In this course, students are trained to use statistical methods in solving chemistry cases and designing a laboratory experiment in order to obtain valid data that can be statistically tested. The study cases are given to the students to give them an illustration of using statistics correctly in chemistry</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="2">Errors in qualitative analysis, types of error, error handling, plan and design an experiment, arithmetic tools in statistic calculations, distribution of repeated measurements, confidence interval, present the experimental results, error propagation, t-test, comparison of experiments with known values, comparison of means between two experiments, paired sample t-test, one- and two-tailed test, F-test, outliers, ANOVA, Chi-Squared-test, normality distribution test, sampling, separation and estimation of variance using ANOVA, Shewart Chart, Cusum Chart, J Chat, proficiency test schemes, collaborative test, uncertainty, calibration curve in instrument measurement, the correlation coefficient, regression lines, slope and intercept errors in the regression line, calculation of concentration and random errors, detection limits, standart addition methods, use of regression lines to compare analytical methods, weighted regression lines, the intersection of two straight lines, linear curve regression method, curve fitting, outliers in regression, median, sign test, Wald Wolfowitz test, Wilcoxon test, independent two-sample simple test, non-parametric test, robust method, blocking and randomization, two-way ANOVA, Latin squares design and others, factorial design vs one by one, design factorial and optimization, incremental method, simplex optimization, annealing simulation, PCA, cluster analysis, discriminant analysis, K nearest neighbor method, separate class modeling, MLR, PCR, PLS regression, artificial neural networks</td></tr>
<tr><td>Reference</td><td colspan="2">Primary:

1. James N Miller and Jane C Miller, “ Statistics and Chemometric for Analytical Chemistry”, 5ed, Pearson Educations Limited, England, 2004.
2. Sudono,”Analisis Data Multivariat”, Edisi ke 2, BPFE, Yogjakarta, 2012.
3. Sugiyono, “Statistika Non Parametrik”, Cetakan ke 6, CV Alfa Beta, Bandung, 2012.

Secondary:</td></tr>
<tr><td>Lecturer</td><td colspan="2">Suprapto, M.Si., Ph.D.; Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td>Pre-Requisite Courses</td><td colspan="2">Have taken the course Introduction to Statistical Methods</td></tr>
</table>

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Students are able to know problems in analytics	• The accuracy in explaining errors inqualitative analysis • The accuracy in explaining the types oferror • The accuracy in explaining errors handling • The accuracy in explaining the plan anddesign experiment • The accuracy in explaining the arithmetic tools in statistic calculations	**Technical:** Non-test **Criteria:**	**Introduction lecture and brainstorming [TM: 1×(2×50'')]**		• Insights into errorsin quantitative analysis • Types of error • Errors handling method • Planning and designing experiment • Introduction of arithmetic tools in statistic calculations (calculator and computer)	
2	Students are able to apply statistics in repeated measurements	• The accuracy in explaining the distribution of repeated measurements • The accuracy in calculating the confidence interval	**Technical:** Non-test **Criteria:**	**Lecture and brainstorming [TM: 1×(1×50'')]** **Practice [TM: 1×(1×50'')]**		• Mean and standard deviation • Distribution of repeated measurements • Logarithm normal	

		• The accuracy in presenting the measurement results • The accuracy in explaining error propagation				distribution • The definition ofsample • Average of sampling distributions • The confidence interval of large sample means • The confidence interval of small sample means • Present the measurem entresults • Another applicationof the confidence interval • The confidence interval of geometrymeans for logarithm normal distribution • Propagation ofrandom errors • Propagation	

						of systematic errors	
3,4	Skilled students apply the significance tests in the calculation	• The accuracy in explaining T-test • The accuracy in conducting a comparison of experiments withknown values • The accuracy in conducting a comparison of meansbetween two experiments • The accuracy in conducting paired sample t-test • The accuracy in conducting F-test, outliers test, ANOVA test, Chi-Squared test,and normality distribution test	**Technical:** Non-test **Criteria:**	**Lecture and brainstormi ng [TM: 1×(2×50'')]** **Practice [TM: 1×(2×50'')]**		• t-test • Comparison of experiments withknown values • Comparison of means between twoexperiments • Paired sample t-test • One-tailed test • Two-tailed test • F-test • Outliers • ANOVA • Comparison ofseveral means • The arithmetics of ANOVA calculation • Chi-Squared test • Normality distribution test	
5,6	Students are able to know the quality of analytical measurements	• The accuracy in explaining sampling	**Technical:** Non-test	**Lecture and group discussion [TM: 1×(2×50'')]**		• Sampling • Separation and	

		• The accuracy in explaining separationand estimation of variance • The accuracy in usingANOVA • The accuracy in creating Shewhart Chart, Cusum Chart,and J Chart • The accuracy in explaining proficiencytest schemes, collaborative test • The accuracy in explaining uncertainty	**Criteria:**	**Practice [TM: 1×(2×50'')]**		estimation of variance using ANOVA • Sampling strategy • Quality control method • Shewhart Chart formeans value • Shewhart Chart forranges • Processabili ty determinati on • Cusum Chart • J Chart • Proficiency testschemes • Uncertainty • Collaborative test • Acceptance sampling	
7,9	Skilled students apply calibration method in measurements	• The accuracy in creating calibration curve in instrument measurements • The accuracy in calculating the correlation	**Technical:** Non-test **Criteria:**	**Lecture and brainstorming [TM: 1×(2×50'')]**		• Instrument analysis • Calibration curve ininstrument measurements • Product-moment correlation coefficient • Regression lines	7,9

		coefficient • The accuracy in creating regressionlines • The accuracy in calculating slope and intercept errors in the regression line • The accuracy in explaining the calculation of concentration andrandom errors • The accuracy in calculating detectionlimits • The accuracy in explaining the standardaddition method • The accuracy in usingregression line to compare analytical method • The accuracy in creating weighted				of yon x • Slope and intercepterrors in the regression line • Calculation of concentration andrandom errors • Detection limits • Standard addition method • Use of regression line to comparing analytical method • Weighted regressionlines • The intersection oftwo straight lines • ANOVA and regressio n calculati on • The linear curve regression method • Curve fitting	

		regression lines • The accuracy in explaining the intersection of twostraight lines • The accuracy in explaining the linearcurve regression method • The accuracy in conducting curve fitting • The accuracy in explaining outliers in regression				• Outliers in regression	
8	**Mid-semester Evaluation**						
10,11	Skilled students apply the non-parametric method and robust method	• The accuracy in explaining median • The accuracy in conducting sign test • The accuracy in conducting the WaldWolfowitz test • The accuracy in theWilcoxon test	**Technical:** Non-test **Criteria:**	**Lecture and brainstormi ng [TM: 1×(2×50'')]** **Practice [TM: 1×(2×50'')]**		• Median • Sign test • The Wald Wolfowitztest • The Wilcoxon test • Independent two- sample simple test • Non-parametric testfor more than two sample • Rank correlation • Non-parametric	

		The accuracy in conducting an independent two- sample simple test • The accuracy in conducting the non-parametric method • The accuracy in conducting robust method				regression method • Robust method • Robust estimationon location and distribution • Robust regression method • Statistical resampling	
12-13	Students are able to analyze experimental design and optimation	• The accuracy in explaining blocking andrandomization • The accuracy in usingtwo-way ANOVA • The accuracy in explaining Latin squaredesign and others • The accuracy in factorial design vs oneby one • The accuracy in designfactorial and optimization • The accuracy in	**Technical:** Non-test **Criteria:**	**Lecture and brainstormi ng [TM: 1×(2×50'')]** **Practice [TM: 1×(2x50'']**		• Blocking and randomizati on • Two-way ANOVA • Latin square designand other • Interactions • Factorial design vsone by one • Design factorial andoptimization • Optimation: the basic principle andunivariate method • Optimation: Usingvariable neighborhood	

		explaining the incremental method • The accuracy in simplexoptimization • The accuracy in explaining annealing simulation				search methods • Incremental method • Simplex optimization • Annealing simulation	
14-15	Skilled students apply multivariate analysis	• The accuracy inexplaining PCA • The accuracy in explaining clusteranalysis • The accuracy in explaining the discriminant analysis • The accuracy in explaining K nearestneighbor method • The accuracy in explaining separateclass modeling • The accuracy in explaining MLR,	**Technical:** Non-test **Criteria:**	**Lecture and brainstorming [TM: 1×(2×50'')]** **Practice [TM: 1×(2x50'')]**		• Principal Component Analysis(PCA) • Cluster analysis • Discriminant analysis • K nearest neighbor method • Separate class modeling • Multiple Linear Regression (MLR) • Principal Component Regression (PCR) • Partial Least Squares(PLS regression	

		PCR,and PLS regression • The accuracy in artificial neural networks				• Artificial neural networks	
16	**Final Semester Evaluation**						

32. CHEMICAL ANALYSIS LABORATORY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMICAL ANALYSIS LABORATORY	SK 184615	Analytical Chemistry	2	0	VI	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Suprapto, Ph.D.		Suprapto, PhD		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	B.3 (LO 5)	Able to take responsibility for his/her own work and to be give the responsibility of the achievement of an organization
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Able to carry out chemistry analysis and documentate the correct analysis results

LO - CLOMAP	

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1			√		√		√	√	

Course Short Description	This course covers the laboratorium experiments which are the applications of the Methods of Separation and Purification, Spectroscopy, and Electrometry and Thermal courses. In the laboratory experiments of this course, the students will be given a couple of topics during one semester, in which the topics will have to be done as group assignments. The students will be given the task to make their own reagents and used to analyse the given samples. At the end of the course, the students have to compile their findings in the form of written paper and present it in the front of the class.
Study Material: Subject Matter	1. Working safely in the laboratorium 2. Preparing organic and anorganic samples 3. Making standard and buffer solutions 4. Analyte separations by using extraction and chromatography 5. Measuring organic and anorganic samples by using chemical instruments
Reference	**Primary:** 1. Pawliszyn, James and Lord, Heather.L,"Handbook of sample preparation", John Wiley, USA, 2011. 2. Kenkel J.,Kelter P., and Hage D, " Chemistry: An Industry-Based Introduction, CRC Press/Lewis Publisher, Boca Raton, FL, 2000. 3. Mitra Somenath ," Sample preparation techniques in analytical chemistry", John Wiley & Sons, New Jersey, Kanada, 2003. **Secondary:**
Lecturer	Suprapto, Ph.D.
Pre-Requisite Courses	Have taken the courses Measurement Methods in Chemistry, Separation and Purification Methods, and Intrumental Measurement Methods.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to apply the concept of work safety in the laboratory	•		**Introductory lectures**		• Experiment Topic 1	
2	Students are able to perform sample preparation using relevant methods	• Individual and Group Assessment		**Laboratory practice**		• 1, 2	
3	Students are able to make buffer solutions and standard solutions according to the analyzed sample	• Individual and Group Assessment		**Laboratory practice**		• 1, 2	
4	Students are able to perform chemical tests/analyzes using correct instruments	• • Individual and Group Assessment		**Laboratory practice**		• 1, 2	**10**
5	Students are able to analyze measurement results and present the results in writing and orally	• Individual and Group Assessment		**Lecture Group discussions Presentation**		• 1, 2	**20**
6	Students are able to perform sample preparation using relevant methods	• Individual and Group Assessment		**Laboratory practice**		• Experiment Topic 2	
7	Students are able to apply separation techniques and make standard solutions according to the analyzed sample	• Individual and Group Assessment		**Laboratory practice**		• 1, 2	
8	**Mid-semester Evaluation**						
9	Students are able to perform chemical tests/analyzes using correct instruments	• • Individual and Group Assessment		**Laboratory practice**		• 1, 2	**15**

10	Students are able to analyze measurement results and present the results in writing and orally	• Individual and Group Assessment		**Lecture Group discussions Presentation**		• 1, 2	**20**
11	Students are able to perform sample preparation using relevant methods	• Individual and Group Assessment		**Laboratory practice**		• Experiment Topic 3	
12	Students are able to apply separation techniques and make standard solutions according to the analyzed sample	• Individual and Group Assessment		**Laboratory practice**			
13	Students are able to perform chemical tests/analyzes using correct instruments	• Individual and Group Assessment		**Laboratory practice**			
14	Students are able to analyze measurement results and present the results in writing and orally	• Individual and Group Assessment		**Lecture Group discussions Presentation**			**20**
15-16	**Final Semester Evaluation**						

33. SYNTHESIS AND CHARACTERIZATION OF INORGANIC MATERIALS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCE AND DATA ANALYTICS DEPARTMENT OF CHEMISTRY	**Document Code**
TEACHING AND LEARNING PLAN		

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units	SEMESTER	Compilation Date

SYNTHESIS AND CHARACTERIZATION OF INORGANIC MATERIALS	SK 184623	Inorganic Chemistry	5	0	VI	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Inorganic Chemistry Lecturer Team		Dra. Ratna Ediati, MS., Ph.D.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	The students are able to choose the suitable characterisation method that matches with the anorganic synthesis product
	CLO 2	The students are able to combine the synthesis method through the basic principles approach of anorganic synthesis

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1			√			√	√	√	
CLO 2			√			√		√	

Course Short Description	In this course, the students will learn about the principles of anorganic material synthesis (complex compound, organometallic, anorganic solids) followed by characterization. In addition, this course also covers the synthesis of anorganic compounds in high and low temperatures, rute precursors, and physical (top down) and chemical (bottom up) nano particle material synthesis, therefore the students are able to combine the methods of synthesis through the basic principle approach of anorganic synthesis. The synthesis and characterization methods of anorganic materials are covered in the class lecturers and in the laboratorium, so that the students have the knowledge of performing synthesis and characterization of organic materials. This course will also give study cases on synthesis and characterization of anorganic compounds that are related to the synthesis and characterization techniques, so that students will have the learning experience to think critically on anorganic compound synthesis implemented on some fields such as industry, energy, environment, health and able to make the correct decision regarding on the use of anorganic materials in everyday life.
Study Material: Subject Matter	1. The principles of anorganic material synthesis (complex compounds, organometallic, anorganic solids) followed by characterization that covers contact surface area between the reactants, diffusion speed, nucleation speed (solid state metathesis reactions).

	2. Synthesis at high temperatures (solid state/ceramic method): choosing the starting material, weighing, mixing techniques, pellets making, choosing the correct container, determining the mixing temperature, calcination, sintering, product pulverization. 3. Synthesis at low temperature and precursor routes (sol-gel methods, hydrothermal/solvothermal, desolvation, redox, oxygen-free, intercalation): intimate cation mixing, controlling the diffusion speed, choosing the starting material, choosing the solvents, choosing the agents depending on the methods (such as gelating agent, precipitation agent), determining the mixing/reaction conditions (pH level, temperature, mixing), choosing the reactor, determining the temperatures (calcination). 4. Nano particle material synthesis - Physical (top down): for nano-composite materials or bul nanoparticle materials (refining, the thermal cycle, size,shape or geometri particle distribution, pollutants). - Chemical (bottom up): thermodynamic equilibrium approach (supersaturated, nucleation, nucleus growth) Precipitation, Hydrothermal, Colloid, Thermolysis, Photolysis, and Sonolysis, Sol-gel, Polyol, IBM (Combination of Polyol-Thermolysis), kinetic approach (precursor limit for growth, confinement). 5. Characterization methods: X-Ray Diffraction, IR, UV-vis, BET, SEMU, TEM, magnetic susceptibility, TGA, conductivity, oxidation-reduction potentials, NMR (variable temperature, multinuclear, multidimensional), optical rotation, ESR, Mössbauer, mass spectrometry. 6. Laboratorium Experiment: - Complex Compound Synthesis and Characterization: molecular control. - Zeolite Synthesis and Characterization: molecular control.
Reference	**Primary:** 1. D. D. Shriver and P. W. Atkins, "Inorganic Chemistry", 5th Edition, W.H. Freeman and Company, Oxford, 2010 2. J. E. Huheey, E. A. Keiter and R. L. Keiter, "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Edition, Harper Collins College Publishers, London 1997. 3. G. L. Miessler, P. J. Fischer and D. A. Tarr, "Inorganic Chemistry", 5th Edition, Prentice Hall, London, 2013. 4. C. E. Housecroft and A.G. Sharpe, "**Inorganic Chemistry**", 2nd Edition, Pearson Education Limited, 2005. 5. A.R. West, "Solid State Chemistry", John Wiley & Sons, Singapore, 1992. **Secondary:**
Lecturer	Inorganic Chemistry Lecturer Team
Pre-Requisite Courses	Have taken the courses Structure, Properties and Reactivity of Inorganic Compounds; Elements and Inorganic Compound, and Separation and Purification Methods passed with a minimum grade D.

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	**[C3, A3, P1]:** Students are able to explain the principles of inorganic material synthesis	• The accuracy in explaining the principles of inorganic material synthesis.		**Introductory lecture** **[TM: 1x(2x50")]** **Lecture and discussion** **[TM: 1x(2x50")]**		• Types of inorganic material synthesis including complex, organometallic and inorganic solids • Introduction to high and low temperature synthesis • Introduction to the general characterization of inorganic materials • Early examples of synthesis and characterization of inorganic materials	
2, 3	**[C6, A4, P6]:** Students are able to study and design synthesis of inorganic materials using the solid-state method	• The accuracy in explaining the principles of solid-state synthesis. • The accuracy in determining the reactants used. • The accuracy in designing solid-state synthesis procedures.		**Lecture,** **[TM: 2x(2x50")]** **Group presentations and discussions** **[TM: 2x(2x50")]**		• The principle of solid-state method: Tamman's rule • Selection of starting materials: types of reactants and their properties, types of reactants that can and cannot be used.	**10**

		• The accuracy in selecting the correct characterization procedure.		**Non-Test:** **Assignment 1** Retell and present scientific journals that discuss the synthesis of inorganic materials using the solid-state method and the characterization		• Solid-state synthesis procedures: weighing, mixing technique, pelletizing, container selection, calcination fixing, sintering and product crushing • Characterization: SEM-EDX/TEM, XRF, DTA-TGA	
4	**[C6, A4, P6]:** Students are able to study and design the nano materials making in physics (top down)	• The accuracy in studying and evaluating physics nano synthesis methods (top down)		**Lecture, group discussions, [TM: 1x(2x50")]** **Quiz** Quiz materials include materials from week 1 to week 4, including the principles of inorganic synthesis, solid state methods and top-down method of making nano materials. **[TM: 1x(2x50")]**		• Physical synthesis of nanoparticle materials for nanocomposite materials: refinement, thermal cycling, size distribution, particle shape and geometry, impurities	**15**

5, 6	**[C6, A4, P6]:** Students are able to study and design the inorganic materials making by using the solgel method	• The accuracy in explaining the principles of sol-gel synthesis. • The accuracy in determining the reactants used. • The accuracy in designing the sol-gel synthesis procedure. • The accuracy in selecting the appropriate characterization procedure. • The accuracy in studying the inorganic materials making by using the solgel method and getting conclusions as the basis for designing other material synthesis methods using the solid-state method		**Lecture** **[TM: 2x(2x50")]** **Group presentations and discussions** **[TM: 2x(2x50")]** **Non-Test:** **Assignment 2** (Paper and presentation) Write a journal resume that discusses the synthesis of inorganic material using the solgel method and its characterization.		• The principle of the sol-gel method: definition of the solution and gelation system • Intimate cation mixing • Diffusion speed control • Selection of starting material • Solvent selection	**10**
7	**[C6, A4, P6]:** Students are able to study and design the nano materials	• The accuracy in studying and evaluating chemical nano		**Lecture, group discussions** **[TM: 2x(2x50")]**		• Thermodynamic equilibrium approaches (supersaturation, nucleation, nucleation growth),	

	making chemically (bottom up)	synthesis methods (bottom up)				precipitation, hydrothermal, colois, thermolysis, photolysis, sonolysis, solgel, polyol, IBM (polyol-thermolysis combination) • Kinetic approach (limit number of precursors to growth, confinement)	
8	**Mid-semester Evaluation**						**15**
9	**[C4, A3]:** Students are able to explain the working principles of X-ray diffraction (XRD) and analyze XRD results	• The accuracy in explaining the working principle of X-ray diffraction • The accuracy in analyzing diffractogram / analysis result data		**Lecture** **Group discussions** **[TM: 2x(2x50")]**		• X-ray interactions with materials • The process of forming a diffractogram on XRD • Matching the diffractogram of the sample with the standard diffractogram • Determination of the crystal structure • Determination of the crystallinity of the material • Examples of using XRD	

10, 11	**[C6, A4, P6]:** Students are able to study and design the inorganic materials making by using hydrothermal and solvothermal methods	• The accuracy in explaining the synthesis principle by hydrothermal and solvothermal methods • The accuracy in determining the reactants used • The accuracy in designing hydrothermal and solvothermal synthesis procedures		**Lecture** **[TM: 2x(2x50")]** **Presentations** **Group discussions** **[TM: 2x(2x50")]** **Non-Test:** **Assignment 3** (paper and presentation) Write a resume of scientific journals that discuss the synthesis of inorganic materials by hydrothermal and solvothermal method s, and the characterization		• Principles of hydrothermal and solvothermal methods • Selection of starting material • Solvent selection • Determination procedure: Temperature and pressure	**10**
12	**[C4, A3]:** Students are able to explain the working principles of IR, Raman and N_2 adsorption-desorption	• The accuracy in explaining the working principle of IR, Raman, adsorption-desorption N_2 • The accuracy in analyzing IR, Raman and N_2 adsorption spectra		**Lecture** **[TM: 1x(2x50")]** **Quiz II** Quiz II Material: XRD, sol-gel and characterization of IR, Raman, Adsorption / desorption of N_2		• The working principle of IR, Raman and N_2 adsorption/desor ption • Types of adsorption isotherms • Analysis of IR, Raman spectra and adsorption-desorption N_2	**15**

				[TM: 1x(2x50")]		• Example of spectral analysis	
13	**[C6, A4, P6]:** Students are able to study and design the inorganic materials making by using the reflux method	• The accuracy in explaining the synthesis principle by reflux method • The accuracy in determining the reactants used • The accuracy in designing synthesis procedures using the reflux method		**Lecture Discussions** **[TM: 2x(2x50")]** **Non-Test: Assignment 4 (short paper)** Write a scientific journal resume that discusses the synthesis of inorganic materials by reflux method, and the characterization.		• The principle of the reflux method • Selection of starting material • Solvent selection • Procedure determination: determining the temperature and the instrumentation	**10**
14	**[C6, A4, P6]:** Students are able to study and design the inorganic materials making by using the oxygen-free method (Schlenk)	• The accuracy in explaining the principles of synthesis with the oxygen-free method (Schlenk) • The accuracy in determining the reactants used • The accuracy in explaining various instruments and equipment used in Schlenk technique		**Lecture Discussions** **[TM: 2x(2x50")]**		• The principle of the oxygen free method • Common instruments/equipment in Schlenk technique • Selection of starting materials and procedures	

		• The accuracy in designing synthesis procedures					
15	**[C4, A3]:** Students are able to explain the working principles of UV, solid NMR, ESR, Mössbauer and their analysis on inorganic materials	• The accuracy in explaining the working principle of UV, solid NMR, ESR and Mössbauer • The accuracy in analyzing UV, solid NMR, ESR and Mössbauer data on inorganic materials		**Lecture** **Group discussions** **[TM: 2x(2x50")]**		• The working principle of UV, solid NMR, ESR and Mössbauer • Examples of use and analysis of UV, solid NMR, ESR and Mössbauer data on inorganic materials	
16	**Final Semester Evaluation**						**15**

34. BIOPROCESS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
BIOPROCESS	SK 184632	Biochemistry	4	0	VI	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Biochemistry Lecturer Team		Herdayanto Sulistyo Putro, S.Si., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

<table>
<tr><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td></td><td></td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="3">Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="3">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td></td><td></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">The students are able to explain the concepts and metabolic pathways of biomolecules</td></tr>
<tr><td>CLO 2</td><td colspan="3">The students are able to apply the concept of metabolism to solve problems in daily routines</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>CLO 2</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">The lesson learned from this course is cellular process control. This courses discusses the following topics: Structures and chemical characteristics/functions of the energy producer materials (carbohydrates, lipids); structures and chemical characteristics of energy carrier materials (ATP); carbohydrate biosynthesis (photosynthesis); carbohydrate degradation (bioenergetics); lipids biosynthesis (trigliserida); lipids degradation; The Kreb Cycle; respiratory chain and energy production; metabolism control (genetic and enzymatic); the general metabolism of amino acid and nucleic acid; molecule transportations through cell membranes; determining metabolic pathways with marked carbons; metabolism process testing; fermentation; biotransformation; biodegradation.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">Structures and chemical characteristics/functions of energy producing materials (carbohydrates, lipids); Chemical characteristics of energy carrier materials (ATP); carbohydrate biosynthesis (photosynthesis)l carbohydrate degradation (bioenergetics); lipid biosynthesis (trigliserida); lipid degradation; The Kreb Cycle; respiratory chain and energy production; metabolism control (genetically and enzymatically); general metabolism of amino and nucleic acid; molecule transports through cell membranes; determining the metabolic pathways with charged carbons; metabolism process testing; fermentation; biotransformation; biodegradation.</td></tr>
<tr><td>Reference</td><td>Primary:</td><td colspan="3"></td></tr>
</table>

	1. D. L. Nelson and M. M. Cox, "Lehninger Principles of Biochemistry", 6th edition, W.H. Freeman, New York, 2012. 2. L. Stryer, "Biochemistry", 3rd edition, W.H. Freeman and Company, New York, 1988. 3. R. F. Boyer, "Modern Experimental Biochemistry", Addison-Wesley publishing company, California, 1986. **Secondary:**
Lecturer	Prof. Dr. Drs. Surya Rosa Putra, M.S., Drs. Refdinal Nawfa, M.S., Adi Setyo Purnomo, S.Si, M.Sc, Ph.D., Herdayanto Sulistyo Putro, S.Si, M.Si
Pre-Requisite Courses	Have taken the course Biochemistry.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1, 2, 3	Able to explain what metabolism is and predict the physical /chemical properties of energy-carrying materials (ATP) based on their chemical structure.	• The accuracy in explaining what metabolism is • The accuracy in explaining the chemical properties of energy carriers		**Lecture [TM:2x(2x50')]** **Lecture [TM:1x(2x50')]** **Lecture [TM: 1x(2x50')]** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]**		• General metabolism. • Determination of marked carbon metabolic pathways. • The structure and chemical properties of the energy carrier (ATP)	

4, 5	Able to predict the control of carbohydrates during the photosynthesis process and their degradation, calculate the energy produced in the degradation of carbohydrates in chemotropic cells.	• The accuracy in explaining the process of anabolism of carbohydrate/ photosynthesis. • The accuracy in calculating the energy produced by carbohydrate catabolism		**Lecture Assingments [TM: 1x(2x50')]** **Lecture [TM: 1x(2x50')]** **Lecture Quiz I [TM: 1x(2x50')]**		• Biosynthesis of carbohydrates (photosynthesis); • Degradated carbohydrates (bioenergitics), • Kreb Cycle; Respiratory chain and energy production	**15**
6, 7	Predicts the process of lipid formation and able to calculate the energy generated in the degradation of lipids in chemotropic cells	• The accuracy in explaining the lipid anabolism process. The accuracy in calculating the energy produced by lipid catabolism		**Lecture Assignments [TM: 1x(2x50')]** **Lecture Quiz II [TM: 1x(2x50')]** **[TM: 1x(2x50')]**		• Lipid biosynthesis (triglycerides); • Degradated lipids (bioenergitics)	**15**
8	**Mid-semester Evaluation**						**20**
9, 10	Able to predict changes in amino acids as an energy source and be able to calculate the energy produced	• • The accuracy in reading and using IR data to determine the structure of organic compounds		**Lecture Assignments** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]**		• General metabolism of amino acids	**5**

11	Able to predict the regulation of metabolic processes	• The accuracy in explaining metabolic regulation		**Lecture** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]**		• Control of metabolism (genetic and enzymatic)	
12	Able to predict the formation and change of nucleic acids	• The accuracy in describing changes in nucleic acids		**Lecture Assignemnts** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]**		• General metabolism of nucleic acids	**5**
13	Able to predict the occurrence of biomolecule movement in cell membranes	• The accuracy in predicting the transfer of biomolecules on the cell membrane		**Lecture** **[TM: 1x(2x50')]** **[TM: 1x(2x50')]**		• Transport of molecules through cell membranes	
14, 15	Able to predict testing of metabolic processes	•		**Laboratory practice** **[TM: 4x(2x50')]**		• Metabolic process testing; fermentation; biotransformation; biodegradation	**20**
16	**Final Semester Evaluation**						**20**

35. IDENTIFICATION IN ORGANIC CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**
TEACHING AND LEARNING PLAN		

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units	SEMESTER	Compilation Date

<table>
<tr><td>IDENTIFICATION IN ORGANIC CHEMISTRY</td><td>SK 184654</td><td>Organic Chemistry</td><td>3</td><td>0</td><td>VI</td><td></td></tr>
<tr><td rowspan="2">AUTHORIZATION / LEGALIZATION</td><td colspan="2">TLP Editor</td><td colspan="2">Course Group Coordinator</td><td colspan="2">Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2">Prof. Dr. Taslim Ersam, MS.; Prof. Mardi Santoso, Ph.D.; Zjahra Vianita Nugraheni, M.Si.</td><td colspan="2">Drs. Agus Wahyudi, MS.</td><td colspan="2">Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="7">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="4"></td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="5">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>B.2 (LO 4)</td><td colspan="5">Able to give alternative solutions with the characters of leadership, creativity and communication ability</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="5">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="5">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="4"></td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>CLO 1</td><td colspan="5">Able to show the correlations between the spectrum to determine the structure of an organic compound (C4).</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="6"><table><tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr><tr><td>CLO 1</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr></table></td></tr>
<tr><td>Course Short Description</td><td colspan="6">Petrol, oil, tyres, clothes, wood furnitures, papers, medicines, plastics, photo negatives, perfumes, carpets, polyethylene, epoxy, nicotine, cholesterol are some of the organic compounds which we come across frequently and are easily found. The huge amount of organic compounds itself caused troubles in determining the structure of a compound, is the organic compound in a single state (pure state)?, or is the compound in the state of being merged with another compound as a pollutant? This simple chemistry test can be used to differentiate the different functional groups. Melting and boiling points tests can give more information on the identity and the purity of the compounds, but in general only in the form of predicted structure, the results cannot be used to identify new compounds, and are not effective in differentiating between the same compounds. The spectroscopy analysis technique of visible ultraviolet, infrared spectroscopy, mass spectrometry and magnetic nucleus resonance spectroscopy (NMR) have been developed to overcome such problems. This course gives the analysis technique applications to elucidate organic molecule structures so that students are able to show the correlations between the spectrum to determine the structure of an organic compound. The learning process will be based on the cases which can be solved both independently and as a group in order to achieve the learning outcomes. The learning activities can be reported in the spoken or written form, both independently and/or as a group.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="6">1. Structure analysis in determining the molecule equatuons of organic compounds.
2. Basic measurement theories and principles of spectroscopies UV-Vis, IR, MS, NMR.</td></tr>
</table>

	3. Identification study case of spectrum UV-Vis, IR, MS, NMR (Integrated problems)
Reference	**Primary:** 1. D.L. Pavia, G. M. Lampman and G. S. Kriz, "Introduction of Spectroscopy: A Guide for Students of Organic Chemistry", 3rd edition, Forth Worth, Harcourt College Publishing, Australia, 2001. 2. P. Crews, J. Rodríguez and M. Jaspars, "Organic Structure Analysis", Oxford University Press, New York, 1998. 3. R.M. Silverstein, G.C. Bassler and T.C. Morril, "Spectrometric Identification of Organic Compounds", 7th edition, John Wiley & Sons, Inc., New York, 2005. 4. L.D. Field, S. Sternhell and J.R. Kalman, "Organic Structures from Spectra", 4th edition, John Wiley & Sons, Inc., New York, 2008. **Secondary:**
Lecturer	Prof. Dr. Taslim Ersam, MS., Prof. Mardi Santoso, Ph.D., Zjahra Vianita Nugraheni, M.Si.
Pre-Requisite Courses	Have taken the courses Basic Organic Chemistry and Organic Reactions and Mechanisms, and have passed with a minimum grade D.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to use the results of elemental analysis to determine the molecular formula of organic compounds Students are able to explain the initial concepts of H-NMR (resonance, shielding-	• The accuracy in determining the molecular formula for organic compounds is using elemental analysis data • The accuracy in explaining the initial concepts of H-NMR		**Introductory lectures Brainstorming** **[TM: 1x(2x50")]** **Lectures Discussions** **[TM: 1x(2x50")]**		• Lecture contracts and Lecture plans • Elemental analysis • The basic principle H-NMR includes t through Home Visits nuclear spin , Theory of nuclear magnetic moments , Absorption of	

	deshielding, relaxation, spin, magnetic moment and energy absorption)	(resonance, shielding-deshielding, relaxation, spin, magnetic moment and energy absorption)				energy , mechanism of absorption (resonance) , population density of the nuclear spins , Shielding-deshielding and Relaxation	
2	Students are able to explain and use the H-NMR concept (chemical environment and chemical shear)	• The accuracy to describe and use H - NMR (chemical environment and chemical shear) data		**Lectures Discussions** **[TM: 2x(2x50")]** **[BT+BM:(2+2)x (4x60")]**		• Chemical environment and chemical shear (example problems for local diamagnetic shielding; electronegativity effect, hybridization effect, acid and exchange protons: hydrogen bonding), magnetic anisotropy.	
3	Students are able to explain and use the C-NMR concept in determining the molecular formula for organic compounds	• The accuracy in explaining and using C-NMR spectra data		**Lectures Discussions** **[TM: 2x(2x50")]** **[BT+BM:(2+2)x (4x60")]**		• 13C spectra: 13C nucleus, 13C chemical shift (correlation diagram), proton coupled 13C spectra (spin-spin-coupled 13C signal), proton	

						decoupling 13C spectra.	
4	Students are able to explain and use the C-NMR concept to determine the structure of compounds with aromatic rings and other types of compounds	• • The accuracy in explaining and using C-NMR spectra data to determine the structure of compounds with aromatic rings and other types of compounds		**Quiz** **[TM: 2x(2x50')]**		• 13C Spectra: compounds with aromatic rings, surveying several types of 13C NMR absorption in different types of compounds.	**10**
5	Students are able to explain and use MS concepts in determining the structure of organic compounds	• The accuracy in explaining and using the MS concept in determining the molecular structure of organic compounds		**Lecture** **[TM: 2x(2x50')]** **[BT+BM:(1+1)x (2x60")]**		• The theory of mass spectrometer, mass spectrum, determination of molecular weight from molecular formula and mass spectrum, the rule of thirteen, double bond equivalent (DBE), isotopes.	
6, 7	Students are able to demonstrate the fragmentation process in organic molecules	• The accuracy of the students in doing the fragmentation of the molecules of organic in accordance with the data of MS are given		**Lectures** **Discussions** **Assignment 1**		Fragmentation	**10**
8	**Mid-semester Evaluation**						**30**

9, 10	Students are able to explain and use the basic principles of IR in determining the structure of organic compounds	• • The accuracy in reading and using IR data to determine the structure of organic compounds		**Lectures** **Group discussions** **[TM: 4x(2x50")]** **[BT+BM:(1+1)x (2x60")]**		• The theory of mass spectrometer, mass spectrum, determination of molecular weight from molecular formula and mass spectrum, the rule of thirteen, double bond equivalent (DBE), isotopes. • A practical approach to read the IR spectrum (reading and interpretation of infrared spectra data, correlation diagrams and tables, surveying the key wave numbers of several functional groups).	
11, 12	Students are able to explain and use the basic principles of UV in determining the structure of organic compounds	• The accuracy in describing and using UV spectra data to determine the structure of organic compounds		**Lectures** **Group discussions** **[TM: 4x(2x50")]** **[BT+BM:(1+1)x (2x60")]** **Assignment 2**		• The theory of electronic excitation, UV band structure, chromophore, solvent influence (batochromic, hypochromic, hyperchromic,	**10**

						hypochromic), resonance effect, conjugation effect of alkenes. • Woodward-Fieser's rule for conjugated dienes, carbonyl compounds: keto-enones & Woodward's rule for enones. • Aldehydes/ketones α, β- unsaturated, aromatic compounds	
13, 14, 15	Students use H-NMR, C-NMR, MS, IR and UV-Vis spectrum data to determine the structure of organic compounds	• The accuracy in explaining and using H-NMR, C-NMR, MS, IR and UV-Vis spectrum data to determine the structure of organic compounds		**Lectures** **Group discussions** **Presentation** **[TM: 4x(2x50")]** **[BT+BM:(1+1)x (2x60")]**		• UV-Vis, IR, MS, NMR (Integrated problems) spectra identification case studies	**10**
16	**Final Semester Evaluation**						**30**

36. COLLOQUIUM

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
COLLOQUIUM	SK 184705	Mandatory	2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dr. Hendro Juwono, M.Si		Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics and personality in completing one's task
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity and communication ability
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced
	Course Learning Outcomes (CLO)	
	CLO 1	The students have the ability to think critically and empirically with the life-long learning concept in creating a solution to solve a problem
	CLO 2	The students have the ability to disseminate data and information from the previous researches, and use them to solve the current problem being faced and held responsible for the solution towards the problem being faced in the final assignment exam.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√			√				√	
CLO 2	√			√				√	

Course Short Description	In Colloquium, the students are being directed to discuss the scientific research journal,searching the literatures, gathering secondary data and write a scientific report in the form of a paper, and present and hold responsible for the paper that they are presenting in a seminar.
Study Material: Subject Matter	Current research topics, techniques for understanding and evaluating scientific journals, scientific writing, presentation techniques.
Reference	**Primary:**

1. Scientific journal published in the last five years

	Secondary:
Lecturer	The supervisor of each student
Pre-Requisite Courses	Have achieved at least 96 CREDITS

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain the research topics that are currently being developed	• Accuracy in explaining research topics that are currently being developed		**Introductory Lecture** **Small Group discussion** **[TM: 2×(2×50')]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• Research topics that are developing today and in the future	10%
2, 3	Students are able to explain the problems faced in each research topic based on quality scientific work	• Accuracy in explaining problems faced in a research topic and efforts to overcome these problems that have been carried out at this time		**Lecture** **Presentation** **Class discussion** **[TM: 2x(2x50")]**		• Selection of quality scientific works • Understand the main points of research journals	10%
4	Students are able to explain the problems faced in each	Accuracy in explaining problems that arise in		**Presentation** **[TM: 1x(2x50")]**		• Presentation technique	10%

	research topic based on quality scientific work.	research topics and in overcoming these problems that have been implemented at this time					
5	Students are able to choose quality scientific papers to be appointed in the final colloquia seminar	• Accuracy in choosing a reputable journal • Accuracy in explaining the issues raised by the journal in outline • Accuracy in explaining journal contents in outline		**Lecture** **Group discussion** **[TM: 1x(2x50")]**		• Choosing a reputable journal. • Understanding the issues raised by the journal in an outline. • Understanding the journal contents in an outline	
6.7	Students are able to interpret the contents of the journal and the data contained in it	• Accuracy in showing the flow of journal discussions and the role of research data in supporting that flow • Accuracy in interpreting the data contained in the journal manuscript		**Lecture** **Discussion** **[TM: 2x(2x50")]**		• How to read the flow of the journal's discussion as a whole • Identify important data points in the journal • Interpret and understand research data	
8	**Mid-semester Evaluation**						**10%**
9	Students are able to study the relationship between data in scientific papers and their discussion	• Accuracy in integrating the meaning and intent of the data in the journal		**Lecture** **Class discussion** **[TM: 1x(2x50")]**		• Analyze journal contents	

10, 11	Students are able to evaluate their strengths and / or weaknesses in the discussion of scientific papers	• Accuracy in evaluating their strengths and / or weaknesses in the discussion of scientific papers		**Lecture** **Class discussion** **[TM: 2x(2x50")]**		• Evaluate the weaknesses / deficiencies of the journal	15%
12	**Presentation 2**	• Accuracy in explaining the results of the evaluation of the journal review and justifying it		**Presentation** **[TM: 1x(2x50")]**		•	10%
13, 14	Students are able to compile scientific papers in a structured manner based on understanding, analysis and evaluation of the journal content they have chosen	• The accuracy in arranging scientific papers in a structured manner with a logical frame of mind		**Lecture** **Tutorial** **[TM: 2x(2x50")]**		• Making scientific papers • The composition of scientific papers • Administration of scientific writing	20%
15,16	**Final Semester Evaluation** Students are able to disseminate scientific papers they have compiled and account for their arguments in front of the board of examiners	•		**Presentation** **Discussion** **[TM: 2x(2x50")]**		•	25%

37. TECHNOPRENEUR

38. CHEMISTRY STUDY CASE

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMISTRY STUDY CASE	SK 184706	Mandatory	2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
					Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.1 (LO 1)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	B.3 (LO 5)	Responsible for one's own work and is able to be give the responsibility of the achievement of an organization
	C.2 (LO 7)	Able to master concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Able to think critically and empirically with the life-long learning concept in solving problems
	CLO 2	Able to solve problems encountered inside the laboratorium
	CLO 3	Able to compile reports and disseminate data and information obtained.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1			√		√			√	
CLO 2					√		√	√	
CLO 3					√			√	

Course Short Description	During this course, the students will work in groups and they will be supervised to implement the concepts of chemistry in solving the problems with the approach of scientific methods, write a report and present it.

