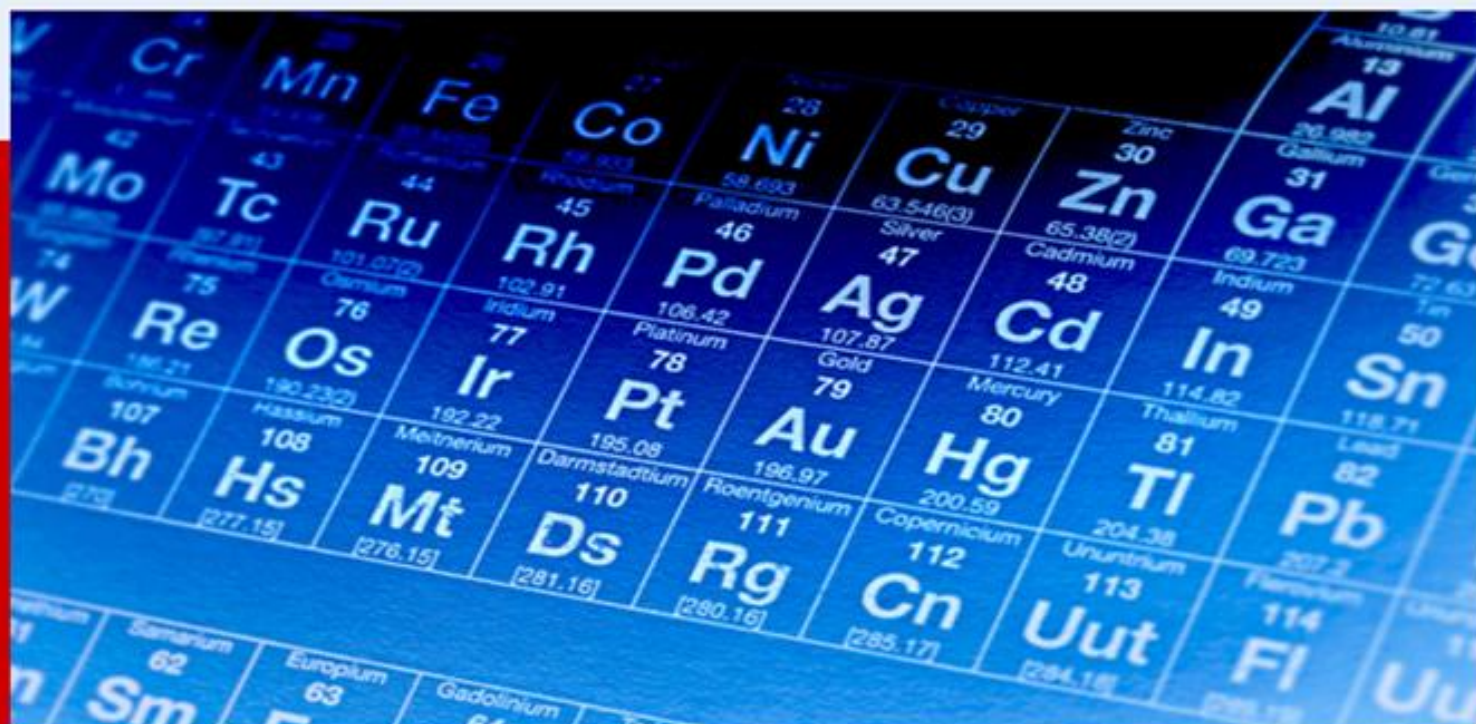


STUDENT GUIDE BOOK
MASTER DEGREE PROGRAM OF CHEMISTRY
Institut Teknologi Sepuluh Nopember



DEPARTMENT OF CHEMISTRY
2020

**ACADEMIC STUDENT
GUIDEBOOK
Curriculum 2018-2023**

**Master's degree Program
(Version 2020)**

**Chemistry Department
Institut Teknologi Sepuluh Nopember
2020**

INTRODUCTION

This academic guidebook was prepared as a reference for all students regarding the curriculum of the chemistry master study program as well as providing instructions for students in compiling a thesis in order to produce a good and uniform thesis quality. This book can also help supervisors to carry out their task of guiding students more easily. The preparation of this academic guidebook has not been optimal, especially with the limited time, therefore constructive suggestions are expected to be improved.

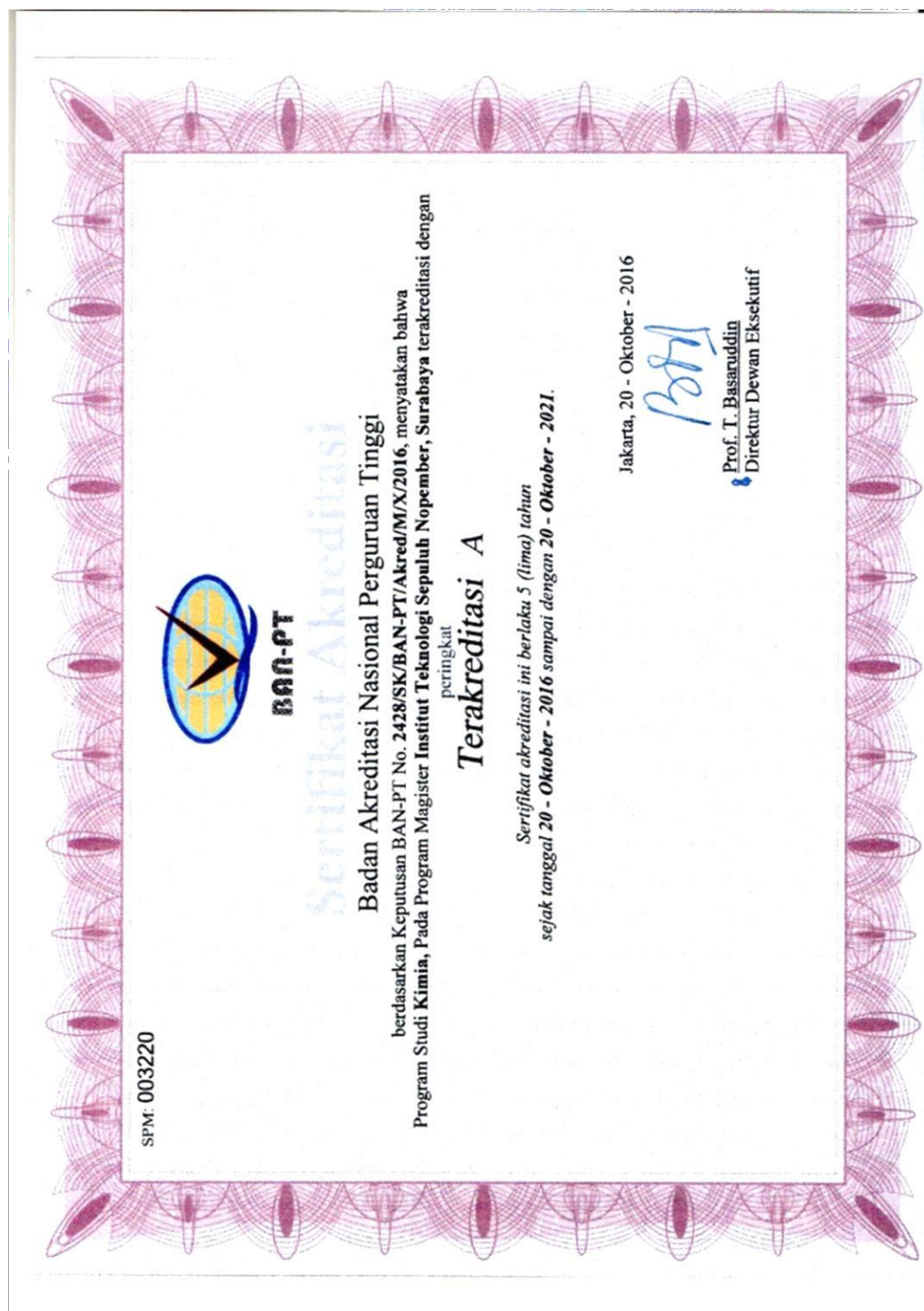
Surabaya, 9th January 2020
Head of
Chemistry Master's Degree
Program

Prof. Dr. Didik Prasetyoko, M. Sc .

Program Education Objectives

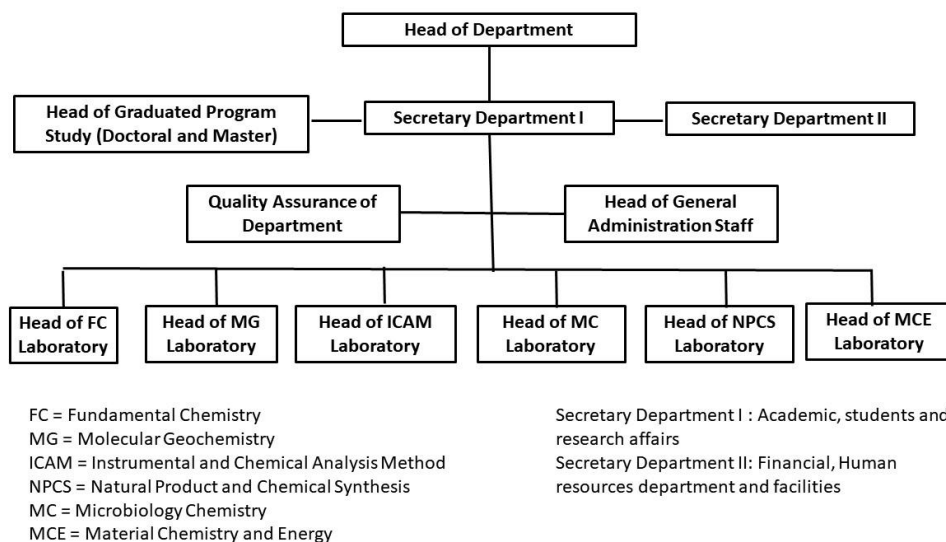
- ❖ To produce graduates who able to use their knowledge, skills, and competence in the area of chemistry for their professional career (PEO1).
- ❖ To produce graduates who able to develop themselves through further studies (doctoral degree) both domestic and abroad by training or research (PEO2)
- ❖ To produce graduates who can carry out their profession responsibly, ethically, have leadership characteristics and are able to develop a network system (PEO3)

I. NATIONAL ACCREDITATION



II. Organization structure and the Lecturer Staff of Master Degree

Program of Chemistry ITS



Official Management in Chemistry Department

Head of Department	:	Prof. Dr. rer.nat Fredy Kurniawan, M. Si
Secretary Department I	:	Dr. Yuly Kusumawati, MSi.
Secretary Department II	:	Yatim Lailun Ni'mah, M. Si, Ph. D
Head of Graduated program	:	Prof. Dr. Didik Prasetyoko, M. Sc
Doctoral Degree Quality Assurance Team	:	Prof. Dr. Taslim Ersam Prof. Dr. R. Y. Perry Burhan, M. S Prof. Drs. Syafsir Akhlus, M. Prof. Drs. Surya Rosa Putra, M.S Prof. Dr.rer.nat. Irminda Kris M, M. Si Prof. Drs. Mardi Santoso, Ph. D Prof, Dr. Didik Prasetyoko, M. Sc

Master Degree Quality Assurance Team	:	Suprpto, Ph. D (Kimia Analitik) Prof. Dr.rer.nat. Irmira K. Murwani, MSi. (Kimia Anorganik) Dr. Hendro Juwono (Kimia Fisik) Prof. Dr. Taslim Ersam, MS (Kimia Organik)
Bachelor Degree Quality Assurance Team	:	Suprpto, Ph. D (Kimia Analitik) Dra. Ratna Ediaty, Ph. D (Kimia Anorganik) Drs. Eko Santoso, M. S (Kimia Fisik) Drs. Agus Wahyudi, M. S. (Kimia Organik) Herdayanto S. Putro, M. Si (Biokimia)
Head of Laboratory	:	
FC Lab	:	Dr. Hendro Juwono, M. Si.,
MG Lab	:	Dr. Yulfi Zetra, M. S.
ICAM Lab	:	Dra. Ita Ulfin, M. Si.
MCE Lab	:	Prof. Dr. Djoko Hartanto, M. S.
NPCS Lab	:	Prof. Dr. Mardi Santoso
MC Lab	:	Adi Setyo Purnomo, Ph. D

Lecturer of Chemistry Master Degree Program ITS

No	Name	Education
1	Prof. Dr. TaslimErsam, MS.	S1 Universitas Andalas
		S2 Universitas Gadjah Mada
		S3 Institut Teknologi Bandung
2	Dr. Ir. Endah Mutiara Marhaeni Putri, M. Si	S1 Institut Teknologi Sepuluh Nopember
		S2 Universitas Airlangga
		S3 Universitas Airlangga
3	Dra. Ratna Ediaty, M. S., Ph.D	S1 Institut Teknologi Bandung
		S2 Institut Teknologi Bandung
		S3 University of Manchester Institute of Science and

No	Name	Education
		Technology, Inggris
4	Prof. Dr. R. Y. Perry Burhan, M. S	S1 Universitas Andalas
		S2 Institut Teknologi Bandung
		DEA University of Louis Pasteur,Perancis
		S3 University of Louis Pasteur,Perancis
5	Prof. Drs. Syafsir Akhlus, M. S	S1 Universitas Andalas
		S2 Institut Teknologi Bandung
		S3 ENSIC-NPL, Perancis
6	Prof. Drs. SuryaRosa Putra, M.S	S1 Institut Teknologi Bandung
		S2 Institut Teknologi Bandung
		S3 University of Louis Pasteur,Perancis
7	Drs. Lukman Atmaja, M. S.,Ph. D.	S1 Institut Teknologi Bandung
		S2 Institut Teknologi Bandung
		S3 The University Birmingham, Inggris
8	Prof. Dr. rer. nat. Irmina Kris Murwani, M. Si.	S1 Institut Teknologi SepuluhNopember
		S2 Universitas Gadjah Mada
		S3 Humboldt University, Jerman
9	Prof. Drs. MardiSantoso, Ph. D	S1 Institut Teknologi SepuluhNopember
		S3 The University of New SouthWales, Australia
10	Dr. Fahimah Martak, M. Si	S1 Institut Teknologi SepuluhNopember

No	Name	Education
		S2 Institut Teknologi Bandung
		S3 Institut Teknologi Bandung
11	Hamzah Fansuri, M. Si., Ph. D	S1 Institut Teknologi Sepuluh Nopember
		S2 Institut Teknologi Bandung
		S3 Curtin University of Tech., Australia
12	Nurul Widiastuti, M.Si., Ph. D	S1 Institut Teknologi Sepuluh Nopember
		S2 Institut Teknologi Bandung
		S3 Curtin University of Tech., Australia
13	Prof, Dr. Didik Prasetyoko, M.Sc	S1 Institut Teknologi Sepuluh Nopember
		S2 Universiti Teknologi Malaysia
		S3 Universiti Teknologi Malaysia
14	Dr. rer. nat. Fredy Kurniawan, M.Si	S1 Institut Teknologi Sepuluh Nopember
		S2 Institut Teknologi Bandung
		S3 University of Regensburg, Jerman
15	Suprpto, M.Si., Ph. D	S1 Institut Teknologi Sepuluh Nopember
		S2 Institut Teknologi Bandung
		S3 University of Manchester, Inggris
16	Dr. Afifah Rosyidah, M.Si	S1 Institut Teknologi Sepuluh Nopember
		S2 Institut Teknologi Bandung
		S3 Institut Teknologi Bandung

No	Name	Education
17	Sri Fatmawati, M. Sc., Ph. D.	S1 Institut Teknologi SepuluhNopember
		S2 Kyushu University, Jepang
		S3 Kyushu University, Jepang
18	Adi Setyo Purnomo, M.Sc., Ph. D	S1 Institut Teknologi SepuluhNopember
		S2 Kyushu University, Jepang
		S3 Kyushu University, Jepang
19	Dr. Hendro Juwono, M. Si	S1 Universitas Gadjah Mada
		S2 Institut Tenologi Bandung
		S3 Universitas Gadjah Mada
20	Dr. Yuly Kusumawati, M.Si.	S1 Institut Teknologi Bandung
		S2 Institut Teknologi Bandung
		S3 Institut Teknologi Bandung double degree dengan UniversitePierre Marie Curie
21	Yatim Lailun Ni'mah, M. Si.,Ph. D	S1 Institut Teknologi SepuluhNopember
		S2 Institut Teknologi SepuluhNopember
		S3 Taiwan
22	Dr. Yulfi Zetra, M. S	S1 Universitas Andalas
		S2 Institut Teknologi Bandung
		S3 Institut Teknologi SepuluhNopember
23.	Prof. Dr. Djoko Hartanto, M. Si	S1 Universitas Gajah Mada
		S2 Universitas Gajah Mada

No	Name	Education
		S3 Instiut Teknologi SepuluhNopember
24.	Dsc. Arif Fadlan	S1 Chemistry ITS
		S2 Chemistry ITS
		S3 Nara Inst of Science &Techology Jepang

CURRICULUM and MODUL

FACULTY OF SCIENCE AND ANALYTICAL DATA

Program Study	Chemistry
Educational Level	Postgraduate

LIST OF SUBJECTS FOR POST GRADUATE PROGRAM**A. GENERAL CURRICULUM**

No.	Code	Subject Name	Credits
1ST SEMESTER			
1	SK185101	Research Methodology	3
2	SK185102	Solid State Spectroscopy	3
3	SK1851XX	Compulsory Courses	3-4
Total Credits			9-10
2ND SEMESTER			
1	SK185201	Pre-Thesis	2
2	SK1852XX	Compulsory Courses	8-10
3	SK1852XX	Elective Courses	0-2
Total Credits			10-11
3RD SEMESTER			
1	SK1853XX	Compulsory Courses	0-4
2	SK1853XX	Elective Courses	6-10
Total Credits			10
4TH SEMESTER			
1	SK185401	Thesis	6
Total Credits			6