Study Material: Subject Matter	-
Reference	**Primary:** 1. Supporting journals. 2. Books, research reports, dissertations, thesis, final assignments, patents, proceedings related to the research topics. **Secondary:**
Lecturer	Ratna Ediati, MS., Ph.D; Dr. Djoko Hartanto, M.Si.; Dra. Harmami, MS.; Zjahra Vianita Nugraheni, S.Si., M.Si.; Drs. Refdinal Nawfa, MS.; Hamdan Dwi, M. Si
Pre-Requisite Courses	Have achieved at least 96 CREDITS

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to apply the concept of work safety in the laboratory	•		**Lecture** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	•	**10%**
2, 3	Students are able to conduct literature studies that are	•		**Group discussions and presentations**		•	**20%**

	relevant to the topic of the case study to be carried out						
4	Students are able to perform sample preparation using relevant methods					•	
5-10	Students are able to make solutions and carry out sample treatment with good accuracy for relevant analyzes	•				•	
11, 12	Students are able to perform chemical tests / analyzes using appropriate instruments	•				•	**20%**
13-16	Students are able to analyze measurement results and present the results in writing and orally	•	**Group discussions and presentations**				**40%**

39. FINAL PROJECT/UNDERGRADUATE THESIS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
FINAL PROJECT/UNDERGRADUATE THESIS	SK 184807	Mandatory	8	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

			Dr. rer. nat. Fredy Kurniawan, M. Si

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics and personality in completing one's task
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity and communication ability
	B.3 (LO 5)	Responsible for one's own work and is able to be give the responsibility of the achievement of an organization
	C.2 (LO 7)	Able to master concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	The students should be able to use the principles of basic chemistry knowledge as a basis to learn chemistry inwhich they will learn further throughout their whole studies.
	CLO 2	The students have the ability to disseminate data and information from the previous researches, and use them to solve the current problem being faced and held responsible for the solution towards the problem being faced in the final assignment exam
	CLO 3	The students can report the results of their research in the form of scientific articles

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1			√		√			√	
CLO 2	√		√	√	√		√	√	
CLO 3	√		√	√	√			√	

Course Short Description	During this course, the students are being supervised to implement the concepts of chemistry in solving the problems through the approach of scientific methods, and publicize and held responsible for the solutions to the given problems that they are doing for their final assignment.
Study Material: Subject Matter	The research topics are according to the student's area of interest, scientific journal reading techniques, scientific writing, presentation techniques, and making conclusions
Reference	**Primary:**

1. Supporting journals.
2. Books, research reports, dissertations, thesis, final assignments, patents, proceedings related to the research topics.

	Secondary:
Lecturer	The supervisor of each student
Pre-Requisite Courses	Have achieved at least 110 CREDITS.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain and design research research topics to be carried out	• Accuracy in explaining the research topics that are currently being developed research research topics to be carried out		**Introductory lecture and brainstorming** **discussion** **[[TM: 1x(2x50")]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• Research topics	**5%**
2-15	Students are able to conduct research in accordance with the design that has been made and report it in the form of a thesis scientific report	• The accuracy in conducting research according to the design that has been made and properly reporting it in the form of a scientific thesis report		**Laboratory Practice** **[[TM: 1x(2x50")]**		• Research topics	**35%**

16	Final Semester Evaluation Students are able to disseminate the thesis they have compiled and account for their arguments in front of the board of examiners			**Presentation and discussion with the examiners** **[[TM: 1x(2x50")]**		•	

40. LABORATORY MANAGEMENT

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**						**Document Code**
TEACHING AND LEARNING PLAN							
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**	
LABORATORY MANAGEMENT	SW184801	Kimia Organik	2	0	VIII		
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**		
					Dr. rer. nat. Fredy Kurniawan, M. Si		

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.3 (LO 5)	Responsible for one's own work and is able to be give the responsibility of the achievement of an organization
	C.2 (LO 7)	Able to master concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced
	Course Learning Outcomes (CLO)	
	CLO 1	After completing the course, the students will have the adequate knowledge and abilities in managing laboratories according to ISO/IEC 17025:2017 standards.

LO - CLOMAP	

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1					√		√	√	

Course Short Description	A mandatory course for all the students studying in the Chemistry Department (Faculty of Science). In this course, students will learn how to manage and organise laboratoriums in general, and at the same time meet the ISO/IEC 17025:2017.
Study Material: Subject Matter	1. The basic understanding of laboratorium 2. Safety standards in laboratorium. 3. Handling poisonous and dangerous chemicals. 4. Understanding the scope of the laboratorium standard systems. 5. The technical and quality requirements of laboratory and calibration tests. 6. Documenting and tracing measurements on laboratory tests, 7. The uncertainties in measurements 8. Laboratorium inventory system.
Reference	**Primary:** 1. ISO, ISO/IEC 17025:2017, “General requirements for the competence of testing and calibration laboratories”, 2017 2. R. J. Alaimo, “Handbook of chemical health and safety”, Oxford University Press, New York, 2001. 3. BSN, SNI ISO IEC 17025 2008, “Standar Nasional Indonesia. Persyaratan umum kompetensi laboratorium pengujian and laboratorium kalibrasi”, 2008. 4. R. Burke,” Hazardous Materials Chemistry for Emergency Responders”, 2nd Edition, Lewis Publisher, 2002. **Secondary:**
Lecturer	Dr. Hendro Juwono. M.Si.
Pre-Requisite Courses	Physics Fundamentals I, Chemistry Fundamentals I, Biology (Service).

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**	**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**			

(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)

ELECTIVE COURSES

1. ENVIRONMENTAL CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCE AND DATA ANALYTICS DEPARTMENT OF CHEMISTRY	Document Code

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
ENVIRONMENTAL CHEMISTRY	SK 184711	Analytical Chemistry	2		VII	
AUTHORIZATION / LEGALIZATION	TLP Editor		Course Group Coordinator		Head of Study Program (PRODI)	

<table>
<tr><td colspan="2"></td><td>Dra. Ita Ulfin, M.S.</td><td>Suprapto, M. Si., Ph. D</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="7">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>B.2 (LO 4)</td><td colspan="3">Able to give alternative solutions with the characters of leadership, creativity, and communication ability</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Students should be able to measure environmental pollution parameters, process data, analyze correctly and present in the form of papers for presentation.</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">This subject discusses environmental principles, carrying capacity, environmental terms, methods commonly used in environmental parameter analysis, sampling and preservation methods of water samples, environmental analysis of water, soil, and air, and knowledge of Amdal. Students will be given a project on the analysis of the quality of water, soil, and air and compiled it in a report to be presented.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Definition and terms in environmental chemistry.
2. Water pollution (water distribution, water carrying capacity, sampling method, types of pollutants, sources of pollutants, analysis of pollutants in water).
3. Practical training in water quality analysis (rivers, se\awater, brackish water).
4. Air pollution (acid rain, ozone depletion, greenhouse effect, noise).
5. Practical training in air quality analysis (particulate analysis / SO2 / CO in the air).
6. Pollution on the ground (sources of pollutants, types of pollutants).
7. Practical training in soil contamination analysis (pollutant analysis (Pb / Cd / Fe in soil)

9. Knowledge of Environmental impact assessment and strategic environmental assessment.</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:</td></tr>
</table>

	1. S.E. Manahan, ”Fundamentals of Environmental Chemistry”, 2nd edition, CRC Press LLC, 2001 2. Peraturan Gubenur Jawa Timur no 10 tahun 2009 tentang Baku Mutu Udara Ambien dan Emisi Sumber tidak bergerak di Jawa Timur. 3. Surat Keputusan Gubernur Jawa Timur no: 45/2002 tentang Baku Mutu Limbah Cair Bagi Industri atau kegiatan Usaha lainnya di Jawa Timur. 4. APHA, “Standard Methods of the Examination of Water and Wastewater”, 21th edition, American Public Health Association, Washington DC, 2005. 5. Collection of Legislation Law No.5 / 1982 concerning Industry, Law No23 / 1997 concerning Environmental Management, PP.20 concerning Water Pollution, Decree of the State Minister of the Environment, SK Governor KDH Tk I. **Secondary:**
Lecturer	Dra. Ita Ulfin, M.S.
Pre-Requisite Courses	Have taken Measurement Methods in Chemistry, Separation and Purification Methods, and Intrumental Measurement Methods.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students can explain several terms in environmental chemistry (C3, A2).	1. Students know the material to be learned in environmental chemistry 2. Students can explain terms used in environmental chemistry 3. Students can choose environmental quality standards correctly		Lecture [2 x 50’] Lecture [2 x 50’]	Lecture [2 x 50’] Lecture [2 x 50’]	• Explanation of the Lecture Contract Definition and terms in environmental chemistry	

2-3	Students can distinguish between Environmental impact assessment and strategic environmental assessment. (C3, P3, A2)	1. Students can explain the difference between Environmental impact assessment and strategic environmental assessment. 2. Students can determine the important impact of an activity 3. Students can write papers about activities that have an important impact on the environment		Lecture [2(2x 50')] Assignment [4x50']	Lecture [2(2x 50')] Assignment [4x50']	Environmental impact assessment and strategic environmental assessment knowledge	
4-5	Students can explain the problem of water pollution (C3, A2)	1. Students can classify water correctly. 2. Students can choose the correct sampling method 3. Students can find out the types and sources of pollutants 4. Students can determine pollutant analysis correctly		Lecture [3 (2x 50')]	Lecture [3 (2x 50')]	Water Pollution (water distribution, sampling method, type of pollutant, pollutant source, pollutant analysis)	
6	Students can explain the problem of soil pollution	1. Students can find out the types and sources of pollutants		Lecture [2x 50']	Lecture [2x 50']	Soil pollution (sources of pollutants, types of pollutants)	

	(C3, A2)	2. Students can determine pollutant analysis correctly					
7	Students can identify and analyze environmental pollution (P3, A2)	1 Student can conduct water sampling and identify environmental impacts at the location of activities visited		Field Lecture Discussion	Field Lecture Discussion	Lecture Lapangan Field study	
8		1. Students can document papers correctly 2. Students can explain the important environmental impacts of the selected activities.				QUIZ / Mid-Term Evaluation	20 %
9-10	Students are skilled in doing water quality tests according to standard methods (P3)	1. Students can do water sampling 2. Students can analyze water quality parameters 3. Students can process data and present it in the form of a paper that will be presented		Field Sampling [4 x 50'] Laboratory Practice [2x4x50 ']	Field Sampling [4 x 50'] Laboratory Practice [2x4x50 ']	Practical training in Water Quality Analysis	25%

11	Students can document the results of practical training on water pollution	1. Students can present practical training results correctly. 2. Students can process data and analyze it correctly 3. Students can document the results of Practical training correctly		Presentation in class [2 x 50’]	Presentation in class [2 x 50’]	QUIZ	15%
12-14	Students can explain air pollution problems (C3, A2)	1. Students can explain the source of air pollution. 2. Students can explain the impact of air pollution		Lecture [3 (2 x 50’)]	Lecture [3 (2 x 50’)]	Air Pollution (acid rain, ozone depletion, ERK, NOx, noise)	
15	Students are skilled in conducting air quality tests according to standard methods (P3)	1. Students can conduct air analysis sampling 2. Students can do particulate analysis		Sampling [4 x 50’] Practical training [4x 50’]	Sampling [4 x 50’] Practical training [4x 50’]	Practical training Air quality analysis	25 %
16	Students can document the results of practical training on air pollution	1. Students can present practical training results correctly.		Presentation in class [2 x 50’]	Presentation in class [2 x 50’]	Presentation Practical training on air pollution (UAS)	15 %

		2. Students can process data and analyze it correctly 3. Students can document the results of Practical training correctly					

2. ELECTROMETRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
ELECTROMETRY	**SK 184712**	Analytical Chemistry	2		VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Djarot Sugiarso S., M.Si.		Suprapto, M. Si., Ph. D		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	C.1 (LO 6)	Able to apply the concepts of structure, character, and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	

	CLO 1	Able to apply electrochemical concentrations measurement for qualitative and quantitative tests

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1			√			√	√	√	

Course Short Description	The Electrometry course studies the concepts and applications of qualitative and quantitative measurements based on the electrochemical properties of the analyte being measured. The analytical methods studied include the amperometric method, potentiometry, voltammetry, and electrochemical impedance spectroscopy.
Study Material: Subject Matter	1. Basic electrochemical concepts for chemical analysis 2. Classification of electrochemical qualitative and quantitative test methods. 3. Application of amperometric, potentiometric, and voltammetric methods for chemical measurements 4. The concept and application of electrochemical impedance spectroscopy methods
Reference	**Primary:** 1. J. Wang, "Analytical Electrochemistry", 3rd ketiga, John Wiley & Sons, New Jersey, 2006. 2. A. J. Bard and L. R. Faulkner, "Electrochemical Methods: Fundamental and Applications", John Willey and Sons, New York **Secondary:**
Lecturer	Suprapto, Ph. D.
Pre-Requisite Courses	Have taken *Intrumental Measurement Methods*

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students can explain the basic concepts of electrochemistry			**Lecture**		**1,2 dan 3**	

	for quantitative and qualitative tests						
2	Students can explain potentiometric analysis methods			**Lecture**		1,2	
3	Students can explain potentiometric analysis methods			**Lecture**		**1,2**	
4	Students can explain the polarographic analysis method			**Lecture**		1,2	
5-6	Be able to explain linear and differential voltammetry analysis methods			**Lecture**		1,2	
7	Response			Discussion			20
8	**Mid-semester Evaluation**						**30**
9-11	Students can explain cyclic voltammetry analysis methods along with data processing and data interpretation			**Lecture, Group Discussion, and Presentation**			
12-13	Students can explain voltammetric stripping analysis and its application			**Lecture**			
14	Students can explain the theory and application of electrochemical impedance spectroscopy			**Lecture**			20
15-16	**Final Semester Evaluation**						**30**

3. RADIOMETRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
RADIOMETRY	**SK 184713**	Analytical Chemistry	2		VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
					Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity, and communication ability
	C.2 (LO 7)	Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Be able to explain various qualitative and quantitative test methods based on the results of the interaction between radiation and matter, and calculate the absorption dose of radiation as well as explaining its application (C3)

LO - CLOMAP

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CLO 1	√			√			√	√	

Course Short Description	In the Radioactivity Analysis course, students study qualitative and quantitative analysis methods based on the results of the interaction between radiation and material, measurement of radiation doses, and the Radionuclide Separation Technique and its use. Thus, it is hoped that students will gain knowledge regarding special radioactivity analysis which is useful if students will later work with radioactive materials such as the Atomic Energy Agency or other industries related to radioactivity.
Study Material:	1. The interaction of radiation with matter

Subject Matter	2. Radiation spectrometry (gamma or alpha) 3. Neutron Activation Analysis 4. Dosimetry 5. Radionuclide Separation Techniques with chemical separation methods: distillation, chromatography, solvent extraction, deposition and electrochemical and special techniques using: carrier, scavenger, collector, milking, and radiochemical yield 6. Utilization of radioactive
Reference	**Primary:** 1. D. A. Skoog, F. J. Holler, and S. R. Crouch, "Principles of Instrumental Analysis", 6th Edition, Cengage Learning, Inc., USA, 2006. 2. J. Wang," Electroanalitical Chemistry", Wiley VCH, USA, 2000 **Secondary:**
Lecturer	Dra. Harmami, M.S.
Pre-Requisite Courses	Have taken Measurement Methods in Chemistry, Separation and Purification Methods, and Intrumental Measurement Methods.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students know the learning plan of the Radioactivity Analysis course and its application for one semester.	-	-	-			
2	Students can explain the interaction of various types of radiation with matter	Conformity with concept	Question and answer session/ response	• Tutorial • Discussion			

3	Students can explain the various radiation detectors and how they work		Question and answer session	• Tutorial Discussion			
4	Students can count The absorbed dose of radiation (Dosimetry)	Calculation accuracy and unit operation accuracy	Question and answer session	• Tutorial Exercise			
5-6	Students can determine the metal content in a sample both qualitatively and quantitatively Based on secondary data analysis of gamma spectrometry	Accuracy in describing and writing down the reaction.	Question and answer session/ Response	• Tutorial • Exercise			**5**
7	Students can determine the metal content in a sample from secondary data from Neutron Activation Analysis	Calculation accuracy and concept suitability	Response	• Tutorial Exercise			**5**
8	**Mid-semester Evaluation**						
9-10	Students can describe various radionuclide separation methods	Conformity to Concept	Question and answer session	• Lecture Discussion			
11-14	Students can explain orally or in writing some examples of radionuclide separation analysis taken from articles/journals (4 Examples of different methods)	The acuity of journal analysis And the accuracy of the argument is in accordance with the concept	Makalah dan Question and answer session	• Field study at BATAN Jogjakarta Paper presentation			**40**
15-16	**Final-semester Evaluation**						**30**

4. APPLIED ANALYSIS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
APPLIED ANALYSIS	SK 184714		3	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dra. Ita Ulfin, M.S.		Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Able to demonstrate metal and nonmetal analysis on biological and non-biological samples using standard methods
	CLO 2	Able to analyze and record the results of the analysis correctly and submit it in the form of a paper to be presented

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√		√				√	√	
CLO 2	√		√				√	√	

Course Short Description	This course provides several ways of analyzing metals and metals in biological and non-living materials that are around us using several methods. Comprehension is achieved by classical, case study writing, and laboratory practice

Study Material: Subject Matter	1. Types and properties of the destructive material 2. Sample preparation for metal analysis 3. Sample preparation for nonmetal analysis 4. Metal analysis on biological and non-biological samples 5. Non-metal analysis on food and beverage samples.
Reference	**Primary:** 1. J. Kenkel, "An Industry-based Laboratory Manual", Lewis Publisher, Tokyo, 2000. 2. S. Bell, "Forensic Chemistry", Pearson Prentice Hall, New Jersey, 2006 3. D. Owen, "Hidden Evidence", Periplus Edition, Hongkong, 2000 **Secondary:**
Lecturer	Dra. Ita Ulfin, M.S.
Pre-Requisite Courses	Have taken the courses Measurement Methods in Chemistry and Separation and Purification Methods

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1		• Students are able to know the material that will be received		**Lecture Discussions [TM: 1x(2x50")]**		• Explanation of the Lecture Contract	
2, 3	Students are able to choose the right destructive materials (C2, A2).	• Students are able to know the kinds of materials and tools for the right destruction		**Lectures Discussions [TM: 2x(2x50")]**		• Types and properties of the destructive material	

		• Students are able to choose the standard quality of the environment properly					
4, 5, 6	Students are able to prepare the metal samples properly (C3, A2)	• Students are able to find out the various ways of preparing biological samples for metal analysis. • Students are able to find out the various types of non-biological sample preparation methods for metal analysis. Students are able to select and perform sample preparation methods for metal analysis with a variety of destruction.		**Lectures [TM: 2x(2x50")]** **Assignment [TM: 1x(4x50")]**		• Sample preparation for metal analysis	
7	Quiz						**20**
8, 9, 10, 11	Students are able to perform metal analysis on biological samples. (P3, A2)	• Students are able to perform metal analysis on biological samples		**Laboratory Practice [TM: 4x(4x50')]**		• Metal analysis on biological samples	**20**

		• Students are able to process the collected data and present it in the form of paper					
12	Students are able to document the results of the metal analysis performed on biological samples (C3, A2)	• Students are able to present the laboratory practice results correctly. • Students are able to process the collected data and analyze it correctly • Students are able to document laboratory practice results correctly		**Presentation Discussions [TM: 1x(2x50')]**		Presenting the metal analysis on biological samples result	**5**
13, 14, 15, 16	Students are able to perform metal analysis on non-biological samples. (P3)	• Students are able to perform metal analysis on non-biological samples • Students are able to process the collected data and present it in the form of paper		**Laboratory Practice [TM: 4x(4x50')]**		• Metal analysis on non-biological samples	
17	Students are able to document the results of the metal analysis performed on	• Students are able to present the laboratory		**Presentation Discussions [TM: 1x(2x50')]**		• Presenting the metal analysis on non-biological	**20**

	non-biological samples. (C3, A2)	practice results correctly. • Students are able to process the collected data and analyze it correctly • Students are able to document laboratory practice results correctly				samples result	
18, 19, 20	Students are able to prepare the non-metal analysis samples properly (C3, A2)	• Students are able to learn many kinds of sample preparation methods for non-metal analysis. • Students can choose and perform sample preparation methods for proper non-metal analysis.		**Lectures [TM: 3x(2x50')]** **Paper assignment**		• Non-metal analysis samples preparation	
21, 22, 23, 24	Students are able to perform non-metal analysis on food samples. (P3)	• Students are able to perform non-metal analysis on food samples • Students are able to process the data collected and present		**Laboratory Practice Presentation [TM: 4x(4x50')]** **Paper assignment**		• Non-metal analysis on food samples	

		it in the form of paper					
25	Students are able to document the results of the non-metal analysis performed on food samples (C3, A2)	• Students are able to present the laboratory practice results correctly. • Students are able to process the collected data and analyze it correctly • Students are able to document laboratory practice results correctly		**Presentation Discussions [TM: 1x(2x50')]**		• Presenting the non-metal analysis on food samples result	**20**
26, 27, 28, 29	Students are able to perform non-metal analysis on beverage samples. (P3)	• Students are able to perform non-metal analysis on beverage samples • Students are able to process the collected data and present it in the form of paper		**Laboratory Practice Presentation [TM: 4x(4x50')]** **Paper assignment**		• Non-metal analysis on beverage samples	
30	Students are able to document the result of non-metal analysis on beverage samples. (C3, A2)	• Students are able to present the laboratory practice results correctly. • Students are able to process the collected		**Presentation Discussions [TM: 1x(2x50')]**		• Presenting the non-metal analysis on beverage samples result.	**20**

		data and analyze it correctly • Students are able to document laboratory practice results correctly					

5. COMPLEX COMPOUNDS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**	
TEACHING AND LEARNING PLAN							
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**	
Complex COMPOUNDS	**SK 184721**	Inorganic Chemistry	2		VII		
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**		
	Prof. Dr. rer. nat. Irmina Kris Murwani, M. Si., Dr. Fahimah Martak, M.Si.		Dra. Ratna Ediati, M. S., Ph. D		Dr. rer. nat. Fredy Kurniawan, M. Si		
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**						
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners					
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that arefaced.					
	Course Learning Outcomes (CLO)						
	CLO 1	Students can explain the definition of complex compounds					
	CLO 2	Students can show the difference between ordinary covalent compounds and complex compounds					
	CLO 3	Students can distinguish the formation of covalent compounds and complex compounds					

<table>
<tr><td></td><td>CLO 4</td><td>Students can explain the benefits of using complex compounds in various fields written or oral</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 3</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 4</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="2">In this course, students will learn about complex compounds, the characteristics of complex compounds, the Nomenclature of complex compounds, the concept of forming complex compounds. Students also know examples of complex compounds and their benefits.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="2">1. Introduction to complex compounds and coordination bonds, ligands-monodentate, bidentate, and polydentate ligands; coordination number; complex compound nomenclature,

2. Isomers: linkage-, ionization-, hydrate-, coordination-, position coordination, geometry- (cis- and trans-, fac- and mer-), optics.

3. Stability of complex formation.

4. Valence and magnetic bond hybridization theory, crystal field theory, CFSE, crystal field splitting, high spin, low spin, spectrochemical series

5. Utilization of complex compounds.</td></tr>
<tr><td>Reference</td><td colspan="2">Primary:

1. Geoffrey A. Lawrance, “Introduction to Coordination Chemistry “ John Wiley and Sons Ltd, 2010.
2. Housecroft, C.E. and Sharpe A. G.,” Inorganic Chemistry” 2nd Ed. Pearson Education Limited, 2005.
3. Miessler, G.L. and Tarr, D.A., “Inorganic Chemistry”, 3rd Edition, Pearson Education International, Minnesota 2001
4. House, J.E., “Inorganic Chemistry”, Academic Press, London, 2008.
5. Shriver, D. D. & Atkins, P. W. “Inorganic Chemistry”, 5th Edition, W.H. Freeman and Company, Oxford, 2010

Secondary:</td></tr>
<tr><td>Lecturer</td><td colspan="2">Dr. Fahimah Martak, M.Si.</td></tr>
<tr><td>Pre-Requisite Courses</td><td colspan="2">Have taken Structures, Properties, and Reactivity of Inorganic Compounds and obtained a minimum grade of D</td></tr>
</table>

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	[C2, A3, P2]: Students can explain the definition of complex compounds	• • Accuracy in explaining the definition of complex compounds		• Introductory Lecture & Brainstorming **[1x(2x50")]**	• Introductory Lecture & Brainstorming **[1x(2x50")]**	• Introduction to complex compounds • Chemical bonds: the difference between covalent bonds and coordinate covalent bonds • • Examples of covalent and coordination covalent compounds	
2	[C2, A3, P2]: Students can explain the properties and electron structure of the central metal ion	• • Accuracy in explaining the properties and electron structure of the central metal ion		• Lecture, Discussion, **[1x(2x50")]**	• Lecture, Discussion, **[1x(2x50")]**	• Elements that can act as central metal ions: group 1 and 2 metals, transition metals • • transition metal ion configurations	
3	[C2, A3, P2]: Students can explain types of ligands and their properties	• Accuracy in describing types of ligands and their properties		• Lecture, Watching the video, Discussion **[1x(2x50")]**	• Lecture, Watching the video, Discussion **[1x(2x50")]**	• Definition of ligands • Types of ligands: monodentate,	

						bidentate, multidentate ligands • • Ligand strength	
4-5	[C3, A3, P2]: Students can show the structure of complex compounds	• Accuracy in naming complex compounds of various structures • • Accuracy in showing the structure of complex compounds	Non-test: Assignment 1 The accuracy in naming the names of complex compounds from various structural forms that have been given. Shows the electrical configuration and geometry of complex compounds	• Lecture, Discussion, Quiz **[2x(2x50")]**	• Lecture, Discussion, Quiz **[2x(2x50")]**	• Nomenclature of complex compounds • Electron configuration of complex compounds • Hybridization • Molecular geometry • • Coordination number	10%
6	[C3, A3, P3]: Students can explain the nomenclature and structure of complex compounds	• • Accuracy in explaining the nomenclature and structure of complex compounds	Tes: Evaluasi tertulis Quiz	• Quiz **[1x(2x50")]**	• Quiz **[1x(2x50")]**	•	15%
7	[C4, A3, P3]:	• • Accuracy in determining the		• Lecture, Discussion, **[1x(2x50")]**	• Lecture, Discussion,	• Isomers: linkage, ionization, hydrates, coordination	

	Students can analyze the isomeric structure of complex compounds and their properties	isomers of complex compounds and analyzing the resulting properties			**[1x(2x50")]**	positions, optical (cis and trans) geometry, facial and meridional isomers, stereochemistry	
8	**Mid-semester Evaluation**						**25%**
9	[C4, A3, P3]: Students can consider the stability of the formation of complex compounds	• • Accuracy in estimating the factors that affect the stability of the formation of complex compounds		• Lecture, Discussion kelas **[1x(3x50")]**	• Lecture, Discussion kelas **[1x(3x50")]**	• • Stability of complex compounds: structure, reactivity, steric effects, trans effects	
10-11	[C4, A3, P3]: Students can relate the theory of the formation of complex compounds with the results obtained in the laboratory	• • The accuracy of analyzing a theory of compound formation and relating it to the formation of complex compounds in real terms	Non-test: Assignment 2 analyzes the formation of complex compounds from a given case example	• Lecture, Discussion, **[1x(3x50")]**	• Lecture, Discussion, **[1x(3x50")]**	• • Valence and magnetic bond hybridization theory, crystal field theory, crystal field stabilization energy, crystal field splitting: high spin, low-spin, ligand spectrochemical series	10%
12	[C4, A4, P3]: Students can relate the theory of the formation of complex compounds and structural stability	• • Accuracy in estimating the structural stability of the complex compound formation process	**Tes: Quiz**	• Quiz **[1x(2x50")]**	• Quiz **[1x(2x50")]**	•	15%

13	[C4, A4, P3]: Students should be able to correlate the structure of complex compounds to the resulting properties	• • Accuracy in correlating the structure and properties of complex compounds		• Lecture, Group Discussion, [**1x(3x50")**]	• Lecture, Group Discussion, [**1x(3x50")**]	• Nature of toxicity • Magnetic properties • • Electrical properties	
14-15	[C5, A4, P3]: Students should be able to select potential applications of complex compounds based on their properties	• • Accuracy in selecting complex compound applications	Assignment 2: Paper (making a paper about examples of complex compounds, and their properties and applications) The accuracy in selecting the application/use of a complex compound	• Lecture, Presentation, Discussion **[[1x(3x50")]]**	• Lecture, Presentation, Discussion **[[1x(3x50")]]**	• • Application of complex compounds in the world of medical, electronic, instrumentation, and energy	20%
15-16	**Final Semester Evaluation**						**20%**

6. CATALYSIS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
CATALYSIS	**SK 184722**	Inorganic Chemistry	3		VII	

<table>
<tr><td colspan="2">AUTHORIZATION / LEGALIZATION</td><td>TLP Editor</td><td>Course Group Coordinator</td><td>Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2"></td><td>Prof.Dr.rer.nat. Irmina Kris Murwani dan Dra. Ratna Ediati, M. S., Ph. D</td><td>Dra. Ratna Ediati, M. S., Ph. D</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="7">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>B.2 (LO 4)</td><td colspan="3">Able to give alternative solutions with the characters of leadership, creativity, and communication ability</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="3">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Students can show the relationship between basic concepts, catalyst characterization, and the catalysis process with its application (C4, A3, P2)</td></tr>
<tr><td>CLO 2</td><td colspan="3">Students are skilled in creating and characterizing catalysts (C4, A3, P2)</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4"><table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td>√</td></tr>
<tr><td>CLO 2</td><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td>√</td><td></td></tr>
</table></td></tr>
<tr><td>Course Short Description</td><td colspan="4">In this course, students will learn about the basic concepts of catalysts and catalytic reactions, kinetics, and catalytic reaction mechanisms, catalyst energetics and catalytic reactions, preparation, characterization, activity test, and catalyst selectivity. In this lecture, a practicum is also carried out which is an application of a concept that has been given or is part of a thesis research and a practicum report under the thesis format.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Introduction to catalysts and catalytic reactions, catalyst classification, catalyst applications and catalytic reactions, kinetics and reaction mechanisms of homogeneous and heterogeneous catalysis

2. Catalyst energetics and catalytic reactions, activation of the reagent by the catalyst, and surface reactivity

3. Catalyst preparation

4. Methods for determining the activity and selectivity of catalysts

5. Catalyst characterization methods and catalysis reactions</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:</td></tr>
</table>

	1. I. Chorkendorff and J. W. Niemantsverdriet, "Concepts of Modern Catalysis and Kinetics", Wiley-VCH GmbH & Co. KGaA, Weinheim, 2003. 2. C. Perego and P. Villa, "Catalyst Preparation Methods" in *Catalysis Today*, Vol. 34, p 281-305, Elsevier Science B.V., 1997. 3. C. Perego and L. Feroni, *Catalysis Today*, Vol. 55, Elsevier Science B.V., 1999. 4. O. Levenspiel, "Chemical Reaction Engineering", 3rd edition, John Wiley & Sons, New York, 1999. 5. J. M. Thomas and W. J. Thomas, "Principles and Practice of Heterogeneous Catalysis", VCH, Weinheim, 1997. **Secondary:**
Lecturer	Prof.Dr.rer.nat. Irmina Kris Murwani dan Dra. Ratna Ediati, Ph.D.
Pre-Requisite Courses	Have taken Chemical Thermodynamics, Chemical Dynamics, Separation and Purification Methods and obtained a minimum grade of D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	[C2, A3, P2]: Students can explain the meaning of catalyst and catalysis	• Accuracy in explaining the meaning of catalyst and catalysis		• Introductory Lecture & Brainstorming **[1x(2x50")]**	• Introductory Lecture & Brainstorming **[1x(2x50")]**	• Introduction of catalysts • Catalysis reactions	
2	[C2, A3, P2]: Students can explain catalyst classification	• The accuracy in explaining the		• Lecture, • Discussion, **[1x(2x50")]**	• Lecture, • Discussion,	• Catalyst classification	

		classification of catalysts			**[1x(2x50")]**	• Homogeneous catalyst • Heterogeneous catalyst	
3,4	[C2, A3, P2]: Students can provide examples of catalyst applications and catalysis reactions	Accuracy in providing examples of catalyst applications and catalytic reactions	Non-test: Assignment 1 makes a short paper on examples of catalysts and their uses	• Lecture, Watching video, Discussion **[2x(2x50")]**	• Lecture, Watching video, Discussion **[2x(2x50")]**	• Examples of catalyst applications and catalytic reactions	10%
5	[C3, A3, P2]: Students can show examples and types of catalysts and their applications	• Accuracy in providing examples and types of catalysts and their applications in chemical reactions	**Written Test: Quiz 1**	• Quiz **[1x(2x50")]**	• Quiz **[1x(2x50")]**	•	15%
6-7	[C4, A3, P2]: Students can demonstrate the ability to analyze the kinetics and reaction mechanisms of homogeneous and heterogeneous catalysis	• Accuracy in analyzing the kinetics and reaction mechanisms of homogeneous and heterogeneous catalysis		• Quiz **[2x(2x50")]**	• Quiz **[2x(2x50")]**	•	

8	**Mid-semester Evaluation**						**20%**
9	[C4, A3, P2]: Students can analyze the energetic aspects of the catalyst	• The accuracy in analyzing the energetic aspects of the catalyst		• Lecture, Discussion kelas • **[1x(3x50")]**	• Lecture, Discussion kelas • **[1x(3x50")]**	• Catalyst energetics and catalytic reactions • Activation of reagents by the catalyst • Surface reactivity	
10-11	[C5, A4, P3]: Students can assess the method of creating catalysts and choosing the appropriate method for it	• The accuracy in assessing the advantages and drawback of the catalyst preparation method • Accuracy in determining the correct preparation method	Non-test: 2 short papers containing descriptions of the types of catalyst manufacturing methods, analysis of the advantages and disadvantages of each, and improvements to minimize these deficiencies (method evaluation)	• Lecture, Discussion, • **[2x(3x50")]**	• Lecture, Discussion, • **[2x(3x50")]**	• Catalyst preparation • Methods for creation of catalysts: sol-gel, hydrothermal, solvothermal, solid-state	10%
12	[C5, A4, P3]: Students can predict catalyst activity and selectivity	• Accuracy in predicting catalyst activity and selectivity		• Quiz [**1x(2x50")**]	• Quiz [**1x(2x50")**]	• Definition of activity and selectivity • Activity and selectivity calculations	

						• Factors that determine activity and selectivity	
13	[C5, A4, P3]: Students can determine the catalyst synthesis method and predict the activity and selectivity of the resulting catalyst.	• The accuracy in determining the catalyst preparation method and predicting the activity and selectivity of the catalyst	**Tes: Quiz 2**	• Quiz **[1x(3x50")]**	• Quiz **[1x(3x50")]**	•	15%
14-15	[C5, A4, P3]: Students can design synthesis and catalyst characterization methods and integrate the data obtained in an integrated report	• Accuracy in compiling integrated reports with thesis format	Assignment 3: Creating an integrated report of the synthesis and characterization of catalyst materials	• Lecture, Presentation, Discussion **[2x(3x50")]**	• Lecture, Presentation, Discussion **[2x(3x50")]**	• Catalyst characterization methods and catalyst reactions	20%
15-16	**Final Semester Evaluation**						**20%**

7. COLLOIDAL CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
Colloidal Chemistry	**SK 184723**	Physical Chemistry	3		VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

		Nurul Widiastuti, M. Si., Ph. D dan Dr. Ir. Endah Mutiara Marhaeni Putri, M. Si	Drs. Eko Santoso, M.S., M.Si.	Dr. rer. nat. Fredy Kurniawan, M. Si

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	B.1 (LO 3)	Able to collect data and information correctly, analyse and use analysis for correct decision making
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Students can generate ideas for the development of stability or destruction of simple colloid systems that exist in industrial products related to colloid design
	CLO 2	Students can identify problems, collect data and information, analyze correctly, use qualitative and quantitative evidence to compile scientific arguments, and make the right decisions in solving problems

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√							√	
CLO 2	√		√						

Course Short Description	Colloid science is widely applied in industries such as the soap, detergent, and fabric softener industry, the cosmetic, pharmaceutical, and food industry, the paint industry, the ink industry, oil, and gasoline additives. This Colloid Chemistry course discusses the basic principles of colloid science as well as its application in several industries. The application of the colloid system is very much determined by the stability of the colloid dispersion and the prevention of damage to the colloid system. However, for some purposes, the destruction of the colloid dispersion system is also required. Apart from lecturing activities in class, this course is also conducted in a laboratory with a mini-project learning model, namely making colloid dispersion stability and studying the causes of destabilizing the colloid dispersion. This activity is reported in a paper and presented at the end of the semester.
Study Material: Subject Matter	Basic principles of colloid science, basic principles of colloidal dispersion stability, forces between particles on colloid dispersion stability, colloid dispersion preparation techniques, surface tension and adsorption, colloid properties: colloid kinetics, colloid scattering, rheology, colloid dispersion destruction: aggregation process, coalescence and particle growth, thin films, foams and emulsions, gels. Some industries related to colloid science, Future development of colloids science
Reference	**Primary:**