B. ANALYTIC CHEMISTRY CURRICULUM

No.	Code	Subject Name	Credits
1ST SEMESTER			
1	SK185101	Research Methodology	3
2	SK185102	Solid State Spectroscopy	3
3	SK185111	Chemical Instrumentation	2
4	SK185112	Chemoinformatics	2
Total Credits			10
2ND SEMESTER			
1	SK185201	Pre-Thesis	2
2	SK185211	Electroanalysis	2
3	SK185212	Micro Project	2
4	SK185213	Separation and Speciation	2
5	SK185214	Thermal Analysis	2

Total Credits			10
3RD SEMESTER			
1	SK185311	Bioanalytics	2
2	SK185312	Electrochemistry Sensors	2
3	SK1853XX	Elective Courses	6
Total Credits			10
4TH SEMESTER			
1	SK185401	Thesis	6
Total Credits			6

C. INORGANIC CHEMISTRY CURRICULUM

No.	Code	Subject Name	Credits
1ST SEMESTER			
1	SK185101	Research Methodology	3
2	SK185102	Solid State Spectroscopy	3
3	SK185121	Structures and Reactivities of Inorganic Compounds	2
4	SK185122	Characterization of Inorganic Materials I	2
Total Credits			10
2ND SEMESTER			
1	SK185201	Pre-Thesis	2
2	SK185221	Characterization of Inorganic Materials II	3
3	SK185222	Material Properties and Performance	2
4	SK185223	Inorganic Solids	3
Total Credits			10
3RD SEMESTER			
1	SK1853XX	Elective Courses	10
Total Credits			10
4TH SEMESTER			
1	SK185401	Thesis	6
Total Credits			6

D. BIOCHEMISTRY CURRICULUM

No.	Code	Subject Name	Credits
1ST SEMESTER			
1	SK185101	Research Methodology	3
2	SK185102	Solid State Spectroscopy	3
3	SK185131	Bioinformatics	3
Total Credits			9
2ND SEMESTER			
1	SK185201	Pre-Thesis	2
2	SK185231	Advanced Biochemistry	3
3	SK185232	Microorganism Metabolisms	3

4	SK185233	Elective Courses	3
Total Credits			11
3RD SEMESTER			
1	SK185331	Biosynthesis	3
2	SK1853XX	Elective Courses	7
Total Credits			10
4TH SEMESTER			
1	SK185401	Thesis	6
Total Credits			6

E. PHYSICAL CHEMISTRY CURRICULUM

No.	Code	Subject Name	Credits
1ST SEMESTER			
1	SK185101	Research Methodology	3
2	SK185102	Solid Phases Chemistry	3
3	SK185141	Quantum Chemistry	3
Total Credits			9
2ND SEMESTER			
1	SK185201	Pre-Thesis	2
2	SK185241	Molecular Dynamics	3
3	SK185242	Statistical Thermodynamics	3
4	SK185243	Molecular Computational Chemistry	3
Total Credits			11
3RD SEMESTER			
3	SK1853XX	Elective Courses	10
Total Credits			10
4TH SEMESTER			
1	SK185401	Thesis	6
Total Credits			6

F. ORGANIC CHEMISTRY CURRICULUM

No.	Code	Subject Name	Credits
1ST SEMESTER			
1	SK185101	Research Methodology	3
2	SK185102	Solid State Spectroscopy	3
3	SK185151	Advanced Physical Organic Chemistry	3
Total Credits			9
2ND SEMESTER			
1	SK185201	Pre-Thesis	2
2	SK185251	Advanced Organic Synthesis	3
3	SK185252	Natural Product Organic Chemistry	3
4	SK185253	Organic Geochemistry	3

Total Credits		11
3RD SEMESTER		
1	SK185351 Structure Determination of Organic Compounds	3
2	SK1853XX Elective Courses	7
Total Credits		10
4TH SEMESTER		
1	SK185401 Thesis	6
Total Credits		6

G. ELECTIVE COURSES

No.	Code	Subject Name	Credits
1	SK185301	Green Chemistry	2
2	SK185302	Elective	2
3	SK185313	Nanomaterials for Sensors	2
4	SK185314	Specific Analysis	2
5	SK185315	Corrosion Analysis	2
6	SK185316	Conductive Polymers	2
7	SK185321	Organometallic Chemistry	2
8	SK185322	Catalysis	2
9	SK185323	Coordination Chemistry	2
10	SK185324	Porous Materials	3
11	SK185325	Advanced Inorganic Synthesis	2
12	SK185326	Energy Storage Materials	3
13	SK185327	Modern Ceramics	2
14	SK185328	Physical Inorganic Chemistry	2
15	SK185332	Biodegradation	3
16	SK185333	Food Chemistry	2
17	SK185334	Bioassay	3
18	SK185341	Surface Structure and Analysis	3
19	SK185342	Membrane Synthesis	2
20	SK185343	Carbon Materials	2
21	SK185344	Photochemistry	2
22	SK185345	Industrial Processes Chemistry	2
23	SK185346	Functional Polymers	2
24	SK18552	Phenolate Chemistry	2
25	SK18553	Pigments Chemistry	2
26	SK18554	Petroleum Chemistry	2
27	SK18555	Heterocyclic Chemistry	3
28	SK18556	Medicinal Chemistry	2
29	SK18557	Essential Oils Chemistry	2
30	SK18558	Rearrangement and Pericyclic Chemistry	2

Course Short Description							
Study Material: Subject Matter		The understanding of photochemistry, the laws in photochemistry, ray sources, the interaction of rays with molecules and materials, the kinetics of photochemistry, lasers and photodissociation, semiconductor catalyst, photosynthesis, photoinduction phenomenons, and applications of photochemistry					
Reference		Primary:					
		1. D.W. Bahnemann, P.K.J. Robertson, “Environmental Photochemistry”, Springer, London, 2015					
		2. R.C. Evans, P. Douglas, H.D. Burrows, “Applied Photochemistry”, Springer, London, 2013					
		3. B. Wardle, “Principles and Applications of Photochemistry”, John Wiley & Sons, Ltd., 2009					
		4. A.G. Kutateladze, “Computational Methods in Photochemistry”, Taylor & Francis, London, 2005					
		Secondary:					
Supporting Lecturer		Dr. Ir. Endah Mutiara M.P., M.Si.; Prof. Dr. Syafsir Akhlus, M.Sc.					
Pre-Requisite Courses							
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Introduction of photochemistry	• The accuracy in explaining	Technical: Criteria:	Lecture and discussion [TM: 2×50’']		• The definition of photochemistry, laws of photochemistry, and light source	Entered in Quiz-1
2	Students are able to explain and understand the interactions between light with molecules and materials	• The accuracy in explaining and understanding	Technical: Criteria:	Lecture and discussion [TM: 2×50’']		• Electron excitation, the interaction between light and matter	Entered in Quiz-1

3	Students are able to understand the photochemical kinetics	The accuracy in understanding	Technical: Criteria:	Lecture and discussion [TM: 2×(2×50'')]		Reaction mechanism in photochemistry, excitation state	Entered in Quiz-1
4	QUIZ-1						20
5	Students are able to understand and connect between laser and photodissociation	The accuracy in understanding and	Technical: Criteria:	Lecture and discussion [TM: 2×50'']		- Definition of laser and photodissociation - Correlation between laser and photodissociation	Entered in Mid-Semester Evaluation
6	Students are able to understand and apply the effect of solvent on Stokes shift computationally	Expertise in computation applications	Technical: Practice Criteria:	Computational practice [TM: 2×50'']		Various solvents on Stokes shift	Entered in Mid-Semester Evaluation
7	Students are able to apply laser application and photodissociation	The accuracy in understanding and explaining in the group discussion	Technical: Paper assignment, Presentation, and discussion Criteria:	Case studies [TM: 2×(2×50'')]		Laser application and photodissociation	Entered in Mid-Semester Evaluation
8	Mid-Semester Evaluation						30
9	Students are able to understand and know several semiconductor catalysts in photochemistry	The accuracy in understanding	Technical: Assignment Criteria:	Lecture and discussion [TM: 2×50'']		Variety of semiconductor catalysts (its advantages and disadvantages in the photochemical reaction applications)	Entered in Quiz-1

10	Students are able to explain and understand photosynthesis and photoinduction	The accuracy in explaining and understanding	Technical: Assignment Criteria:	Lecture and discussion [TM: 2×50'']		Photosynthesis, photoinduction, (theory and application)	Entered in Quiz-1
11	Students are able to understand and connect the effect of the photochemistry process on the formation of mercury oxide for the environment	Case studies	Technical: Assignment: Case and solution idea analysis Criteria:	Lecture and case studies [TM: 2×50'']		Photochemistry reactions in the formation of mercury oxide	Entered in Quiz-2
12	QUIZ-2						20
13	Students are able to understand and explain the application of photochemistry in environment preservation	The accuracy in explaining and understanding	Technical: Class assignment Criteria:	Lecture and case studies [TM: 2×50'']		Photodegradation, photooxidation, and photodecomposition	Entered in End-of-Semester Evaluation
14	Students are able to convey their ideas in writing about the application of photochemistry in everyday life	Presentation and discussion	Technical: Assignment: Conveying ideas in writing Criteria:	Student presentation [TM: 2×50'']		Application of photochemistry in the formation of carbon nanotube, santonin reaction	Entered in End-of-Semester Evaluation
15-16	End-of-Semester Evaluation						30