1. D. H. Everett, “Basic Principles of Colloid Science”, 1988, ISBN: 978-0-85186-44-3, ISBN: 978-1-84755-020-, DOI:10.1039/9781847550200

	Secondary:
Lecturer	Nurul Widiastuti, PhD dan Ir. Endang Purwanti, MT
Pre-Requisite Courses	Have taken Chemical Thermodynamics, Chemical Dynamics and obtained a minimum grade of D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students can identify several industrial problems related to colloid science (C1)	• Accuracy on identifying	Individual assignment: identifying some industrial problems related to science colloids	1. Lectures on case studies in industry and everyday life 2. Watch videos of some colloid systems in the industry 3. Material is shared and explained as a group task [2x50']	1. Lectures on case studies in industry and everyday life 2. Watch videos of some colloid systems in the industry 3. Material is	• Several industrial and daily life problems related to the colloid system	In Mid-Term Evaluation

					shared and explained as a group task [2x50']		
2	Students can explain the basic principles of colloid science and the stability of colloidal dispersion (C2)	•		1. Lecture 2. Class discussion [2x50']	1. Lecture 2. Class discussion [2x50']	• The basic principles of colloid science and the stability of colloidal dispersions	In Mid-Term Evaluation
3	Students can connect the stability of the colloidal dispersion with the forces between particles (C3)	Accuracy on connecting	Group assignment: According to the specified topic	1. Lecture 2. Group discussion for Assignment [2x50']	1. Lecture 2. Group discussion for Assignment [2x50']	• The forces between the particles in the stability of colloidal dispersion	In Mid-Term Evaluation
4,6	Students can demonstrate the process of creating colloid dispersions (C3)	• Ability to create a colloid system	Practice in the laboratory	1. Lecture 2. Practice creating colloids in the laboratory for some colloid systems	1. Lecture 2. Practice creating colloids in the laboratory for some	• Technique on creating Colloid dispersion	20%

				[3(2x50')]	colloid systems [3(2x50')]		
7	Students can connect surface tension and adsorption (C3)	•		1. Lecture 2. Group discussion for Assignment [2x50']	1. Lecture 2. Group discussion for Assignment [2x50']	• Surface tension and adsorption	In Mid-Term Evaluation
8	**Mid-semester Evaluation**						**15%**
9	Students can analyze the colloid properties of several colloid systems in everyday life (C4)	Analytical acuity • with the heading	Group assignment: According to the specified topic	Lecture [2x50']	Lecture [2x50']	• Colloid properties: Colloid kinetics, colloid scattering, rheology	10%
10	Students can analyze the destruction of colloid dispersions in several colloid systems in everyday life (C4)	Analytical acuity • with the heading	Group assignment: According to the specified topic	Lecture [2x50']	Lecture [2x50']	• Destruction of colloid dispersion: aggregation process, coalescence, and particle growth	
11-12	Students can distinguish thin films, foams, emulsions, gels (C4)	•		1. Lecture 2. Group discussion for Assignment [2(2x50')]	1. Lecture 2. Group discussion for Assignment [2(2x50')]	• Thin film, foam emulsion, gel	

13	Students can generate ideas for developing a simple colloid system in the context of everyday life's problems (C5)	The significance of the ideas and arguments with the heading •	Group assignment: According to the specified topic	Assignment group discussion [2x50']	Assignment group discussion [2x50']	• Future development of science colloid	
14	Students can convey the idea of developing a simple colloid system in the problems of everyday life through Presentation and writing paper (C5)	• Ability to convey ideas in presentations and papers	Group presentation	Student presentations Written idea Paper [2x50']	Student presentations Written idea Paper [2x50']	• Future development of science colloid	Presentation 15% Paper 25%
15-16	**Final Semester Evaluation**						**EAS**

8. SURFACE CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**					**Document Code**
SEMESTER LEARNING PROGRAMME						
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
SURFACE CHEMISTRY	SK 184724	Optional Courses	3	0	VII	23 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	
	Drs. Eko Santoso, M.Si., Dr. Ir. Endah Mutiara Marhaeni Putri		Dr. Drs. Eko Santoso, M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	
	LO-PRODI Charged to the Courses					

Program Learning Outcomes (LO)	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	LO MK 1	Able to explain the physical and chemical interface phenomena and implement to technology in daily life such as gluing, coating and lubrication
LO – LO MK Map		

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1	√					√	√	√	

Course Description	In this lecture the students will get the knowledge related to the role of interface chemistry (interface forces) in daily life (washing and gluing) and modern technology (coating, painting and lubrication). This lecture will deliver with tutorials, discussion and class presentation, and experience in laboratory.
Study Material: Subject matter	Introduction to surface chemistry
References	**Primary:** H. J. Butt, K.Graf and M. Kappl, "Physics and Chemistry of Interfaces", Wiley-VCH Verlag &Co. KgaA, Weinheim, 2003. **Secondary:** A. W. Adamson, "Physical chemistry of surfaces", John Wiley and Sons, Canada, , 1997.
Lecturer	Drs. Eko Santoso, M.Si., Dr. Ir. Endah Mutiara Marhaeni Putri
Pre-Requisite Courses	Have taken Thermodynamic Chemistry and Dynamic Chemistry

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**

1-4	The students should be able to explain the definition of surface/interface, type of surface chemistry, the scope of surface chemistry and the application in daily life and industry	• Accuracy in explaining, creativity, presentation and group cohesiveness	**Technical:** Reading, listening, writing, presentation, discussion, group discussion **Criteria:**	**Reading text, presentation, writing, discussion [TM: 4×(2×50')]**		• Introduction of surface chemistry [1] (page 1-15)	**5**
5-8	The students should be able to explain the concept of surface tension, various method to measure the surface tension and further application for surface tension value	• Accuracy in explaining, creativity in writing and presentation, group cohesiveness	**Technical:** Reading, listening, writing, experiment, presentation, discussion, group discussion **Criteria:**	**Reading text, presentation, experiment, discussion [TM: 4×(2×50')]**		• Capillarity and surface tension [1] (page 17-58) [2] (page 4-35)	**10**
9-12	The students should be able to explain the use of surfactant, type of srufactant and its application	• Accuracy in explaining, creativity in writing and presentation	**Technical:** Reading, listening, writing, experiment, writing presentation, discussion **Criteria:**	**Reading text, discussion, experiment, presentation and discussion [TM: 4×(2×50')]**		• Surfactant [1] (page 59-100)	**10**

13,14	The students should be able to explain characteristic of electricity of surface chemistry and its application	• Accuracy in explaining	**Technical:** Reading, listening, writing, answering the question in assignment and quiz **Criteria:**	**Reading text, presentation and discussion [TM: 2×(2×50')]**		• Aspect of electric surface [2] (page 160-214)	**5**
15	**Mid Semester Evaluation**						**20**
16,17	The students should be able to explain the type of forces in solid surface	• Accuracy in explaining	**Technical:** Reading, listening, writing, answering the question in assignment and quiz **Criteria:** •	**Reading text, presentation and discussion [TM: 2×(2×50')]**		• Solid surface : Forces in solid surface [2] (page 225-249) •	**5**
18,19	The students should be able to explain the free energy in solid surface, how to estimate the value of free energy and the factors influence the value of free energy	• Accuracy in explaining and calculating	**Technical:** Reading, listening, answering the question in assignment and quiz **Criteria:**	**Reading text, presentation and discussion, exersice**		• Solid surface : surface energy [2] (page 257-281)	**5**

20,21	The students should be able to explain the use of specific characterization method to identify the characteristic of solid surface	• Accuracy in explaining	**Technical:** Reading, listening, answering the question in assignment and quiz **Criteria:**	**Reading text, presentation and discussion [TM: 2×(2×50')]**		• Solid surface : characterization (microscopy and spectroscopy) [2] (page 293-311)	**5**
22,23	The students should be able to explain the type of adsorption isotherm model, the difference between model and the application	• Accuracy in explaining	**Technical:** Reading, listening, answering the question in assignment and quiz **Criteria:**	**Reading text, presentation and discussion [TM: 2×(2×50')]**		• Adsorption in solid surface [1] (page 146-154) [2] (page 390-397)	**5**
24	The students should be able to explain the source, use, advantages and disadvantages of adsorbent from natural sources, synthetic, semi-synthetic and waste materials	• Accuracy in explaining	**Technical:** Reading, listening, answering the question in assignment and quiz **Criteria:**	**Reading text, presentation and discussion [TM: 2×(2×50')]**		• Solid adsorbent [3]	**5**
25	The students should be able review and understand the journal of adsorption, present	• Accuracy in explaining	**Technical:**	**Reading text, presentation and discussion**		• Case study : review journal	**5**

	the journal and give some conclusion		Reading, listening, presentation and discussion **Criteria:**	**[TM: 2×(2×50')]**			
26-28	The students should be able to synthesize adsorbent, design experiment and doing adsorption experiment	• Good data • Accuracy in explaining, data analysis, writing, creativity in presentation, and group cohesiveness	**Technical:** Reading, reviewing, designing, observing, writing, presentation, and discussion **Criteria:**	**Reading text, experiment, presentation and discussion** **[TM: 3×(2×50')]**		• Case study of adsorption : review journal, design and doing adsorption experiment [4]	**10**
29-32	**End Semester Evaluation**						**10**

9. POLYMERS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**					**Document Code**
SEMESTER LEARNING PROGRAMME						
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
POLYMERS	SK 184725	Optional Courses	2	0	VII	23 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	

<table>
<tr><td colspan="2"></td><td>Dr. Hendro Juwono, M.Si.;Lukman Atmaja, M.Si., PhD.</td><td>Dr. Drs. Eko Santoso, M.Si</td><td>Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="4">LO-PRODI Charged to the Courses</td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="3">Able to report his/her own work in a good and discipline manners</td></tr>
<tr><td>b.2 (LO 4)</td><td colspan="3">Able to give alternative solutions with the characters of leadership, creativity and communication ability</td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="3">Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="3">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (LO MK)</td><td colspan="2"></td></tr>
<tr><td>LO MK 1</td><td colspan="3">Able to think critically related to the utilization of polymer compound in daily life based on the principal of synthesis, characteristic and physical properties of polymer</td></tr>
<tr><td>LO MK 2</td><td colspan="3">Have the knowledge related to the synthesis method of polymer and the characterization</td></tr>
<tr><td>LO MK 3</td><td colspan="3">Able to express the idea in oral or writing</td></tr>
<tr><td>LO – LO MK Map</td><td colspan="4"><table><tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr><tr><td>CP MK 1</td><td>√</td><td></td><td></td><td>√</td><td></td><td>√</td><td></td><td></td><td>√</td></tr></table></td></tr>
<tr><td>Course Description</td><td colspan="4">In this course, the students will learn about the basics concept of synthesis and characterization polymer so that students are able to think critically about the development of polymer materials for various applications. The discussion begins with the basic concepts of polymers, polymer properties etc. so that students are able to choose polymer materials for several examples of applications in everyday life.</td></tr>
<tr><td>Study Material:
Subject matter</td><td colspan="4">Introduction to polymer, natural polymer, synthetic polymer, addition polymer, example of addtion polymer, addition polymer mechanism, condensation polymer, example of condensation polymer, kinetic mechanism of polymerization, cation-anion ionic polymer, copolymerization, graft, block, characterization of polymer, application of copolymerization, polymer technology, molding</td></tr>
<tr><td>References</td><td colspan="4">Primary:

3. Billmayer, 2004, Polymer Chemistry</td></tr>
</table>

	Secondary: 4. Odian, G., " Principles of Polymerization", 3rd edition, Wiley, 2012. 5. Rabek, J.F., "Experimental methods in Polymer Chemistry", Wiley., 1990.
Lecturer	Dr. Hendro Juwono, M.Si. Lukman Atmaja, M.Si., PhD. Drs. Eko Santoso, M.Si.
Pre-Requisite Courses	Have taken Organic Compound Reaction and Dynamic Chemistry, and passed with minimum grade D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1	The students should be able to understand and explain the introduction and technology of polymer	• Accuracy, the order/calculation logic of solving the chemistry problem related to introduction of polymer	**Technical:** Assignment **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Introduction to science and technology of polymer	**5**
2	The students should be able to understand and explain the type of polymer, natural and synthetic polymer.	• Accuracy, the order/calculation logic of solving the chemistry problem	**Technical:** Assignment **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Natural and synthetic polymer	**5**
3	The students should be able to understand and explain the type of polymerization	• Accuracy, the order/calculation logic of solving the chemistry problem related to the	**Technical:** Assignment **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Addition polymer • Condensation polymer	**5**

		concept of polymerization type					
4	The students should be able to understand and explain the copolymerization	• Accuracy, the order/calculation logic of solving the chemistry problem related to the copolymeritization	**Technical:** Quiz **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Graft copolymer, block, chain and random	**10**
5,6	The students should be able to understand and explain the polymerization kinetic, molecular relative mass control, polymer dispersity	• Accuracy, the order/calculation logic of solving the chemistry problem related to the polymerization kinetic, molecular relative mass control, polymer dispersity	**Technical:** Assignment Quiz **Criteria:**	**Lecture, discussion [TM: 2×(2×50')]**		• Polymerization kinetic, molecular relative mass control, polymer dispersity	**Assignment (5%) Quiz (10%)**
7	The students should be able to understand and implement the concept of synthetic polymer, plastic polymer, atactic PE, syndiotactic polymer, PP, PS< PVC	• Accuracy, the order/calculation logic of solving the chemistry problem related to the synthetic polymer, plastic polymer, atactic PE, syndiotactic polymer, PP, PS< PVC	**Technical:** Assignment **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Synthetic polymer • Plastic polymer • Atactic PE • Syndiotactic • PP • PS • PVC	**5**
8	**Mid Semester Evaluation**						**7.5**

9,10	The students should be able to understand and implement the technique of liquid, suspense and coloid polymerization	• Accuracy, the order/calculation logic of solving the chemistry problem related to the technique of liquid, suspense and coloid polymerization	**Technical:** Assignment **Criteria:** •	**Lecture, discussion** **[TM: 2×(2×50')]**		• Technique of liquid, suspense and coloid polymerization	**10**
11	The students should be able to understand the physical properties of polymer	• Accuracy, the order/calculation logic of solving the chemistry problem related to the physical properties of polymer	**Technical:** Assignment **Criteria:**	**Lecture, discussion** **[TM: 1×(2×50')]**		• Physical properties of polymer	**10**
12,13	The students should be able to understand and implement the implication concept of polymerization such as PE, PP, PMMA and PS in the analysis of tensile strength	• Accuracy, the order/calculation logic of solving the chemistry problem related to the polymerization such as PE, PP, PMMA and PS in the analysis of tensile strength	**Technical:** Quiz **Criteria:**	**Lecture, discussion** **[TM: 2×(2×50')]**		• Polymerization such as PE, PP, PMMA and PS in the analysis of tensile strength	**15**
14	The students should be able to connect the structure and properties of composite material with the present and future material needs (C3)	• Accuracy, the order/calculation logic of solving the chemistry problem related to the polymerization such as PE, PP, PMMA and PS in	**Technical:** Assignment **Criteria:**	**Lecture, study case** **[TM: 1×(2×50')]**		• Molding concept technology	**5**

		the analysis of tensile strength					
15,16	**End Semester Evaluation**						**7.5**

10. BUILDING MATERIAL CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**					**Document Code**
SEMESTER LEARNING PROGRAMME						
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
BUILDING MATERIAL CHEMISTRY	SK 184726	Optional Courses	2	0	VII	23 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	
	Nurul Widiastuti, PhD dan Dr. Triyanda Gunawan, S.Si.		Dr. Drs. Eko Santoso, M.Si		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**	
	A.5 (LO 2)	Able to internalize the spirit of independence, struggle, and entrepreneurship
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (LO MK)	
	LO MK 1	Able to solve the problems of science and technology in the development of building materials in accordance with the demands of the needs of the present and future

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1		√						√	√

Course Description	This lecture discusses about the building materials that commonly used in daily life
Study Material: Subject matter	Building materials including cement, ceramics, metal, glass, building accessories, composite, plastic, foam, wood, asbestos, stone, gypsum, glue, paint.
References	**Primary:** **Secondary:**
Lecturer	Nurul Widiastuti, PhD dan Dr. Triyanda Gunawan, S.Si.
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1	The students should be able to explain the demand for the development of building materials in present and future	• Accuracy in explaining	**Technical:** Assignment (analysis the potency of building materials development) **Criteria:**	**Lecture, video playback, discussion [TM: 1×(2×50')]**		• Potency of building materials development	**Include to mid-semester evaluation**
2	The students should be able to explain the principal of building materials properties	• Accuracy in explaining	**Technical:** Assignment (identify the	**Lecture, discussion [TM: 1×(2×50')]**		• Principal and properties of building materials	**Include to mid-semester**

			properties of building materials) **Criteria:**				**evaluation**
3,4	The students should be able to connect the structure and properties of building materials (clay based) with the demand of the materials in present and future	• Accuracy in explaining the structure and properties of building materials (clay based) with the demand of the materials in present and future	**Technical:** Assignment (identify structure and properties of building materials (clay based) with the demand of the materials in present and future) **Criteria:**	**Lecture, discussion [TM: 2×(2×50')]**		Product of clay, rock and stone, gypsum, asbestos, brick	**Include to mid-semester evaluation**
5	The students should be able to connect the structure and properties of building materials (wood and glass) with the demand of the materials in present and future	• Accuracy in explaining the structure and properties of building materials (wood and glass) with the demand of the materials in present and future	**Technical:** Assignment (identify structure and properties of building materials (wood and glass) with the demand of the materials in present and future) **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Wood and glass materials	**Include to mid-semester evaluation**

6,7	The students should be able to connect the structure and properties of building materials (cement) with the demand of the materials in present and future	• Rubic case study system	**Technical:** Assignment (identify structure and properties of building materials (cement) with the demand of the materials in present and future) **Criteria:**	**Lecture, study case [TM: 2×(2×50')]**		• Materials for concrete cement, concrete III water, concrete IV lime, puzzolanas, concrete mix design	**10**
8	**Mid Semester Evaluation**						**20**
9	The students should be able to connect the structure and properties of ceramics materials with the demand of the materials in present and future	• Accuracy in explaining the structure and properties of of ceramics materials with the demand of the materials in present and future	**Technical:** Assignment (identify structure and properties of ceramics materials with the demand of the materials in present and future) **Criteria:**	**Lecture, study case [TM: 2×(2×50')]**		• Ceramics materials and mortar bulding	**Include to final-semester evaluation**
10	The students should be able to connect the structure and properties of iron metal and non iron metal materials with the demand of the materials in present and future	• Accuracy in explaining the structure and properties of of the materials with the demand of the	**Technical:** Assignment (identify structure and properties of the materials with the demand of the materials in present and future)	**Lecture, study case [TM: 1×(2×50')]**		• Iron and non iron metal materials	**Include to final-semester evaluation**

		materials in present and future	**Criteria:**				
11,12	The students should be able to connect the structure and properties of polymer, paint, glue, plastic, foam materials with the demand of the materials in present and future	• Rubic case study system	**Technical:** Assignment (analysis of case and idea for solution) **Criteria:**	**Lecture, study case [TM: 2×(2×50')]**		• Polymer building materials, paint, glue, plastic, foam	**5**
13	The students should be able to connect the structure and properties of composite materials with the demand of the materials in present and future	• Rubic case study system	**Technical:** Assignment (analysis of case and idea for solution) **Criteria:**	**Lecture, study case [TM: 1×(2×50')]**		• Composite materials	**5**
14	The students should be able to convey the idea related to the development of building materials in accordance with the demand of the materials in present and future with presentation and writing	• Rubic case study system • Presentation • Writing the idea	**Technical:** Presentation of idea related to the development of building materials **Criteria:**	**Lecture, study case [TM: 1×(2×50')]**		• Development of building materials	**15** **25**
15,16	**End Semester Evaluation**						**20**

11. GENETICAL MANIPULATION

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**				**Kode Dokumen**	
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
GENETICAL MANIPULATION	SK 184731	Biochemistry	2	0	VII	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Drs. Refdinal Nafwa, M.S.		Herdayanto S. Putro, S.Si., M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (LO MK)	
	CP MK	Students are able to explain the steps and use of technology in the genetic engineering process and their applications

LO – LO MK Map

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CP MK 1-10						√	√	√	√

Course Short Description

After studying this course, students can understand international publications related to Genetic Engineering material. The material discussed are:

1. The introduction to Genetic Engineering (history, importance, applications)
2. Prokaryotic and eukaryotic organisms
3. gene transformation

	4. DNA / RNA isolation and purification 5. Plasmid and vector preparation 6. The propagation of recombinant DNA using PCR 7. Insertion of recombinants in host cells 8. The gene overexpression 9. The presentation of assignment
Study Material: Subject matter	Knowing the importance of genetic engineering, knowing the terms found in genetic engineering, how to isolate DNA, cutting DNA with restriction enzymes, forming recombinant DNA, chemically synthesizing DNA, propagating DNA using Polymerase chain reaction (PCR) tools and scanning of genetically engineered microorganisms
Reference	**Main:** 6. D. Freifelder, ”Recombinant DNA”, W.H. Freeman and Company, San Fransisco, 1978. **7.** J. Sambrook and D. W. Russel, ”Molecular Cloning, A Laboratory Manual”, 3rd edition, Cold Spring Harbor Laboratory Press, New York, 2001 **Supporting:** 2.
Supporting Lecturer	Drs. Refdinal Nafwa, M.S.
Pre-Requisite Courses	Have taken the course Biochemistry

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to understand the importance of genetic engineering	• The accuracy in explaining the importance of genetic engineering	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• The history of genetic engineering • The definition of genetic engineering • The explanation of why it should be genetic engineering • The application of genetic engineering in biological and biotechnology research	
2-3	Students are able to understand the terms found in genetic engineering	• The accuracy in understanding the terms in genetic engineering	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]** **Lecture** **[TM: 1x(2x50")]**		• The difference of procaryotic and eucaryotic organisms • The terms found in genetic engineering • The restriction of enzyme, Vector, cell host, etc.	
4	Students are able to understand the steps of genetic transformation	• The accuracy in explaining the steps of genetic transformation	**Technical :** Assignment **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		An outline of the recombinant process of DNA and its transformation	**10**
5-6	Students are able to understand how to isolate and purify DNA	• The accuracy in explaining how to isolate and purify DNA	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]** **Lecture** **[TM: 1x(2x50")]**		• Cell cleavage • The separation of DNA plasmids and DNA insert	

7	Students are able to understand how to prepare Plasmids and Vectors	• The accuracy in preparing Plasmids and Vectors	**Technical :** **Criteria :**	**Lecture [TM: x(2x50")]**		• Plasmid cutting • DNA insert taking • The formation of DNA recombinant	
8	**Mid-term evaluation**						**30**
9-10	Students are able to understand how to propagate recombinant DNA by PCR	• The accuracy in designing, synthesizing, and explaining how to propagate recombinant DNA by PCR	**Technical :** **Criteria :**	**Lecture [TM: 1x(2x50")]** **Lecture [TM: 1x(2x50")]**		• Design and synthesis of primary DNA • The propagation of gen/DNA by PCR	
11	Students are able to insert recombinant to the host cell	• The accuracy of explaining how to insert DNA	**Technical :** **Criteria :**	**Lecture [TM: 1x(2x50")]**		• Recombinant Insertion in Host Cells and Insertion Cell Scans	
12	Students are able to explain what the gene overexpression is	• The accuracy of explaining the gene overexpression	**Technical :** Non-test **Criteria :**	**Lecture [TM: x(2x50")]**		• Regulation of enzyme / protein biosynthesis	
13-15	Students are expected to present their assignment/journal			**Assignment, presentation, and discussion**			**30**
16	**End-term evaluation**						**30**

12. BIOREMEDIATION

INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FACULTY OF SCIENCE AND DATA ANALYTICS
DEPARTMENT OF CHEMISTRY

Kode Dokumen

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data
BIOREMEDIATION	SK 184732	Biochemistry	2	0	VII	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Adi Setyo Purnomo, M.Sc, Ph.D		Herdayanto S. Putro, S.Si., M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (LO MK)	
	CP MK 1	Students are able to apply bioremediation principles and techniques in dealing with environmental problems

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1						√	√	√	√

Course Short Description	This subject studies about the process of treating hazardous waste with bioremediation techniques and knowing the microorganisms involved in the processing. The material provided includes: the principle of bioremediation; types of bioremediation; several bioremediation techniques; and bioremediation of organic waste (pesticides, chlorinated aromatic compounds, explosives, dyes)
Study Material: Subject matter	The principle of bioremediation, types of bioremediation, several bioremediation techniques, bioremediation monitoring, and the bioremediation in contaminated environment

Reference	**Main:** 1. R. M. Atlas and J. Philip, "Bioremediation: Applied Microbial Solution for Real-Word Environmental Clen up", ASM Press, Washington DC, 2005 2. S. P. Cummings, "Bioremediation: Method and Protocols", Humana Press, New York, USA, 2010 3. J. W. Talley, "Bioremediation of Recalcitrant compounds", Taylor & Francis, Boca Raton, FL, 2006 4. Related articles **Supporting:** 3.
Supporting Lecturer	Adi Setyo Purnomo, M.Sc, Ph.D
Pre-Requisite Courses	Have taken the course Biochemistry

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1-2	Students are able to understand the principle of bioremediation	• The accuracy in explaining the principle of bioremediation	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• The principle of bioremediation	

3	Students are able to understand several techniques of bioremediation	• The accuracy in mentioning and explaining techniques of bioremediation	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• Bioremediation techniques	
4-5	Students are able to understand the microorganisms involved in the process of bioremediation	• The accuracy in mentioning and explaining the fungi involved in the process of bioremediation	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		Ligninolytic fungi	**15**
6-7	Students are able to understand the bioremediation of organic waste	• The accuracy in explaining bioremediation of DDT	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Bioremediation of DDT	
8	**Mid-term evaluation**						**25**
9-11	Students are able to understand the bioremediation of organic waste	• The accuracy in explaining bioremediation of chlorinated-monoaromatic compounds and polyaromatic hydrocarbons	**Technical :** **Quiz 2** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		• Bioremediation of chlorinated-monoaromatic compounds and polyaromatic hydrocarbons	**20**

12-15	Students are able to understand the bioremediation of organic waste	• The accuracy in explaining bioremediation of pesticides, explosives, dyes.	**Technical : Assignment** **Criteria :**	**Lecture and discussion [TM: 3x(2x50")]** **Assignment [TM: 1x(2x50")]**		• Bioremediation of pesticides, explosives, dyes.	**15**
16	**End-term evaluation**						**25**

13. MICROBIOLOGICAL CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**						**Kode Dokumen**
TEACHING AND LEARNING PLAN							
COURSE (MK)		**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
MICROBIOLOGICAL CHEMISTRY		SK 184733	Biochemistry	2	0	VII	07 Januari 2020
AUTHORIZATION / LEGALIZATION		**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
		Herdayanto S. Putro, S.Si., M.Si., Hamdan Dwi Rizqi, M.Si.		Herdayanto S. Putro, S.Si., M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**						
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics					
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances					
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.					
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities					
	Course Learning Outcomes (LO MK)						
	CP MK 1	Students are able to explain the role of microorganisms in the environment and industry and know the proper handling techniques					

LO – LO MK Map	

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1						√	√	√	√

Course Short Description	The course studies everything related to microbes which are microbial growth, their control, and the application of microorganisms in industry.
Study Material: Subject matter	Introduction to microbiology; Microbial growth; Nutrition, media, and cultivation; Diversity of microorganisms (prokaryotes, fungi, protists, and viruses); Control of microorganisms (sterilization, disinfection and addition of antimicrobial substances); Production of secondary metabolites; Microorganisms in the environment (soil, freshwater and sea water); Microorganisms in industry.
Reference	**Main:** **Supporting:**
Supporting Lecturer	Herdayanto S. Putro, S.Si., M.Si., Hamdan Dwi Rizqi, M.Si.
Pre-Requisite Courses	Have taken the course Biochemistry

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to understand the basic knowledge of microbiology	• The accuracy in explaining the basic knowledge of microbiology	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• Introduction to microbiology	
2-3	Students are able to understand the stages of microbial growth and the method of determination	• The accuracy in explaining the stages of microbial growth and the method of determination	**Technical :** **Quiz 1** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• The growth curve of microbe • The method of determining microbial growth	**10**
4-5	Students are able to understand the use of nutrition, media selection, and cultivation methods	• The accuracy in using nutrition and suitable media for cultivation	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		Nutrition, media, and cultivation methods	
6-7	Students are able to understand the biodiversity of microorganisms	• The accuracy in understanding the biodiversity of microorganisms	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		Diversity of microorganisms (prokaryotes, fungi, protists, and viruses)	
8	**Mid-term evaluation**						**25**

9-10	Students are able to understand how to control microorganisms	• The accuracy in understanding toxic compounds in food	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Control of microorganisms (sterilization, disinfection, and addition of antimicrobial substances)	
11	Students are able to understand the process of secondary metabolite production	• The accuracy in understanding the ways of food preservation	**Technical :** **Assignment** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• Production of secondary metabolites	
12	Students are able to understand how to analyze secondary metabolites	• The accuracy in understanding the food packaging methods	**Technical :** **Quiz 2** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• Analysis of secondary metabolites (GC-MS, LC-MS (HRMS), NMR)	**10**
13	Students are able to recognize microorganisms in the environment	• The accuracy in understanding the biological process in food caused by microorganisms	**Technical :** **Group assignment** **Criteria :**	**Focus group discussion (FGD)** **[TM: 1x(2x50")]**		• Microorganisms in the environment (soil, freshwater, sea water)	**10**
9-10	Students are able to recognize microorganisms in industry	• The accuracy in analyzing many cases encountered in food product	**Technical :** **Group presentation** **Criteria :**	**Focus group discussion (FGD)** **[TM: 2x(2x50")]**		• Microorganisms in industry	**20**
16	**End-term evaluation**						**25**

14. PHYTOCHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Kode Dokumen**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
PHYTOCHEMISTRY	SK 184741	Organic Chemistry	2	0	VII	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Prof. Dr. Taslim Ersam, M.S., Sri Fatmawati, M.Sc, Ph.D.		Drs. Agus Wahyudi, M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	CP MK 1	Students are expected to have skills in conducting qualitative testing of secondary metabolite compounds in the laboratory and conveying the knowledge they have to the public

LO – LO MK Map

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1			√				√	√	

Course Short Description	In this course, students can find out about the chemical affinity of plants as a source of secondary metabolite compounds from each plant species. Students are guided to make field study proposals, which consist of developing procedures for conducting surveys and phytochemical screening. From the survey results, students will be trained to make herbariums, preparation for laboratory experiments, qualitative tests for alkaloids, phenolics, saponins, steroids, essential oils (mono terpenoids) and triterpenoids. Data from the results of this experiment are analyzed to produce facts that can

	be used to make decisions (conclusions), make a report on the results and present a seminar at the end of the lecture. Learning outcomes are in the form of knowledge and skills that can be used in further education and research and are useful in social life.
Study Material: Subject matter	1. Introduction to plant taxonomy, creation of herbarium, designing survey proposals, and phytochemical screening. 2. Preparing survey and screening materials, tools and equipment. 3. Field survey, collection of plant species, and screening for secondary metabolites and tests for certain bioactivity, such as antibacterial, antioxidant and cytotoxic. 4. Creating final reports and presentations.
Reference	**Main:** 1. T. Ersam, "Kimia Mikromolekul", ITS Press, Surabaya, 2012. 2. A. F. Kristanti, S. A. Aminah, M. Tanjung dan B. Kurniadi, "Fitokimia", Airlangga University Press, 2008. 3. Journal of Phytochemistry, Science Direct On-line 4. Journal of Natural Product Chemistry, Science Direct On-line **Supporting:**
Supporting Lecturer	Prof. Dr. Taslim Ersam, M.S., Sri Fatmawati, M.Sc, Ph.D.
Pre-Requisite Courses	Have taken the course of Organic Chemistry Fundamentals, Measuring Methods, and Purification and Separation Methods

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to explain about plant taxonomy and making herbarium	• The accuracy in explaining about secondary metabolites	**Technical :** **Criteria :**	**Introductory lecture and brainstorming [TM: 1x(1x50")]** **Lecture and Discussion [TM: 1x(2x50")]**		• Plant taxonomy • Herbarium making	
2	Students are able to design the phytochemical screening and compile survey proposal	• The accuracy in explaining the biosynthetic mechanism of the formation of terpenoids, phenolics, alkaloids and steroids correctly	**Technical :** **Assignment 1** **Criteria :**	**Lecture and Discussion [TM: 1x(3x50")]**		The principle of phytochemical screening	**5**
3	Students are able to prepare materials, tools, and others needed for the use in phytochemical screening	• The accuracy in preparing research materials	**Technical :** **Assignment 1** **Criteria :**	**Lecture and Discussion [TM: 1x(3x50")]**		Methods of phytochemical screening.	**5**
4-7	Students are able to collect several plant species and conduct phytochemical screening		**Technical :** **Field study** **Criteria :**	**Field study [TM: 1x(3x60")]** **Laboratory work [3x(1x160")]**		• Plant sampling technique • Phytochemical screening practicum	**15**
8	**Mid-term evaluation**						**20**

9-12	Students are able to screen secondary metabolites in plants and carry out several bioactivity tests such as antibacterial, antioxidant and toxicity tests.	• The accuracy in choosing and performing extraction, isolation and fractionation, purification and chromatography methods for research on plant materials appropriately	**Technical : Laboratory study** **Criteria :**	**Laboratory work [4x(1x160")]**		• Screening of secondary metabolites in plants • Bioactivity test on screening results	**20**
13-15	Students are able to compile a report and present it in the end of class	• The accuracy in understanding elucidating compound structures using a combination of spectroscopic data from research results and determining the type of compounds correctly	**Technical : Presentation** **Criteria :**	**Presetation, Discussion [2x(3x50")]**		• Presentation of laboratory work	**15**
16	**End-term evaluation**						**20**

15. FRAGRANCE AND FLAVOR CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Kode Dokumen**
TEACHING AND LEARNING PLAN		

COURSE (MK)	CODE	Course disciplines (RMK)	Semester Credit Units	SEMESTER	Compilation Data

FRAGRANCE AND FLAVOR CHEMISTRY	SK 184742	Organic Chemistry	2	0	VII	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Prof. Dr. Mardi Santoso		Drs. Agus Wahyudi, M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	CP MK 1	Able to think critically about various sources of fragrances and flavors; and purification, identification of fragrance and flavor compounds
	CP MK 2	Having knowledge about biogenesis and synthesis of fragrance and flavor compounds, chemical aspects, and application of fragrance and flavor compounds
	CP MK 3	Able to express their ideas orally and in writing

LO – LO MK Map

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CP MK 1	√						√	√	
CP MK 2							√	√	
CP MK 3	√							√	

Course Short Description	This course discusses various sources of fragrances and flavors; separation, purification, identification of fragrance and flavor compounds; introduction of biogenesis and synthesis of fragrance and flavor compounds; chemical aspects and application of fragrance and flavor compounds.
Study Material: Subject matter	1. Various sources of fragrances and flavors 2. Method of separation, purification, identification of fragrance and flavor compounds 3. Introduction to biogenesis and synthesis of fragrance and flavor compounds, chemical aspects and application of fragrance and flavor compounds 4. Case study
Reference	**Main:**

	1. D. Rowe, “Chemistry and Technology of Flavors and Fragrances”, CRC Press, New York, 2005. 2. D.H. Pybus and C.S. Sell, “The Chemistry of Fragrances”, Royal Society of Chemistry, London, 1999. 3. Fisher and T.R. Scott, “Food Flavors”, Royal Society of Chemistry, London, 1997. 4. Research articles related to Perfumer & Flavorist, Flavor and Fragrance Journal, Journal of Essential Oil Research, Journal of Agricultural and Food Chemistry, Flavor Science, Food Research International. **Supporting:**
Supporting Lecturer	Prof. Dr. Mardi Santoso
Pre-Requisite Courses	Have taken the course of Organic Chemistry Fundamentals, Measuring Methods, and Spectrometry with grade of minimal D

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	Students are able to explain about the types of sources for fragrance and flavor compounds	• The accuracy in the types of sources for fragrance and flavor compounds correctly	**Technical :** **Criteria :**	**Lecture and [TM: 1x(2x50”)]**		• Introduction to the chemistry of fragrances and flavors • Types of fragrance and flavor compounds	

3-5	Students are able to explain the separation and purification method and identify fragrance and flavor compounds	• The accuracy in the separation and purification method and identify fragrance and flavor compounds correctly	**Technical :** **Assignment 1** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		• Methods of separating fragrance and flavor compounds • Methods for purifying fragrance and flavor compounds • Methods for identifying fragrance and flavor compounds	**10**
6,7	Students are able to explain the biogenesis of fragrance and flavor compounds	• The accuracy in explaining the biogenesis of fragrance and flavor compounds correctly	**Technical :** **Assignment 2** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		Biogenesis of fragrance and flavor compounds	**15**
8	**Mid-term evaluation**						**25**
9,10	Students are able to choose suitable method to synthesize fragrance and flavor compounds	• The accuracy in choosing suitable method to synthesize fragrance and flavor compounds	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Method to synthesize fragrance and flavor compounds	
11,12	Students are able to explain the chemical composition and application of fragrance and flavor compounds	• The accuracy in explaining the chemical composition and application of fragrance and flavor compounds	**Technical :** **Assignment 3** **Criteria :**	**Lecture** **[2x(2x50")]**		• Chemical composition of fragrance and flavor compounds • • Application of fragrance and flavor compounds	**10**

13-15	Students are able to explain and solve several cases related to fragrance and flavor compounds	• The accuracy in explaining and solving several cases related to fragrance and flavor compounds	**Technical : Presentation** **Criteria :**	**Lecture [3x(2x50")]**		• Study cases related to fragrance and flavor compounds	**15**
16	**End-term evaluation**						**25**

16. ORGANIC STEREOCHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
ORGANIC STEREOCHEMISTRY	SK 184751		2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Drs. Agus Wahyudi, M.Si.		Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics and personality in completing one's task
	C.1 (LO 6)	Able to master the concepts of structure, character, and change of substance according to the aspects of dynamics and energetics
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced
	Course Learning Outcomes (CLO)	

	CLO 1	The students should be able to use the principles of basic chemistry knowledge as a basis to learn chemistry inwhich they will learn further throughout their whole studies.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√					√		√	

Course Short Description

Study Material:
Subject Matter

1. Configuration and chirality of carbon atom
2. Conformation of *n*-butane and cyclohexane
3. Enantiomers and meso compounds
4. Ficher projection of compounds with 1 or 2 chiral carbon atoms, R or S configurations, and chiral N.
5. The absolute configuration of monosaccharide
6. Newman configurations of *n*-butane and cyclohexane
7. Cis/Trans and E/Z geometric isomers
8. Allene, alkyd cyclo alkene, spirane, biphenyl, para cyclophane, and ansa compounds
9. Nucleophilic substitution (SN2), neighboring group participation in nucleophilic substitution, internal nucleophilic substitution, elimination, cis/trans addition reactions