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FACULTY OF SCIENCES AND ANALYTICAL DATA
DEPARTMENT OF CHEMISTRY

**Document
Code**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date			
INDUSTRIAL PROCESSES CHEMISTRY		SK 185345	Physical Chemistry	2	0	III				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)				
		Drs. Eko Santoso, M. Si.; Prof. Dr. Syafsir Akhlus, M.Sc.		Dr. Hendro Juwono, M.Si.		Prof. Dr. Didik Prasetyoko, M.Sc				
Learning Outcomes (LO)	LO-PRODI Charged to The Course									
	LO 2	Show a spirit of independence and team work in completing their duties								
	LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry								
	LO 9	Able to build chemical knowledge especially in the energy, environmental, marine, and medical in order to develop the research, industry, and employment creation								
	Course Learning Outcomes (LO MK)									
	LO MK 1	Able to understand, explain, and connect the interrelationship between chemistry, especially regarding thermodynamics, catalyst, and their applications in the industrial processes								
LO – LO MK Map										
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
	LO MK 1		√					√		√
Course Short Description										

Study Material: Subject Matter		Industrial non-equilibrium thermodynamics, pulp suspensions multiphase thermodynamics, thermodynamics in natural gas clathrate hydrates, ionic liquids in separation processes, micro- and nano-particles production using supercritical fluids, plastic recycling, new materials thermodynamics, adsorption thermodynamics, applied thermodynamics for petroleum fluids in the refining industry, organic reactions catalysis, deactivation and poisoning of catalysts, catalysis and surface science, innovations on chemical industries					
Reference		Primary:					
		1. H.H. Trimm, W. Hunter Jr., “Industrial Chemistry New Applications, Processes and Systems”, Apple Academic Press, 2011 2. W.H. Flank, M.A. Abraham, M.A. Matthews, “Innovations in Industrial and Engineering Chemistry”, American Chemical Society, Washington DC, 2008 3. T.M. Letcher, “Chemical Thermodynamics for Industry”, The Royal Society of Chemistry, Cambridge, 2004 4. H.K. Abdel-Aal, M.A. Aggour, M.A. Fahim, “Petroleum and Gas Field Processing”, Second edition, CRC Press, New York, 2015					
		Secondary:					
Supporting Lecturer		Drs. Eko Santoso, M. Si.; Prof. Dr. Syafsir Akhlus, M.Sc.					
Pre-Requisite Courses							
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment 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 and explain non-equilibrium thermodynamics for industry	• The accuracy in explaining	Technical: Class discussion Criteria:	Lecture and discussion [TM: 2×50’']		• Non-equilibrium thermodynamics for industry	Entered in Quiz-1
2	Students are able to explain the principle and material properties for industry	• The accuracy in explaining	Technical: Assignment: Identification of industrial material properties	Lecture and discussion [TM: 2×50’']		• The principle of material industrial properties	Entered in Quiz-1

			Criteria:				
3	Students are able to understand, explain, and link the multiphase thermodynamics theory with the suspension industry	The accuracy in linking the multiphase thermodynamics theory with the suspension industry	Technical: Class discussion Criteria:	Lecture and discussion [TM: 2×(2×50'')]		Multiphase thermodynamics	Entered in Quiz-1
4	QUIZ-1						20
5	Students are able to understand, explain, and link the thermodynamics theory with the natural gas industry	The accuracy in linking	Technical: Assignment: Identification of what is included in natural gas Criteria:	Lecture and discussion [TM: 2×50'']		Thermodynamics in the natural gas industry	Entered in Mid-Semester Evaluation
6,7	Students are able to understand and explain the separation theory	Case studies	Technical: Assignment and discussion Criteria:	Lecture and case studies [TM: 2x(2×50'')]		Variety of separation processes in the industry	Entered in Mid-Semester Evaluation
8	Mid-Semester Evaluation						30
9	Students are able to link the role of supercritical fluid with the industry	The accuracy in linking the role of supercritical fluid with production in the industry	Technical: Assignment: Identify the structure and properties of the fluid and connect its roles to the industry Criteria:	Lecture and discussion [TM: 2×50'']		Production of micro- and nano-particle using supercritical fluid	Entered in Quiz-2

10	Students are able to understand the recycling process in the industry	The accuracy in understanding	Technical: Assignment and class discussion Criteria:	Lecture and discussion [TM: 2×50'']		Recycling of the plastics industry	Entered in Quiz-2
11	Students are able to think about finding chemicals for environmentally friendly industrial processes	Case studies	Technical: Assignment: Case and solution idea analysis Criteria:	Lecture and case studies [TM: 2×(2×50'')]		Polymer materials of building, paint, plastic, foam, and glue	Entered in Quiz-2
12	QUIZ-2						20
13	Students are able to think about finding the latest process for environmentally friendly industrial processes	Case studies	Technical: Assignment: Case and solution idea analysis Criteria:	Lecture and case studies [TM: 2×50'']		Variety of industrial processes	Entered in End-of-Semester Evaluation
14	Students are able to link the role of a catalyst with industrial process and know the methods for the identification of toxic catalyst	Written ideas	Technical: Presentation of written ideas Criteria:	Lecture and case studies [TM: 2×50'']		Variety of catalysts used in the industry (utilization and prevention so as not to become toxic)	Entered in End-of-Semester Evaluation
15-16	End-of-Semester Evaluation						30



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
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DEPARTMENT OF CHEMISTRY

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Code**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date				
FUNCTIONAL POLYMERS		SK 185346	Physical Chemistry	2	0	III					
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator		Head of Study Program (PRODI)				
		Lukman Atmaja, Ph.D.; Dr. Hendro Juwono, M.Si.			Dr. Hendro Juwono, M.Si.		Prof. Dr. Didik Prasetyoko, M.Sc				
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry									
	LO 9	Able to build chemical knowledge especially in the energy, environmental, marine, and medical in order to develop the research, industry, and employment creation									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to master the theory of structure and properties, energetic, kinetic, analysis, micro- and macro-molecule synthesis and its applications									
LO – LO MK Map											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		LO MK 1	√						√		√
Course Short Description											
Study Material: Subject Matter											

Reference	Primary:						
	Secondary:						
Supporting Lecturer	Lukman Atmaja, Ph.D.; Dr. Hendro Juwono, M.Si.						
Pre-Requisite Courses							
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment 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 role of molecular structures in polymers on their properties	The accuracy level of the statement about the role of molecular structure	Technical: Criteria:	Lecture [TM: 2×50'']		Correlation of structure and all physical and chemical properties of materials	5
2	Students are able to understand the origin of the conduction behavior of polymers and the main concept of synthesis through molecular structure modification	The accuracy level of the conduction behavior statement	Technical: Criteria:	Lecture [TM: 2×50'']		The principle of electrical and intrinsical conduction properties of polymers – 1	5
3	Students are able to understand the origin of the conduction behavior of polymers and the main	The accuracy level of the conduction behavior statement	Technical: Criteria:	Lecture [TM: 2×50'']		The principle of electrical and intrinsical conduction	8

	concept of synthesis through molecular structure modification					properties of polymers – 2	
4	Students are able to understand the conduction properties of polymers caused by ion behavior	The accuracy level of statement about the role of ions	Technical: Criteria:	Lecture [TM: 2×50'']		Polymers which conducts through ion mechanism – 1	8
5	Students are able to understand the conduction properties of polymers caused by ion behavior	The accuracy level of statement about the role of ions	Technical: Criteria:	Lecture [TM: 2×50'']		Polymers which conducts through ion mechanism – 2	8
6	Students are able to understand the basis of magnetic interaction in polymers	The accuracy level of statement about the basis of magnetic interactions	Technical: Criteria:	Lecture [TM: 2×50'']		Study of polymer structure with magnetic properties – 1	8
7	Students are able to understand the basis of magnetic interaction in polymers	The accuracy level of statement about the basis of magnetic interactions	Technical: Criteria:	Class discussion [TM: 2×50'']		Study of polymer structure with magnetic properties – 2	8
8	Mid-Semester Evaluation						
9	Students are able to understand the role of polymers as the reaction system controller	The accuracy level of statement about the role of polymers as the reaction system controller	Technical: Criteria:	Lecture [TM: 2×50'']		Polymers for drug release applications in body – 1	10

10	Students are able to understand the role of polymers as the reaction system controller	The accuracy level of statement about the role of polymers as the reaction system controller	Technical: Criteria:	Class discussion [TM: 2×50'']		Polymers for drug release applications in body – 2	10
11	Students are able to understand the unique structure of biomaterials in the context of polymer applications	The accuracy level of statement about the unique structure of biomaterials	Technical: Criteria:	Lecture [TM: 2×50'']		Interaction between synthetic polymers and natural materials	10
12	Students are able to understand structure modification of polymer for membrane applications	The accuracy level of statement about the structure modification for membrane	Technical: Criteria:	Lecture [TM: 2×50'']		Modified polymer structure for all types of membrane – 1	7
13	Students are able to understand structure modification of polymer for membrane applications	The accuracy level of statement about the structure modification for membrane	Technical: Criteria:	Lecture [TM: 2×50'']		Modified polymer structure for all types of membrane – 2	8
14	Students are able to understand the general theory in the structure modification of polymer molecules	The accuracy level of statement about the structure modification for membrane	Technical: Criteria:	Lecture [TM: 2×50'']		Structure modification methods of polymers – overview	5
15-16	End-of-Semester Evaluation						50



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)			Semester Credit Units		SEMESTER	Compilation Date		
PHENOLATE CHEMISTRY		SK 185552	Organic Chemistry			2	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program (PRODI)			
		Prof.Dr. Taslim Ersam, MS				Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc			
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to master the properties of phenolat compounds how to synthesis those compounds 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
		LO MK 1	√					√			
Course Short Description											
Study Material: Subject Matter											
Reference		Primary:									



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)			Semester Credit Units		SEMESTER	Compilation Date		
PIGMENTS CHEMISTRY		SK 185554	Organic Chemistry			2	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program (PRODI)			
		Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.				Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc			
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	LO 2	Show a spirit of independence and team work in completing their duties									
	LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry									
	LO 9	Able to build chemical knowledge especially in the energy, environmental, marine, and medical in order to develop the research, industry, and employment creation									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to master the various compounds that usually used as pigments includind their structure and properties									
LO – LO MK Map											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		LO MK 1		√					√		√
Course Short Description											
Study Material: Subject Matter		Definitions, essential oil separations and analysis, compositions, uses, and chemical aspects									
Reference		Primary:									

5	Students are able to explain the condition of pigments in a dye bath and substrates	The accuracy in explaining the condition of pigments in a dye bath and substrates	Technical: Assignment 2 Criteria:	Lecture and discussion [TM: 2×50'']		- Pigments in a dye bath - Pigments in substrates	15
6,7	Students are able to understand and explain the reaction mechanism of pigment	The accuracy in understanding and explaining the reaction mechanism of pigment	Technical: Criteria:	Lecture and discussion [TM: 2×50'']		Reaction mechanism of pigment	
8	Mid-Semester Evaluation						25
9	Students are able to explain and apply various types of pigments for different types of textile materials such as cellulose, wool, silk, etc.	The accuracy in explaining and applying various types of pigments for different types of textile materials such as cellulose, wool, silk, etc.	Technical: Criteria:	Lecture, demonstration, and discussion [TM: 2×50'']		Textile dyes	
10,11	Students are able to explain and apply various types of pigments for different types of non-textile materials such as paper, food, skin, etc.	The accuracy in explaining and applying various types of pigments for different types of non-textile materials such as paper, food, skin, etc.	Technical: Assignment 3 Criteria:	Lecture, demonstration, and discussion [TM: 2×50'']		Non-textile dyes	10
12,13	Students are able to explain various types of functional pigments and their applications such as imaging,	The accuracy in explaining various types of functional pigments and their applications	Technical: Criteria:	Lecture, presentation, and discussion [TM: 2×50'']		Functional pigments	

	printing, electrochromic, laser, chemiluminescence, etc.	such as imaging, printing, electrochromic, laser, chemiluminescence, etc.					
14,15	Students are able to explain optical brighteners agents, their characteristics, and their function	The accuracy in explaining optical brighteners agents, their characteristics, and their function	Technical: Assignment 4 Criteria:	Lecture, presentation, and discussion [TM: 2×50"]		Optical brighteners agents	15
16	End-of-Semester Evaluation						25



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date			
PETROLEUM CHEMISTRY		SK 185554	Organic Chemistry	2	0	III				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)				
		Prof. Dr. R.Y. Perry Burhan, M.Sc.; Dr. Yulfi Zetra, M.S.		Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc				
Learning Outcomes (LO)	LO-PRODI Charged to The Course									
	LO 3	Able to collect, document, and analyze data and information and develop them using logical thinking based on scientific principles								
	LO 4	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem								
	LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry								
	LO 9	Able to build chemical knowledge especially in the energy, environmental, marine, and medical in order to develop the research, industry, and employment creation								
	Course Learning Outcomes (LO MK)									
	LO MK 1	Able to master the various compounds in petrouleum								
	LO MK 2	Able to master the structure and properties of chemical compounds in petroluem								
	LO MK 3	Able to master the application of petroluem chemistry								
LO – LO MK Map										
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
	LO MK 1			√				√		
	LO MK 2							√		
	LO MK 3				√			√		√

Course Short Description							
Study Material: Subject Matter		1. Definition and importance of petroleum geochemistry 2. Strategy and assessment planning of petroleum geochemistry 3. Determination and interpretation of maturity, the quality level of source rocks, the depositional environment of source rocks, kerogen 4. Formation and migration of hydrocarbon, types of petroleum and natural gas as well their correlation with source rocks, the modeling of hydrocarbon formation					
Reference		Primary:					
		Secondary:					
Supporting Lecturer		Prof. Dr. R.Y. Perry Burhan, M.Sc.; Dr. Yulfi Zetra, M.S.					
Pre-Requisite Courses							
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment Portion (%)
		Indicator	Criteria and Technical	Face-to-face Class (5)	Online Class (6)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1-3	Students are able to explain the importance of petroleum geochemistry and understand the strategy and assessment planning of geochemistry	The accuracy in explaining the importance of petroleum geochemistry and understand the strategy and assessment planning of geochemistry	Technical: Assignment 1 Criteria:	Lecture and discussion [TM: 3x(2x50'')] Assignment 1 [BT+BM:(1+1)x(2x60)]		- Definition of petroleum geochemistry - Role of petroleum geochemistry - Strategy and assessment planning of geochemistry	10

4,5	Students are able to determine and interpret the maturity of petroleum and the quality of source rocks	The accuracy in determining and interpreting the maturity of petroleum and the quality of source rocks	Technical: Criteria:	Lecture and group discussion		- Determination and interpretation of the maturity of petroleum - Determination and interpretation of the quality level of source rocks	
6-7	Students are able to determine and interpret the depositional environment of source rocks and kerogen	The accuracy in determining and interpreting the depositional environment of source rocks and kerogen	Technical: Assignment 2 Criteria:	Lecture and group discussion [TM: 2x(2×50'')] Assignment 2 [BT+BM:(1+1)x(2x60)]		Determination and interpretation of the depositional environment of source rocks and kerogen	10
8	Mid-Semester Evaluation						25
9,10	Students are able to explain the formation process of hydrocarbon and the migration process of hydrocarbon	The accuracy in explaining the formation process of hydrocarbon and the migration process of hydrocarbon	Technical: Criteria:	Lecture and group discussion [TM: 2x(2×50'')]		- The formation process of hydrocarbon - The migration process of hydrocarbon - The formation process of kerogen	
11-13	Students are able to explain types of petroleum and natural gas as well as their correlation with source rocks	The accuracy in explaining types of petroleum and natural gas as well as their correlation with source rocks	Technical: Assignment 3 Criteria:	Lecture and group discussion [TM: 2x(2×50'')] Assignment 3 [BT+BM:(1+1)x(2x60)]		- Types of petroleum - Types of natural gas - Correlation of petroleum and natural gas with source rocks	15

14,15	Students are able to explain the modeling of hydrocarbon formation	The accuracy in explaining the modeling of hydrocarbon formation	Technical: Assignment 4 Criteria:	Lecture and group discussion [TM: 2x(2×50'')] Assignment 4 [BT+BM:(1+1)x(2x60)]		Modeling of hydrocarbon formation	15
16	End-of-Semester Evaluation						25



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)			Semester Credit Units		SEMESTER	Compilation Date		
HETEROCYCLIC AROMATIC CHEMISTRY		SK 185555	Organic Chemistry			3	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program (PRODI)			
		Prof. Mardi Santoso, Ph.D.				Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc			
Learning Outcomes (LO)		LO-PRODI Charged to The Course									
		LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry								
		Course Learning Outcomes (LO MK)									
		LO MK 1	Able to understand the definition, nomenclature, structure, reactivity, synthesis, role, and benefits of heterocyclic aromatic compounds								
LO – LO MK Map											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		LO MK 1							√		
Course Short Description											
Study Material: Subject Matter		The definition, nomenclature, structure, reactivity, synthesis, role, and benefits of heterocyclic aromatic compounds									
Reference		Primary:									

1. J.A. Joule, K. Mills, "Heterocyclic Chemistry", edisi keempat, Blackwell, Oxford, 2002
2. J.A. Joule, K. Mills, "Heterocyclic Chemistry at a Glance", edisi kedua, Wiley, 2013
3. Related journals

Secondary:

Supporting Lecturer

Prof. Mardi Santoso, Ph.D.