Reference

Primary:

Secondary:

Lecturer

Drs. Agus Wahyudi, M.S

Pre-Requisite Courses

-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to explain the configuration and chirality of carbon atom	• The accuracy in explaining the configuration and chirality of carbon atom	**Technical:Criteria:**	**Lecture and discussion[TM: 1×(2×50'')]**		• The configuration ofthe carbon atom • The properties ofthe carbon atom • The chirality of the carbon atom	
2	Students are able to explain the conformation of *n*-butane and cyclohexane	• The accuracy in explaining and describing the conformation of *n*-butane and cyclohexane	**Technical:Criteria:**	**Lecture and discussion[TM: 1×(1×50'')]**		• Conformation of *n*-butane and cyclohexane	
3	Students are able to understand enantiomers and meso compounds	• The accuracy in explaining and describing enantiomers and meso compounds	**Technical:Criteria:**	**Lecture and discussion[TM: 1×(2×50'')]**		• Formation of enantiomer compounds • Formation of meso compounds	
4,5	Students are able to understand the Fischer projection of compounds with 1 or two chiral carbon atoms, R or S configurations, and chiral nitrogen	• The accuracy in explaining and describing the Fischerprojection of compounds with 1 or two chiral carbon atoms, R or S configurations,	**Technical:** Assignment 1 **Criteria:**	**Lecture and discussion[TM: 1×(2×50'')]**		• Ficher projection ofcompounds with 1 or 2 chiral carbon atoms • R or S configurations • Projection of chiral nitrogen compounds	**15**

		and chiral nitrogen					
6	Students are able to understand the absolute configuration of monosaccharide	• The accuracy in explaining and describing the absolute configuration of monosaccharide	**Technical:Criteria:**	**Lecture and discussion[TM: 1×(2×50'')]**		• The absolute configuration of monosaccharide	
7	Students are able to understand the Newman projection of *n*-butane and cyclohexane	• The accuracy in explaining and describing the Newmanprojection of *n*-butane and cyclohexane	**Technical:Criteria:**	**Lecture and discussion[TM: 1×(2×50'')]**		• Newman projection • Newman projectionof *n*-butane Newman projection of cyclohexane	
8	**Mid-semester Evaluation**						**20**
9	Students are able to understand cis/trans and E/Z geometric isomers	• The accuracy in explaining and describing cis/trans and E/Z geometric isomers	**Technical:** **Criteria:**	**Lecture and discussion[TM: 1×(2×50'')]**		• Competition between nucleophilic	
10,11	Students are able to understand allene, alkyd cyclo alkene, spirane, biphenyl, para cyclophane, and ansa compounds	• The accuracy in explaining and describing the structure of allene, alkyd cyclo alkene, spirane, biphenyl, para cyclophane, and ansa compounds	**Technical:** Assignment 2 **Criteria:**	**Lecture and discussion[TM: 2×(2×50'')]**		• Markovnikov and Anti-Marknovnikov addition, electrophilic addition with acid (H^+) catalyst • Halogenation, halogenation associated with stereochemistry , epoxidation,	**15**

						oxidation, and the reaction of alkenes • with the carbocation	
12-15	Students are able to understand nucleophilic substitution (SN2), neighboring group participation in nucleophilic substitution, internal nucleophilic substitution (SNi), elimination, cis/trans addition reactions	• The accuracy in explaining, writing, and describing the structureof compounds involved in nucleophilic substitution (SN2), neighboring group participation in nucleophilic substitution, internal nucleophilic substitution, elimination, cis/trans • addition reactions	**Technical:** Presentation **Criteria:**	**Lecture [TM: 2×(2×50'')]** **Discussion [TM: 2×(2x50'']**		• Stereochemistry inSN2 reactions • Stereochemistry inneighboring group participation in nucleophilic substitution reactions • Stereochemistry in internal nucleophilic substitution (SNi) reactions • Stereochemistry in elimination reactions • Stereochemistry in cis/trans addition reactions	**25**
16	**Final Semester Evaluation**						**20**

17. COAL GEOCHEMISTRY

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
COAL GEOCHEMISTRY	SK 184752		2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Prof. Dr. R.Y. Perry Burhan, M.Sc.; Dr. Yulfi Zetra, MS.		Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics and personality in completing one's task
	C.1 (LO 6)	Able to master the concepts of structure, character, and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to master concepts, theory, and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced
	Course Learning Outcomes (CLO)	
	CLO 1	Able to explain the characteristics and chemical composition of coal as the basis for determining the type, rank, and analysis method of coal
	CLO 2	Able to understand the role of organic geochemistry in the exploration process for petroleum and coal as well as other geological sediments

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√					√	√		
CLO 2								√	

Course Short Description

Study Material:
Subject Matter

1. Physical and chemical characteristics of coal which include the definition and origin of coal
2. Classification and composition of coal
3. Process of forming coal which initiated with the decay of living creatures that have died
4. Formation of peat into coal
5. Biomarker compounds commonly found in coal

	6. Basic analysis of coal, coal rank, and types of coal
Reference	**Primary:** **Secondary:**
Lecturer	Prof. Dr. R.Y. Perry Burhan, M.Sc.; Dr. Yulfi Zetra, MS.
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain the definition and origin of coal	• The accuracy in explaining the definition and origin of coal	**Technical:Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The definition ofcoal • The origin of coal	
2,3	Students are able to explain the classification and composition of coal	• The accuracy in explaining the classification and composition of coal	**Technical:** Assignment 1 **Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The classification ofcoal • The composition of coal	**10**
4,5	Students are able to explain the process of forming coal	The accuracy in explaining the processof forming coal	**Technical:** Quiz **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• The process of forming coal	**10**
6,7	Students are able to explain biomarker compounds commonly found in coal	• The accuracy in explaining biomarker	**Technical:Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Biomarker compounds commonly found in	

		compounds commonly found in coal				coal and their characteristics	
8	**Mid-semester Evaluation**						**25**
9,10	Students are able to explain biomarker compounds commonly found in coal	• The accuracy in explaining biomarker compounds commonlyfound in coal	**Technical:Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Biomarker compounds commonly found incoal and their characteristics	
11,12	Students are able to explain about coal rank	• The accuracy in explaining coal rank	**Technical:** Assignment 2 **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Coal rank based on its composition	**10**
13-15	Students are able to	• The accuracy in determining the type ofcoal according to the biomarker analysis • results	**Technical:**	**Lecture**		• Types of coal basedon its composition • Case studies of coal biomarkers	**20**
16	**Final Semester Evaluation**						**25**

18. ON JOB TRAINING

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units	SEMESTER	Compilation Date

ON JOB TRAINING	SK 184761		2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
			Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics, and personality in completing one's task
	A.2 (LO 2)	Capable of teamwork and has social sensitivity awareness of the public and the environment
	B.3 (LO 5)	Responsible for one's own work and is able to give the responsibility of the achievement of an organization
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (CLO)	
	CLO 1	Able to apply the chemical concepts and theories in providing alternative solutions to problems in the world of work following their fields based on problem identification, information gathering, data analysis, and appropriate decision making
	CLO 2	Able to work together as a team, adapted to the work environment, understand the professional ethics in the world of work

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√				√				√
CLO 2	√	√			√				

Course Short Description	
Study Material: Subject Matter	A brief overview about organization and governance of companies or government institutions or private agencies, employment policy and workforcerecruitment, occupational health and safety, human resource management as well as the application of chemistry in industrial activities at the company/institution where the internship takes place
Reference	**Primary:**
	Secondary:

Lecturer	
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	Students are able to explainthe work system and mechanism that will be applied during the internship	•	**Technical:** **Criteria:**	**Discussion and presentation**		•	**20**
3-13	Students are able to do work in accordance with the objectives of the internship company/institution	•	**Technical:Criteria:**	**Internship**		•	**40**
14-16	Writing reports and presenting them to the interested parties		**Technical:** **Criteria:**	**Discussion and presentation**		•	**40**

19. MARINE CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**	**SEMESTER**	**Compilation Date**

<table>
<tr><td colspan="2">MARINE CHEMISTRY</td><td>SK 184762</td><td></td><td>2</td><td>0</td><td>VII</td><td></td></tr>
<tr><td colspan="2" rowspan="2">AUTHORIZATION / LEGALIZATION</td><td colspan="2">TLP Editor</td><td colspan="2">Course Group Coordinator</td><td colspan="2">Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2">Herdayanto S. Putro, S.Si., M.Si.; Drs. M. Nadjib M., M.S.</td><td colspan="2">Drs. R. Djarot S.K.S., M.S.</td><td colspan="2">Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="6">Program Learning Outcomes (LO)</td><td colspan="3">LO-PRODI Charged to The Course</td><td colspan="4"></td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="6">Has good moral, ethics and personality in completing one’s task</td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="6">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="6">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="5"></td></tr>
<tr><td></td><td colspan="6"></td></tr>
<tr><td></td><td>CLO 1</td><td colspan="6">Able to understand the physical and chemical properties of seawater, mixing process, energy flow, organic matter cycle and marine microorganisms, differentiation and accumulation of inorganic as well as pollution and prevention</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="7"><table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td>√</td><td></td><td></td><td></td><td></td><td>√</td><td></td></tr>
</table></td></tr>
<tr><td>Course Short Description</td><td colspan="7"></td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="7">This course discusses oceanography phenomenons including:
1. Physical and chemical properties (water and its characteristics, water effects on the earth, Atmo-ocean)
2. Mixing process (ocean characteristics ▪ global circulation and global atmospheric circulation pattern as well as growth and spread of the marine organism ▪ prevention of abrasion ▪ presence of water in solid, liquid, and gas form ▪ seawater, thus regulating climate and waste ▪the main habitat of living creatures
3. Energy flow (carbon cycle ▪ phosphorus cycle ▪ oxygen saturation ▪ organic matter cycle ▪ oxyanion cycle ▪ Martin experiment)
4. Biochemistry process (phytoplankton nutrition ▪ continental weathering ▪ photosynthesis and biological process ▪ metabolism of ocean microorganism)
5. Differentiation and accumulation of inorganic (the major component of seawater ▪ marine mineral exploration ▪ seawater salinity ▪ desalination, reverse osmosis ▪ drinking water standards)
6. Pollution and countermeasures (Case studies in the field (choice of location) ▪ the latest video)</td></tr>
<tr><td>Reference</td><td colspan="7">Primary:</td></tr>
</table>

	Secondary:
Lecturer	Herdayanto S. Putro, S.Si., M.Si.; Drs. M. Nadjib M., M.S.
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to understand the physical andchemical properties ▪ Water and its characteristics ▪ Water effects on the earth Atmo-ocean	• Able to explain correctly about water phenomenons which hydrogen atoms are positively charged andthe oxygen atom is negatively charged, such as magnet, andwater is polar	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		• Formation of hydrogen bond • Adhesion/cohesionproperty • Viscosity • Surface tension	**2.5**
2	Students are able to understand the mixingprocess ▪ Ocean characteristics ▪ Global circulation and globalatmospheric circulation as well as growth and spread of	• Able to explain the properties of water (H_2O) correctly	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		• Properties of H_2O tend to resist temperature changes; high evaporation heat sothat it cools down the surface;	**2.5**

	marine organisms ▪ Prevention of abrasion ▪ The presence of water in solid, liquid, and gas form ▪ Seawater, thus regulatingclimate and waste The main habitat of living creatures					wider surface area when frozen; a universal solvent	
3	Students are able to understand energy flow ▪ The cycle of CO_2 (carboncycle) ▪ Phosphorus cycle ▪ Oxygen saturation ▪ Oxyanion cycle ▪ Organic matter cycle ▪ Martin experiment	The accuracy in explaining energy flow	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		Liquid water: ▪ The most important characteristic of the hydrogen bond is the ability to keep water liquid at room temperature ▪ Hydrogen bond holds the molecules together so it takes more energy to form steam ▪ Earth will be a steamplanet than a liquid water planet	**2.5**
4	Students are able to understand the biochemistryprocess	• The accuracy in explaining the	**Technical:** Review session	**Lecture and discussion[TM: 2×50'']**		• Martin experiment (1991) by adding	**2.5**

	▪ Phytoplankton nutrition ▪ Continental weathering ▪ Photosynthesis and biological process	biochemistry process such as phytoplankton nutrition etc.	**Criteria:**			Feto a sample shows that Fe can stimulate the growth of diatoms production	
5	Students are able to understand the differentiationand accumulation of inorganic ▪ The major component ofseawater ▪ Marine mineral exploration ▪ The salinity of seawater ▪ Desalination; Reverseosmosis ▪ Drinking water standard	• The accuracy in explaining the differentiation and accumulation of inorganic	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		The major componentof seawater: ▪ Cl^- ▪ Na^+ ▪ SO_4^{-2} ▪ Mg^{2+} ▪ Ca^{2+} ▪ K^+ ▪ HCO_3^- ▪ Gas saturation ▪ Organic and • inorganic	**2.5**
6	Students are able to know and understand the marine mineral-based industry	• The accuracy in explaining the marine mineral-based industry correctly	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		• The salinity of seawater: Seawater contains 3.5% salt which affects its physical property (density, compressibility, etc.)	**2.5**
7	Students are able to understand pollution andcountermeasures ▪ Case studies in the field(choice of	• The accuracy in explaining pollution	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		• Salt sources: River and weathering of the ocean crust	**2.5**

	location) ▪ The latest video	and countermeasures of ocean					
8	**Mid-semester Evaluation**						**25**
9	Students are able to understand the physical and chemical properties of seawater	• The accuracy in explaining the physicaland chemical properties of seawater	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		The physical and chemical properties ofwater: ▪ Heat capacity ▪ Light transmission ▪ Solubility • pH	**2.5**
10,11	Students are able to understand the organicmatter cycle	• The accuracy in explaining the organic matter cycle	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2x(2×50'')]**		• The cycle of CO_2(carbon cycle) • Alkalinity • Photosynthesis andexpiration • Phosphorus cycle	**5**
12	Students are able to understand the biogeochemistry aspects	• The accuracy in explaining the biogeochemis try aspects of seawater	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		• General biological process • Carbonate from clamshell	**2.5**
13	Students are able to understand the purification of hard water	• The accuracy in explaining the purification method of hard water	**Technical:** Review session **Criteria:**	**Lecture and discussion[TM: 2×50'']**		• Removes hardness • Removes impurity	**2.5**
14,15	Special topic	• The accuracy in explaining the	**Technical:** Review session	**Lecture and discussion[TM: 2x(2×50'')]**		• Presentation and discussion of paper	**5**

		topicsraised in accordancewith the knowledge they have	**Criteria:**			topic	
16	**Final Semester Evaluation**						**40**

20. INTRODUCTION TO FRAGRANCES AND DYES CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
INTRODUCTION TO FRAGRANCES AND DYES CHEMISTRY	SK 184763*		2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Prof. Mardi Santoso, Ph.D; Drs. Eko Santoso, M.Si.		Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.2 (LO 2)	Able to internalize the spirit of independence, struggle, and entrepreneurship
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	

	CLO 1	Students are able to explain the ingredients of raw fragrance, separation of fragrance from its raw ingredients, structure and fragrance compounds making, standard and analysis of fragrance, utilization of fragrance
LO - CLOMAP		

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1		√				√	√	√	

Course Short Description	The Introduction to Fragrances and Dye Chemistry course is an optional course in the ITS Chemistry Department. The course discusses fragrance raw materials, separation of fragrance from raw ingredients, structure and fragrances compounds making, standards and analysis of fragrances, and the utilization of fragrances. The course also discusses a general introduction to dyes, chromophores of various important classes of dyes, various classes of dyes and their applications, textile dyes, non-textile dyes, functional dyes, and optical brighteners.
Study Material: Subject Matter	Fragrance raw ingredients from plants and animals, separation of fragrance from raw materials (distillation, extraction, squeezing, headspace, deodorant processing after separation), structure and fragrance compounds making (bonds and chemical structures, functional groups and their relationship to aroma, reactions, physical properties, fragrance making), standard and analysis of fragrances (physical and chemical), fragrance applications (perfume formulations, bioactivity).)
Reference	**Primary:** 1. D.K. Bhattacharyya, "Perfumery Materials: Production & Applications", Studium Press, Llc, Texas, 2009 2. R.R. Chalkin, J.S. Jellinek, "Perfumery. Practice and Principles", John Wiley & Sons, New York, 1994 3. G. Ohloff, W. Pickenhagen, P. Kraft, "Scent and Chemistry, The Molecular World of Odors", Wiley-VCH, Zürich, 2012 4. K. Hunger (Editor), "Industrial Dyes : Chemistry, Properties, Applications", Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2003. 5. Gurdeep R. Chatwal, "Synthetic Dyes", Himalaya Publishing House, New Delhi, 2009. **Secondary:**
Lecturer	Prof. Mardi Santoso, Ph.D, Drs. Eko Santoso, M.Si.
Pre-Requisite Courses	Have taken the courses Chemistry 1.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**	**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**			

(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Students are able to explain the dangers of fragrance raw materials	• The accuracy in explaining fragrance raw materials		**Lectures, Discussions, Reading the course material from PowerPoint, Evaluation [TM: 2x50"]** **Assignment 1**		• Definition and raw materials of fragrances both from plants and animals	**5**
2	Students are able to explain methods for separating fragrances from their raw materials	• The accuracy in describing the methods of separating fragrances from their raw materials		**Lectures, Discussions, Reading the course material from PowerPoint, Evaluation [TM: 2x50"]** **Assignment 2**		• Methods of separating fragrance from their raw materials (distillation, extraction, squeezing, headspace, fragrance processing from the separated results)	**5**
3	Students are able to explain the structure of fragrance compounds	• The accuracy in describing the reactions, physical properties and fragrance compounds making		**Lectures, Discussions, Reading the course material from PowerPoint, Evaluation [TM: 2x50"]** **Assignment 3**		• Bond and structure of fragrance compounds, functional groups and their relationship with the aroma of fragrance compounds	**5**

4	Students are able to explain reactions, physical properties, and fragrance compounds making	• • The accuracy in describing the reactions, physical properties and fragrance compounds making		**Lectures, Discussions, Reading the course material from PowerPoint, Evaluation [TM: 2x50”]** **Assignment 4**		• Reactions, physical properties, and fragrance compounds making	**5**
5	Students are able to explain standards and methods of fragrance analysis	• The accuracy in explaining the standards and methods of fragrance analysis		**Lectures, Discussions, Reading the course material from PowerPoint, Evaluation [TM: 2x50”]** **Assignment 5**		• Standards and methods of fragrance analysis	**5**
6	Students are able to explain the application of fragrances	• The accuracy in describing the application of the fragrance		**Lectures, Discussions, Reading the course material from PowerPoint, Evaluation [TM: 2x50”]** **Assignment 6**		Fragrance application in perfume formulation, utilization of fragrance bioactivity	**5**

7	Students are able to explain what dye is and its requirements	• The accuracy in explaining the dye and its requirements		**Lectures and Discussions [TM: 2x50”]** **Assignment 7**		• General introduction of dye	**5**
8	**Mid-semester Evaluation**						**20**
9, 10	Students are able to explain and use the basic principles of IR in determining the structure of organic compounds	• • The accuracy in reading and using IR data to determine the structure of organic compounds		**Lectures** **Group discussions** **[TM: 4x(2x50”)]** **[BT+BM:(1+1)x (2x60”)]**		• The theory of mass spectrometer, mass spectrum, determination of molecular weight from molecular formula and mass spectrum, the rule of thirteen, double bond equivalent (DBE), isotopes. • A practical approach to read the IR spectrum (reading and interpretation of infrared spectra data, correlation diagrams and tables, surveying the key wave numbers of several functional groups).	
11, 12	Students are able to explain and use the basic principles of UV in determining the	• The accuracy in describing and using UV spectra data to		**Lectures**		• The theory of electronic excitation, UV band	**10**

	structure of organic compounds	determine the structure of organic compounds		**Group discussions** **[TM: 4x(2x50")]** **[BT+BM:(1+1)x (2x60")]** **Assignment 2**		structure, chromophore, solvent influence (batochromic, hypochromic, hyperchromic, hypochromic), resonance effect, conjugation effect of alkenes. • Woodward-Fieser's rule for conjugated dienes, carbonyl compounds: keto-enones & Woodward's rule for enones. • Aldehydes/ketones α, β- unsaturated, aromatic compounds	
13, 14, 15	Students use H-NMR, C-NMR, MS, IR and UV-Vis spectrum data to determine the structure of organic compounds	• The accuracy in explaining and using H-NMR, C-NMR, MS, IR and UV-Vis spectrum data to determine the structure of organic compounds		**Lectures** **Group discussions** **Presentation** **[TM: 4x(2x50")]** **[BT+BM:(1+1)x (2x60")]**		• UV-Vis, IR, MS, NMR (Integrated problems) spectra identification case studies	**10**
16	**Final Semester Evaluation**						**20**

21. GEOCHEMISTRY AND MINERALOGY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
GEOCHEMISTRY AND MINERALOGY	SK 184764*	Organic Chemistry	3	0	VII	

AUTHORIZATION / LEGALIZATION	**TLP Editor**	**Course Group Coordinator**	**Head of Study Program (PRODI)**
	Prof. Dr. Drs. Djoko Hartanto, M.Si.	Drs. R. Djarot S.K.S., M.S.	Dr. rer. nat. Fredy Kurniawan, M. Si

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (CLO)	
	CLO 1	Students are able to explain earth phenomena related to the distribution of elements, minerals, and mineral occurrences
	CLO 2	Students have the mineral properties and associations knowledge, so they are able to relate them to the mineral formation in nature
	CLO 3	Students are able to analyze geochemical and mineralogical information in a natural phenomenon and its current development and present it orally and in writing

LO - CLOMAP

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**

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<tr><td>CLO 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 3</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td>In this course, students will learn about earth phenomena related to the distribution of elements, minerals and mineral occurrences. In addition, it also discusses the properties and associations of minerals so that students can explain the formation of minerals in nature.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td>1. Earth and its relation to the universe.
2. Elemental genesis
3. Earth's structure and composition.
4. Magma and igneous rock.
5. Sedimentation and sedimentary rock.
6. Atmosphere, Hydrosphere and Biosphere.
7. Metamorphism as a geochemical process.
8. Geochemical cycle, the study of the genesis of several elementals/compounds
9. Mineralogy introduction.
10. Minerals: tetrahedral silicate, isomorphism, polymorphism solid solution, non-crystalline minerals.
11. Mineral classification: classification by ion and chemical composition.
12. Crystals: growth and crystal geometry. Chemical, physical and optical properties of minerals.
13. Mineral formation and combination: mineral formation, rock mineral associations, sedimentary associations and deposits, metamorphic associations and deposits.
14. Ways of introducing some useful minerals: mining, processing and market share of minerals</td></tr>
<tr><td>Reference</td><td>Primary:

1. B. Mason and C. B. Moore, ”Principles of Geochemistry”, 4th Edition, John Wiley & Sons, New York, 1982.
2. Kusumoyudo, W. (1986) Mineralogi Dasar, Binacipta, Bandung.
3. Sinkankas, J. (1964) Mineralogy for Amateurs, D. Van Nostrand Company, Inc., New Jersey.

Secondary:</td></tr>
<tr><td>Lecturer</td><td>Prof. Dr. Drs. Djoko Hartanto, M.Si.</td></tr>
<tr><td>Pre-Requisite Courses</td><td>Have taken the courses Chemistry 1 and have passed with a minimum grade D.</td></tr>
</table>

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	**[C2, A3, P3]:** Students are able to explain the nature of the earth and the universe, as well as the elemental genesis	• The accuracy in explaining the earth and its relation to the universe • The accuracy in explaining the genesis of the elements and the stability of the elements in the universe		**Introductory lectures** **Brainstorming** **[TM: 1x(3x50")]**		• Earth and its geological processes • Earth and its relation to the universe • Matter genesis: the theory of the big bang, atomic fusion, hydrogen burning, helium burning, the stability of the elements in the universe, the abundance of elements in the universe	
2	**[C2, A3, P3]:** Students are able to explain the structure and composition of the earth	• The accuracy in explaining the structure of the earth and the elements and compounds that make up the earth		**Lectures** **Discussions** **[TM: 1x(3x50")]** **Non-test:** **Assignment** **Write an essay up to 1000 words** Students are able to explain the distribution of		• Earth Structure • The elements and compounds that make up the earth • Distribution of elements and compounds on earth	**10**

				elements and compounds in the crust of the earth, as well as potential utilization and technologies that may support it by writing			
3	**[C2, A3, P3]:** Students are able to explain about magma and igneous rock	• The accuracy in explaining magma and its formation process The accuracy in explaining the formation of igneous rock and the process of its formation		**Lectures** **Watching videos** **Discussions** **[TM: 1x(3x50")]**		• Definition of lava and magma • Magma formation process • Composition of magma • Effect of magma on earth conditions	
4	**[C3, A3, P3]:** Students are able to explain the process of sedimentation and rock sediments, as well as showing its relationship with the process of magma	• The accuracy in explaining the sedimentation process and the resulting sedimentary rock • The accuracy in explaining the relationship of sedimentation process with other natural phenomena, such as magma and volcano		**Lectures** **Discussions** **[TM: 1x(2x50")]** **Quiz** **[TM: 1x(1x50")]** **Test:** **written evaluation** The accuracy in explaining the process of sedimentation and its relationship with the condition of nature		• Sedimentation processes • Sedimentary rock formation • Types of rock sediments • Distribution of rock sediments on earth	**15**

5	**[C3, A3, P3]:** Students are able to explain the atmosphere, hydrosphere and biosphere and show the relationship between them on earth	• The accuracy in describing the atmosphere, hydrosphere and biosphere and showing their relationship on earth		**Lectures** **Discussions** **[TM: 1x(3x50")]**		• Definition of atmosphere, hydrosphere and biosphere • Composition of the atmosphere, hydrosphere and biosphere • The relationship between the atmosphere, hydrosphere and biosphere • The effects of the atmosphere, hydrosphere and biosphere existence on living things on earth	
6	**[C4, A4, P4]:** Students are able to explain geochemical processes and relate metamorphism as geochemical processes	• The accuracy in explaining geochemical processes and relating metamorphism as geochemical processes		**Lectures** **Discussions** **[TM: 1x(3x50")]**		• Geochemical process • Metamorphism on earth Metamorphism as a geochemical process	
7	**[C4, A4, P4]:** Students are able to explain geochemical cycles and relate them to the genesis of several elements/compounds	• The accuracy in explaining geochemical cycles and relating them to the genesis of		**Lectures** **Discussions** **[TM: 1x(3x50")]**		• Geochemical cycle • Impact of geochemical cycles • Elements and compounds genesis on earth	

		several elements/compounds					
8	**Mid-semester Evaluation**						**25**
9	**[C2, A3, P3]:** Students are able to explain general aspects of mineralogy	• • The accuracy in explaining the definition of mineralogy and aspects in mineralogy		**Lectures Discussions [TM: 1x(3x50")]**		• Definition of mineralogy • Crammed solid structure • Coordination number • Ionic solid geometry	
10	**[C2, A3, P3]:** Students are able to explain the types of mineral structures	• The accuracy in explaining the types of mineral structures		**Lectures Discussions [TM: 1x(3x50")]**		• Tetrahedral silicate minerals • Isomorphism • Polymorphic solid solution • Non-crystalline mineral	
11	**[C3, A4, P3]:** Students are able to explain mineral classification	• The accuracy in explaining mineral classification		**Lectures Discussions [TM: 1x(3x50")] Test: write an essay up 1000 words** Students are able to explain mineral structure, mineral properties that are produced		• Classification of minerals by their ion and chemical composition	**10**

12	**[C3, A4, P3]:** Students are able to explain the crystal structure/system in minerals	• The accuracy in describing the geometry of crystals in minerals and the properties they produce		**Lectures** **Discussions** **[TM: 1x(3x50")]**		• Crystal growth • Crystal structure in minerals • Crystal geometry • Mineral crystal analysis • Chemical, physical and optical properties of minerals	
13	**[C4, A4, P4]:** Students are able to explain the process of forming and combining minerals	• The accuracy in explaining the process of mineral formation and combination • The accuracy in showing the relationship between mineral formation and combination by the type of minerals that are generated		**Lectures** **Discussions** **[TM: 1x(3x50")]**		• Mineral formation and combination: mineral formation, rock mineral association, • Sediment associations and deposits • Metamorph associations and deposits	
14, 15	**[C4, A4, P4]:** Students are able to analyze the potential of a mineral	• The accuracy in analyzing the economic potential of mineral mining		**Lectures** **Discussions** **[TM: 2x(3x50")]** **Non-Test:** **Write a paper** The accuracy in analyzing mineral properties and examples of application/use of		• Useful types of minerals • Mining processing and mineral market share	**20**

				these minerals in industry			
16	**Final Semester Evaluation**						**20**

22. BUSINESS CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**						**Document Code**
TEACHING AND LEARNING PLAN							
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**	
BUSINESS CHEMISTRY	SK184765*	Optional	3	0	VIII		
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**		
			Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si		

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.2 (LO 2)	Capable of team work and has social sensitivity awareness of the public and the environment
	C.1 (LO 6)	Able to master the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to master concepts, theory and methods on analysis and synthesis of chemical substances
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (CLO)	
	CLO 1	Students are able to explain and show the types of chemicals and their roles in the world of industry and trade
	CLO 2	Students are able to calculate production costs and set product unit prices
	CLO 3	Students are able to predict and evaluate business opportunities in chemistry, propose and design chemical business ideas

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<tr><td>LO - CLOMAP</td><td>
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<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>CLO 2</td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td></tr>
<tr><td>CLO 3</td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td>In this course, students will learn about the types of chemicals commonly used in the chemical industry and industries related to chemicals, as well as chemicals that have high economic potential. Students will also learn about the chemical cycle system, estimate the cost components required in the chemical industry to determine the unit product sale value, challenges in the chemical industry and plan and start small industries in the chemical sector.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td>1. Chemistry and economics
2. Understanding the chemical business
3. Chemicals and chemical products in various industries
4. Transfer of chemicals from producers to consumers (chemical cycle)
5. Global chemical business: world trade, export and import of chemicals, challenges
6. Business ideas in chemistry
7. Production cost component, and product unit price setting
Started a small business in chemistry</td></tr>
<tr><td>Reference</td><td>Primary:

1. American Chemistry Council, “2017 Elements of The Business of Chemistry”, American Chemistry Council, 2017.
2. Department of Industry, Innovation and Science, “Chemical Business Checklist”, Australian Government, 2016.
3. K.R. Allen, “Entrepreneurship for scientists and engineers”, Pearson Prentice Hall, . Upper Saddle River, N.J, 2010.
4. E. Ries, “The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses”, New York: Crown Business, 2011.
5. B. Barringer, “Preparing Effective Business Plans”. Pearson-Prentice Hall, 2008

Secondary:</td></tr>
<tr><td>Lecturer</td><td></td></tr>
</table>

Pre-Requisite Courses	Have taken Basic Chemistry courses with a minimum score of D						
Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain the role of chemistry in economics	• Accuracy in explaining the role of chemistry in the economy world, including in the fields of marketing and industry		**Introductory Lecture & Brainstorming** **[TM: 1x(3x50")]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• Chemistry in everyday lives • The economic contribution of the chemical business	
2, 3	Students are able to explain the business of chemistry	• Accuracy in explaining the definition of the business of chemistry		**Lecture and discussion** **[TM: 2x(3x50")]**		• Price structure • Production indication • Price indication • Shipping costs	
4, 5	Students are able to explain the various types of chemicals and chemical products in industry	Accuracy in explaining the various types of chemicals in industry and chemical products	Lecture, Watch videos, Discussion	**Lecture and discussion** **[TM: 1x(3x50")]**		• The types of chemical industries and industries that involve chemicals • Important chemicals in the industrial world and their functions	**10%**
6	Students are able to explain the role of chemistry in the economics world, and the	• Accuracy in explaining the role of chemistry in the economics world		**Quiz** **[TM: 1x(3x50")]**		•	**10%**

	various chemicals that are important in marketing and industry	and various important chemicals in the world of marketing and industry					
7	Students are able to explain the chemical cycle	• The accuracy in describing the cycle of benzene derivative chemicals		**Lecture and discussion** **[TM: 1x(3x50")]**		• Chemical production • Chemical distribution • Consumption of chemicals • Chemical regulations	
8	**Mid-semester Evaluation**						**20%**
9	Students are able to explain the global business of chemicals	• Accuracy in explaining the global business of chemicals		**Lecture and discussion** **[TM: 1x(3x50")]**		• World trade • Export and import of chemicals • The challenges of global chemicals business	
10, 11	Students are able to select and analyze chemical business ideas	• Accuracy in analyzing chemical business ideas		**Lecture and discussion** **[TM: 2x(3x50")]**		• Large scale chemical business • Small scale chemical business • Chemical business ideas that are being developed over the last 10 years	**10%**

						• Business ideas that have the potential to grow	
11, 12	Students are able to analyze and calculate the production cost components and set the product unit prices	• Accuracy in analyzing production cost components • Accuracy in calculating the components of production costs and determining the unit price of the product		**Lecture and group discussion** **[TM: 2x(3x50")]**		• Classification of minerals by their ion and chemical composition	**10%**
13, 14	Students are able to analyze and evaluate the important aspects of establishing a small chemical business	• Accuracy in assessing and evaluating important aspects of starting a small chemical business and its economic potential		**Lecture, group discussion, and tutorial** **[TM: 2x(3x50")]**		• Identify target consumers • Identify business competitors • Identify and evaluate market share • Determine product excellence	**15%**
15, 16	Students are able to present their small chemistry business proposals and defend them in front of scientific forums	• Accuracy in presenting business ideas and the ability to analyze and evaluate business ideas and defend them in forums	Presentation and discussion	**Presentation and discussion** **[TM: 1x(3x50")]**		•	**25%**

23. FOOD CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**				**Document Code**	
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
FOOD CHEMISTRY	SK 184766*	Organic Chemistry	3	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Herdayanto Sulistyo Putro, S.Si., M.Si.; Zjahra Vianita Nugraheni, S.Si., M.Si.; Hamdan Dwi, M. Si		Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (CLO)	
	CLO 1	The students should be able to use the principles of basic chemistry knowledge as a basis to learn chemistry inwhich they will learn further throughout their whole studies.
	CLO 2	The students should be able to do the basic chemistry calculations.

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1						√			
CLO 2							√	√	√

Course Short Description	In this course, students will learn about the types of chemical components in food ingredients including structure, function, analysis methods, and food ingredients management. Learning materials include; Fermentation, natural interactions with food components, food additives, food processing technology (fat, flour, eggs, milk, meat, fruits), preservation, and food ingredients packaging.
Study Material: Subject Matter	Introduction to Food Chemical Compounds (Carbohydrates, Proteins and fats), Analysis of food ingredients (carbohydrates, proteins, fats, vitamins, minerals), additives (colorants, flavors, preservatives, metal binders, stabilizers, sweeteners, clarifiers, bleachers, bulking agents, thickeners, wetting agents, surfactants), toxic compounds in food, preservation process, packaging. Introduction to microbiology in food, analysis of cases contained in food products.
Reference	**Primary:** 1. T. P. Coutale,"Food: the Chemistry of its Components", Royal Society of Chemistry, 1993. 2. F. G. Winarno, "Kimia Pangan", Gramedia, Jakarta, 1986 3. L. H. Mayer, "Food Chemistry", 4th ed., Reinhold Publishing Comp., New York, 1986 4. J. Bower , "Food Theory and Application", 2nd edition, Maxwell Macmilian International, New York, 1992. 5. H. D. Belitz and W. Grosch, "Food Chemistry", Spinger Verlag, New York, 1987 **Secondary:**
Lecturer	Herdayanto Sulistyo Putro, S.Si., M.Si.; Zjahra Vianita Nugraheni, S.Si., M.Si.; Hamdan Dwi, M. Si
Pre-Requisite Courses	Have taken the course Chemistry 1

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1, 2	Understand the types of chemical components present in food ingredients	• The accuracy in explaining the structure and function of chemical compounds in food		**Lectures** **Quiz 1** **[TM: 2x(3x50")]**		• The structure and function of carbohydrates • Protein structure and its function • Structure and	**10**

						function of fat	
3, 4	Understand how to analyze and process food ingredients	• The accuracy in analyzing and processing food ingredients		**Lectures** **[TM: 2x(3x50")]**		• Analysis and processing of carbohydrates • Protein analysis and processing • Analysis and processing of fats, vitamins and minerals	
5, 6, 7	Recognizes the use of additives in several food ingredients	• The accuracy in knowing the types of additives in food		**Lectures** **[TM: 3x(3x50")]**		• Additives (colorants, flavors / flavors, preservatives, metal binders, stabilizers, sweeteners, clarifiers, bleachers, bulking agents, thickeners, wetters, surfactants)	
8	**Mid-semester Evaluation**						**25**
9	Understanding toxic compounds in foods	• The accuracy in finding toxic compounds in food		**Lectures** **[TM: 1x(3x50")]**		• Toxic compounds in foods	
10	Understanding the process of food preservation	• The accuracy in knowing the ways of preserving food		**Lectures** **Quiz 2** **[TM: 1x(3x50")]**		• Prevention of microbial decomposition: asepsis, Filtration, Microbial Control, Microbial Digestion • Prevention of food decomposition: Digestion of food	**10**

						enzymes, prevention of chemical reactions • Prevention from damage: caused by insects, caused by animals, caused by mechanical failure	
11	Understanding how food is packaged	• The accuracy in understanding the food packaging methods		**Lectures [TM: 1x(3x50")]**		• Food packaging method • Types of food packaging that is commonly used	
12	Understanding the microbiological processes in food	• The accuracy in knowing the biological processes on foods that are caused by microorganisms		**Lectures [TM: 1x(3x50")]**		• Types of microorganisms in some food samples: growth, prevention and control	
13	Understanding the cases that occur in food	• The accuracy in analyzing the various cases that exist in product food		**Focus Group Discussion [TM: 1x(3x50")]** **Assignment**		• Presentation and Discussion: case study	**10**
14, 15	Analyze cases through the Project Case Presentation	• The accuracy in presenting cases related to food products and proposing solutions		**Presentation Focus Group Discussion [TM: 1x(3x50")]**		• Presentation and Discussion: case study	**20**
15-16	**Final Semester Evaluation**						**25**

26. ENERGY STORAGE

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
ENERGY STORAGE	SK184766	Optional	3	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
			Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.2 (LO 2)	Has good moral, ethics and personality in completing one's task
	C.2 (LO 7)	Able to master the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Students are able to understand the properties, structure and reactivity of the materials used as energy storage along with the techniques for characterization and testing
	CLO 2	Students have basic knowledge about the method of making energy storage materials and fabricating energy stores

LO - CLOMAP

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CLO 1							√	√	
CLO 2		√					√	√	

Course Short Description	This course discusses the most basic concepts regarding energy storage materials in applications which include batteries, hydrogen storage, fuel cells and supercapacitors. The scope of the lecture material is the constituent material and its development, material characteristics, design, and energy storage fabrication. This course is designed for postgraduate students but can also be taken by final stage undergraduate students as an elective course.