Pre-Requisite Courses

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1-3	Students are able to understand the course contract, definition, nomenclature, role, and benefits of heterocyclic aromatic compounds	The accuracy in explaining the definition, nomenclature, role, and benefits of heterocyclic aromatic compounds	Technical: Criteria:	Lecture and discussion [TM: 3x(2×50'')]		Definition, nomenclature, role, and benefits of heterocyclic aromatic compounds	
4	Quiz-1						15
5-14	Students are able to understand the electron-rich heterocyclic aromatic compounds	The accuracy in explaining the structure, reactivity, synthesis, role, and benefits of pyrrole, furan, thiophene, azole, indole, benzofuran,	Technical: Criteria:	Lecture and discussion [TM: 10x(2×50'')]		Structure, reactivity, synthesis, role, and benefits of pyrrole, furan, thiophene, azole, indole, benzofuran, benzothiazole, benzimidazole	

		benzothiazole, benzimidazole					
15-16	Mid-Semester Evaluation						35
17-20	Students are able to understand the electron-deficient heterocyclic aromatic compounds	The accuracy in explaining the structure, reactivity, synthesis, role, and benefits of pyridine, quinoline, isoquinoline, pyrylium, benzopyrylium	Technical: Criteria:	Lecture and group discussion		Structure, reactivity, synthesis, role, and benefits of pyridine, quinoline, isoquinoline, pyrylium, benzopyrylium	
21	Quiz-2						20
22-28	Students are able to understand the latest topics about heterocyclic aromatic compounds	The accuracy in explaining the latest topics about heterocyclic aromatic compounds	Technical: Criteria:	Lecture and group discussion		The latest topics about heterocyclic aromatic compounds	
16	End-of-Semester Evaluation						30



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date				
MEDICINAL CHEMISTRY		SK 185556	Organic Chemistry	2	0	III					
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Sri Fatmawati, M.Sc., Ph.D.		Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	LO 2	Show a spirit of independence and team work in completing their duties									
	LO 5	Able to show responsibility of their individual work by show the free plagiarism result									
	LO 7	Able to develop concepts, theories, and methods on the analysis and synthesis of chemical substances by considering the right instrument and the substance side effect in order to develop the chemistry									
	LO 9	Able to build chemical knowledge especially in the energy, environmental, marine, and medical in order to develop the research, industry, and employment creation									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to know drug and its activities									
	LO MK 2	Able to explain the introduction and discovery of the drug									
	LO MK 3	Able to explain the structure-activity relationship (SAR) and quantitative structure-activity relationship (QSAR), as well as do the computer drug design, combinatorial chemistry, pharmacokinetics, drug metabolism									
LO – LO MK Map											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		LO MK 1					√		√		
		LO MK 2							√		
		LO MK 3		√					√		√

Course Short Description							
Study Material: Subject Matter		Drug and its activities, introduction and discovery of the drug, structure-activity relationship (SAR) and quantitative structure-activity relationship (QSAR), computer-aided drug design, combinatorial chemistry, pharmacokinetics, drug metabolism					
Reference		Primary:					
		1. G. Thomas, “Medicinal Chemistry; an Introduction”, John Wiley & Sons, New York, 2011.					
		2. A. Burger, “Burger’s Medicinal Chemistry and Drug Discovery”, Jones and Barlett Publishers, Boston, 2001.					
		Secondary:					
Supporting Lecturer		Sri Fatmawati, M.Sc., Ph.D.					
Pre-Requisite Courses							
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment 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 show the introduction of the drug and its activities	The accuracy in writing how a drug was discovered, the form of medicine, drug source and lead compound, classification of the drug, pharmaceuticals phase, and drug activity	Technical: Assignment 1: Source and classification of drug Criteria:	Introduction lecture and brainstorming [TM: 2×50’] Lecture and discussion [TM: 2×50’]		- Introduction of drug - Discovery of drug and its form - Drug source and lead compound - Classification of drug - Pharmaceuticals phase - Introduction of drug activity	10

3,4	Students are able to show the introduction and discovery of drug	The accuracy in writing the stereochemistry and solubility in drug design, drug structure, the formation of the salt in structure	Technical: Quiz Criteria:	Lecture and group discussion [TM: 2x(2×50'')]		- Stereochemistry and design of drug - Solubility and structure of a drug - The formation of the salt - Addition of water-soluble groups in a structure	
5-7	Students are able to explain the structure-activity relationship (SAR) and the quantitative structure-activity relationship (QSAR) as well as drug design	The accuracy in writing the mechanism of nucleophilic substitution reaction of carboxylic acid and its derivatives as well as that of amine	Technical: Criteria:	Lecture and group discussion [TM: 3x(2×50'')]		- Structure-activity relationship (SAR) - Quantitative structure-activity relationship (QSAR) - Computer-aided drug design	
8	Mid-Semester Evaluation						20
9,10	Students are able to show combinatorial chemistry	The accuracy in writing combinatorial chemistry compounds	Technical: Assignment Criteria:	Lecture and group discussion [TM: 2x(2×50'')]		- Examples of drug which interfere cell membrane and cell wall - Examples of drug which inhibit the cell wall synthesis	5
11,12	Students are able to show the action of drugs in several common drug target areas	The accuracy in writing the action of drugs in several common drug target areas	Technical: Criteria:	Lecture and group discussion [TM: 2x(2×50'')]		- Transition state inhibitor - Receptor-targeted drug - Nucleic acid-targeted drug - Antiviral drugs	

13,14	Students are able to show pharmacokinetics	The accuracy in writing pharmacokinetics and drug design, pharmacokinetics model, intravascular administration, extravascular administration	Technical: Presentation Criteria:	Lecture and group discussion [TM: 2x(2×50'')]		Modeling of hydrocarbon formation	5
15,16	Students are able to show the metabolism of a drug	The accuracy in writing stereochemistry of drug metabolism, the biological and environmental factors affecting drug metabolism, human and metabolism, secondary pharmacological metabolism implications, active site, phase 1 and 2 metabolism reaction and their metabolites	Technical: Presentation Criteria:	Lecture and group discussion [TM: 2x(2×50'')]		- Stereochemistry of drug metabolism - Biological factors affecting metabolism - Environmental factors affecting metabolism - Human and metabolism - Secondary pharmacological metabolism implications - Active site - Phase 1 metabolism reactions (oxidation, reduction, hydration, and other reactions) - Phase 2 metabolism reactions	

						• Metabolites of pharmacokinetics • Metabolism and drug design • Prodrugs	
16	End-of-Semester Evaluation						25



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course Disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date				
ESSENTIAL OILS CHEMISTRY		SK 185556	Organic Chemistry	2	0	III					
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.		Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	LO 2	Show a spirit of independence and team work in completing their duties									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to understand the definition, separation, analysis, composition, utilization, and chemical aspects of essential oils									
LO – LO MK Map											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		LO MK 1		√							
Course Short Description											
Study Material: Subject Matter		The definition, separation and analysis of essential oils; composition of essential oils; utilization of essential oils; chemical aspects of essential oils									
Reference		Primary:									
		1. K.H.C. Baser, G. Buchbauer (editor), “Handbook of Essential Oils: Science, Technology, and Applications”, Second edition, CRC Press, 2015. 2. Relevant articles.									
		Secondary:									

Supporting Lecturer		Sri Fatmawati, M.Sc., Ph.D.; Arif Fadlan, D.Sc.					
Pre-Requisite Courses							
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1-3	Students are able to explain the definition and separation method of essential oils	The accuracy in explaining the definition and separation method of essential oils	Technical: Assignment 1 Criteria:	Lecture and discussion [TM: 3x(2×50'')] Assignment 1 [BT+BM: (1+1)x(2x60)]		- Definition of essential oils - Process and strategy of essential oils separation	15
4,5	Students are able to analyze the types of essential oils and their properties	The accuracy in analyzing the types of essential oils and their properties	Technical: Criteria:	Lecture and group discussion [TM: 2x(2×50'')] 		The analysis method of essential oils	
6,7	Students are able to determine and explain the composition of essential oils	The accuracy in determining and explaining the composition of essential oils	Technical: Assignment 2 Criteria:	Lecture and group discussion [TM: 2x(2×50'')] Assignment 2 [BT+BM: (1+1)x(2x60)]		Composition of essential oils	15
8	Mid-Semester Evaluation						25

9-11	Students are able to explain essential oil processing and utilization of essential oils	The accuracy in explaining essential oil processing and utilization of essential oils	Technical: Criteria:	Lecture and group discussion [TM: 3x(2×50'')]		- Essential oil processing - Utilization of essential oil	
12-15	Students are able to explain the chemical aspects of essential oils and their function	The accuracy in explaining the chemical aspects of essential oils and their function	Technical: Assignment 3 Criteria:	Lecture and group discussion [TM: 4x(2×50'')] Assignment 3 [BT+BM: (1+1)x(2x60)]		- Chemical aspects of essential oils - Role and function of compounds in essential oils	20
16	End-of-Semester Evaluation						25



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COURSE (MK)		CODE	Course Disiplines (RMK)			Semester Credit Units		SEMESTER	Compilation Date		
REARRANGEMENT AND PERICYCLIC CHEMISTRY		SK 185558	Organic Chemistry			2	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program (PRODI)			
		Prof. Mardi Santoso, Ph.D.				Prof. Mardi Santoso, Ph.D.		Prof. Dr. Didik Prasetyoko, M.Sc			
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	LO 4	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to understand the definition, variety, mechanism, stereochemistry of rearrangement and pericyclic reactions									
LO – LO MK Map											
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	
	LO MK 1				√						
Course Short Description											
Study Material: Subject Matter		The definition, variety, mechanism, stereochemistry of rearrangement and pericyclic reactions									
Reference		Primary:									

1. F.A. Carey, R.J. Sundberg, "Advanced Organic Chemistry. Part B: Reaction and Synthesis", Springer, 2007
2. M.B. Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure", seventh edition, Wiley, 2013
3. Related journals

Secondary:

Supporting Lecturer

Prof. Mardi Santoso, Ph.D.

Pre-Requisite Courses

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Time Estimation]		Learning Material [Reference]	Assessment 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 course contract, definition, and variety of pericyclic reactions	The accuracy in explaining the definition and variety of pericyclic reactions	Technical: Criteria:	Lecture and discussion [TM: 2x50"]		Definition and variety of pericyclic reactions	
2,3	Students are able to understand cycloaddition and electrocyclic reactions as well as the mechanism and stereochemistry aspects	The accuracy in explaining cycloaddition and electrocyclic reactions as well as the mechanism and stereochemistry aspects	Technical: Criteria:	Lecture and group discussion [TM: 2x(2x50")]		Cycloaddition and electrocyclic reactions as well as the mechanism and stereochemistry aspects	
4	Quiz-1						25

5-7	Students are able to understand sigmatropic rearrangement reactions and ene reactions as well as mechanism and stereochemistry aspects	The accuracy in explaining sigmatropic rearrangement reactions and ene reactions as well as mechanism and stereochemistry aspects	Technical: Criteria:	Lecture and group discussion [TM: 3x(2×50'')]		Sigmatropic rearrangement reactions and ene reactions as well as mechanism and stereochemistry aspects	
8	Mid-Semester Evaluation						25
9-11	Students are able to understand the rearrangement reaction of cationic, anionic, etc.	The accuracy in explaining the rearrangement reaction of cationic, anionic, etc.	Technical: Criteria:	Lecture and group discussion [TM: 3x(2×50'')]		Rearrangement reactions of cationic, anionic, etc.	
12	Quiz-2						30
13-15							
16	End-of-Semester Evaluation						20



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FAKULTAS SAINS DAN ANALITIKA DATA
DEPARTEMEN KIMIA

Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Course Disciplines			Credits		SEMESTER	Compilation date		
Research Methodology		SK185101	General			3		I			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program			
		Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si., Prof. Dr. Didik Prasetyoko. M,Sc.				Prof. Dr. Didik Prasetyoko. M,Sc.		Prof. Dr. Didik Prasetyoko. M,Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	(LO 1)	Show moral, ethical, responsibility and good personality in completing their duties									
	(LO 2)	Show a spirit of independence and team work in completing their duties									
	(LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles									
	(LO 5)	Able to show responsibility of their individual work by show the free plagiarism result									
	Learning Outcome of The Course										
	CP MK 1	Students can compile a research plan and present a scientific journal in a good manner.									
Peta LO – CP MK											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		CP MK 1	√	√	√		√				
Subject Description											
The Topics Covered in The Subject		1. This subject covers the meaning of research, how to make a research plan, and compile and present a scientific journal. • Research: what, why, and how • Research suggestion, hypothesis, and planning an experiment									

	- Conducting research, data collecting and processing, evaluating the observations, and statistic tests. - Scientific journal or report, system framework, and their counterparts. 2. Presenting the research orally						
Reference							
	1. E.B. Wilson, “An Introduction to Scientific Research”, New York, McGraw Hill. 2. Related articles.						
	Support:						
Lecturer	Prof. Dr.rer.nat. Irmina Kris Murwani, MSi; Prof. Dr. Didik Prasetyoko, MSc						
Pre-requisite	-						
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Knowledgable about research			Lectures on parts of research: what, why, how, each with an example [3x50]	Lectures on parts of research: what, why, how, each with an example [3x50]	Parts of research including preparation, proposal arrangement, observations, the arrangement of research reports	
2	Knowledgable about the research methodology			Lecture on the characteristics of research methodology [3x50]	Lecture on the characteristics of research methodology [3x50]	Characteristics of the research methodology	

3	Knowledgable about the stages of the research process			Lecture on the stages of the research process [3x50]	Lecture on the stages of the research process [3x50]	The stages of the research process	
4	Able to formulate research problems	Ability to determine research problems	Assignment 1	Lecture on how to formulate research problems including the identification of variables and hypotheses constructs [3x50]	Lecture on how to formulate research problems including the identification of variables and hypotheses constructs [3x50]	Formulating research problems	10
5-6	Able to determine research problems			Presentation and discussion from journals whose problems have been determined from assignment 1 2x [3x50]	Presentation and discussion from journals whose problems have been determined from assignment 1 2x [3x50]	Determine problems in research	
7	Able to compile research designs	Ability to compile research designs	Assignment 2	Research design courses: Instrument construction for data collection	Research design courses: Instrument construction	Research design	10

				Research proposal Writing a report [3x50]	for data collection Research proposal Writing a report [3x50]		
8	Mid-Term Evaluation						30
9	Knowledgable about writing journal			Lectures on why you should write a journal and what to watch out for if you do [3x50]	Lectures on why you should write a journal and what to watch out for if you do [3x50]	Journal writing process	
10	Know the various types of journals			Lectures on various types of journals, their characteristics, and differences [3x50]	Lectures on various types of journals, their characteristics, and differences [3x50]	Different types of journals	
11	Knowledgable about the criteria of writing a good journal and the stages in writing a journal until the submission process			Lectures on the stages of journal writing until the submission process on the target journal [3x50]	Lectures on the stages of journal writing until the submission process on the target journal [3x50]	Journal writing stages	

12	Understand how to review a literature			Literature review Lecture [3x50]	Literature review Lecture [3x50]	Literature review	
13-14	Able to compile a review journal			Presentations and discussions about reviews that have been arranged according to topics in each area of interest 2x [3x50]	Presentations and discussions about reviews that have been arranged according to topics in each area of interest 2x [3x50]	Write a review journal	
15	Understand how to choose a target journal and submit it to the journal	Ability to compile journal manuscripts	Assignment 3	A lecture on how to choose a target journal, what to pay attention to, how to submit it as well as the ethics when submitting a journal [3x50]	A lecture on how to choose a target journal, what to pay attention to, how to submit it as well as the ethics when submitting a journal [3x50]	Selection of target journal and submission	20
16	Final Evaluation						30



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**Kode
Dokumen**

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Course Disciplines	Credits		SEMESTER	Compilation date
Solid State Spectroscopy		SK185102	General	3		I	
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program	
		Lukman Atmaja, M.Si, Ph.D., Dr. Hendro Juwono. M.Si.		Prof. Dr. Didik Prasetyoko. M,Sc.		Prof. Dr. Didik Prasetyoko. M,Sc.	
Learning Outcome	Learning Outcome Targeted From The Course						
	(LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem					
	(LO 5)	Able to show responsibility of their individual work by show the free plagiarism result					
	(LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon					
	(LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach					
	Learning Outcome of The Course						
	CP MK 1	Students can implement the knowledge of Solid Substances Spectroscopy on the research topics that concern energy, health, environment, and other related fields.					
	CP MK 2	Students have a deep awareness of the relationships between the molecular structure of a solid substance with both its physical and macroscopic characteristics.					

	CP MK 3	Students can think critically about the uses of spectroscopy techniques to solve life problems, such as developing materials for renewable energy, developing synthesis medicine, developing materials for analysis methods, and other related topics.								
Peta LO – CP MK										
		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				√	√	√		√	
Subject Description										
The Topics Covered in The Subject	- Crystal shapes, amorphous solids, chemical bonds in solid substances, lattice energy, correlations between energy lattice and ionic solid substances. - Vibration-rotation-electronic energy levels, selection rules vibration-rotation-electronic transitions, spectrum production, qualitative and quantitative methods, adsorption on solid surfaces, imaging basic concepts.									
Reference										
	Support:									
Lecturer	Lukman Atmaja, PhD; Dr. Hendro Juwono, MSi									
Pre-requisite	-									
Meeting -	The final ability of each learning stage	Scoring			Learning Forms; Learning methods; Student Assignment; [Estimated time]			Learning materials [References]	Score Rating (%)	
		Indicator	Criteria & Techniques							
(1)	(2)	(3)	(4)		Tatap Muka (5)		Daring (6)	(7)	(8)	