	In addition, this course is also open to seventh semester students or higher or postgraduate students from other departments at ITS. This subject is delivered using English as an introduction. However, in the learning process it is still possible to use bilingualism (Indonesian and English). The learning method used is an interactive method based on student centered learning (SCL).
Study Material: Subject Matter	General concepts of energy storage, solid chemistry and energy storage, electrochemical energy storage and energy conversion, electrically conducting polymers, applied materials science for battery applications, polymer electrolytes, inorganic materials for SOFCs, materials for solar energy, battery technology and their assembly and testing, hydrogen storage material, and supercapacitors.
Reference	**Primary:** 1. R. A. Huggins, "Energy Storage", Springer, New York, 2010 2. D. W. Bruce, D. O'Hare and R. I. Walton (editors), Energy Materials, Inorganic Materials Series, John Wiley & Sons, Ltd., 2011 3. R. Zito, "Energy Storage: A New Approach", Scrivener Publishing, Salem-Massachusetts, 2010. 4. Y. Brunet (editor), "Energy Storage", ISTE Ltd., London, 2011 5. Scientific articles related to lecture topics **Secondary:**
Lecturer	Hamzah Fansuri, M.Si. Ph.D
Pre-Requisite Courses	The learning method used is an interactive method based on student centered learning so that it does not require special prerequisites to be able to attend this lecture. However, participants are expected to have basic Chemistry knowledge and skills according to the 2018 ITS curriculum.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain general concepts about batteries, polymer electrolytes, SOFCs, solar	• Accuracy in explaining energy reviews and energy demand forecasts		**Introductory lecture and brainstorming** **[TM: 1x(3x50")]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]**	• Energy overview • Energy demand forecast • Other possible sources of energy	**10%**

	cells, hydrogen storage, fuel cells and supercapacitors.	• Accuracy in explaining possible alternative energy sources			**[BM: 2×(2×50')]** **[PT: 1x(1x60')]**		
2, 3	Students are able to explain the chemical composition of biogenic materials	• The accuracy in describing the structure of natural products: carbohydrates, proteins, lipids, lignins, tannins, geochemical implications of variations in composition		**Lecture and group discussion** **[TM: 2x(3x50")]**		• Product structure of natural ingredients: carbohydrates, proteins, lipids, lignins and tannins • Geochemical implications of variations in composition	
4	Students are able to explain general concepts about batteries, polymer electrolytes, SOFCs, solar cells, hydrogen storage, fuel cells and supercapacitors.	Accuracy in explaining general concepts about hydrogen batteries and storage		**Quiz and evaluation** **[TM: 1x(3x50")]**		• Battery • Hydrogen storage	**15%**
5, 6	Students are able to explain general concepts about batteries, polymer electrolytes, SOFCs, solar cells, hydrogen storage, fuel cells and supercapacitors.	• The accuracy in explaining the fuel cell • The accuracy in explaining the supercapacitor		**Lecture, discussion, and quiz** **[TM: 2x(3x50")]**		• Fuel cells • Supercapacitor	
7	Students are able to explain general concepts about batteries, polymer electrolytes, SOFCs, solar	• Accuracy in describing fuel cells and supercapacitors		**Quiz** **[TM: 1x(3x50")]**		• Fuel cells • Supercapacitor	**15%**

	cells, hydrogen storage, fuel cells and supercapacitors						
8, 9, 10	Students are able to connect the link between energy storage materials with energy needs in the future.	• The accuracy in connecting the link between energy storage materials and energy needs in the future		**Lecture and discussion** **[TM: 3x(3x50")]**		• Chemical solids and energy storage • Electrochemical energy storage and energy conversion • Electrically conducting polymers Applied materials science for battery applications	
11	Students are able to make conclusions from the direction of energy storage material development that is being carried out in the last 20 years.	• The accuracy in drawing conclusions from the direction of energy storage material development that is being carried out in the span of the last 20 years		**Lecture and class discussion** **[TM: 1x(3x50")]**		• The development of energy storage materials in the last 20 years	**20%**
12, 14	Students are able to write critical reviews of scientific articles on the topic of energy storage materials in the last 5 years.	• The accuracy in writing critical review papers on the development of energy storage material research from various scientific articles in the last 5 years		**Lectures, guidance on writing critical review papers** **[TM: 2x (3x50 ")]**		• The development of energy storage material research in the last 5 years	

15, 16	Students are able to write critical reviews of scientific articles on the topic of energy storage materials in the last 5 years.	• The accuracy in writing critical review papers on the development of energy storage material research from various scientific articles in the last 5 years		**Writing the presentation** **[TM: 2x (3x50 ")]**		• The development of energy storage material research in the last 5 years	**40%**

27. CHEMO-BIOSENSORS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMO-BIOSENSORS	**SK 184811**	Analytical Cchemistry	2		VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Suprapto, M. Si., Ph. D		Suprapto, M. Si., Ph. D		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity, and communication ability
	C.2 (LO 7)	Able to apply concepts, theory, and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	

	CLO 1	Able to apply knowledge of fabrication systems and data acquisition based on tests with chemical sensor and biosensor (C4) based equipment
LO - CLOMAP		

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√			√			√	√	

Course Short Description	In the Chemo-Biosensor course, students learn analytical methods based on electrochemical sensors, optical sensors, gravimetric sensors, thermal sensors, and sensor applications on organic and inorganic samples, sensor cluster applications on the electronic nose, and electronic tongue.
Study Material: Subject Matter	1. Basic concepts of signals, sensors, and transducers 2. Classification of sensors based on the parameters tested. 3. Common techniques of sensor fabrication 4. Active ingredients for chemical sensors and biosensors 5. Electrochemical Sensor. 6. Electronic nose and electronic tongue 7. Chemical sensor and biosensor applications
Reference	**Primary:** 1. Fraden, Y," Handbook of Modern Sensor," Springer Verlag, New York, 2010 2. Tim C. Pearce(ed.); Susan S. Schiffman(ed.); H. Troy Nagle(ed.); Julian W. Gardner(ed.).," Handbook of Machine Olfaction," Wiley VH, Weinheim, 2003 3. Wang, J." Analytical Electrochemistry", Wiley VCH, New York **Secondary:**
Lecturer	Suprapto, Ph. D.
Pre-Requisite Courses	Have taken Intrumental Measurement Methods.

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Students can explain the basic concepts of signals, sensors, and transducers	•		**Lecture**		• **1,2 dan 3**	
2	Students can classify sensors based on the parameters tested	•		**Lecture**		• **1,2**	
3	Students can explain general techniques of sensor fabrication			**Lecture**		• **1,2**	
4	Students can explain the active ingredients of chemical sensors and biosensors	•		**Lecture**		• **1,2**	
5-7	Students can explain the types, procedure, fabrication method, and applications of electrochemical sensors	•		**Lecture**		• **1,2**	**10**
8	**Mid-semester Evaluation**						**30**
9-12	Students should be able to explain the procedure, fabrication method, and applications of electronic nose and electronic tongue along with its data processing	•		**Lecture, Group Discussion dan Presentation**			**20**
13	Students can explain the concept, way of working, and fabrication of biosensors	•		**Lecture**			

14	Students can explain chemical sensor and biosensor applications	•		**Lecture**			
15-16	**Final Semester Evaluation**						**40**

28. FORENSIC CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
Forensic CHEMISTRY	**SK 184812**	Analytical Chemistry	2		VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Djarot Sugiarso S., M.Si.		Suprapto, M. Si., Ph. D		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity, and communication ability
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Students should be able to understand analysis related to forensics

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√			√				√	

Course Short Description	In the Forensic Chemistry course, the analysis of chemical documents will be discussed; Analysis of firearms and explosives; Fire cause analysis; Alcohol analysis; Drug analysis; Analysis of counterfeit money and sharp weapons; Analysis of hair and fiber, blood, and other body fluids; method of identification of people.
Study Material: Subject Matter	1. a Basic understanding of forensic chemistry 2. Analysis of Document and Money Counterfeit 3. Analysis of Bullets and Explosives 4. Narcotics and Psychotropic Analysis 5. Alcohol analysis 6. Poison and Poisoning 7. Person Identification Method 8. Fire Analysis
Reference	**Primary:** 1. S. Bell, "Forensic Chemistry", Pearson Education, Inc., New Jersey, 2006. 2. A. Curry, "Poisons Detection in Human Organ", 2nd edition, Charles C. Thomas, USA, 1969. 3. O. Hara, "An Introduction to Chriminalistic", 3rd edition, 1956. 4. D. Owen," Hidden Evidence", Periplus Editions(HK) Ltd, London, 2000. 5. I. Sax, " Dangerous Material, 4th edition, 1973. **Secondary:**
Lecturer	Djarot Sugiarso S., M.Si.
Pre-Requisite Courses	Have taken Measurement Methods in Chemistry.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1-2	Able to demonstrate knowledge and apply chemical principles and concepts, especially those related to forensic chemistry	• Know whose the main expert of forensic chemistry • Knowing the advantages and disadvantages of Forensic Chemistry	Non-Test • Question and answer • Discussion	• Lectures & Brainstorming, [1x(4x50")] • Read text and ppt, observe pictures, [1 x (4x50")]	• Lectures & Brainstorming , [1x(4x50")] • Read text and ppt, observe pictures, [1 x (4x50")]	• Basic understanding of Forensic science • History and development of Forensic Science • Basic understanding of Forensic Science • Main Assignment: expert for forensic chemistry	5%
3	Be able to distinguish between genuine or fake documents theoretically	• The accuracy in determining the reagent used • The accuracy in determining the method used.	Non-Test • Question and answer • Discussion	Lectures, group discussion [1x(4x50")]	Lectures, group discussion [1x(4x50")]	• Definition of documents • Document falsification • Document falsification analysis methods	10%
4-5	Be able to distinguish between real or fake money theoretically	• The accuracy in determining the reagent used. The accuracy in determining the method used	Non-Test • Question and answer • Discussion	Lectures, group discussion [2x(4x50")]	Lectures, group discussion [2x(4x50")]	1. Banknotes and coins 2. Paper and ink analysis • Qualitative and quantitative analysis of metal in coins	15%
6-7	Able to analyze types of bullets and explosives	• Accuracy in determining the types of bullets and explosives based on evidence at the crime scene	Non-Test • Question and answer • Discussion	• Lectures, group discussion	• Lectures , group discussion	• Types of bullets based on use and raw materials	10%

		• • The accuracy in choosing the analysis method based on the data obtained		• Independent Assignment [2x(4x50")]	• Independent Assignment [2x(4x50")]	• Bullet residue analysis • Types of Explosives • Explosives analysis	
8	**Mid-semester Evaluation**						**10%**
9-11	Students can classify and analyze narcotics and psychotropic substances	• Accuracy in differentiating narcotics and psychotropic substances • The accuracy of selecting reagents for narcotics / psychotropic analysis • The accuracy of making conclusions about the types of narcotics / psychotropic drugs	Non-Test • Question and answer • Discussion Quiz	• Lectures, • group discussion Independent Assignment [2x(4x50")]	• Lectures, • group discussion Independent Assignment [2x(4x50")]	• The definition of Narcotics is based on the Narcotics Law 35/2009 • The classification of Narcotics and Psychotropics is based on the production, the effect that is caused, and based on the Narcotics Law 35/2009 • Narcotics and psychotropic analysis	15%

						•	
12	Students should be able to know about alcohol and its derivatives and way to analyze it (C4, P3, A3)	• • Accuracy in analyzing alcohol in samples	Non-Test: • discussion • question and answer	Lectures, group discussion [1x(4x50")]	Lectures, group discussion [1x(4x50")]	• Understanding Alcohol • The bad effects of alcohol • Analysis of alcohol in samples	10%
13-14	Students should be able to recognize and analyze poisons	• Accuracy in knowing the conditions of poisoning • The accuracy of explaining the difference between acute and chronic poisoning • The accuracy of selecting the poison analysis method • • accuracy in choosing antidote	Non-Test: • discussion • question and answer	Lectures, group discussion [2x(4x50")]	Lectures, group discussion [2x(4x50")]	• Definition of Poison and Symptoms of Poisoning • Types of Poisoning • The way Poison enters the body. • Poison Treatment • Poison Analysis	10%
15	Person Identification Method	Choose the right fingerprint method • Choosing the right stain analyzer	Non-Test: • discussion • question and answer	Lectures, group discussion [2x(4x50")]	Lectures, group discussion [2x(4x50")]	• Fingerprint analysis • Analyze blood, sperm, dust stains	5%
16	**Final Semester Evaluation**						

29. ORGANOMETALLIC COMPOUNDS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**					**Document Code**
SEMESTER LEARNING PROGRAMME						
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
ORGANOMETALLIC COMPOUNDS	SK 184821	Optional Courses	3	0	VIII	23 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	
	Dra. Ratna Ediati, M.Si., Ph.D.; Prof. Dr. Fahimak Martak, M. Si.		Dra. Ratna Ediati, M.Si., Ph.D		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	

Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	LO MK 1	Able to explain the definition of organometallic compound including the fundamental chemistry of organometallic from block s, p and d metals.
	LO MK 2	Able to predict the implementation of organometallic compound as catalyst in the synthesis of commonly used chemicals in society

LO – LO MK Map

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CP MK 1	√					√		√	

Course Description	In this lecture, the students will learn about the compound with metal-carbon bonding, the principal of organometallic chemistry from metals in s, p and d block related with the bonding, type of ligands, compound and reactions. This lecture also will discuss about the use of organometallic compound in synthesis (as catalyst)
Study Material: Subject matter	Bonding in organometallic compound, type of ligands and the compounds, reactions in organometallic compound and the implementation of organometallic compound in systhesis (as catalyst)
References	**Primary:** 1. D. D. Shriver and P. W. Atkins, "Inorganic Chemistry", 5th Edition, W.H. Freeman and Company, Oxford, 2010. **Secondary:** 1. Huheey, J.E., Keiter, E.A. and Keiter, R.L., "Inorganic Chemistry, Principles of Structure and Reactivity", Fourth Ediation, Harper Collins College Publishers, London 1993 2. Miessler, G.L. and Tarr, D.A., "Inorganic Chemistry", Third Ediation, Pearson Education International, Minnesota 2001 3. House, J.E., "Inorganic Chemistry", Academic Press, London, 2008.
Lecturer	Dra. Ratna Ediati, M.Si., Ph.D.; Prof. Dr. Fahimak Martak, M. Si.
Pre-Requisite Courses	Have taken Structure, Properties and Reactivities of Inorganic Compound, Element and Compund, passed with the minimum grade D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**

1	[C2, A3, P2]: The students should be able to explain the definition of organometallic compound	• Accuracy in explaining the chemical bonding in organometallic chemistry	**Technical:** **Criteria:**	**Lecture, brainstroming [TM: 1×(2×50')]**		• The history of compound • Definition of organometallic compound • The difference of organometallic compound and coordination compound • The examples of organometallic compound	
2	[C2, A3, P2]: The students should be able to explain the name of organometallic compound	• Accuracy in mentioning the name of organometallic compound	**Technical:** **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• Organic ligand and the nomenclature of organometallic compound	
3	[C3, A3, P2]: The students should be able to explain the 18's rule of electron and interprete the result	• Accuracy in interpretation the results of 18's electron rule to the stability of organometallic compound	**Technical:** Assignment 1 Short report **Criteria:**	**Lecture, discussion [TM: 1×(2×50')]**		• 18's electron rule • Electron calculation • The importance of 18's electron rule • Complex of square planar	**10**
4,5	[C3, A3, P2]: The students should be able to show the type of ligand in organometallic chemistry	• Accuracy in showing the type of ligand and the role of species in organometallic compound	**Technical:** **Criteria:**	**Lecture, discussion [TM: 2×(2×50')]**		• Ligand in organometallic chemistry • Carbonyl complexed • Similar ligand with CO	

						• Hydride complex and dihydrogen • Ligand with phi-system	
6,7	[C3, A3, P2]: The students should be able to explain and analysis the bonding in organometallic compound	• Accuracy in explaining and analysis the bonding in organometallic compound	**Technical:** Short quiz **Criteria:**	**Lecture, discussion** **[TM: 1×(2×50')]** **Lecture, discussion** **[TM: 1×(1×50')]** **Quiz** **[TM: 1×(1×50')]**		• Bonding between ionic metal and organic phi-system, linier phi-system, cyclic phi-system, fullerene complex	**15**
8	**Mid Semester Evaluation**						**25**
9,10	[C4, A3, P2]: The students should be able to analysis the data results from characterization of organometallic compound	• Accuracy in analysis the data results from characterization of organometallic compound	**Technical:** Assignment 2 (analysis the given data characterization) **Criteria:** •	**Lecture, discussion** **[TM: 2×(3×50')]**		• Infrared spectra • NMR spectra • Example of interpretation data from characterization	**10**
11,12	[C5, A4, P3]: The students should be able to explain and predict the reaction in organometallic compound	• Accuracy in analysis and predict the reaction in organometallic compound	**Technical:** Assignment 3 (predict the given reaction of organometallic compound) **Criteria:**	**Lecture, discussion** **[TM: 2×(3×50')]**		• Reaction that involve the release and acceptance electron : substitution and dissociation ligand oxidative addition, reductive elimination,	**10**

						nucleophilic substitution	
13-15	[C6, A4, P3]: The students should be able to explain and predict the implementation/application of organometallic chemistry especially in catalysis	• Accuracy in predict the implementation/application of organometallic chemistry especially in catalysis	**Technical:** Assignment 4 (predict the implementation/application of organometallic chemistry especially in catalysis) **Criteria:**	**Quiz** **[TM: 1×(2×50')]**		• The example catalysis: deuteration catalysis • Hydroformylation • Monsanto process (acetic acid) • Wacker process (Smidt) • Hydrogenation with Wilkinson catalyst • Olefin metathesis • Heterogeneous catalyst : Ziegelr Natta polymerization • Water gas reaction	**15**
16	**End Semester Evaluation**						**15**

30. BIOINORGANIC

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**	**Document Code**

SEMESTER LEARNING PROGRAMME

COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
Bioinorganic	SK 184822	Optional Courses	2	0	VIII	23 February 2021
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**	

<table>
<tr><td colspan="2"></td><td>Prof. Dr.rer.nat. Irmina Kris Muwani</td><td>Dra. Ratna Ediati, M.S., Ph.D.</td><td>Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="4">LO-PRODI Charged to the Courses</td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="3">Able to report his/her own work in a good and discipline manners</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="3">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (LO MK)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>LO MK 1</td><td colspan="3">Able to explain the role of metal with the biological reaction inside the body</td></tr>
<tr><td>LO – LO MK Map</td><td colspan="4"><table><tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr><tr><td>CP MK 1</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr></table></td></tr>
<tr><td>Course Description</td><td colspan="4">In this course students learn Storage, Transport and Biomineralization of Transition Metals, Reaction Pathways for Zinc Enzymes and Related Biological Catalysts, Calcium in Biological Systems, Synthetic and Biological Oxygen Carriers, Oxygen Reactions, Electron Transfer, Ferredoxins, Hydrogenases and Nitrogenases: Metal-Sulfides , Proteins, Metal / Nucleic Acid Interactions, Metals in Medicine</td></tr>
<tr><td>Study Material:
Subject matter</td><td colspan="4">Storage, transport, transition metal biomineralization, the connected enzyme reaction pathway of zinc and biology catalyst, calcium in biological system, oxygen transport synthetic and biological, oxygen reaction, electron transfer, ferredoxin, hydrogenase and nitrogenase : metal-sulfide, protein, interaction of metal/nucleic acid, metal in medicine</td></tr>
<tr><td>References</td><td colspan="4">Primary:
1. Bertini, I., Gray, H. B. dan Lippard, S. J., “Bioinorganic Chemistry” University Science Books Mill Valley, California, 1994.

Secondary:
2. Rehder, D., “Bioinorganic Vanadium” John Wiley and Sons Ltd., 2007
3. Housecroft, C.E. and Sharpe A. G. ,” Inorganic Chemistry” 2nd Ed. Pearson Education Limited, 2005</td></tr>
<tr><td>Lecturer</td><td colspan="4"></td></tr>
</table>

	Prof. Dr.rer.nat. Irmina Kris Muwani						
Pre-Requisite Courses	-						
Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1	**[C2, A3, P1]** The students should be able to explain the process of metal storage inside the body	• Accuracy in explaining the material and process of important metal storage inside the body	**Technical:** **Criteria:**	**Lecture, discussion and brainstorming [TM: 1×(2×50')]**		• Metal storage materials • Process of metal storage inside the body	
2,3	**[C2, A3, P1]** The students should be able to explain the transport process and biomineralization of transition metal	• Accuracy in explaining the transport process of transition metal inside the body • Accuracy in explaining the process of biomineralization of transition metal inside the body	**Technical:** Assignment 1 (resume 100 words) Finding one of process transport and biomineralization of transition metal inside the body	**Lecture, discussion [TM: 2×(2×50')]**		• Process transport of transition metal inside the body • Biomineralization of metal transition	**15**

			Criteria: Accuracy in explaining the transport process of transition metal inside the body and biomineralization process inside the body				
4	Quiz 1	•	**Technical:** **Criteria:**	**Written test** **[TM: 1×(2×50')]**			**15**
5,6	**[C2, A3, P1]** The students should be able to explain the enzyme reaction pathway of zinc and the related biological catalysis	• Accuracy in explaining the enzyme reaction pathway of zinc • Accuracy in explaining the biological catalysis which related to enzyme reaction pathway of zinc	**Technical:** **Criteria:**	**Lecture, discussion** **[TM: 2×(2×50')]**		• Type of enzyme and its function • Zinc enzyme and the reaction pathway • Type of biological catalyst	
7	**[C2, A3, P1]** The students should be able to explain the reaction inside the body which involving oxygen	• Accuracy in explaining the type of chemical reaction which involving oxygen and metal transition inside the body	**Technical:** **Criteria:**	**Lecture,study case** **[TM: 2×(2×50')]**		• Type of chemical reaction which involving oxygen • Chemical reaction inside the body which involving oxygen interaction	

						with transition metal	
8	**Mid Semester Evaluation**						**20**
9	**[C2, A3, P1]** The students should be able to explain the electron transfer in reaction between metal and biological network	• Accuracy in explaining the process of electron transfer in reaction between metal and biological network	**Technical:** Assignment 2 (short report) Showing the process of electron transfer in reaction between metal and biological network **Criteria:** Accuracy in explaining the process of electron transfer in reaction between metal and biological network	**Lecture, discussion** **[TM: 1×(2×50')]**		• Electron transfer process	**10**
10,11	**[C2, A3, P1]** The students should be able to explain the ferredoxin process	• Accuracy in explaining the ferredoxin process	**Technical:** **Criteria:**	**Lecture, discussion** **[TM: 2×(2×50')]**		• Ferredoxin process	
12	Quiz 2	•	**Technical:** **Criteria:**	**Written test** **[TM: 1×(2×50')]**			**15**
13-15	**[C2, A3, P1]** The students should be able to explain the process of hydrogenese and nitrogenese;	• Accuracy in explaining the process of hydrogenese and	**Technical:** **Criteria:**	**Lecture, discussion** **[TM: 3×(2×50')]**		• Hydrogenese and nitrogenese which involce metal sulfide and protein	

	metal sulfide, protein, interaction of metal/nucleic acid, metal in medicine	nitrogenese which involce metal sulfide and protein • Accuracy in explaining the interaction between metal and nucleic acid • Accuracy in explaining the role and function of metal in medicine				• Interaction of metal and nucleic acid • Metal in medicine	
16	**End Semester Evaluation**						**25**

31. SOLID STATE CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**						**Document Code**
SEMESTER LEARNING PROGRAMME							
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**	
SOLID STATE CHEMISTRY	SK 184823	Optional Courses	2	0	VIII	23 February 2021	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**		
	Dr. Drs. Eko Santoso, M.Si.		Dr. Drs. Eko Santoso, M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.		
Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**						
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners					

<table>
<tr><td></td><td>C.1 (LO 6)</td><td>Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td></td><td>C.2 (LO 7)</td><td>Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td></td><td>D.1 (LO 8)</td><td>Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td></td><td colspan="2">Course Learning Outcomes (LO MK)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>LO MK 1</td><td>Have the knowledge related to the concept of solid substance and be able to explain the needed physical properties to develop the benefit of solid substance</td></tr>
<tr><td></td><td>LO MK 2</td><td>Have the knowledge related to the concept of solid substance and be able to explain the reactivity of solid substance to develop the benefit of solid substance</td></tr>
<tr><td></td><td>LO MK 3</td><td>Have the knowledge related to the synthesis method and characterization of solid substance</td></tr>
<tr><td>LO – LO MK Map</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CP MK 1</td><td>√</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Description</td><td colspan="2">Solid Chemistry is an in-depth overview of the concepts related to the synthesis, structure, bonding, reactivity and physical properties of materials in the solid phase. In this lecture, these concepts will be presented in detail, and accompanied by an explanation of the methods used to prepare and characterize these solid materials. Furthermore, the latest developments, for example, nanotubes and related structures such as graphene, metal organic frameworks and Fe-based high temperature superconductors will also be presented. Following the Solid Substance Chemistry course is an important stage for students who will have a career in science and the materials industry</td></tr>
<tr><td>Study Material:
Subject matter</td><td colspan="2">Crystal structure, defect of crystal, solid solution, synthesis method, processing, solid fabrication, physical method for solid characterization, electrical properties, magnetic properties, optical properties and application.</td></tr>
<tr><td>References</td><td colspan="2">Primary:

1. L. E. Smart and E. A. Moore, “Solid State Chemistry : An Introduction”, 4th Edition, CRC Press, 2012.

Secondary:

2. The related text book
3. The related scientific articles</td></tr>
</table>

Lecturer	Dr. Drs. Eko Santoso, M.Si., Ir. Endang Purwanti S., M.T.
Pre-Requisite Courses	Have taken Inorganic Elements and Compound and Molecular Structure

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1	The students should be able to explain the difference of hcp and ccp structure, type of solid with cp structure (metal, ionic, covalent, molecular)	• Accuracy in explaining	**Technical:** Reading, listening, discussion **Criteria:**	**Reading text, presentation and discussion [TM: 1×(2×50')]**		• Crystal structure	**5**
2	The students should be able to explain the type of unit cell, crystall lattice, able to draw the unit cell projection and determine the atom coordinate, calculate the crystal density, explain the polyhedra structure and type of important structure in solid	• Accuracy in drawing and calculate	**Technical:** Reading, drawing and calculate **Criteria:**	**Reading text, presentation, assignment, drawing and calculate [TM: 1×(2×50')]**		• Crystal structure	**5**

3	The students should be able to explain the type of defect solid crystalline, effect and the application	• Accuracy in explaining and conclude	**Technical:** Reading, writing, presentation and discussion **Criteria:**	**Reading text, presentation, discussion, assignment, reading journal [TM: 1×(2×50')]**		• Crystal defect	**5**
4	The students should be able to explain type of solid solution, properties and application	• Accuracy in explaining and conclude	**Technical:** Reading, writing, presentation and discussion **Criteria:**	**Reading text, presentation, discussion, assignment of reading journal [TM: 1×(2×50')]**		• Solid solution	**5**
5-7	The students should be able to explain and choose the synthesis method, processing and the fabrication to get desired solid	• Accuracy in explaining and conclude	**Technical:** Reading, writing, presentation and discussion **Criteria:**	**Reading text, presentation, discussion, assignment of reading journal [TM: 1×(2×50')]**		• Synthesis method, processing and fabrication of solid	**10**
8	**Mid Semester Evaluation**						**20**
9-11	The students should be able to explain and choose the correct physical method to characterize the solid to get certain parameter	• Accuracy in explaining and conclude	**Technical:** Reading, writing, presentation and discussion **Criteria:** •	**Reading text, presentation, discussion, assignment of reading journal [TM: 3×(2×50')]**		• Physical method for solid characterization (diffraction, microscopy, spectroscopy and thermal method) •	**15**

12-14	The students should be able to explain the physical properties of solid and application	• Accuracy in explaining and conclude	**Technical:** Reading, writing, presentation and discussion **Criteria:**	**Reading text, presentation, discussion, assignment of reading journal [TM: 3×(2×50')]**		• Physical properties of solid and application (electrical, magnetic and optical properties)	**15**
15-16	**End Semester Evaluation**						**20**

32. INDUSTRIAL CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**						**Document Code**
SEMESTER LEARNING PROGRAMME							
COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**	
INDUSTRIAL CHEMISTRY	SK 184823	Optional Courses	2	0	VIII	23 February 2021	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program**		
	Prof. Dr. Syafsir Akhlus, M.Sc.		Dra. Ratna Ediati, M.S., Ph.D.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.		

Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**	
	A.5 (LO 2)	Able to internalize the spirit of independence, struggle, and entrepreneurship
	B.2 (LO 4)	Able to give alternative solutions with the characters of leadership, creativity and communication ability
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (LO MK)	

	LO MK 1	Able to know and understans the role of chemistry in real industry life, not only in laboratory scale
LO – LO MK Map		

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1		√		√				√	√

Course Description	In this course students will learn about the concept of mass balance, energy balance, chemical engineering operations and chemical industrial processes. This lecture will deliver by discussion in class and also experience in the chemical industry regarding chemical industrial processes. In this lecture, it is necessary to visit one of the chemical industries that is related to processing chemical raw materials into products.
Study Material: Subject matter	Fundamental chemistry, chemical reaction in industry, type of equipment in industry, gas synthesis process, metallurgy industry, petrochemical industry, cement industry, glass industry and pollution control
References	**Primary:** 1. John A. Tyrell, 2014, FUNDAMENTALS OF INDUSTRIAL CHEMISTRY, John Wiley & Sons **Secondary:** 2. K. Weissermel, H. J. Arpe, 2003, Industrial Organic Chemistry, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 3. H.-G. Franck J.w. Stadelhofer, Industrial Aromatic Chemistry, 1988, Springer-Verlag Berlin Heidelberg New York London Paris Tokyo
Lecturer	Prof. Dr. Syafsir Akhlus, M.Sc.
Pre-Requisite Courses	Have taken Thermodynamic Chemistry and Dynamic Chemistry, passed with minimum grade D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**

1	The students should be able to understand the fundamental chemistry in industrial scale	• Accuracy in understanding	**Technical:** Class assignment **Criteria:**	**Lecture and discussion [TM: 1×(2×50')]**		• Stoichiometry in chemical reaction in industrial scale, %yield, thermodynamic chemistry and chemical kinetics	**Include in Quiz 1**
2	The students should be able to understand the mass balance in chemical reaction	• Accuracy in explaining	**Technical:** Assignment of mass balance **Criteria:**	**Lecture and discussion [TM: 1×(2×50')]**		• Mass balance and thermal balance	**Include in Quiz 1**
3,4	The students should be able to understand the use of equipment in industry	• Accuracy in understanding	**Technical:** Assignment (identify the industrial equipment) **Criteria:**	**Lecture and discussion [TM: 1×(2×50')]**		Type of equipment in industry, distillation tower, evaporator, boiler and extraction	**Include in Quiz 1**
5	**QUIZ 1**						**25**
6,7	The students should be able to explain and connect the use of chemical substance in industry	• Accuracy in connecting the use of chemical substance in industry	**Technical:** Assignment (identify the type of substance for industrial purpose) **Criteria:**	**Lecture and discussion [TM: 2×(2×50')]**		• Raw material for industry, safety and storage	**Include in mid-semester evaliation**

8	**Mid Semester Evaluation**						**25**
9,10	The students should be able to understand and know the industry of inorganic chemistry	• Accuracy in understanding	**Technical:** Class assignment **Criteria:** •	**Lecture and discussion [TM: 1×(2×50')]**		• Sulfate, phosphor, chloride and phosphate industry	**Include in Quiz 2**
11	The students should be able to understand and know the industry of material	• Accuracy in understanding	**Technical:** Class assignment **Criteria:**	**Lecture and discussion [TM: 1×(2×50')]**		• Ferrous Metals, Non-Ferrous Metals dan Alloy	**Include in Quiz 2**
12	**QUIZ 2**						**25**
13,14	The students should be able to understand and know the petrochemical and polymer industry	• Accuracy in understanding	**Technical:** Class assignment **Criteria:**	**Lecture and study case [TM: 1×(2×50')]**		• Petrochemical and polymer industry	**Include in final semester evaluation**
15	The students should be able to understand and know the pollution control in chemical industry	• Accuracy in analysis	**Technical:** Assignment of case analysis and idea of solving **Criteria:**	**Lecture and study case [TM: 1×(2×50')]**		• Introduction to the type of pollution control	**Include in final semester evaluation**
16	**End Semester Evaluation**						**25**

33. BASIC MOLECULAR COMPUTATION

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **CHEMISTRY DEPARTMENT**	**Document Code**

SEMESTER LEARNING PROGRAMME

COURSE (MK)	**CODE**	**Course Diciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
BASIC MOLECULAR COMPUTATIONAL	SK 184825	Optional Courses	3	0	VIII	23 February 2021

AUTHORIZATION / LEGALIZATION	**TLP Editor**	**Course Group Coordinator**	**Head of Study Program**
	Dr. Yuly Kusumawati, S.Si., M.Si; Dr. Triyanda Gunawan, S.Si.	Dr. Drs. Eko Santoso, M. Si..	Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.

Program Learning Outcomes (LO)	**LO-PRODI Charged to the Courses**	
	A.1 (LO 1)	Able to report his/her own work in a good and discipline manners
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (LO MK)	
	LO MK 1	Expert the use of software to predict the physical and chemical properties and conclude from the obtained properties

LO – LO MK Map

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CP MK 1	√						√	√	

Course Description	This lecture discusses the molecular simulation using computational method
Study Material: Subject matter	1. Introduction to chemsketch and avogadro to draw molecule structure 2. Numerical method as a basic to computational calculation

	3. Type of computational molecular: Ab-initio, HF, DFT, QM/MM 4. The example of calculation : bond lengthe, dipole moment, partial charge, vibration, electronic transition, thermodynamic, reactivity, isomeric stabilization, simpe organic reaction kinetic
References	**Primary:** **Secondary:**
Lecturer	Dr. Yuly Kusumawati, S.Si., M.Si Dr. Hendro Juwono, M.Si
Pre-Requisite Courses	Have taken Mathematical Chemistry and Computation

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assesment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assesment portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face class (5)**	**Online (6)**	**(7)**	**(8)**
1	The students should be able to explain the numerical method as a basic for calculation in computational chemistry	• Accuracy in explaining the definition of numerical method • Accuracy in give the example of calculation using simple numerical method • Accuracy to give the analogy the numerical method for computational chemistry calculation	**Technical:** Quiz **Criteria:**	**Lecture, exercise [TM: 1×(2×50')]**		• Introduction of numerical method for computational chemistry	**3**

5-8	The students should be able to explain the concept of surface tension, various method to measure the surface tension and further application for surface tension value	• Accuracy in explaining, creativity in writing and presentation, group cohesiveness	**Technical:** Reading, listening, writing, experiment, presentation, discussion, group discussion **Criteria:**	**Reading text, presentation, experiment, discussion [TM: 4×(2×50')]**		• Capillarity and surface tension [1] (page 17-58) [2] (page 4-35)	**10**
2,3	The students should be able to mention the type of method in computational chemistry calculation (C2, P2)	• Accuracy to mention the method for computational chemistry calculation	**Technical:** Quiz **Criteria:**	**Lecture, exercise [TM: 3×(2×50')]**		• Review of quantum mechanics • The method to solve compotational chemistry: ab-initio, DFT, QM/MM	**3**
3	The students should be able to explain the basis set concept and the role in computational chemistry (C2, P2)	• Accuracy to mention the basis set that used in computational chemistry calculation	**Technical:** Quiz **Criteria:**	**Lecture, exercise, assignment [TM: 1×(2×50')]**		• A basis set: slater and Gaussian function • Contraction, polarization and diffusion function	**3**
4,5	The students should be able to use software (chem sketch and avogadro) to draw the molecular structure and solid (C2, P2)	• Accuracy to draw the molecular and solid structure using chemsketch and avogadro	**Technical:** Assignment **Criteria:**	**Lecture, practice [TM: 3×(2×50')]**		• Chemsketch and Avogadro software to draw molecule and preparing the input file	**3**
6,7	The students should be able to predict the bond lengh, dipole moment, partial charge	• Accuracy to calculate and analysis the calculations to predict	**Technical:** Assignment	**Lecture, exercise, practice [TM: 5×(2×50')]**		• The use of software to predict the bond lengh, dipole	**3**

	using available software (C2, P2)	the bond length, dipole moment and partial charge	**Criteria:**			moment, partial charge	
8	**Mid Semester Evaluation**						**20**
9	The students should be able to predict the bond lengh, dipole moment, partial charge using available software (C2, P2)	• Accuracy to calculate and analysis the calculations to predict the bond length, dipole moment and partial charge	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice [TM: 4×(2×50')]**		• The use of software to predict the bond lengh, dipole moment, partial charge	**3**
10	The students should be able to predict the thermodynamic properties using available software (C2, P2)	• Accuracy to calculate and analysis the calculations to predict the thermodynamic properties	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice [TM: 2×(2×50')]**		• The use of software to predict the bond lengh, dipole moment, partial charge	**3**
11	The students should be able to predict the reactivity and stability of isomer using available software (C2, P2)	• Accuracy to calculate and analysis the calculations to predict the reactivity and stability of isomer	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice [TM: 2×(2×50')]**		• The use of software to predict the bond lengh, dipole moment, partial charge	**3**
12	The students should be able to predict the kinetic mechanism using available software (C2, P2)	• Accuracy to calculate and analysis the calculations to predict the kinetic mechanism	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice [TM: 2×(2×50')]**		• The use of software to predict the bond lengh, dipole moment, partial charge	**3**

13,14	The students should be able to predict the properties of protein using available software (C2, P2)	• Accuracy to calculate and analysis the calculations to predict the properties of protein	**Technical:** Assignment **Criteria:**	**Lecture, exercise, practice [TM: 4×(2×50')]**		• The use of software to predict the bond lengh, dipole moment, partial charge	**3**
15,16	**End Semester Evaluation**						**20**

34. FERMENTATION

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**						**Kode Dokumen**
TEACHING AND LEARNING PLAN							
COURSE (MK)		**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
FERMENTATION		SK 184831	Biochemistry	2	0	VIII	07 Januari 2020
AUTHORIZATION / LEGALIZATION		**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
		Drs. Refdinal Nafwa, M.S.		Herdayanto S. Putro, S.Si., M.Si.		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.	
Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**						
	C.1 (LO 6)	Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics					
	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances					
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.					
	D.2 (LO 9)	Able to apply chemistry mindset in driving the creation of job opportunities					
	Course Learning Outcomes (LO MK)						
	CP MK 1	Students are able to explain the concept and application of fermentation					

LO – LO MK Map	

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CP MK 1						√	√	√	√

Course Short Description	
Study Material: Subject matter	Introduction to fermentation, microorganism growth (cell growth kinetics, batch bioreactors, continuous bioreactors); fermentation media, types of fermentation (alcoholic fermentation, lactic acid fermentation); fermentation on an industrial scale, purification of fermentation products and presentation of assignments.
Reference	**Main:** 1. Stanbury, P. F. and Whittaker, A., ”Principles of fermentation Technology”, Pergamon Press Ltd., 1984 2. Smith, J. E., ”Prinsip Bioteknologi”, Penerbit PT Gramedia, Jakarta, 1990 **Supporting:** 4.
Supporting Lecturer	Drs. Refdinal Nafwa, M.S.
Pre-Requisite Courses	Have taken the course Biochemistry

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1-2	Students are able to gain skills in performing some general fermentations	• The accuracy in explaining the principle of fermentation	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Introduction to fermentation • Introductory lecture	
3-5	Students are able to master the concept of making bioreactor	• The accuracy in explaining how to make bioreactor	**Technical :** **Quiz 1** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		Microorganism growth (cell growth kinetics, batch bioreactors, continuous bioreactors)	**15**
6-7	Students are able to gain skills in performing some general fermentations	• The accuracy in mentioning and explaining media for fermentation	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		Media for fermentation	
8	**Mid-term evaluation**						**25**
9	Students are able to gain skills in performing some general fermentations	• The accuracy in explaining the process of alcohol fermentation	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• Alcohol fermentation	

10	Students are able to gain skills in performing some general fermentations	• The accuracy in explaining the process of lactic acid fermentation	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• Lactic acid fermentation	
11-12	Students are able to master the concept of making bioreactor	• The accuracy in explaining the process of fermentation in industrial scale	**Technical :** **Quiz 2** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Fermentation in industrial scale	**20**
13-14	Students are able to master the concept of making bioreactor	• The accuracy in explaining the purification process of fermentation products	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• The purification of fermentation products	
15	Students are able to master the concept of making bioreactor	• The accuracy in re-presenting a research article related to the fermentation	**Technical :** **Assignment** **Criteria :**	**Discussion** **[TM: 1x(2x50")]**		• Presenting the assignment	**15**
16	**End-term evaluation**						**25**

35. ENZIMOLOGY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Kode Dokumen**
TEACHING AND LEARNING PLAN		

<table>
<tr><td colspan="2">COURSE (MK)</td><td>CODE</td><td>Course disciplines (RMK)</td><td colspan="2">Semester Credit Units</td><td>SEMESTER</td><td>Compilation Data</td></tr>
<tr><td colspan="2">ENZYMOLOGY</td><td>SK 184832</td><td>Biochemistry</td><td>2</td><td>0</td><td>VIII</td><td>07 Januari 2020</td></tr>
<tr><td colspan="2" rowspan="2">AUTHORIZATION / LEGALIZATION</td><td colspan="2">TLP Editor</td><td colspan="2">Course Group Coordinator</td><td colspan="2">Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2">Herdayanto S. Putro, S.Si., M.Si.</td><td colspan="2">Herdayanto S. Putro, S.Si., M.Si.</td><td colspan="2">Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="7">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="5"></td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="6">Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="6">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="6">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="6">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (LO MK)</td><td colspan="5"></td></tr>
<tr><td>CP MK 1</td><td colspan="6">Students are able to apply the basic concepts of enzymes in enzyme isolation and purification techniques</td></tr>
<tr><td colspan="2"></td><td colspan="6"></td></tr>
<tr><td>LO – LO MK Map</td><td colspan="8"><table><tr><td></td><td>LO 1</td><td>LO 2</td><td>LO 3</td><td>LO 4</td><td>LO 5</td><td>LO 6</td><td>LO 7</td><td>LO 8</td><td>LO 9</td></tr><tr><td>CP MK 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td></tr></table></td></tr>
<tr><td>Course Short Description</td><td colspan="8">The study covers the roles of enzymes as biocatalyst: Review of enzyme concepts (enzyme structure, enzyme activity, pH effect, temperature, substrates and inhibitors, enzyme sources); the concept of isolation and enzyme purification techniques (cell breakdown, centrifugation, deposition, fractionation, electrophoresis, gel filtration); Enzyme isolation techniques (cell culture, cell breakdown, centrifugation); enzyme purification techniques (precipitation of ammonium sulfate, precipitation with acetone, substrate effect); Laboratory works and presentation.</td></tr>
<tr><td>Study Material: Subject matter</td><td colspan="8">Review of enzyme concepts (enzyme structure, enzyme activity, pH effect, temperature, substrates and inhibitors, enzyme sources); the concept of isolation and enzyme purification techniques (cell breakdown, centrifugation, deposition, fractionation, electrophoresis, gel filtration); Enzyme isolation techniques (cell culture, cell breakdown, centrifugation); enzyme purification techniques (precipitation of ammonium sulfate, precipitation with acetone, substrate effect)</td></tr>
<tr><td>Reference</td><td>Main:</td><td colspan="7">Reference</td></tr>
</table>

	1. Boyer, R. F., ”Modern Experimental Biochemistry”, Addison-Wesley publishing company, California, 1986. 2. Crueger, W. and Crueger, A., ”Biotechnology: A Textbook of industrial Microbiology”, Sinauer associates, Inc., Sanderland and Science Tech, Inc., Madison, 1984. **Supporting:** 5.
Supporting Lecturer	Herdayanto S. Putro, S.Si., M.Si.
Pre-Requisite Courses	Have taken the course Biochemistry

Session	**Learning outcome of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Time Estimation]**		**Learning Material [Reference]**	**Assessment (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to understand the basic concept of enzyme (enzyme structures and enzymatic activity)	• The accuracy in explaining the basic concept of enzymology	**Technical :** **Criteria :**	**Lecture [TM: 1x(2x50”)]**		• Introduction to enzyme structure and enzymatic activity as well as enzyme naming	
2	Students are able to understand the basic concept	• The accuracy in explaining the effect of	**Technical :** **Quiz 1**	**Lecture [TM: 1x(2x50”)]**		The effect of pH and temperature on enzyme activity	**20**

	of enzyme (pH and temperature effects)	pH and temperature on enzyme activity	**Criteria :**				
3-4	Students are able to understand the basic concept of enzyme (substrate and inhibitor)	• The accuracy in understanding the enzymatic inhibition process	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Types of reactions of substrates and inhibitors with enzymes. • The basic principles of Michaelis-Menten and Lineweaver-Burk. • The basic concepts of Feed-back inhibition.	
5-6	Students are able to understand the basic concept of enzyme (sources of enzyme)	• The accuracy in understanding the sources of enzyme	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		Types of enzyme sources	
7	Students are able to understand the concept of enzymological techniques	• The accuracy in understanding the processes of cell breakdown, centrifugation, and deposition	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		The cell breakdown, centrifugation, deposition	
8	**Mid-term evaluation**						**25**
9-10	Students are able to understand the concept of enzymological techniques	• The accuracy in understanding the process of fractionation,	**Technical :** **Assignment** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• fractionation, electrophoresis, and gel filtration	**10**

		electrophoresis, and gel filtration					
11-12	Students are able to understand enzyme isolation techniques		**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Cell culture • The cell separation process	
13-15	Students are able to understand enzyme purification techniques		**Technical :** **Quiz 2** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		• Precipitation method with ammonium sulfate • Precipitation Method with acetone • Effects of substrates on enzymes	**20**
16	**End-term evaluation**						**25**

36. BIOACTIVITY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Kode Dokumen**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disciplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Data**
BIOACTIVITY	SK 184833	Biochemistry	2	0	VIII	07 Januari 2020
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Adi Setyo Purnomo, M.Sc., Ph.D., Drs. Refdinal Nafwa, M.S.</td><td>Herdayanto S. Putro, S.Si., M.Si.</td><td>Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>C.1 (LO 6)</td><td colspan="3">Able to apply the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td>D.2 (LO 9)</td><td colspan="3">Able to apply chemistry mindset in driving the creation of job opportunities</td></tr>
<tr><td colspan="2">Course Learning Outcomes (LO MK)</td><td colspan="2"></td></tr>
<tr><td>CP MK 1</td><td colspan="3">Students are able to apply the basic concept of bioactivity and use it to solve a problem</td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>LO – LO MK Map</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CP MK 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">This subject discusses the principles and methods of general bioactivity, both qualitatively and quantitatively, such as antioxidants, antimicrobials (antibiotics, antifungals), anti-cancer, and anti-malaria and their applications. The material in this course includes: principles and types of bioactivity, Inhibition Concentration (IC), Lethal Concentration (LC), antioxidant bioactivity, antibiotic bioactivity, antifungal bioactivity, anticancer, antimalaria, reading of bioactivity data, bioactivity for drugs, and bioactivity applications.</td></tr>
<tr><td>Study Material: Subject matter</td><td colspan="4">Principles and types of bioactivity, analyzing of bioactivity data: Inhibition Concentration (IC), Lethal Concentration (LC), antioxidant bioactivity, antibiotic bioactivity, antifungal bioactivity, anticancer, antimalaria, bioactivity for drugs, and bioactivity applications.</td></tr>
<tr><td>Reference</td><td colspan="4">Main:
1. Rahman, A., Choudhary, M.I., dan Thomson, W.J. ”Bioassay Techniques for Drug Development”, Harwood academic publishers, 2005.
2. Methods in Natural Product Research and Drug Development”, Springer Verlag, 1999 L. Bohlin, J.G. Bruhn (editor), “Bioassay.

Supporting:
6.</td></tr>
<tr><td>Supporting Lecturer</td><td colspan="4">Adi Setyo Purnomo, M.Sc., Ph.D., Drs. Refdinal Nafwa, M.S.</td></tr>
<tr><td>Pre-Requisite Courses</td><td colspan="4">Have taken the course Biochemistry and Bioprocess</td></tr>
</table>

Session	Learning outcome of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Students are able to understand the basic knowledge of bioactivity	• The accuracy in understanding the principles and types of bioactivity.	**Technical :** **Criteria :**	**Lecture** **[TM: 1x(2x50")]**		• The principles and types of bioactivity.	
2-4	Students are familiar to the bioactivity calculation method and able to understand the types of bioactivity	• The accuracy in understanding the types of bioactivities and calculating their bioactivities	**Technical :** **Quiz 1** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		Reading and analyzing bioactivity data: Inhibition Concentration (IC), and Lethal Concentration (LC)	**15**
5-7	Students are familiar to the microorganism biodiversity	• The accuracy in being familiar and understanding bioactivities, like: antioxidant, antibiotic, antifungal.	**Technical :** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		• Antioxidant, antibiotic, antifungal. .	

8	**Mid-term evaluation**						**30**
9-11	Students are able to understand several methods of bioactivity	• The accuracy in being familiar and understanding bioactivities, like: anticancer and antimalaria	**Technical :** **Quiz 2** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		Anticancer and antimalaria	**15**
12-13	Students are able to understand several methods of bioactivity	• The accuracy in understanding bioactivity for drug	**Technical :** **Criteria :**	**Lecture** **[TM: 2x(2x50")]**		• Bioactivity for drug	
14-15	Students are able to understand the use of bioactivity and its application	• The accuracy in understanding the application of bioactivity	**Technical :** **Assignment** **Criteria :**	**Lecture** **[TM: 3x(2x50")]**		The application of bioactivity	**10**
16	**End-term evaluation**						**30**

37. CHEMICAL SYSTEMATICS OF PLANT

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMICAL SYSTEMATICS OF PLANT	SK 184841		2	0	VIII	

<table>
<tr><td colspan="2">AUTHORIZATION / LEGALIZATION</td><td>TLP Editor</td><td>Course Group Coordinator</td><td>Head of Study Program (PRODI)</td></tr>
<tr><td colspan="2"></td><td>Prof. Dr. Taslim Ersam, M.S.</td><td>Drs. R. Djarot S.K.S., M.S.</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="6">Program Learning Outcomes (LO)</td><td colspan="4">LO-PRODI Charged to The Course</td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="3">Has good moral, ethics and personality in completing one’s task</td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to master concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Able to explain the chemical composition in a plant for determining the appropriate separation, purification, and characterization method</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4"></td></tr>
<tr><td colspan="5"><table>
<tr><td></td><td>LO 1</td><td>LO 2</td><td>LO 3</td><td>LO 4</td><td>LO 5</td><td>LO 6</td><td>LO 7</td><td>LO 8</td><td>LO 9</td></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td>√</td><td></td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
</table></td></tr>
<tr><td>Course Short Description</td><td colspan="4"></td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Secondary metabolite compounds
2. Mechanism of the biosynthesis reactions for the formation of terpenoids, phenolates, alkaloids, and steroids
3. Preparation of plant research materials
4. Selection of extraction, isolation and fractionation, purification and chromatography method
5. Elucidation structure of compounds using a combination of spectroscopic data from research results</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:

Secondary:</td></tr>
<tr><td>Lecturer</td><td colspan="4">Prof. Dr. Taslim Ersam, MS.</td></tr>
</table>

Pre-Requisite Courses	-						
Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	Students are able to explain secondary metabolite compounds	• Able to explain secondary metabolite compounds correctly	**Technical:Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Introduction of plantsystematic chemicals • Secondary metabolite compounds	
3-5	Students are able to explain the mechanism of biosynthesis for the formation of terpenoids, phenolates, alkaloids, and steroids	• Able to explain the mechanism of biosynthesis for the formation of terpenoids, phenolates, alkaloids, and steroids correctly	**Technical:** Assignment 1 **Criteria:**	**Lecture [TM: 3×(2×50'')]**		• Mechanism of biosynthesis for theformation of terpenoids, phenolates, alkaloids, and steroids	**15**
6,7	Students are able to perform the preparation of plant research materials	• Able to perform thepreparation of plant research materials properly	**Technical:** Assignment 2 **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Preparation of plant research materials	**20**
8	**Mid-semester Evaluation**						**20**
9-11	Students are able to choose the extraction, isolation and fractionation, purification and	• Able to choose the extraction,	**Technical:Criteria:**	**Lecture [TM: 3×(2×50'')]**		• Selection of extraction, isolationand	

	chromatography method for plant material research	isolationand fractionation, purification and chromatography method for plant material research correctly				fractionation, purification and chromatography method	
12-15	Students are able to perform the elucidation structure of compounds using a combine spectroscopic data from research results and determine the type of compound	• Perform the elucidationstructure of compoundsusing a combine spectroscopic data from research results and determine the type of compound correctly	**Technical:** Assignment 3 **Criteria:**	**Lecture [TM: 4×(2×50'')]**		• Elucidation structure of compounds using a combination of spectroscopic data from research results	**20**
16	**Final Semester Evaluation**						**25**

38. DRUG CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
DRUG CHEMISTRY	SK 184842		2	0	VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Dr. Hendro Juwono, M.Si</td><td>Djarot Sugiarso S., M.Si.</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="3">Has good moral, ethics and personality in completing one’s task</td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Able to think critically about medicine use and its application</td></tr>
<tr><td>CLO 2</td><td colspan="3">Gain knowledge about differentiating drugs based on class as well as the way of absorption, distribution, and excretion of medicines</td></tr>
<tr><td>CLO 3</td><td colspan="3">Gain knowledge about the structure and metabolism of medicines</td></tr>
<tr><td>CLO 4</td><td colspan="3">Able to convey ideas orally and in writing</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4"></td></tr>
<tr><td>Course Short Description</td><td colspan="4"></td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Natural product medicines
2. Synthetic product medicines
3. Drug restrictions, drug forms, and classification of drugs
4. Development of drugs
5. Correlation between structure, physical and chemical properties with the absorption, distribution, and excretion processes of the drug
6. Correlation between structure with the metabolism process of the drug
7. Case studies</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:</td></tr>
</table>

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√							√	
CLO 2			√					√	
CLO 3			√					√	
CLO 4	√		√					√	

	Secondary:
Lecturer	Sri Fatmawati, Ph.D.
Pre-Requisite Courses	-

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1,2	Students are able to explain the types of medicines that come from natural products	• Able to explain the types of medicines that come from natural products correctly	**Technical:** **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Introduction of medicinal chemistry • Types of natural product medicines	
3,4	Students are able to explain the types of medicines that come from synthetic products	• Able to explain the types of medicines that come from synthetic products correctly	**Technical:** Assignment 1 **Criteria:**	**Lecture [TM: 3×(2×50'')]**		• Types of synthetic product medicines	**10**
5,6	Students are able to explain drug restrictions, drug forms, and classification of drugs	• Able to explain drug restrictions, drug forms,and classification of drugs correctly	**Technical:** Assignment 2 **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Drug restrictions • Drug forms • Classification of drugs	**15**
7	Students are able to explain the development of	• Able to explain the development of	**Technical:Criteria:**	**Lecture [TM: 1×(2×50'')]**		• The development ofmedicines from natural	

	medicines from natural and synthetic products	medicines from natural and synthetic products correctly				compounds • The development ofmedicines from synthetic compounds	
8	**Mid-semester Evaluation**						**25**
9,10	Students are able to explain the correlation between structure, physical and chemical properties with the absorption, distribution, and excretion processes	• Able to explain the correlation between structure, physical andchemical properties with the absorption, distribution, and excretion processes appropriately	**Technical:Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Structure reactivityof compounds • Correlation betweenstructure, physical and chemical properties with the absorption, distribution, and excretion processes	
11,12	Students are able to explain the correlation between a structure with metabolism process of the drug	• Able to explain the correlation between a structure with metabolism process of the drug correctly	**Technical:** Assignment 3 **Criteria:**	**Lecture [TM: 2×(2×50'')]**		• Structure reactivityof compounds • Correlation between a structure with metabolism process the drug	**10**
13-15	Students are able to explain and solve several cases associated with drug compounds	Able to explain and solve several cases associated with drug compounds appropriately	**Technical:** Presentation **Criteria:**	**Lecture [TM: 3×(2×50'')]**		• Case studies associated with drug compounds	**15**
16	**Final Semester Evaluation**						**25**

39. INTRODUCTION TO ORGANIC GEOCHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
INTRODUCTION TO ORGANIC GEOCHEMISTRY	SK 184851		3	0	VIII	

AUTHORIZATION / LEGALIZATION	**TLP Editor**	**Course Group Coordinator**	**Head of Study Program (PRODI)**
	Prof. Dr. R.Y. Perry Burhan, M.Sc.; Dr. Yulfi Zetra, MS.	Drs. R. Djarot S.K.S., M.S.	Dr. rer. nat. Fredy Kurniawan, M. Si

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Has good moral, ethics and personality in completing one's task
	C.1 (LO 6)	Able to master the concepts of structure, character, and change of substance according to the aspects of dynamics and energetics
	C.2 (LO 7)	Able to master concepts, theory, and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced
	Course Learning Outcomes (CLO)	
	CLO 1	Able to know the formation and chemical composition of petroleum, coal, and other geological sediments
	CLO 2	Able to know and understand the role of organic geochemistry for the exploration of petroleum and coal

LO - CLOMAP

	LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
CLO 1	√					√	√		
CLO 2	√					√		√	

Course Short Description	
Study Material:	1. Production and cycle of organic matter in nature

Subject Matter	2. Chemical composition of biogenic substances 3. Condition of accumulation of sediment which is rich in organic matter 4. Formation of humic substances, coal, and kerogen 5. Formation and composition of petroleum 6. Molecular evaluation of new sedimentary 7. Molecular assessment of aged sedimentary and petroleum formation 8. Environmental habits of anthropogenic organic compounds
Reference	**Primary:** **Secondary:**
Lecturer	Prof. Dr. R.Y. Perry Burhan, M.Sc.; Dr. Yulfi Zetra, MS.
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	Students are able to demonstrate how the production and cycle of organic matter in nature in organic geochemistry	• The accuracy in understanding the production and cycle of organic matter in nature	**Technical:** Assignment 1 (Global carbon cycle, Photosynthesis and Evolution of life, Main contribution to	**Introduction lectureand brainstorming [TM: 2×(2×50'')]** **Lecture and discussion[TM: 2×(2×50'')]** **Assignment**		• Global carbon cycle • Photosynthesis andEvolution of life • The main contribution to sedimentary organicmatter • Photosynthesis andstable isotopes	**10**

			sedimentary organic matter, Photosynthesi sand stable isotopes of carbon) **Criteria:**	**[BT+BM:(1+1)x(4x60”)]**		of carbon	
3,4	Students are able to demonstrate the chemical composition of biogenic substances	• The accuracy in demonstrating the chemical composition of biogenic substances	**Technical:Criteria:**	**Lecture and group discussion** **[TM: 4×(2×50’’)]** **[BT+BM:(1+1)x(4x60”)]**		• Chemical structureof natural compounds • Carbohydrate • Protein • Lipid • Lignin, tannin, andother associated compounds • Geochemical implications forvariations in biogenic composition	
5,6	Students are able to demonstrate the condition of accumulation of sediment which is rich in organic matter	The accuracy in demonstrating the condition of accumulation of sediment which is richin organic matter	**Technical:** Quiz **Criteria:**	**Lecture and group discussion** **[TM: 2×(2×50’’)]** **[BT+BM:(2+2)x (4x60”)]**		• Primary productionfactor • Preservation and degradation of organic matter	**10**

						• Depositional environment	
7	Students are able to demonstrate the formation of humic substance, coal, and kerogen	• The accuracy in explaining the formation of humic substance, coal, and kerogen	**Technical:Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')] [BT+BM:(1+1)x (4x60")]**		• Diagenesis • Humic substances • Coal • Kerogen	
8	**Mid-semester Evaluation**						**20**
9-11	Students are able to demonstrate the molecular evaluation of new sedimentary	• The accuracy in demonstrating the molecular evaluation ofnew sedimentary	**Technical:** Group discussion **Criteria:**	**Lecture [TM: 2×(2×50'')]** **Group discussion [1x160"]**		• Distribution of biomarkers inherited from the organism	**15**
12,13	Students are able to demonstrate the molecular assessment of aged sedimentary and petroleum formation	• The accuracy in demonstrating the molecular assessment of aged sedimentary and petroleum formation	**Technical:** Assignment 2 **Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')]**		• Source indicator • Depositional environment indicator • Thermal maturityand molecular transformation • Molecular maturityand source parameters for petroleum exploration • Hydrocarbon biomarker analysis	**15**

14,15	Students are able to demonstrate the environmental habits of anthropogenic organic compounds	• The accuracy in demonstrating the environmental habits ofanthropogenic organic compounds	**Technical:** Assignment and Final presentation **Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')]**		• Human impacts onthe carbon cycle • Reduction of hydrocarbon andozone • Hydrocarbon pollution in the aquatic environment • Several xenobiotic organic compounds • Factors contributing to anthropogenic inputs	**5**
16	**Final Semester Evaluation**						**25**

40. BIOMARKER ANALYSIS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
BIOMARKER ANALYSIS	SK 184852		2	0	VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Dr. Yulfi Zetra, MS.; Drs. Agus Wahyudi, M.S.</td><td>Drs. R. Djarot S.K.S., M.S.</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="6">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>A.1 (LO 1)</td><td colspan="3">Has good moral, ethics and personality in completing one’s task</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to master concepts, theory, and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Able to provide an understanding of the role of organic geochemical aspects through biomarker analysis in the exploration process of
organic materials (coal, petroleum, and natural gas)</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4"><table><tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr><tr><td>CLO 1</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td></td></tr></table></td></tr>
<tr><td>Course Short Description</td><td colspan="4"></td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Biomarker (term, definition, and understanding of biomarker)
2. Structure of biomarker (Structure and nomenclature of biomarkers, nomenclature notation in relation to stereochemistry)
3. Classification of biomarker (aliphatic hydrocarbon fraction, aromatic hydrocarbon fraction, ketone fraction, alcohol fraction, acid fraction, groups of –S, –P, and –N fraction)
4. Organic geochemical aspects in relation to biomarker analysis (biomarker as an origin indicator, biomarker as a depositional environmentindicator, biomarker as a geological sedimentary sample maturity indicator)
5. Biomarker in a geological sample (sediment, petroleum, and coal)
6. Biomarker analysis (fundamental principle of separation and fractionation)
7. Biomarker identification (structure identification through spectroscopic studies involving FTIR, NMR, and GCMS analysis)
8. The role of organic geochemistry in the exploration process of organic materials (coal, petroleum, and natural gas)</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:</td></tr>
</table>

	Secondary:
Lecturer	Dr. Yulfi Zetra, MS.; Drs. Agus Wahyudi, M.S.
Pre-Requisite Courses	-

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1,2	Students are able to provide an understanding of biomarker in organic geochemistry	• The accuracy in understanding the meaning of biomarker in organic geochemistry	**Technical:** Assignment 1 (Term, definition,and the understanding ofbiomarker in organic geochemistry) **Criteria:**	**Introduction lectureand brainstorming [TM: 2×(2×50'')]** **Lecture and discussion[TM: 2×(2×50'')]** **Assignment of biomarker definitions [BT+BM:(1+1)x(4x60")]**		• Biomarker terms • Biomarker definition • Understanding of biomarker	**10**
3,4	Students are able to show the structure of biomarker (structure and nomenclature of biomarker, nomenclature notation in relation to stereochemistry)	• The accuracy in showing the structureof biomarker accompanied by nomenclature and naming notation in molecular	**Technical:Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')] [BT+BM:(1+1)x(4x60")]**		• Structure and nomenclature ofbiomarker • Nomenclature notation in relation to stereochemistry	

		• stereochemistry					
5	Students are able to explain the classification of biomarker according to the structures and functional groups (aliphatic hydrocarbon fraction, aromatic hydrocarbon fraction, ketone fraction, alcohol fraction, acid fraction, and groups of –S, –P, and –N fraction)	The accuracy in writing the classification of biomarker according to the structures and functional groups	**Technical:** Quiz **Criteria:**	**Lecture and group discussion [TM: 2×(2×50'')] [BT+BM:(2+2)x (4x60")]**		• Biomarkers ofaliphatic hydrocarbo n fraction • Biomarkers ofaromatic hydrocarbo n fraction • Biomarkers of oxygen-containing functional group (alcohol, ketone, acid) • Biomarkers of sulfur-containing functional group (thiophene and itsderivatives) • Biomarkers of phosphor-containing functional group	**10**
6,7	Students are able to explain how the organic geochemical aspects in relation to biomarker analysis	• The accuracy in explaining the organic geochemical aspects through biomarker analysis	**Technical:Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')] [BT+BM:(1+1)x (4x60")]**		• Biomarke r as an origin indicator of organic compoun	

						ds in geological sediment • Biomarker as an environmental indicator of the depositional environment of geological sediment • Biomarker as a geological sedimentsample maturity indicator	
8	**Mid-semester Evaluation**						**20**
9	Students are able to show multiple examples of biomarkers in a geological sample	• The accuracy in writing multiple examples of biomarkers in a geogical sample (sediment, sludge, coal,and petroleum)	**Technical:** Group discussion **Criteria:**	**Lecture** **[TM: 2×(2×50'')]** **Group discussion and practice [1x160"]**		• Biomarkers in a sediment sample • Biomarkers in a petroleum sample • Biomarkers in a coalsample	**5**
10,11	Students are able to explain the biomarker analysis method of a geological sediment sample (fundamental principle of separation and fractionation)	• The accuracy in explaining the biomarker analysis method of a geological sediment sample (fundamental principle	**Technical:** Assignment 2 **Criteria:**	**Lecture, group discussion, and practice[TM: 4×(2×50'')]**		• The fundamental principle of separation in biomarker analysis (extraction, soxhletation, and	**15**

		of separation and fractionation)				centrifugation) The fundamental principle of fractionation in biomarker analysis (column chromatograp hyand thin layer chromatograp hy)	
12,13	Students are able to explain the identification method for the elucidation structure of biomarker	• The accuracy in explaining the identification method for the elucidation structure of biomarker	**Technical:Criteria:**	**Lecture, group discussion, and practice[TM: 4×(2×50'')]**		• FTIR spectroscopy study for identification of biomarker structure • Mass spectroscopy study for identification of biomarker structure • NMR spectroscopy study for identification of biomarker structure	**5**
14,15	Students are able to explain the role of organic geochemistry in the exploration process of organic	• The accuracy in explaining the role of organic geochemistry in the exploration process	**Technical:** Final presentation **Criteria:**	**Lecture and group discussion [TM: 4×(2×50'')]**		• Organic geochemical aspects in the exploration	**10**

	materials (coal, petroleum, and natural gas)	of organic materials (coal, petroleum, and natural gas)				process of coal • Organic geochemical aspects in the exploration process of petroleum • Organic geochemical aspects in the exploration process • of natural gas	
15-16	**Final Semester Evaluation**						**25**

41. CAPITA SELECTA

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CAPITA SELECTA	SK 184861		2	0	VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
			Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

<table>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td></tr>
<tr><td>A.1 (LO 1)</td><td>Able to report his/her own work in a good and discipline manners</td></tr>
<tr><td>A.2 (LO 2)</td><td>Able to internalize the spirit of independence, struggle, and entrepreneurship</td></tr>
<tr><td>B.3 (LO 5)</td><td>Able to take responsibility for his/her own work and to be give the responsibility of the achievement of an organization</td></tr>
<tr><td>D.1 (LO 8)</td><td>Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>CLO 1</td><td>Able to think critically and empirically with the concept of lifelong learning in assessing quality research work</td></tr>
<tr><td>CLO 2</td><td>Able to disseminate data and information from the results of the research work and being responsible for own arguments.</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td></td><td>√</td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="2">The development of modern science and technology in various fields in the moment and in the future has a lot to do with chemistry and its applications. Therefore this course reviews the latest developments in chemistry and the actualization of its development trends.</td></tr>
<tr><td>Study Material: Subject Matter</td><td colspan="2">The latest topics related to the development of Chemistry in relation to its application in life, especially in ITS superior fields which include the fields of Energy, Environment, Marine, and Health.</td></tr>
<tr><td>Reference</td><td colspan="2">Primary:

1. The latest scientific articles (published at the latest in the last 10 years) published by well-known publishers.
2. Popular scientific magazines such as the monthly magazine "Chemistry World" published by the Royal Society of Chemistry (RSC)

Secondary:</td></tr>
<tr><td>Lecturer</td><td colspan="2"></td></tr>
<tr><td>Pre-Requisite Courses</td><td colspan="2">Have taken minimum 76 credits.</td></tr>
</table>

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]	Learning Material [Reference]	Assesment Portion (%)
		Indicator	Criteria and Technical			

(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1, 2, 3, 4, 5, 6, 7	Able to perform literature studies in accordance with topics that are relevant to the subject matter of the course			**Group discussions Presentation [TM: 7x(2x50")]**			**50**
8	**Mid-semester Evaluation**						
9, 10, 11, 12, 13, 14	Able to compile literature study result documents correctly			**Group discussions Presentation [TM: 6x(2x50")]**			**50**
15	**Final Semester Evaluation**						
16	Able to present literature study documents						

42. HAZARDOUS AND DANGEROUS MATERIALS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date
HAZARDOUS AND DANGEROUS MATERIALS	SK 184862*		3	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Drs. M. Nadjib Mujahid M.S.; Ratna Ediati, Ph.D.</td><td>Drs. R. Djarot S.K.S., M.S.</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="9">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>B.1 (LO 3)</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>B.2 (LO 4)</td><td colspan="3">Able to give alternative solutions with the characters of leadership, creativity and communication ability</td></tr>
<tr><td>C.2 (LO 7)</td><td colspan="3">Able to apply concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>D.1 (LO 8)</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Students are able to explain the types of hazardous and dangerous chemicals</td></tr>
<tr><td>CLO 2</td><td colspan="3">Students are able to identify the potential and risks that can be caused by hazardous and dangerous materials</td></tr>
<tr><td>CLO 3</td><td colspan="3">Students are able to study the methods to handle hazardous and dangerous materials</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 3</td><td></td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">In this course, students will study the types of poisonous and dangerous chemicals (B3), their characterization processes, and their handling so that they are able to handle dangerous chemicals in accordance with occupational safety and health standards. In addition, students are expected to have the knowledge to anticipate and reduce the negative impacts of poisonous and dangerous materials.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Toxic and hazardous substance control regulations
2. Safety principles
3. Types of toxic and dangerous chemicals
4. Health hazard
5. Flammability
6. Chemical reactivity and stability
7. Hazard identification and site evaluation
8. Handling and processing toxic and hazardous materialS</td></tr>
</table>

Reference	**Primary:** 1. D.A. Shafer, "Hazardous Materials Characterization: Evaluation, Methods, Procedures and Consideration", New Jersey: John Wiley & Sons, 2006 2. M. Armour, "Hazardous Laboratory Chemicals Disposal Guide", New York: Lewis Publisher, 2003 **Secondary:**
Lecturer	Drs. M. Nadjib Mujahid M.S.; Ratna Ediati, Ph.D.
Pre-Requisite Courses	

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	**[C2, A3, P1]:** Students are able to explain the definition of toxic and hazardous materials	The accuracy in explaining the definition and parameters of toxic and hazardous materials		**Introductory lectures** **Brainstorming** **[TM: 1x(2x50")]**		• Definition of toxic and hazardous materials Parameters for the determination of toxic and hazardous materials	
2	**[C2, A3, P1]:** Students are able to explain the toxic and hazardous materials controlling rules	The accuracy in mentioning and explaining various regulations related to B3 that apply in the world		**Lectures** **Discussions** **[TM: 1x(2x50")]**		• EPA: Clean Water Act • Clean Air Act Hazardous Waste Management Resource	

						Conservation And Recovery Act (ACRA)	
3	**[C2, A3, P1]:** Students are able to explain safety principles related to B3	• The accuracy in explaining the application of B3 safety principles		**Lectures** **Discussions** **[TM: 1x(2x50")]** **Assignment 1.** **Short paper** Students are asked to look for examples of the application of B3 safety principles in an institution		• Safety work practices • Communicating hazard information Hazard identification	**10**
4	**[C2, A3, P1]:** Students are able to explain the types of toxic and hazardous materialsrings and other types of compounds	• The accuracy in explaining the types of toxic and hazardous materials		**Lectures** **Discussions** **[TM: 1x(2x50")]**		• Properties of toxic and hazardous material • Material shape Corrosive hazard	
5	**Quiz 1**	The accuracy in explaining the rules for B3 controlling, safety principles, and types of B3		**Writing test** **[TM: 1x(2x50")]**			**15**
6, 7	**[C3, A3, P1]:** Students are able to identify the health hazards that can be caused by B3	The accuracy in identifying potential health hazards that can be caused by B3		**Lectures** **Discussions** **[TM: 2x(2x50")]**		• Potential health hazards • Toxicity Chronic, acute hazards	
8	**Mid-semester Evaluation**						**25**

9	**[C3, A3, P1]:** Students are able to identify types of B3 that have the potential to cause fires	• The accuracy in identifying flammable materials and their potential hazards		**Lectures** **Discussions** **[TM: 1x(2x50")]**		• Definition of flammable material • Flammable solids, liquids, and gases • Handling of flammable materials Identification of potential fire	
10, 11	**[C4, A3, P1]:** Students are able to identify the relationship between reactivity and stability of chemicals with their potential hazards	The accuracy in explaining the relationship between the properties and reactivity of chemicals to the potential hazards that may arise		**Lectures** **Discussions** **[TM: 2x(2x50")]** **Non-Test:** **Assignment 2** **(Short paper)** Students write a short paper explaining the properties and reactivity of a chemical and its potential hazards		• Reactivity and stability • Chemical reactivity classification Pyrophoric material	**10**
12	**Quiz 2**	Describing and identifying fire hazards caused by B3 materials and the relationship between the reactivity of the materials and the potential hazards		**Writing test** **[TM: 1x(2x50")]**			**15**
13	**[C4, A4, P1]:**	The accuracy in identifying potential		**Lectures**		• Site classification • Documentation	

	Students are able to identify potential hazards in the workplace (site evaluation)	hazards in the workplace or places associated with toxic and hazardous materials (B3)		**Discussions [TM: 1x(2x50")]**		• Sampling • Hazard assessment The emergency of B3 material	
14, 15	**[C4, A4, P1]:** Students are able to study methods for handling toxic and hazardous materials	• The accuracy in proposing methods of storage, transportation, labeling of B3 materials The accuracy in proposing the B3 waste treatment method		**Lectures Presentation Discussion with examiners [TM: 2x(2x50")]**		• B3 material storage • B3 materials transport • B3 material labeling B3 waste treatment	
16	**Final Semester Evaluation**						**25**

43. CORROSION ANALYSIS METHODS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CORROSION ANALYSIS METHODS	SK 184863		3	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dra. Harmami, M.S.		Drs. R. Djarot S.K.S., M.S.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	A.1 (LO 1)	Able to collect data and information correctly, analyze and use analysis for correct decision making
	B.1 (LO 3)	Able to collect data and information correctly, analyze and use analysis for correct decision making

	C.2 (LO 7)	Able to apply concepts, theory and methods on analysis and synthesis of chemical substances
	D.1 (LO 8)	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	Course Learning Outcomes (CLO)	
	CLO 1	Students are able to analyze the corrosion occurrence of several metal/metal alloy samples using various analytical methods

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1	√		√				√	√	

Course Short Description	In this course, students learn about the definition of corrosion and the forms of corrosion, how to control and its monitoring methods, and analysis of corrosion. Also, students are able to analyze the process of corrosion of several metal/metal alloy samples through practical analysis in the laboratory using either the gravimetric method or the polarization method as well as able to provide an alternative to control corrosion on some examples of metals/metal alloys that are often used in daily life
Study Material: Subject Matter	Overview of corrosion, forms of corrosion, passivation, polarization methods, corrosion control, and corrosion control methods.
Reference	**Primary:** 1. Jones, D. J., "Principles and Prevention of Corrosion", Macmillan International Publishing, New York, 1992. 2. Shier, L. L. and Jarman, R.A., "Corrosion. Vol. 1 dan 2", Buttherworth, Heinemann Ltd, Oxford, 1995. **Secondary:**
Lecturer	Dra. Harmami, M.S.
Pre-Requisite Courses	Have taken the courses Chemical Thermodynamics, Chemical Dynamics, and Separation and Purification Methods.

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	The students should know the learning plan of the course for one semester.						
2, 4	Students should be able to explain the general properties of electrochemical and other forms of corrosion of metal/metal alloy	The accuracy in describing and differentiating the properties and form of corrosion		**Lectures Discussions Exercises-Response**			
5,6	Students should be able to use the Pourbaix diagram to predict the probability of corrosion on metal/metal alloy occurrence	• The accuracy in using pH diagrams to predict corrosion occurrence		**Lectures Discussions Exercises-Response**			**10**
7, 8	Students should be able to analyze the probability of the occurrence of corrosion on various types of metal using the Pourbaix diagram	The accuracy of the analysis results in accordance with the concepts and analytical skills		**Laboratory Practice Paper Assignment**			**5**
9-12	Students should be able to apply Faraday's rule to analyze and determine the amount of mass that is lost due to corrosion on the metal/metal alloy	The accuracy in using Faraday's rule to determine the corrosion rate and explain the factors which influence the corrosion rate.		**Lectures Discussions Laboratory Practice Paper Assignment**			**5**
13-16	Students should be able to apply the concept of passivation and the factors that affect passivation on several types of metals	The accuracy in describing/illustrating passivation diagram of some metal/alloy samples		**Lectures Discussions Laboratory Practice Paper Assignment**			**5**
17-18	**Mid-semester Evaluation (Presentation)**						**20**

19-24	Students should be able to apply the method of polarization to measure the rate of corrosion on some metals/metal alloys	• The accuracy in calculating the corrosion rate		**Lectures Discussions Laboratory Practice Paper Assignment**			**10**
25-28	Students should be able to choose the correct method for protection/corrosion control based on the results of the analysis of several metals/metal alloys	The accuracy in choosing the methods of protection/corrosion control and the sharpness of the analysis		**Lectures Discussions Laboratory Practice Paper Assignment**			**10**
29-32	**Final Semester Evaluation (Presentation)**						**35**

44. CHEMICAL ANALYSIS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CHEMICAL ANALYSIS	SK184864*		3	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
			Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	LO 3	Able to collect data and information correctly, analyze and use analysis for correct decision making
	LO 6	Able to master the concepts of structure, character and change of substance according to the aspects of dynamics and energetics

<table>
<tr><td></td><td>LO 7</td><td>Able to master concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td></td><td>LO 8</td><td>Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced</td></tr>
<tr><td></td><td colspan="2">Course Learning Outcomes (CLO)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>CLO 1</td><td>Able to connect knowledge of structure, properties, reactivity with identification and measurement based on mass and volume</td></tr>
<tr><td></td><td>CLO 2</td><td>Be able to practice measurements based on mass and volume</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="3">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td></td><td></td><td>√</td><td></td><td></td><td></td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="3">Analysis Chemistry is a way to analyze a compound in food and environmental samples using simple conventional methods, namely titration and gravimetric methods. This course introduces several beaker equipment, quantitative element / compound testing using volumetric and gravimetric methods. In the lecture on measurement methods students are shown the ways to use chemical tools and according to their functions and how to titrate with several methods which will be visualized via video.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="3">1. Solution Equilibrium
2. Calibration and Selection of glassware
3. Qualitative Analysis Techniques
4. Quantitative Analysis Techniques
5. Qualitative Analysis Applications
6. Applications of Quantitative Analysis (Volumetry: Asidi-alkalimetri, Argentometry, Complexometry, Redox Titration)
7. Gravimetry and its applications
8. Crystallization and its application</td></tr>
<tr><td>Reference</td><td colspan="3">Primary:

1. Skoog, D.A, West, Donal M and Holler, F.James“Analytical Chemistry . An Introduction”, Sixth edition, Saunders Golden Sunburst series, USA, 1994.
2. Skoog, Douglas A., et al. ” Principles of Analysis chemistry”, 5th ed. Saunders College Publishing, USA, 1998
3. Vogel, Arthur Israel, “ A text book of Macro and Semimicro Qualitative Inorganic Analysis”, 1989
4. Harris Daniel C, “ Quantitative Chemical Analysis”,ed 8, Clancy Marshall, 2010
Secondary:</td></tr>
</table>

Lecturer	-
Pre-Requisite Courses	Chemistry I

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1, 2	Students are able to apply the concept of equilibrium with aqueous solutions	• Able to calculate the kinds of chemical equilibrium which includes acid-base equilibrium and heterogeneous equilibrium.		**Lecture** **[TM: 1x(2x50")]** **Responsi** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• College contract Aqueous solution equilibrium	**2,5 %**
3, 4	Students are able to calibrate and choose beakers correctly	1. Able to perform the beaker calibration 2. Able to choose beakers precisely		**Lecture** **[TM: 1x(2x50")]**		• Calibration and Selection of glassware	
4, 5	Students are skilled to perform qualitative analysis techniques correctly.	1. Able to mix ingredients with the correct reagent 2. Able to carry out the process of deposition and separation of the analate properly.		**Lecture** **[TM: 1x(2x50")]**		• Qualitative Analysis Techniques	

6, 7	Students are skilled to perform quantitative analysis techniques correctly.	1. Able carry out weighing, dissolving and diluting correctly. 2. Able find out the correct titration method 3. Able to process data statistically and draw conclusions correctly		**Lecture** **[TM: 1x(2x50")]** **Laboratory Practice** **[TM: 1x(2x50")]**		• Quantitative Analysis Techniques	**2,5 %**
8, 9	Students are able to identify cations and anions	1. Able to identify elements qualitatively. 2. Able to apply the identification of elements in food / beverage ingredients qualitatively.		**Lecture** **[TM: 1x(2x50")]**		• Qualitative Analysis	**5%**
10, 11	Students are able to apply the basic concepts of quantitative analysis and indicator selection.	1. Able to explain the basic concepts of titrimetry. 2. Able to apply the concept of indicator equilibrium and determine appropriate indicators in volumetric analysis 3. Able to calculate the content of a material through titrimetric analysis.		**Lecture** **[TM: 1x(2x50")]** **Exercise** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]**		Titrimetry-volumetric theory	**5%**

12-14	Students are able to apply the basic concepts of acid-base titration	1. Able to determine the acid-base indicator precisely. 2. Able to calculate the pH of a mono and poly alkaline / acid buffer solution with accuracy. 3. Skilled at performing multiple acid-base titrations. 4. Able to apply the acid-base concept to material / sample analysis.		**Lecture** **[TM: 1x(2x50")]** **Exercise** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]** **Laboratory Practice** **[TM: 1x(2x50")]**		• Acid-Base Titration (Neutralization)	**5%**
15-16	**Mid-semester Evaluation**						**30%**
17-19	Students are able to apply the basic concepts of precipitation titration.	1. Able to explain the basis of precipitation titration. 2. Able to distinguish various kinds of precipitation titrations. 3. Skilled in performing several argentometric titrations. 4. Able to apply the concept of precipitation titration to determine the salinity of water.		**Lecture** **[TM: 1x(2x50")]** **Exercise** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]** **Laboratory Practice** **[TM: 1x(2x50")]**		• Argentometry	**5%**

20, 21	Students are able to apply basic Gravimetry concepts	1. Able to explain the basic concept of sediment formation. 2. Able to distinguish the types of deposits. 3. Skilled at doing gravimetric analysis. 4. Able to calculate the content of a substance gravimetry		**Lecture** **[TM: 1x(2x50")]** **Exercise** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]** **Laboratory Practice** **[TM: 1x(2x50")]**		• Gravimetry	**2,5 %**
22, 23	Students are able to explain the crystallization process.	1. Able to explain the basic concept of crystallization correctly. 2. Able to apply the concept of crystallization for the purification of a substance		**Lecture** **[TM: 1x(2x50")]** **Responsi** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]**		• Crystallization	**2,5 %**
24-26	Students are able to apply the basic concepts of complexometric titration.	1. Able to explain the basis of complex formation reactions. 2. Able to determine the appropriate indicator. 3. Skilled at performing complexometric titrations. 4. Able to apply the basic concept of		**Lecture** **[TM: 1x(2x50")]** **Exercise** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]**		• Complexometric	**5 %**

		complexometric titration for the determination of water hardness. 5. Able to apply the basic concepts of complexometric titration to the determination of elements in environmental samples.		**Laboratory Practice** **[TM: 1x(2x50")]**			
27-30	Students are able to apply the basic concepts of redox titration.	1. Able to explain the basic concepts of redox reactions. 2. Able to distinguish between different types of redox titrations. 3. Skilled at performing multiple redox titrations. 4. Able to apply the basic concept of redox titration for the determination of DO, BOD and COD 5. Able to apply the basic concepts of redox titration to foodstuff analysis		**Laboratory Practice** **[TM: 1x(2x50")]**		• Redox Titration	**5%**

17-19	Students are able to apply the basic concepts of precipitation titration.	1. Able to explain the basis of precipitation titration. 2. Able to distinguish various kinds of precipitation titrations. 3. Skilled in performing several argentometric titrations. 4. Able to apply the concept of precipitation titration to determine the salinity of water.		**Lecture** **[TM: 1x(2x50")]** **Exercise** **[TM: 1x(2x50")]** **Assignment** **[TM: 1x(2x50")]** **Laboratory Practice** **[TM: 1x(2x50")]**		• Argentometry	**5%**
31-32	**Final Semester Evaluation**						**30%**

45. CERAMICS

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**	**Document Code**

TEACHING AND LEARNING PLAN

COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
CERAMICS	SK184865*	Optional	2	0	VII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	

<table>
<tr><td colspan="2"></td><td>Dr. Afifah Rosyidah, M.Si.</td><td>Djarot Sugiarso S., M.Si.</td><td>Dr. rer. nat. Fredy Kurniawan, M. Si</td></tr>
<tr><td rowspan="8">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td><td colspan="2"></td></tr>
<tr><td>LO 3</td><td colspan="3">Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>LO 6</td><td colspan="3">Able to master the concepts of structure, character and change of substance according to the aspects of dynamics and energetics</td></tr>
<tr><td>LO 7</td><td colspan="3">Able to master concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td>LO 8</td><td colspan="3">Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td>CLO 1</td><td colspan="3">Students are able to explain various methods of making ceramics and their decorations</td></tr>
<tr><td>CLO 2</td><td colspan="3">Students are able to connect basic chemical concepts related to ceramic material processing</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="4">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>CLO 2</td><td></td><td></td><td>√</td><td></td><td></td><td>√</td><td></td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="4">This course discusses the basic concepts of chemistry involved in the processing of ceramic materials.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="4">1. Ceramic Material Introduction
2. Ceramics Manufacturing Process
3. Ceramic Furnaces and Burners
4. Addition of Additives and Decoration Process
5. Glass
6. Process of Formation
7. Ceramic Characterization</td></tr>
<tr><td>Reference</td><td colspan="4">Primary:</td></tr>
</table>

	1. J.S. Reed, "Introduction to The principles of Ceramic Processing", John Wiley & Sons, New York, 1989. 2. G. Flight, "Introduction to Ceramics", New Jersey. Prentice-Hall Inc., 1991. 3. G. Elssner, H. Hoven, G. Kiessler, P. Wellner and R. Wert, "Ceramics and Ceramic Composites Engineering", 3rd edition, John Wiley & Sons, New York, 1999. **Secondary:**
Lecturer	Dr. Afifah Rosyidah, M.Si.
Pre-Requisite Courses	Has taken Basic Chemistry courses with a minimum score of D

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1	Students are able to explain the basic ingredients in making ceramics	• Accuracy in explaining the materials needed in making ceramics		**Instroductionary Lecture and brainstorming** **[TM: 1x(3x50")]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• Traditional ceramic materials: clay, clay, and their characteristics • Modern ceramic material	
2, 3	[C2, A3, P3]: Students are able to explain the process of making ceramics	• Accuracy in explaining the process of making ceramics		**Lecture and discussion** **[TM: 1x(3x50")]**		• Preparation of ceramic materials • Stages of making ceramics: printing, sintering	**10%**

				Presentation **[TM: 1x(3x50")]**		• Types of ceramic manufacturing methods: dust pressing, slurry	
4	Students are able to explain the ceramic burning process and the specifications of the used furnace	● Accuracy in explaining the ceramic combustion process Accuracy in explaining the types of furnaces that can be used in ceramic burning		**Lecture, watching video lectures, discussion** **[TM: 1x(3x50")]**		● Sintering: definition, process, mechanism, requirements ● Ceramic burning process in industry • Equipment in ceramic kilns: high temperature furnaces, other types of furnaces	
5-7	Students are able to explain the types and functions of additives in the making of ceramic, as well as the ceramic decoration process	● Accuracy in explaining the types of ceramic additives and their functions in the ceramic manufacturing process • Accuracy in explaining the decoration process on ceramics		**Lecture, Discussion** **[TM: 1x(3x50")]** **Journal analysis** **[TM: 1x(3x50")]** **Presentation** **[TM: 1x(3x50")]**		● Types of additives that are commonly used in ceramics: chemical and physical properties ● Additive addition function ● Additive reactions in ceramics ● Effect of the presence of additives on ceramics	**15%**

						• Types of materials for ceramic decoration • Ceramic decoration methods	
8	**Mid-semester Evaluation**						**20%**
9	Students are able to explain the grinding process on ceramics and the appropriate glaze materials	• Accuracy in explaining the glaze method in ceramics • Accuracy in explaining the types of glaze		**Lecture** **Class discussion** **[TM: 1x(3x50")]**		• The definition of glass • Types and examples of glaze materials • Glazing method on ceramics • Examples of ceramics after the glaze process	
10, 11	Students are able to explain the process of forming ceramics	• Accuracy in explaining the process of forming ceramics		**Lecture, Discussion** **[TM: 1x(3x50")]** **Responsi** **[TM: 1x(3x50")]**		• Ceramic forming process	**10%**
12	Students are able to explain and connect the various information about ceramics and their chemical aspects	• The accuracy in explaining the relationship between the chemical aspects of ceramics and the ceramic products		**Quiz** **[TM: 1x(3x50")]**		• Analyzing the process of making ceramics according to the type of ceramic that about to be produced	**15%**
13, 14	Students are able to select and explain the appropriate type of ceramic characterization and associate	• Accuracy in explaining the types of ceramic characterization and selecting the		**Lecture, Discussion** **[TM: 1x(3x50")]** **Presentation**		• Types of ceramic characterization	**15%**

	the characterization results with the properties of the produced ceramics	appropriate type of characterization • Accuracy in analyzing and explaining the relationship between the characterization results and the properties of ceramics		**[TM: 1x(3x50")]**		• Principles of ceramic characterization • Analysis of data characterization results • Analysis of ceramic properties	
15-16	**Final Semester Evaluation**						**15%**

46. PLASTIC CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
PLASTIC CHEMISTRY	SK184866*	Optional	3	0	VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Lukman Atmaja, M.Si, Ph.D.; Dr. Hendro Juwono. M.Si.		Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	LO 2	Capable of team work and has social sensitivity awareness of the public and the environment
	LO 7	Able to master concepts, theory and methods on analysis and synthesis of chemical substances
	LO 9	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (CLO)	

	CLO 1	Students have the ability to explain various polymer compounds
	CLO 2	Students are able to explain the basic concepts of polymerization and its application to material properties and mechanical properties of plastic polymer compounds based on how they are formed
	CLO 3	Students are able to explain the difference between plastic and non-plastic polymers which are degradable or non-degradable

LO - CLOMAP

	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
CLO 1		√					√		√
CLO 2		√					√		√
CLO 3		√					√		√

Course Short Description	This course reviews the basic ideas of the development of polymers based on plastic or thermoplastic polymers, starting with understanding polymer compounds, polymerization and the formation of thermoplastic or non-plastic polymer compounds.
Study Material: Subject Matter	Polymers and polymerization types, polymer nomenclature, linear, branched and 2-dimensional polymers, polymer relative molecular mass, dispersity, thermal / glass transition, polymer application, plastic packaging code, Ethylene Poly (PE), Propylene Poly (PP), Styrene Poly (PS), ABS / Acrylonitrile Butadiene Styrene, Poly ethylene terephthalate (PET), Poly vinyl chloride (PVC)
Reference	**Primary:** 1. Odian, G., " Principles of Polymerization", 3rd edition, Wiley, 2012. 2. Rabek, J.F., "Experimental methods in Polymer Chemistry", Wiley., 1990. **Secondary:**
Lecturer	Lukman Atmaja, M.Si, Ph.D.; Dr. Hendro Juwono. M.Si.
Pre-Requisite Courses	Has taken Chemistry I, Mathematics I and Physics courses

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**

1	Students are able to explain the types of polymer and polymerization	• Accuracy in describing polymer type and polymerization		**Lecture, exercise problems and tutorial** **[TM: 1×(3×50')]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• Composition, structure, polymer classification, polymerization mechanism, polymerization types	**10%**
2	Students are able to explain natural synthetic, addition, condensation polymers	• Accuracy, logic, in describing natural polymers		**Lecture, exercise problems and tutorial** **[TM: 1×(3×50')]**		• Natural polymers, synthetic polymers, addition polymers, some examples of addition polymers	**5%**
3	Students are able to explain linear polymers, branched in two dimensions, relative molecular mass	Accuracy, sequence/logic, correct calculations in solving chemical problems related in distinguishing the relative molecular mass of linear, branched, 2-dimensional polymers		**Lecture, exercise problems and tutorial** **[TM: 1×(3×50')]**		• polymer linear, branched 2-dimensional, relative molecular mass	**5%**
4-5	Students are able to explain mechanical properties, thermal/glass transitions	Accuracy, sequence/logic, • Description of mechanical properties, thermal/glass transitions		**Lecture, exercise problems and tutorial** **[TM: 1×(3×50')]**		• mechanical properties, thermal/glass transitions	**10%**

6-7	Students are able to explain the phenomenon of addition and condensation polymer degradation	• Accuracy, sequence / logic, correct calculations in solving chemical problems related to polymer degradation phenomena		**Lecture, exercise problems and tutorial** **[TM: 1×(3×50')]**		• Polimer degradasi	**15%**
8	**Mid-semester Evaluation**						**7.5%**
9-10	Students are able to complete plastic code as packaging	• Accuracy, sequence/logic, correct calculations in solving chemical problems. Plastic, Polypropylene, Polyurethane, Polyester, OLED, Polyethylene, PVC, Polycarbonate, Tupperware, Conductive Polymers, Rubber, Polysaccharides, Urea-Formaldehyde Resin, Teflon, Polystyrene, Gelatin, Earl Silas Tupper, Polyethylene glycol, Polyethylene terephthalate, Plastic clips, Rayon, Silicone,		**Lecture, exercise problems and tutorial** **[TM: 2×(3×50')]**		• Plastics, Polypropylene, Polyurethane, Polyester, OLED, Polyethylene, PVC, Polycarbonate, Tupperware, Conductive Polymers, Rubber, Polysaccharides, Urea-Formaldehyde Resin, Teflon, Polystyrene, Gelatin, Earl Silas Tupper, Polyethylene glycol, Polyethylene terephthalate, Rayon, Silikone	**10%**

11-12	Students are able to explain various types of plastics and their applications	• Accuracy, sequence/logic, correct calculations in solving chemical problems related to plastics degradable and its application.		**Lecture, exercise problems and tutorial** **[TM: 2×(3×50')]**		• Polyvinyl acetate, Synthetic polymers, Cellulose acetate, Epoxy, Low density polyethylene, High density polyethylene, Acrylonitrile butadiene styrene, Celluloid, Acrylic glass, Photoresist, Polyimide. Quote: Polypropylene or polypropene (PP) is a thermoplastic polymer made by the chemical industry and is used in a variety of applications,	**15%**
13-14	Students are able to explain the basic plastic processing	• Accuracy, sequence/logic, correct calculations in solving chemical problems related to polymers.		**Lecture, exercise problems and tutorial** **[TM: 2×(3×50')]**		• Polypropene is usually recycled, and the recycling symbol is the number "5". The melting processing of polypropylene can be accomplished by extrusion and molding. Common extrusion (melting) methods involve the production of spun	**5%**

						bond and melt (blow) blow to form long coils that are later converted into a variety of useful products such as face masks, filters, diapers and rags. The most common forming technique is injection molding, which is used for various parts such as cups, cutlery, vials, caps, containers	
15-16	**Final Semester Evaluation**						**7.5%**

47. MEMBRANE CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
MEMBRANE CHEMISTRY	SK184867*	Optional	2	0	VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Nurul Widiastuti, M.Si., Ph.D.		Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

<table>
<tr><td rowspan="5">Program Learning Outcomes (LO)</td><td colspan="2">LO-PRODI Charged to The Course</td></tr>
<tr><td>LO 1</td><td>Has good moral, ethics and personality in completing one’s task</td></tr>
<tr><td>LO 3</td><td>Able to collect data and information correctly, analyze and use analysis for correct decision making</td></tr>
<tr><td>LO 7</td><td>Able to master concepts, theory and methods on analysis and synthesis of chemical substances</td></tr>
<tr><td colspan="2">Course Learning Outcomes (CLO)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>CLO 1</td><td>After taking this course, students are able to apply membrane design and technology to solve science and technology problems related to membrane materials</td></tr>
<tr><td>LO - CLOMAP</td><td colspan="2">
<table>
<tr><th></th><th>LO 1</th><th>LO 2</th><th>LO 3</th><th>LO 4</th><th>LO 5</th><th>LO 6</th><th>LO 7</th><th>LO 8</th><th>LO 9</th></tr>
<tr><td>CLO 1</td><td>√</td><td></td><td>√</td><td></td><td></td><td></td><td>√</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Course Short Description</td><td colspan="2">This course will lead students to the ability to apply membrane science and technology to solve science and technology problems related to membrane materials, such as industry, energy, health, food processing, the environment, provision of clean and drinking water, and processing of natural resources. At the beginning of the lecture, students will be given knowledge about the application of membranes in industry and daily life, as well as the development of membrane materials in the future, so that it is hoped that students will be able to identify real problems that can be solved with membrane technology. The problem will then become a topic in the group assignment which will be resolved through 4 stages according to the Membrane Chemistry course material and ends with a final presentation assignment and a paper on solving science and technology problems by applying membrane design and technology.</td></tr>
<tr><td>Study Material:
Subject Matter</td><td colspan="2">1. Introduction which includes the application of membranes in industry and everyday life, as well as the development of membrane materials in the future
2. Fundamentals in membrane science and technology which includes the definition, membrane type, membrane process and mass transport fundamentals
3. Membrane preparation and characterization
4. The principle of the membrane separation process which includes microfiltration, ultrafiltration, nanofiltration, reverse osmosis, gas separation and pervaporation, dialysis, electromembrane, contactor membranes and reactor membranes.
5. The membrane module, membrane design, and membrane washing method according to their applications</td></tr>
<tr><td>Reference</td><td colspan="2">Primary:</td></tr>
</table>

	1. Heinrich Strathmann, “Introduction to Membrane Science and Technology”, Wiley-VCH Verlag & Co, KGaA, Weinheim, 2011. 2. Ramesh R. Bhave, “Inorganic Membranes: Synthesis, Characteristics and Applications”, New York, 1991. 3. W.S. Winston Ho and Kamalesh K. Sirkar, “Membrane Handbook”, New York, 1992. 4. Membrane Science and Technology, Science Direct Online 5. Journal of Membrane Science, Science Direct On-line 6. Membrane Technology, Science Direct Online **Secondary:**
Lecturer	Nurul Widiastuti, M.Si., Ph.D.
Pre-Requisite Courses	Has taken Chemistry I and Chemical Thermodynamics courses

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1, 2	Students are able to identify several industrial problems and daily life (in the fields of energy, environment, health, food processing, clean water supply) that can be solved with membranes and the potential for developing membran	• Accuracy in identifying problems	Lectures on case studies in industry and everyday life 2. Watch the membrane application video 3. Discussion of membrane development in the	**Lecture** **[TM: 2×(2×50’)]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50’)]** **[BM: 2×(2×50’)]** **[PT: 1x(1x60’)]**	• Several industrial and daily life problems that can be solved with membranes • Application of membranes in industry • Future development of membrane materials	**5%**

			future from several journal reviews 4. Divide and explain Assignment groups to compile papers and presentations on solving daily and industrials problems				
3	Students are able to explain membrane definition, membrane type, membrane process and mass transport fundamentals (C2)	• Accuracy in explaining the membrane definition, membrane type, membrane process and mass transport fundamentals		**Lecture and class discussion** **[TM: 2×(2×50')]**		• Definition of the membrane • Membrane type • Membrane process • Mass transport fundamentals	
4-7	Students are able to determine the membrane preparation method and its characterization according to the target membrane properties for certain applications (C2)	Accuracy in determining the membrane preparation method and its characterization		**Lecture** **Group discussion** **Assignment** **Tutorial** **[TM: 3×(2×50')]**		• Membrane preparation/synthesis methods include symmetric and asymmetric membrane preparation, phase inversion method for polymer membranes, mixed matrix membrane (MMM) preparation, inorganic	**10%**

						membrane synthesis • Characterization of membranes	
8	**Mid-semester Evaluation**						**25%**
9-11	Students are able to connect the membrane separation process to the appropriate membrane properties as well the method of preparation/synthesis (C3)	Depth analysis in relating the membrane separation process to the appropriate membrane properties as well • method of preparation/synthesis		**Lecture and group discussion** **[TM: 3×(2×50')]**		• The principle of the membrane separation process which includes microfiltration, ultrafiltration, nanofiltration, reverse osmosis, gas separation and pervaporation, dialysis, membrane electro, contactor membrane and reactor membrane	**5%**
12-13	Students are able to choose modules and membrane designs as well as membrane washing methods according to their application (C4)	• Depth of analysis in selecting modules and membrane design and membrane washing method according to the application		**Lecture and group discussion** **[TM: 2×(2×50')]**		• Membrane module • Membrane blockage and alternative washing methods • Membrane process design and operation	**5%**
14	Students are able to apply membrane science and technology to solve science and technology problems	• Ability to present thoughts/ideas in solving problem, both orally and in writing		**Group presentation** **Papers submission**		• Group presentation • Class discussion	**presentation**

	related to membrane materials which are presented in group presentation assignments and papers.	in a paper		**[TM: 1×(2×50')]**			**(10 %)** **Paper** **(15 %)**
15-16	**Final Semester Evaluation**						**25%**

48. UPSTREAM OIL AND GAS CHEMISTRY

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) **FACULTY OF SCIENCE AND DATA ANALYTICS** **DEPARTMENT OF CHEMISTRY**					**Document Code**
TEACHING AND LEARNING PLAN						
COURSE (MK)	**CODE**	**Course disiplines (RMK)**	**Semester Credit Units**		**SEMESTER**	**Compilation Date**
UPSTREAM OIL AND GAS CHEMISTRY	SK184868*	Optional	3	0	VIII	
AUTHORIZATION / LEGALIZATION	**TLP Editor**		**Course Group Coordinator**		**Head of Study Program (PRODI)**	
	Dr. Hendro Juwono, M.Si		Djarot Sugiarso S., M.Si.		Dr. rer. nat. Fredy Kurniawan, M. Si	

Program Learning Outcomes (LO)	**LO-PRODI Charged to The Course**	
	LO 1	Has good moral, ethics and personality in completing one's task
	LO 6	Able to master the concepts of structure, character and change of substance according to the aspects of dynamics and energetics
	LO 8	Able to apply a chemistry mindset and utilize science and technology in their field and overcome problems that are faced.
	LO 9	Able to apply chemistry mindset in driving the creation of job opportunities
	Course Learning Outcomes (CLO)	
	CLO 1	Able to explain the process of petroleum production, exploration and its use as a fossil fuel (C3).
LO - CLOMAP		

		LO 1	**LO 2**	**LO 3**	**LO 4**	**LO 5**	**LO 6**	**LO 7**	**LO 8**	**LO 9**
	CLO 1			**√**		**√**		**√**	**√**	
Course Short Description	Petroleum, known as black gold, is a thick, dark brown, or greenish flammable liquid that resides in the upper layers of several areas of the Earth's crust. Petroleum consists of a complex mixture of various hydrocarbons, mostly alkanes, but varying in structure, composition and purity. Petroleum is extracted from oil wells in oil mines. The locations of these oil wells were obtained after going through a process of geological studies, sediment analysis, character and source structure, and various other studies. As a non-renewable natural resource, it will take a very long time, around 60 million years to form organic sediment into petroleum. Through the study of the cycle of carbon compounds in the atmosphere, photosynthesis and the evolution of life, we can find out what are the main contributors to sedimentary organic matter and know how the production and origin of organic matter in petroleum. Piles of organic materials derived from microorganisms, algae, bacteria, phytoplankton and land plants produce sedimentary organic material accumulation which in the next stage will be converted into petroleum by chemical processes and geological evolution including the stages of diagenesis, catagenesis, metagenesis and metamorphosis. This upstream oil and gas chemistry course study will also briefly discuss the migration of oil and gas, the correlation of source rocks with oil and gas. The use of petroleum will also be discussed in this course by studying the properties and composition of oil and gas, classification of oil and gas, petroleum refining and petroleum reforming. Learning that is carried out synergistically between petroleum production and the chemical composition of petroleum, it is hoped that students will be able to explain the process of petroleum production, petroleum exploration, petroleum distillation and its use as a fossil fuel.									
Study Material: Subject Matter	1. Production and origin of organic matter (cycle of carbon compounds in the atmosphere, photosynthesis and the evolution of life, major contributors to sedimentary organic matter) 2. Chemical composition of biogenic substances (product structure of natural materials: carbohydrates, proteins, lipids, lignins, tannins, geochemical implications of variations in composition) 3. Sedimenter organic matter evolution (sedimentation process and material accumulation) 4. Formation of humic materials, coal and kerogen (diagenesis, humic materials, coal, kerogen) 5. Kerogen (chemical analysis of kerogen, general structure of kerogen, classification of kerogen, kerogen to petroleum) 6. Petroleum and natural gas (petroleum migration, properties, composition and classification of petroleum, petroleum refining, petroleum reforming) 7. Correlation of source rocks with oil and gas 8. Use of petroleum (distillation and processing of petroleum)									
Reference	**Primary:** 1. Tissot, B.P., Welte, D.H., 1984. Petroleum formation and occurrence, second ed. Springer Verlag, Berlin-Heidelberg, p. 599 2. Killops and Killops., 1993. An Introduction to Organic Geochemistry, John Wiley and Sons, Inc., New York, p.265 **Secondary:**									

Lecturer	Prof. Dr. R.Y. Perry Burhan, M.Sc; Dr. Yulfi Zetra, MS
Pre-Requisite Courses	Has taken Chemistry I

Session	**Learning outcomes of each learning stage (Sub-LOMK)**	**Assessment**		**Learning Design; Learning Method; Student Assignment; [Estimated Time]**		**Learning Material [Reference]**	**Assesment Portion (%)**
		Indicator	**Criteria and Technical**				
(1)	**(2)**	**(3)**	**(4)**	**Face-to-face Class (5)**	**Online Class (6)**	**(7)**	**(8)**
1, 2	Students are able to explain the production and origin of organic materials	• Accuracy in explaining the production and origin of organic matter • The precision in explaining the cycle of carbon compounds in the atmosphere, photosynthesis and the evolution of life • The accuracy in explaining what is the main contributor to sedimentary organic matter	**Assignment I** (production and origin of organic matter in the formation of petroleum and gas)	**Lecture** **[TM: 1×(2×50')]** **Lecture and discussion** **[TM: 1x(2x50")]** **Assignment I [BT+BM:(1+1)x(4x60")]**	**Responsi** ***Small Group discussion*** **[TM: 2×(2×50')]** **[BM: 2×(2×50')]** **[PT: 1x(1x60')]**	• Carbon compounds cycle in the atmosphere • Photosynthesis and the evolution of life • Main contributor to sedimentary organic matter	**10%**
3, 4	Students are able to explain the chemical composition of biogenic materials	• The accuracy in describing the structure of natural products: carbohydrates, proteins, lipids, lignins, tannins, geochemical implications of		**Lecture and group discussion** **[TM: 2x(2x50")]**		• Product structure of natural ingredients: carbohydrates, proteins, lipids, lignins and tannins • Geochemical	

		variations in composition				implications of variations in composition	
5	Students are able to explain the evolution of organic matter in sediment	The accuracy in explaining the evolution of sedimentary organic matter in the formation of petroleum and gas		**Lecture and group discussion** **[TM: 2x(2x50")]**		• Sedimentation process • Accumulation of organic matter	**10%**
6, 7	Students are able to explain the formation of humic, coal and kerogen materials before the formation of oil and natural gas	• Accuracy in explaining the formation of humic material, coal and kerogen prior to the formation of oil and natural gas	**Assignment II** (resume and journal analysis in the form of group discussion) related to the chemical composition of biogenic materials, evolution of sedimentary organic matter, formation of humic material, coal and kerogen before the formation of petroleum and natural gas	**Lecture and group discussion** **[TM: 2x(2x50")]**		• Geological process stages include diagenesis, catagenesis, metagenesis and metamorphosis • Humic, coal and kerogen materials	**15%**
8	**Mid-semester Evaluation**						**20%**
9	Students are able to explain about kerogen in the formation of oil and natural gas	• Accuracy in in describing kerogen in the formation of oil and natural gas	Lecture, Group discussion	**Lecture and group discussion** **[TM: 1x(2x50")]**		• Kerogen chemical analysis • General structure of kerogen	**10%**

						• Kerogen classification • Kerogen becomes petroleum and natural gas	
10, 11	Students are able to explain about petroleum and natural gas migration, properties, composition and classification of petroleum, petroleum distillation, petroleum refining and petroleum reforming	• Accuracy in describing and explaining the migration of oil and gas, the nature, composition and classification of petroleum, petroleum refining and petroleum reforming	Lecture, Group discussion	**Lecture and group discussion** **[TM: 2x(2x50")]**		• Oil and natural gas migration • The nature, composition and classification of petroleum • Petroleum distillation • Petroleum refining dan petroleum reforming	
12, 13	Students are able to explain the correlation of source rocks with oil and natural gas	• Accuracy in describing the correlation of source rock with oil and gas		**Lecture and group discussion** **[TM: 2x(2x50")]**		• Correlation of source rocks with oil and natural gas	
14, 15	[C3,A3]: Students are able to explain about the processing and use of petroleum	• Accuracy in describing the process and the use of petroleum	**Assignment III** (Group presentation and discussion of all material materials related to Upstream Oil and Gas Chemistry)	**Lecture and group discussion** **[TM: 2x(2x50")]**		• The process and the use of petroleum • Chemical reactions associated with petroleum refining and petroleum reforming	**15%**
15-16	**Final Semester Evaluation**						**20%**

PANDUAN PELAKSANAAN
TUGAS AKHIR - PRODI SARJANA ITS

IMPLEMENTATION GUIDE of FINAL PROJECT - ITS BACHELOR PROGRAM

KANTOR PENJAMINAN MUTU

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

2017

KATA PENGANTAR (FOREWORD)

Sebagaimana diamanatkan di dalam Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Nomor 62 Tahun 2016 tentang perguruan tinggi wajib mengimplementasikan Sistem Penjaminan Mutu Internal (SPMI). SPMI bertujuan menjamin pemenuhan atau pelampauan Standar Nasional Pendidikan Tinggi (SN Dikti). Dengan maksud agar setiap perguruan tinggi dapat memenuhi amanat UU tersebut secara tepat, Kantor Penjaminan Mutu membuat panduan untuk pelaksanaan akademik, yaitu Tugas Akhir/Skripsi di lingkungan ITS.

Buku ini disusun dengan bantuan Tim Penyusun Panduan Pelaksanaan Tugas Akhir/Skripsi yang terdiri atas para pakar yang berpengalaman dan perwakilan dosen. Kami ucapkan terimakasih kepada Tim Penyusun dan Editor, dengan koordinasi oleh Kantor Penjaminan Mutu, sehingga menghasilkan panduan pelaksanaan Tugas Akhir/Skripsi.

ITS berharap agar buku ini dapat menjadi pegangan di setiap Prodi dalam mengimplementasikan SPMI bidang akademik, khususnya dalam pelaksanaan Tugas Akhir/Skripsi dengan baik.

As mandated in the Regulation of the Minister of Research, Technology and Higher Education Number 62 of 2016 concerning universities are required to implement the Internal Quality Assurance System (SPMI). SPMI aims to ensure the fulfillment or exceedance of the National Higher Education Standards (SN Dikti). With the intention that each university can fulfill the mandate of the law appropriately, the Quality Assurance Office makes guidelines for academic implementation, namely Final Projects/Thesis in ITS environment.

This book was compiled with the help of the Final Project / Thesis Implementation Guide Compilation Team which consists of experienced experts and lecturer representatives. We would like to thank the Drafting Team and Editors, with coordination by the Quality Assurance Office, resulting in the implementation of the Final Project / Thesis manual. ITS hopes that this book can become a guide in every study program in implementing SPMI in the academic field, especially in implementing the Final Project / Thesis properly.

Surabaya, Januari 2017

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6.4 Hal–hal yang belum diatur pada dokumen panduan ini dapat dikembangkan di setiap Prodi masing-masing, dengan syarat tidak melanggar ketentuan pada buku panduan ini, peraturan yang lebih tinggi: Peraturan Akademik, dan/atau Peraturan Menteri. 30

7 RUJUKAN 30

DEFINISI ISTILAH (DEFINITIONS OF TERMS)

Fakultas adalah himpunan sumber daya pendukung yang menyelenggarakan dan mengelola pendidikan akademik, pendidikan profesi, dan/atau pendidikan vokasi dalam satu rumpun disiplin ilmu pengetahuan dan teknologi.	*Faculty is a set of supporting resources that organize and manage academic education, professional education, and / or vocational education in one scientific and technological discipline.*
Departemen adalah unsur dari Fakultas yang mendukung penyelenggaraan kegiatan akademik dalam satu atau beberapa cabang ilmu pengetahuan dan teknologi dalam jenis pendidikan akademik, pendidikan vokasi, dan/atau pendidikan profesi.	*Departments are elements of the Faculty that support the implementation of academic activities in one or several branches of science and technology in the types of academic education, vocational education, and / or professional education.*
Program Studi yang selanjutnya disingkat Prodi adalah kesatuan kegiatan pendidikan dan pembelajaran yang memiliki kurikulum dan metode pembelajaran tertentu dalam satu jenis pendidikan akademik, pendidikan vokasi, dan/atau pendidikan profesi.	*Study Program, hereinafter abbreviated as Prodi, is a unit of educational and learning activities that have a certain curriculum and learning methods in one type of academic education, vocational education, and / or professional education.*

Dosen adalah pendidik profesional dan ilmuwan dengan tugas utama mentransformasikan, mengembangkan, dan menyebarluaskan ilmu pengetahuan dan teknologi melalui pendidikan, penelitian, dan pengabdian kepada masyarakat.	*Lecturers are professional educators and scientists with the main task of transforming, developing and disseminating science and technology through education, research, and community service.*
Mahasiswa adalah peserta didik pada jenjang pendidikan tinggi di ITS.	*Students are students at the higher education level at ITS.*
Standar Nasional Pendidikan Tinggi adalah satuan standar yang meliputi Standar Nasional Pendidikan ditambah dengan Standar Nasional Penelitian dan Standar Nasional Pengabdian kepada Masyarakat.	*The National Higher Education Standards are standard units covering the National Education Standards coupled with the National Research Standards and the National Community Service Standards.*
Standar Pendidikan Tinggi yang ditetapkan oleh Perguruan Tinggi adalah sejumlah standar pada perguruan tinggi yang melampaui Standar Nasional Pendidikan Tinggi.	*Higher Education Standards set by Higher Education are a number of standards in higher education that exceed the National Higher Education Standards*
Penelitian adalah kegiatan yang dilakukan menurut kaidah dan metode ilmiah secara sistematis untuk memperoleh informasi, data, dan keterangan yang berkaitan	*Research is an activity carried out according to scientific principles and methods systematically to obtain information, data and information relating to the*

dengan pemahaman dan/atau pengujian suatu cabang ilmu pengetahuan dan teknologi.	*understanding and / or testing of a branch of science and technology.*
Tugas Akhir/Skripsi adalah karya ilmiah yang disusun oleh mahasiswa sesuai dengan kaidah dan etika keilmuan**,** di bawah bimbingan dosen yang berkompeten dan merupakan luaran dari capaian pembelajaran dalam menerapkan ilmu pengetahuan, teknologi dan seni pada lingkup keilmuan tertentu.	*Final Project / Thesis is a scientific work prepared by students in accordance with scientific principles and ethics, under the guidance of competent lecturers and is the output of learning outcomes in applying science, technology and art to a certain scientific scope.*
Pembelajaran adalah proses interaksi mahasiswa dengan dosen dan sumber belajar pada suatu lingkungan belajar.	*Learning is a process of interaction between students and lecturers and learning resources in a learning environment.*
Capaian Pembelajaran Lulusan Program Studi yang selanjutnya disingkat CPL Prodi adalah kemampuan lulusan yang mencakup sikap, pengetahuan, dan keterampilan.	*Study Program Graduate Learning Outcomes, hereinafter abbreviated as CPL Study Program, are the ability of graduates that include attitudes, knowledge, and skills.*

Surat Keterangan Pendamping Ijasah yang selanjutnya disingkat SKPI adalah dokumen yang berisi keterangan kemampuan mahasiswa yang melengkapi ijasah dan transkrip sebagai pernyataan mahasiswa telah lulus dari perguruan tinggi.

Certificate of Companion diploma, hereinafter abbreviated as SKPI, is a document containing information on the student's ability to complete the diploma and transcript as a statement that the student has graduated from college.

Jabatan fungsional Dosen yang juga dapat disebut sebagai Jabatan Akademik Dosen adalah kedudukan yang menunjukkan tugas, tanggung jawab, wewenang, dan hak seseorang Dosen dalam suatu satuan pendidikan tinggi yang dalam pelaksanaannnya didasarkan pada keahlian tertentu serta bersifat mandiri.

Lecturer functional positions which can also be referred to as Lecturer Academic Positions are positions that indicate the duties, responsibilities, authorities, and rights of a Lecturer in a higher education unit which in its implementation is based on certain expertise and is independent.

Industri adalah seluruh kegiatan ekonomi yang sistematis untuk mengolah bahan baku dan/atau memanfaatkan sumber daya sehingga menghasilkan barang dan jasa yang mempunyai nilai tambah atau manfaat lebih tinggi.

Industry is all systematic economic activities to process raw materials and / or utilize resources so as to produce goods and services that have added value or higher benefits.

Asesmen atau Penilaian adalah satu atau lebih proses mengidentifikasi, mengumpulkan, dan mempersiapkan data yang digunakan untuk mengevaluasi pencapaian hasil mahasiswa dan tujuan program pendidikan[1]	*Assessment or assessment is one or more processes of identifying, collecting, and preparing data used to evaluate student achievement and educational program objectives.*
Evaluasi adalah salah satu atau lebih proses untuk menafsirkan data dan bukti yang telah dikumpulkan melalui proses penilaian/asesmen[1].	*Evaluation is one or more processes for interpreting data and evidence that has been collected through an assessment / assessment process1*
Plagiat adalah perbuatan secara sengaja atau tidak sengaja dalam memperoleh atau mencoba memperoleh kredit atau nilai untuk suatu karya ilmiah, dengan mengutip sebagian atau seluruh karya dan/atau karya ilmiah pihak lain yang diakui sebagai karya ilmiahnya, tanpa menyatakan sumber secara tepat dan memadai.	*Plagiarism is an act intentionally or unintentionally in obtaining or trying to obtain credit or value for a scientific work, by quoting part or all of the work and / or scientific work of another party that is recognized as scientific work, without stating the source accurately and adequately.*
Fabrikasi adalah mengarang data	*Fabrication is the fabrication of data*
Falsifikasi adalah mengubah data supaya hasil sesuai dengan keinginan peneliti / pembimbing / pihak pemberi dana penelitian / sponsor	*Falsification is changing the data so that the results are in accordance with the wishes of the researcher / supervisor / research funder / sponsor*

1 LANDASAN HUKUM

1. Undang-undang No 12 Tahun 2012, tentang Sistem Pendidikan Tinggi.
2. Peraturan Presiden Nomor 8 Tahun 2012, tentang Kerangka Kualifikasi Nasional Indonesia.
3. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi, Nomor 44 Tahun 2015 tentang Standar Nasional Pendidikan Tinggi.
4. Lampiran Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi, Nomor 44 Tahun 2015 tentang Standar Nasional Pendidikan Tinggi.
5. Peraturan Menteri Pendayaan Aparatur Negara dan Reformasi Birokrasi, Nomor 17 Tahun 2013, tentang Jabatan Fungsional Dosen dan Angka Kreditnya.
6. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor: 073255/IT2/HK.00.00/2014, Tentang Peraturan Akademik.

1. *Law No. 12 of 2012, concerning the Higher Education System.*
2. *Presidential Regulation Number 8 of 2012, concerning the Indonesian National Qualifications Framework.*
3. *Regulation of the Minister of Research, Technology and Higher Education, Number 44 of 2015 concerning National Higher Education Standards.*
4. *Attachment to the Regulation of the Minister of Research, Technology and Higher Education, Number 44 of 2015 concerning National Higher Education Standards.*
5. *Regulation of the Minister of State Apparatus Empowerment and Bureaucratic Reform, Number 17 of 2013, concerning Lecturer Functional Positions and Credit Points.*
6. *Regulation of the Chancellor of the Sepuluh Nopember Institute of Technology Number: 073255 / IT2 / HK.00.00 / 2014, Concerning Academic Regulations.*

2 TUJUAN / MAKSUD (*PURPOSE*)

Tujuan / maksud Panduan Pelaksanaan Tugas Akhir/Skripsi adalah agar pelaksanaan Tugas Akhir/Skripsi di ITS sesuai secara akademik dan administrasi. Secara akademik, yaitu:

- Mencapai CPL Prodi,
- Memenuhi persyaratan minimum pengambilan MK Tugas Akhir/Skripsi,
- Memenuhi persyaratan minimum pembimbing dan penguji pelaksanaan Tugas Akhir/Skripsi.
- Sebagai syarat disusunnya Surat Keterangan Pendamping Ijasah (SKPI).

secara administrasi yaitu:

Keseragaman dokumen proposal dan laporan Tugas Akhir/Skripsi.

The purpose / purpose of the Final Project / Thesis Implementation Guide is so that the implementation of the Final Project / Thesis at ITS is academically and administratively appropriate. Academically, namely:

- *Achieve CPL Study Program,*
- *Fulfills the minimum requirements for making MK Final / Thesis,*
- *Fulfill the minimum requirements of supervisors and examiners for the implementation of the Final Project / Thesis.*
- *As a condition for compiling a Certificate of Companion Ijasah (SKPI).*

administratively, namely:

•Uniformity of proposal documents and Final Project / Thesis reports.

3 RUANG LINGKUP *(SCOPE)*

Ruang lingkup panduan pelaksanaan Tugas Akhir/Skripsi:

Berlaku untuk seluruh Prodi Sarjana dan Serjana Terapan di ITS.

The scope of the guidelines for implementing the Final Project / Thesis: Valid for all Undergraduate and Applied Bachelor Study Programs at ITS.

4 TARGET MUTU *(QUALITY TARGETS)*

Target mutu pelaksanaan Tugas Akhir/Skripsi adalah:

1. Proses pelaksanaan Tugas Akhir/Skripsi tertib, lancar, tidak ditemui adanya keterlambatan pelaksanaan, kesesuaian dengan CPL Prodi, kesesuaian kompetensi dosen pembimbing dan penguji ujian Tugas Akhir/Skripsi.
2. Lama pelaksanaan Tugas Akhir/Skripsi adalah 1 (satu) semester

The quality targets for the implementation of the Final Project / Thesis are:

1. *The process of implementing the Final Project / Thesis is orderly, smooth, there is no delay in implementation, conformity with the CPL Study Program, conformity of the competence of the supervisor and examiner of the Final Project / Thesis examination.*
2. *The duration of the Final Project / Thesis is 1 (one) semester*

5 PIHAK YANG BERTANGGUNG JAWAB *(RESPONSIBLE PARTIES)*

Pihak yang bertanggung jawab terhadap pelaksanaan Tugas Akhir:

1. Wakil Rektor I
2. Direktur Direktorat Akademik
3. Dekan
4. Kepala Departemen
5. Kepala Program Studi
6. Dosen Pembimbing dan Penguji

The party responsible for the implementation of the Final Project:

1. *Vice Chancellor I*

2. *Director of the Academic Directorate*
3. *Dean*
4. *Head of Department*
5. *Head of Study Program*
6. *Supervisor and Examiner*

6 PROSEDUR (PROCEDURE)

6.1 Umum (General)

Panduan ini berlaku sejak tanggal ditetapkan. Setiap perubahan atas panduan harus menggunakan mekanisme yang diatur dalam prosedur pengendalian.

This guide is in effect from the date specified. Any changes to the guidelines must use the mechanisms set out in the control procedures.

6.2 Ketentuan Umum *(general requirements)*

6.2.1 Prodi harus melaksanakan proses Tugas Akhir/Skripsi melalui persiapan, pelaksanaan dan evaluasi secara administrasi dan akademis yang mendukung tercapainya CPL Prodi.

(6.2.1 Prodi must carry out the Final Project / Thesis process through preparation, implementation and evaluation administratively and academically that support the achievement of CPL Study Program)

Pernyataan 6.2.1 tersebut di atas dirinci sebagai berikut
(Statement 6.2.1 above is detailed as follows)

A. Pelaksanaan Tugas Akhir/Skripsi mendukung kepada kemampuan mahasiswa untuk mencapai kompetensi lulusan.
(A. The implementation of the Final Project / Thesis supports the ability of students to achieve graduate competencies.)
B. Pelaksanaan Tugas Akhir/Skripsi terdiri dari tahap Proposal, presentasi Proposal, Penelitian/Perancangan, Pembuatan Laporan, dan Ujian.

(B. The implementation of the Final Project / Thesis consists of the Proposal stage, Proposal presentation, Research / Design, Reporting, and Examinations.)

C. Tahap presentasi Proposal sebagai bagian dari pelaksanaan Tugas Akhir/Skripsi.
(C. Proposal presentation stage as part of the implementation of the Final Project / Thesis)

D. Departemen mengusulkan dosen pembimbing dan penguji Tugas Akhir/Skripsi sesuai dengan persyaratan yang berlaku.
(D. The Department proposes the supervisor and examiner for the Final Project /Thesis in accordance with the applicable requirements)

E. Dekan menetapkan nama-nama Dosen Pembimbing dan Penguji Tugas Akhir/Skripsi sesuai dengan usulan Kepala Departemen.
(E. The Dean determines the names of the Supervisors and Examiners for the Final Project/Thesis in accordance with the proposal of the Head of the Department)

6.2.2 Mahasiswa pengambil Tugas Akhir/Skripsi telah menempuh MK minimal 110 sks dan telah mengikuti ujian TOEFL atau yang setara.
(6.2.2 Students who take Final Project / Thesis have taken MK at least 110 credits and have taken the TOEFL exam or equivalent)

6.2.3 Hasil Penilaian Pelaksanaan Tugas Akhir/Skripsi harus sesuai dengan Standar Penilaian pada Peraturan Akademik ITS.
(6.2.3 The results of the Final Project / Thesis Implementation Assessment must be in accordance with the Assessment Standards in the ITS Academic Regulations)

Pernyataan 6.2.3 tersebut di atas dirinci sebagai berikut:
(The above 6.2.3 Statement is detailed as follows:)

A. Pembimbing dan Penguji Tugas Akhir/Skripsi bertugas untuk melakukan penilaian dan memberikan evaluasi terhadap pelaksanaan Tugas Akhir/Skripsi.

(A. Supervisor and Examiner of the Final Project / Thesis is tasked with conducting an assessment and providing an evaluation of the implementation of the Final Project / Thesis)

B. Hasil Penilaian dan Evaluasi Pelaksanaan Tugas Akhir/Skripsi dinyatakan dengan Angka dan Huruf

(B. The results of the Assessment and Evaluation of the Implementation of the Final Project / Thesis are stated in Numbers and Letters)

6.2.4 Hasil deskripsi Tugas Akhir/Skripsi disusun dalam bentuk karya ilmiah diunggah dalam laman ITS.

(6.2.4 The results of the final / thesis description are arranged in the form of a scientific paper uploaded on the ITS page)

6.3 Ketentuan Khusus *(Special Provisions)*

6.3.1 Proposal Tugas Akhir/Skripsi *(Final Project / Thesis Proposal)*

A. Format proposal Tugas Akhir/Skripsi memenuhi standar format yang ditetapkan oleh ITS, dalam panduan

(A. Final Project / Thesis proposal format meets the standard format set by ITS, in the guidelines)

B. Proposal Tugas Akhir/Skripsi harus mencerminkan CPL Prodi yang telah ditetapkan dalam standar kompetensi lulusan.

(B. Final Project / Thesis proposal must reflect the CPL of the Study Program which has been determined in the graduate competency standard)

C. Proposal Tugas Akhir/skripsi harus menunjukkan kemampuan

(C. Final project proposal / thesis must demonstrate capability)

D. penulisan yang memuat:
(D. writing which contains:)

1. Judul Penelitian / Perancangan
   (Research / Design Title)
2. Nama dosen pembimbing / calon pembimbing
   (The name of the supervisor / prospective supervisor)
3. Abstrak
   (Abstract)
4. Latar Belakang
   (Background)
5. Perumusan Masalah
   (formulation of the problem)
6. Tujuan Penelitian/Perancangan
   (Research / Design Objectives)
7. Tinjauan Pustaka
   (Literature review)
8. Metode Penelitian / Perancangan
   (Research / Design Methods)
9. Jadwal Pelaksanaan
   (Implementation Schedule)
10. Daftar Pustaka
    (Bibliography)

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E. Jadwal pendaftaran Proposal Tugas Akhir/Skripsi ditentukan Prodi tidak melebihi minggu ke 2 (dua) pada semester berjalan.

6.3.2 Presentasi Proposal Tugas Akhir/Skripsi di hadapan pembimbing/calon pembimbing dan penguji/calon penguji
Presentation of Final Project / Thesis Proposals in front of mentors / prospective supervisors and examiners / prospective examiners

A. Jadwal Presentasi Proposal Tugas Akhir/Skripsi tidak lebih dari minggu ke 4 (empat) pada semester berjalan.
Presentation of Final Project / Thesis Proposals in front of mentors / prospective supervisors and examiners / prospective examiners

B. Presentasi Proposal Tugas Akhir/Skripsi bersifat terbuka, wajib dihadiri oleh dosen pembimbing/calon pembimbing, penguji dan dapat dihadiri oleh dosen dan mahasiswa.
Presentation of the Final Project / Thesis Proposal is open, must be attended by supervisors / prospective supervisors, examiners and can be attended by lecturers and students.

C. Presentasi Proposal Tugas Akhir/Skripsi dilaksanakan minimal 1 (satu) kali, dan maksimum 3 (tiga) kali untuk tema yang sama dalam semester berjalan.
Presentation of Final Project / Thesis Proposals is carried out at least 1 (one) time, and a maximum of 3 (three) times for the same theme in the current semester.

D. Dosen pembimbing/calon pembimbing dapat bertindak sebagai penguji.
Supervisors / prospective supervisors can act as examiners.

E. Tim penguji presentasi Proposal Tugas Akhir/Skripsi ditentukan pada saat proposal didaftarkan ke Prodi.
The examination team for the presentation of the Final Project / Thesis Proposal is determined when the proposal is submitted to the Study Program.

F. Jumlah penguji presentasi Proposal minimum 2 (dua) dan maksimum 3 (tiga) orang diluar pembimbing.
The minimum number of examiners for the Proposal presentation is 2 (two) and a maximum of 3 (three) people outside the supervisor.

G. Presentasi Proposal Tugas Akhir/Skripsi dipimpin oleh moderator.
Presentation of the Final Project / Thesis Proposal led by a moderator.

H. Moderator presentasi Proposal Tugas Akhir/Skripsi dapat berasal dari dosen pembimbing atau salah satu penguji atau dosen lain.
The moderator for the presentation of the Final Project / Thesis Proposal can come from the supervisor or one of the examiners or another lecturer.
Berita acara pelaksanaan presentasi Tugas Akhir/Skripsi memuat minimal:
Minutes of the implementation of the presentation of the Final Project / Thesis contain at least:

1. Nama Mahasiswa, NRP Mahasiswa, Nama Moderator, Nama Pembimbing/Calon Pembimbing, Nama Penguji.
   Name of Student, Student NRP, Name of Moderator, Name of Advisor / Prospective Advisor, Name of Examiner.
2. Jadwal.
   Schedule
3. Tanda tangan mahasiswa, moderator, dan semua penguji.
   Signature of students, moderators, and all examiners.
4. Hasil keputusan dari penguji yang dinyatakan dalam bentuk satu dari tiga kategori berikut: diterima tanpa perbaikan, diterima dengan perbaikan, atau ditolak.
   The results of examiners' decisions are expressed in the form of one of the following three categories: accepted without correction, received with correction, or rejected.

J. Lama waktu pelaksanaan Presentasi proposal Tugas Akhir/Skripsi maksimal adalah 60 menit.
The maximum time for the presentation of the Final Project / Thesis proposal is 60 minutes.

K. Penilaian presentasi proposal Tugas Akhir/Skripsi menjadi satu bagian dengan nilai pelaksanaan Tugas Akhir/Skripsi.
Evaluation of the presentation of the Final / Thesis proposal into one part with the value of the implementation of the Final / Thesis.

L. Masukan pada presentasi proposal Tugas Akhir/Skripsi harus ditindak lanjuti dengan perbaikan proposal dalam jangka waktu maksimum 1 (satu) minggu setelah pelaksanaan presentasi.
Input on the presentation of the Final Project / Thesis proposal must be followed up by revision of the proposal within a maximum period of 1 (one) week after the presentation.

M. Aspek penilaian terhadap proposal yaitu: tata tulis; kualitas ide, perumusan masalah dan tujuan; rencana penyelesaian masalah. Aspek penilaian dirinci oleh masing-masing Prodi dengan rubrik penilaian. Pada Tugas Akhir/Skripsi dalam bentuk karya seni dan desain diperlukan portofolio. Rubrik dapat dikembangkan oleh masing-masing Prodi.

Aspects of the assessment of the proposal, namely: writing procedures; quality of ideas, problem formulation and objectives; problem solving plan. The assessment aspects are detailed by each study program with an assessment rubric. In the Final Project / Thesis in the form of artwork and design, a portfolio is required. Rubrics can be developed by each Prodi.

6.3.3 Pelaksanaan Tugas Akhir/Skripsi

Implementation of Final Project / Thesis

A. Pelaksanaan Tugas Akhir/Skripsi harus mendapat bimbingan dari Dosen/Tim Dosen Pembimbing.
The implementation of the Final Project / Thesis must receive guidance from the Lecturer / Advisory Lecturer Team.

B. Pelaksanaan Tugas Akhir/Skripsi mencerminkan kemampuan mahasiswa sesuai dengan CPL Prodi yang telah ditetapkan.
The implementation of the Final Project / Thesis reflects the ability of students in accordance with the established CPL Study Program.

C. Waktu pelaksanaan Tugas Akhir / Skripsi dimulai sejak proposal disetujui sampai dengan pelaksanaan ujian.
The implementation time of the Final Project / Thesis starts from the time the proposal is approved until the implementation of the exam.

D. Prodi menentukan pelaksanaan Tugas Akhir/Skripsi dengan judul yang sama dalam waktu maksimum 2 (dua) semester aktif.
Prodi determines the implementation of the Final Project / Thesis with the same title within a maximum of 2 (two) active semesters.

E. Penentuan kelulusan Tugas Akhir/Skripsi didasarkan dari hasil penilaian dan evaluasi dosen pembimbing dan penguji.
Determination of the final / thesis graduation is based on the results of the assessment and evaluation of the supervisor and examiner.

F. Aspek penilaian terhadap Pelaksanaan Tugas Akhir/Skripsi yaitu: aktifitas, kemampuan dan kemandirian, taat azas terhadap metode ilmiah sesuai dengan substansi yang direncanakan.
Aspects of assessment of the implementation of the Final Project / Thesis, namely: activities, abilities and independence, adhering to the principles of the scientific method in accordance with the planned substance.

G. Penilaian terhadap pelaksanaan Tugas Akhir/Skripsi dilakukan oleh dosen pembimbing.
Evaluation of the implementation of the Final Project / Thesis is carried out by the supervisor.

H. Pengumpulan laporan Tugas Akhir/Skripsi yang telah direvisi berdasarkan masukan saat Ujian Tugas Akhir/Skripsi dilakukan sebelum yudisium Departemen.
Submission of revised Final Project / Thesis reports based on input when the Final / Thesis Examination is carried out before the Department's judiciary.

6.3.4 Laporan Tugas Akhir/Skripsi
Final Project / Thesis Report

A. Format laporan Tugas Akhir/Skripsi memenuhi standar format yang ditetapkan oleh ITS.
The format of the Final Project / Thesis report meets the standard format set by ITS.

B. Laporan Tugas Akhir/skripsi menunjukkan kemampuan penulisan yang memuat:
The final report / thesis shows the writing ability which contains:

1. Judul Penelitian/Perancangan
   Research / Design Title
2. Halaman pengesahan
   An attestation page
3. Pernyataan bebas plagiasi

Statement of free plagiarism

4. Abstrak
   Abstract
5. Latar Belakang
   Background
6. Perumusan Masalah
   Problem Formulation
7. Tujuan Penelitian/Perancangan
   Research / Design Objectives
8. Tinjauan Pustaka
   Literature Review
9. Metode Penelitian/Perancangan
   Research / Design Methods
10. Hasil dan Pembahasan
    Results and Discussion
11. Kesimpulan
    Conclusion
12. Daftar Pustaka
    Bibliography

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6.3.5 Pelaksanaan Ujian Tugas Akhir/Skripsi
Execution of Final Project / Thesis

A. Jadwal Ujian Tugas Akhir/Skripsi ditentukan oleh Prodi paling lambat 2 (dua) minggu sebelum yudisium institut.
   Final Project / Thesis Examination Schedule is determined by the Study Program no later than 2 (two) weeks before the institute graduation.
B. Ujian Tugas Akhir/Skripsi dilaksanakan dihadapan tim Penguji.
   Final / Thesis Examination is carried out in front of the Examiner team.
C. Mahasiswa tidak hadir pada saat ujian Tugas Akhir/Skripsi tanpa alasan yang jelas, dianggap tidak lulus.

Students do not attend the Final / Thesis examination without clear reasons, are considered not passing.

D. Toleransi waktu keterlambatan mahasiswa saat ujian Tugas Akhir/Skripsi diatur oleh masing-masing Prodi.
Students do not attend the Final / Thesis examination without clear reasons, are considered not passing.

E. Ujian Tugas Akhir/Skripsi dipimpin oleh moderator
The final / thesis examination is led by a moderator

F. Moderator ujian Tugas Akhir/Skripsi dapat berasal dari dosen pembimbing atau penguji.
Final / Thesis exam moderators can come from the supervisor or examiner.

G. Moderator mempunyai hak memberikan penilaian.
Moderators have the right to give judgments.

H. Dosen pembimbing dapat bertindak sebagai penguji.
Supervisor can act as examiner.

I. Penguji yang tidak hadir pada saat ujian dapat digantikan oleh penguji lain dengan syarat berasal dari bidang ilmu yang sama.
Examiners who are not present at the time of the examination can be replaced by other examiners on condition that they come from the same field of knowledge.

J. Berita acara pelaksanaan ujian Tugas Akhir/Skripsi memuat minimal:
Minutes of the implementation of the Final Project / Thesis examination contain at least:

1. Nama Mahasiswa, NRP Mahasiswa, Nama Moderator, Nama dosen pembimbing, Nama Penguji
   Name of Student, Student NRP, Name of Moderator, Name of supervisor, Name of Examiner
2. Jadwal.
   Schedule.
3. Tanda tangan mahasiswa, moderator, dan semua penguji.
   Signature of students, moderators, and all examiners.
4. Hasil evaluasi dari tim penguji untuk proses ujian Tugas Akhir/Skripsi dinyatakan dalam bentuk satu dari tiga kategori berikut: lulus, lulus dengan perbaikan, atau mengulang.

The results of the evaluation from the examiner team for the Final Project / Thesis examination process are stated in the form of one of the following three categories: passed, passed with corrections, or repeated.

K. Ketentuan Jumlah tim penguji Tugas Akhir/Skripsi minimum 2 (dua) dan maksimum 3 (tiga) orang di luar pembimbing.
Provisions The minimum number of final assignment / thesis examiners is 2 (two) and a maximum of 3 (three) people outside the supervisor.

L. Anggota tim penguji ujian Tugas Akhir/Skripsi minimal sama dengan Tim Penguji Presentasi Proposal Tugas Akhir/Skripsi.
Members of the Final Project / Thesis examiner team are at least the same as the Final Project / Thesis Proposal Presentation Examining Team.

M. Lama waktu ujian Tugas Akhir/Skripsi maksimum 60 menit.
The maximum length of time for the Final / Thesis exam is 60 minutes.

N. Ujian Tugas Akhir/Skripsi dihadiri minimal oleh salah satu Pembimbing.
Final / Thesis Examination is attended by at least one of the supervisors.

O. Pelaksanaan ujian Tugas Akhir/Skripsi dilengkapi dengan:
Examination of Final Project / Thesis is completed with:
    1. Lembar catatan untuk revisi Laporan Tugas Akhir/Skripsi
    A note sheet for the revision of the Final Project / Thesis Report
    2. Form pernyataan bebas plagiasi.
    A plagiarism free statement form.
    3. Form Penilaian dalam bentuk rubrik yang sesuai dengan aspek yang dinilai.
    The Assessment Form is in the form of a rubric in accordance with the aspects being assessed.

P. Aspek penilaian Ujian Tugas Akhir/Skripsi didasarkan pada: tata tulis, kualitas ide, rumusan masalah dan tujuan, kontribusi dan penyelesaian masalah.
The assessment aspects of Final / Thesis Examination are based on: writing system, quality of ideas, formulation of problems and objectives, contribution and problem solving.

Q. Ujian Tugas Akhir/Skripsi dapat diulang berdasarkan hasil evaluasi dari tim penguji.

Final / Thesis Examination can be repeated based on the results of the evaluation from the examiner team.

R. Ujian Tugas Akhir/Skripsi dinyatakan harus diulang dengan ketentuan sebagai berikut:
Final / Thesis Examination must be repeated with the following conditions:

1. Nilai akhir dari Tugas Akhir/Skripsi adalah C
   The final grade of the Final Project / Thesis is C.
2. Tim Penguji sepakat bahwa tujuan Tugas Akhir/Skripsi tidak tercapai
   The Testing Team agrees that the objectives of the Final / Thesis are not achieved.
3. Mahasiswa terbukti melakukan plagiarisme yang dibuktikan pada saat Ujian Tugas Akhir/Skripsi.
   Students are proven to have committed plagiarism which is proven during the Final Project / Thesis Examination.

S. Nilai diumumkan maksimum 2 (dua) minggu setelah pelaksnaan ujian Tugas Akhir/Skripsi.
The score is announced at a maximum of 2 (two) weeks after the implementation of the Final Project / Thesis examination.

6.3.6 Monitoring dan evaluasi proses dan hasil pelaksanaan Tugas Akhir/Skripsi *Monitoring and evaluation of the process and results of the implementation of the Final Project / Thesis*

A. Mekanisme pelaksanaan monitoring dan evaluasi:
Mechanism for implementing monitoring and evaluation:

1. Monitoring dan evaluasi dilakukan untuk menjamin kesesuaian antara pelaksanaan dan perencanaan.
   Monitoring and evaluation is carried out to ensure conformity between implementation and planning.
2. Monitoring dan evaluasi dapat dilakukan minimum 1 (satu) kali.
   Monitoring and evaluation can be done a minimum of 1 (one) time.
3. Monitoring dan evaluasi dapat dilakukan oleh pembimbing secara mandiri atau tim.

Monitoring and evaluation can be carried out by the mentor independently or by a team.

4. Hasil monitoring dan evaluasi digunakan untuk menentukan status keberlanjutan pelaksanaan Tugas Akhir/Skripsi.
   The results of monitoring and evaluation are used to determine the status of the sustainability of the implementation of the Final Project / Thesis.

B. Evaluasi terhadap Tugas Akhir/Skripsi, terdiri dari penilaian:
   Evaluation of the Final Project / Thesis, consisting of assessments:
   1. Proposal.
      Proposal.
   2. Proses pembimbingan Tugas Akhir/Skripsi
      Final Project / Thesis guidance process
   3. Ujian Tugas Akhir/Skripsi
      Prosentase diatur oleh Prodi dengan ketentuan prosesntase terbesar adalah pada proses pembimbingan.
      Final Project Examination / Thesis
      The percentage is regulated by the Study Program with the provision that the largest percentage process is in the mentoring process

6.3.7 Pembimbing dan Penguji Tugas Akhir/Skripsi

Supervisor and Examiner of Final Project / Thesis

A. Jumlah pembimbing Tugas Akhir/Skripsi maksimum 2 (dua) orang sebagai Pembimbing I dan Pembimbing II.
   The maximum number of final assignment / thesis supervisors is 2 (two) as Supervisor I and Supervisor II.

B. Kedua pembimbing mempunyai Tanggung jawab dan tugas yang sama dalam proses pembimbingan.
   Both mentors have the same responsibilities and duties in the mentoring process.

C. Persyaratan pembimbing Tugas Akhir/Skripsi**,** sebagai berikut:
   Requirements for the supervisor of the Final Project / Thesis, as follows:
   1. Kualifikasi akademik minimal S2 dan Asisten Ahli.

Minimum academic qualifications of S2 and Expert Assistant

2. Pembimbing I adalah dosen Prodi.
   Supervisor I is a lecturer at the Study Program.
3. Pembimbing I harus dalam bidang keilmuan yang sama dengan tema Tugas Akhir/Skripsi.
   Supervisor I must be in the same scientific field as the theme of the Final Project / Thesis.
4. Pembimbing II dapat berasal dari:
   Supervisor II can come from:
   a. Dosen Prodi yang sudah pensiun dari ITS dengan kualifikasi minimal S2.
      Study program lecturers who have retired from ITS with a minimum qualification of S2.
   b. Industri / instansi dengan syarat mempunyai kemampuan setara dengan level 8 KKNI, yaitu:
      Industries / agencies with the condition that they have the ability equal to level 8 of the KKNI, namely:
      i. Mempunyai kualifikasi akademik minimal Sarjana dalam bidang keahlian yang relevan dengan topik Tugas Akhir/Skripsi, dan
         Have a minimum academic qualification of a Bachelor in a field of expertise relevant to the topic of Final Project / Thesis, and
      ii. Sedang / pernah menjabat sebagai manajer, atau
         Currently / has served as a manager, or
         - memiliki pengalaman dalam bidangnya minimal 10 (sepuluh) tahun, atau
           have at least 10 (ten) years of experience in the field, or
         - memiliki publikasi dalam jurnal nasional terakreditasi atau jurnal internasional bereputasi.
           have publications in accredited national journals or reputable international journals.

D. Persyarat penguji Tugas Akhir/Skripsi
   Requirements for Final Project / Thesis examiners
   1. Kualifikasi akademik minimal S2 dan Asisten Ahli

Minimum academic qualifications of S2 and Expert Assistant

2. Penguji dapat berasal dari:
   Examiners can come from:
   a. Dosen dari luar Prodi di dalam ITS
      Lecturers from outside the study program inside ITS
   b. Dosen yang sudah pensiun dari ITS
      Lecturers who have retired from ITS
   c. Industri / instansi / lembaga penelitian dengan syarat: mempunyai kemampuan setara dengan level 8 KKNI, dengan kriteria:
      Industry / agency / research institute with the following requirements: have the ability equal to level 8 KKNI, with the following criteria:
      i. Kualifikasi akademik minimal Sarjana, dan
         Minimum academic qualification of Bachelor degree, and
      ii. Sedang / pernah menjabat sebagai manajer, atau
         Currently / has served as a manager, or
      - memiliki pengalaman dalam bidangnya minimal 10 (sepuluh) tahun, atau
        have at least 10 (ten) years of experience in the field, or
      - memiliki publikasi dalam jurnal nasional terakreditasi atau jurnal internasional bereputasi.
        have publications in accredited national journals or reputable international journals.

6.3.8 Lokasi/tempat pelaksanaan Tugas Akhir / Skripsi
Location / place of implementation of the Final Project / Thesis

Lokasi/tempat pelaksanaan Tugas Akhir/Skripsi dapat dilakukan:
Location / place where the Final Project / Thesis can be carried out:

A. di laboratorium/ studio/ bengkel di departemen setempat;
   in the laboratory / studio / workshop in the local department;
B. di industri/ instansi penelitian/ instansi pemerintah / swasta baik di dalam dan luar negeri, dengan syarat: kualifikasi sumber daya yang tersedia mendukung kegiatan Tugas Akhir/Skripsi.

in industry / research institutions / government / private institutions both at home and abroad, with the following requirements: qualifications of available resources to support Final Project / Thesis activities.

6.3.9 Etika pelaksanaan Tugas Akhir/Skripsi
Ethics of Final Project / Thesis implementation

A. Proses pelaksanaan dan pembuatan laporan Tugas Akhir/ Skripsi dilakukan secara mandiri atau dalam arti tidak dikerjakan oleh pihak lain.
The process of implementing and preparing the Final / Thesis report is carried out independently or in the sense that it is not done by another party.

B. Menjauhi hal – hal yang mengarah kepada kecurangan, plagiasi, fabrikasi, falsifikasi dan lain-lain yang sejenis.
Staying away from things that lead to fraud, plagiarism, fabrication, falsification and other similar things.

C. Pelanggaran terhadap etika pelaksanaan Tugas Akhir/ Skripsi dapat diberi sanksi berupa pembatalan Tugas Akhir/ Skripsi.
Violation of the ethics of the implementation of the Final / Thesis can be given a sanction in the form of cancellation of the Final / Thesis.

6.3.10 Tata tertib pelaksanaan ujian Tugas Akhir/ Skripsi
The rules for implementing the Final Project / Thesis examination

A. **Untuk mahasiswa:** baju formal dan rapi ditentukan oleh Prodi masing-masing, menggunakan sepatu kecuali dilakukan di dalam ruang yang mempunyai persyaratan khusus, dan HP dinon aktifkan.
For students: *formal and neat clothes are determined by each study program, use shoes unless done in a room that has special requirements, and the cellphone is turned off.*

B. **Untuk dosen:** baju rapi ditentukan oleh Prodi masing-masing, menggunakan sepatu kecuali dilakukan dalam ruang yang mempunyai persyaratan khusus, dan HP di mode silent.
For lecturers: *neat clothes are determined by each study program, use shoes unless done in a room that has special requirements, and cellphone on silent mode.*

6.3.11 Hasil Penilaian Pelaksanaan Tugas Akhir/Skripsi

Results of Final / Thesis Implementation Assessment

Hasil penilaian pelaksanaan Tugas Akhir/Skripsi, dinyatakan dalam bentuk Angka dan Huruf, dengan ketentuan sebagai berikut:

The results of the assessment of the implementation of the Final Project / Thesis, are stated in the form of Numbers and Letters, with the following conditions:

Nilai Angka *Score*	Nilai Huruf *Letter Value*	Nilai Numerik *Numeric Value*	Sebutan *Mention*
81 - 100	A	4	Istimewa *excellent*
71 - 80	AB	3,5	Baik sekali *Very good*
66 - 70	B	3	Baik *Good*
61 – 65	BC	2,5	Cukup Baik *Good enough*
51 - 60	C	2	Cukup *Sufficient*
41 - 50	D	1	Kurang *Deficient*
0 - 40	E	0	Kurang Sekali Very less

6.3.12 Karya Ilmiah

Scientific Papers

A. Karya ilmiah merupakan bagian atau keseluruhan dari Tugas Akhir/ Skripsi.
   Scientific work is part or all of the Final Project / Thesis.
B. Jumlah halaman karya ilmiah 6 – 8 halaman
   Number of pages of scientific papers 6 - 8 pages
C. Karya ilmiah harus menunjukkan kemampuan penulisan:
   Scientific work must demonstrate the ability to write:

1. Judul karya ilmiah
   Title of scientific work
2. Nama mahasiswa dan pembimbing
   Name of student and supervisor
3. Nama departemen, fakultas, ITS
   Name of department, faculty, ITS
4. Alamat email mahasiswa dan pembimbing
   Student and supervisor email addresses
5. Abstrak dalam bahasa Indonesia dan bahasa Inggris
   Abstract in Indonesian and English
6. Kata kunci
   Keywords
7. Pendahuluan, berisi: latar belakang, perumusan masalah, dan tujuan penelitian
   Introduction, contains: background, problem formulation, and research objectives
8. Metode Penelitian
   Research Methods
9. Hasil dan pembahasan
   Results and discussion
10. Kesimpulan
    Conclusion
11. Daftar Pustaka
    Bibliography

D. Karya ilmiah harus direview dan disetujui minimal oleh pembimbing.
Scientific work must be reviewed and approved at least by the supervisor.

6.3.13 Pelaksanaan Tugas Akhir/ Skripsi di luar negeri
Implementation of Final Project / Thesis abroad

Ketentuan khusus pelaksanaan Tugas Akhir/ Skripsi di luar negeri adalah sebagai berikut:
The special provisions for implementing the Final Project / Thesis abroad are as follows:

A. Pelaksanaan Tugas Akhir/Skripsi dapat dilakukan antara lain dalam rangka program: (1) joint degree, (2) double degree, (3) joint research, (3) internship, (4) student exchange, dengan salah satu pembimbing dari ITS.
The implementation of the Final Project / Thesis can be carried out, among others, in the framework of the program: (1) joint degree, (2) double degree, (3) joint research, (3) internship, (4) student exchange, with one of the supervisors from ITS .

B. Monitoring dan evaluasi dilakukan dengan menggunakan media yang tersedia.
Monitoring and evaluation is carried out using available media.

C. Tempat ujian Tugas Akhir/Skripsi ditentukan oleh Prodi sesuai dengan kesepakatan dalam pelaksanaan program.
The place for the Final Project / Thesis examination is determined by the Study Program in accordance with the agreement in the implementation of the program.

6.4 Hal–hal yang belum diatur pada dokumen panduan ini dapat dikembangkan di setiap Prodi masing-masing, dengan syarat tidak melanggar ketentuan pada buku panduan ini, peraturan yang lebih tinggi: Peraturan Akademik, dan/atau Peraturan Menteri.
Matters that have not been regulated in this guidance document can be developed in each respective Prodi, provided that they do not violate the provisions of this guidebook, higher regulations: Academic Regulations, and / or Ministerial Regulations.

7 RUJUKAN
REFERENCE

1. Peraturan Menteri Pendidikan Nasional, Nomor 17 Tahun 2010 tentang pencegahan dan penanggulangan plagiat.
   Regulation of the Minister of National Education, Number 17 of 2010 concerning the prevention and overcoming of plagiarism.
2. Undang-undang No 12 Tahun 2012, tentang Sistem Pendidikan Tinggi.

Law No. 12 of 2012, concerning the Higher Education System.

3. Peraturan Presiden Nomor 8 Tahun 2012, tentang Kerangka Kualifikasi Nasional Indonesia.
   Presidential Regulation Number 8 of 2012, concerning the Indonesian National Qualifications Framework.
4. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi, Nomor 44 Tahun 2015 tentang Standar Nasional Pendidikan Tinggi.
   Regulation of the Minister of Research, Technology and Higher Education, Number 44 of 2015 concerning National Higher Education Standards.
5. Lampiran Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi, Nomor 44 Tahun 2015 tentang Standar Nasional Pendidikan Tinggi.
   Attachment to the Regulation of the Minister of Research, Technology and Higher Education, Number 44 of 2015 concerning National Higher Education Standards.
6. Peraturan Menteri Pendayaan Aparatur Negara dan Reformasi Birokrasi, Nomor 17 Tahun 2013, tentang Jabatan Fungsional Dosen dan Angka Kreditnya.
   Regulation of the Minister of State Apparatus Empowerment and Bureaucratic Reform, Number 17 of 2013, concerning Lecturer Functional Positions and Credit Points.
7. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor: 073255/IT2/HK.00.00/2014, Tentang Peraturan Akademik.
   Regulation of the Chancellor of the Ten November Institute of Technology Number: 073255 / IT2 / HK.00.00 / 2014, Concerning Academic Regulations.