1	Able to understand crystal structure in the context of spectroscopy	The degree of clarity in explaining crystal structure	Lecture	Lecture [100]	Lecture [100]	Bulk crystal: a three-dimensional lattice	3
2	Able to understand crystal structure in the context of spectroscopy	The degree of clarity in explaining crystal structure	Lecture	Lecture [100]	Lecture [100]	Crystal plane: two-dimensional lattice	3
3	Able to understand the structure of amorphous solids in the context of spectroscopy	The degree of clarity in explaining the structure of amorphous solids	Lecture	Lecture [100]	Lecture [100]	Amorphous solid	3
4	Able to understand the types of chemical bonds present in the solid phase	The degree of clarity in explaining the types of bonds	Lecture	Lecture [100]	Lecture [100]	Chemical bonds in the solid phase - 1	3
5	Able to understand the types of chemical bonds present in the solid phase	The degree of clarity in explaining the types of bonds	Lecture	Lecture [100]	Lecture [100]	Chemical bonds in the solid phase - 2	3
6	Able to understand the reality of electromagnetic radiation and the theoretical procedures for its amplification	The degree of clarity in explaining the interaction between radiation and matter in solids	Group Discussion	Lecture [100]	Lecture [100]	Interaction between radiation and solids - Hertzian Dipole and Fourier transformation	4
7	Understand the concepts of coherence and correlation for radiation applications in spectroscopy	The degree of clarity in explaining the interaction between	Group Discussion	Lecture [100]	Lecture [100]	Interaction between radiation and solids - Limited frequency, coherence, and correlation	4

		radiation and matter in solids					
8	Understand the relationship between the lattice energy of a material and its solubility properties	The degree of clarity in explaining the relationship between energy as a general concept and physical properties, especially its solubility properties	Lecture	Lecture [100]	Lecture [100]	Relationship between lattice energy and ionic solid solubility - 1	4
9	Understand the relationship between the lattice energy of a material and its solubility properties	The degree of clarity in explaining the relationship between energy as a general concept and physical properties, especially its solubility properties	Lecture	Lecture [100]	Lecture [100]	Relationship between lattice energy and ionic solid solubility - 2	4
10	Understand the behavior of solids in response to the radiation that hits them	The degree of clarity in explaining the response of solids and their use as one axis in the spectrum	In-Class Discussion	Lecture [100]	Lecture [100]	Dielectric response functions	4
11	Understand the origin of rotational, vibrational, and electronic energy levels	The degree of clarity in explaining the formation of energy levels in a molecule	Lecture	Lecture [100]	Lecture [100]	Rotational-vibrational-electronic energy levels - 1	3

12	Understand the origin of rotational, vibrational, and electronic energy levels	The degree of clarity in explaining the formation of energy levels in a molecule	Lecture	Lecture [100]	Lecture [100]	Rotational-vibrational-electronic energy levels - 2	3
13	Understand the relationship between molecular symmetry and selection rules	The degree of clarity in explaining molecular symmetry and the rules of selection for rotational, vibrational, and electronic transitions	Lecture	Lecture [100]	Lecture [100]	Symmetry and selection rules - 1	5
14	Understand the relationship between molecular symmetry and selection rules	The degree of clarity in explaining molecular symmetry and the rules of selection for rotational, vibrational, and electronic transitions	Lecture	Lecture [100]	Lecture[100]	Symmetry and selection rules - 2	4
15-16	Mid-Term Evaluation						
17	Understand the transitions that produce a spectrum	The degree of clarity in explaining the process of spectrum formation	Lecture	Lecture [100]	Lecture [100]	Vibration-rotational-electronic transition – 1	4

18	Understand the transitions that produce a spectrum	The degree of clarity in explaining the process of spectrum formation	Lecture	Lecture [100]	Lecture [100]	Vibration-rotational-electronic transition – 2	4
19	Understand the special features of the solids IR spectra	The degree of clarity in explaining the presence and appearance of peaks at the vibrational transition	Lecture	Lecture [100]	Lecture [100]	IR Spectra	4
20	Understand the special features of the solid-looks-alike spectra	The degree of clarity in explaining the presence and appearance of peaks in electronic transitions	Lecture	Lecture [100]	Lecture [100]	Visible Spectra	4
21	Understand the special features of a solid UV spectra	The degree of clarity in explaining the presence and appearance of peaks in electronic transitions	Lecture	Lecture [100]	Lecture [100]	UV Spectra	4
22	Understand the special features of the solid X-ray spectra	The degree of clarity in explaining the presence and appearance of peaks in X-ray-based spectroscopy	Lecture	Lecture [100]	Lecture [100]	X-rays spectra	4
23	Understand the basic theory of NMR spectroscopy and its spectra	The degree of clarity in explaining the interaction of magnetic fields in solid	Lecture	Lecture [100]	Lecture [100]	NMR Spectroscopy - 1	5

		molecules and the process by which the spectrum appears					
24	Understand the basic theory of NMR spectroscopy and its spectra	The degree of clarity in explaining the interaction of magnetic fields in solid molecules and the process by which the spectrum appears	Group Discussion	Lecture [100]	Lecture [100]	NMR Spectroscopy - 2	5
25	Understand the basic theory of NMR spectroscopy and its spectra	The degree of clarity in explaining the interaction of magnetic fields in solid molecules and the process by which the spectrum appears	Presentation	Lecture [100]	Lecture [100]	NMR Spectroscopy - 3	5
26	Understand the procedures of qualitative and quantitative methods using different types of spectroscopy	The degree of clarity in explaining the stages of preparation for qualitative and quantitative analysis	Lecture	Lecture [100]	Lecture [100]	Qualitative and quantitative methods - 1	4
27	Understand the procedures of qualitative and quantitative methods using different types of spectroscopy	The degree of clarity in explaining the stages of preparation for qualitative and quantitative analysis	Lecture	Lecture [100]	Lecture [100]	Qualitative and quantitative methods - 2	4

28	Understand the basic concepts of 3-dimensional spectroscopy	The degree of clarity in explaining the main ideas of space spectroscopy.	Lecture	Lecture [100]	Lecture [100]	Basic imaging concepts	3
29-32	Final Evaluation						



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**Kode
Dokumen**

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Course Disciplines		Credits		SEMESTER	Compilation date			
Chemical Instrumentation		SK185111	Analytical Chemistry		2		I				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator		Head of Study Program				
		Yatim Lailun Ni'mah, M.Si., Ph.D			Suprpto, M.Si. Ph.D.		Prof. Dr. Didik Prasetyoko. M,Sc.				
Learning Outcome	Learning Outcome Targeted From The Course										
	(LO 1)	Show moral, ethical, responsibility and good personality in completing their duties									
	(LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem									
	(LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	(LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Learning Outcome of The Course										
	CP MK 1	Students can explain the purposes of instruments being taught, and									
	CP MK 2	Students able to explain data interpretations given by the instruments.									
	CP MK 3	Students able to express their ideas or suggestions orally or in written forms.									
Peta LO – CP MK											
			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	√			√					√

Subject Description							
The Topics Covered in The Subject		Analytic method classification and their types, simple instrument measurements, electrical circuit components, amplifier, transducer, feedback and control, signal, noise and noise reduction, digital electronic and microcomputer.					
Reference							
		1. D.A. Skoog, F.J. Holler, S.R. Crouch, "Principles of Instrumental Analysis", John Wiley and Sons, 2006.					
		Support: 1. J. Wang, "Electroanalytical Chemistry," Wiley VCH, USA, 2000.					
Lecturer		Yatim Lailun Ni'mah, PhD; Dr.rer.nat. Fredy Kurniawan, MSi					
Pre-requisite		-					
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students know the a learning plan for one semester						
2	Students can explain classification of analytic methods and their types	Conformity with concept, Questions, and answers		Tutorial, Discussion [2x50]	Tutorial, Discussion [2x50]	Classification of analytical methods and their types	
3,4	Students can explain simple instrument measurements	Conformity with concept, Questions, and answers		Tutorial, Discussion 2[2x50]	Tutorial, Discussion 2[2x50]	Simple instrument measurement	20

5,6	Students can explain the electrical components and circuits in the instrument	Conformity with concept, Questions, and answers		Tutorial 2[2x50]	Tutorial 2[2x50]	Electrical components and circuits	
7	Students can classify analytical methods, using simple instruments as well as the components in the instrument.	Quiz		Discussion [2x50]	Discussion [2x50]	Classification of methods, measurement of instruments and electrical components therein	20
8	Mid-Term Evaluation						30
9-10	Students can explain about amplifiers and transducers	Conformity with concept, Questions, and answers		Lecture, Discussion 2[2x50]	Lecture, Discussion 2[2x50]	Amplifiers, transducers	
11-12	Students can explain orally or in writing some examples of radionuclide separation analysis taken from articles/journals (4 examples of different methods)	Conformity with concept, Questions, and answers		Lecture, Discussion 2[2x50]	Lecture, Discussion 2[2x50]	Feedback and control	
13	Students can explain signal, noise, and noise reduction as well as Digital electronics and microcomputers	Conformity with concept, Questions, and answers		Lecture, Discussion [2x50]	Lecture, Discussion [2x50]	• Signal, Noise, and noise reduction • Digital electronics and microcomputers	
14	Students can apply theories in chemical instrumentation with their respective research	Conformity with concept, Questions, and answers		Lecture, Discussion [2x50]	Lecture, Discussion [2x50]	Application of chemical instrumentation theory	20
15-16	Final Evaluation						30

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RENCANA PEMBELAJARAN SEMESTER																																								
SUBJECT NAME	CODE	Course Disciplines	Credits		SEMESTER	Compilation date																																		
Chemoinformatics	SK185112	Analytical Chemistry	2		I																																			
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer		RMK Coordinator		Head of Study Program																																			
	Suprpto, M.Si. Ph.D.		Suprpto, M.Si. Ph.D.		Prof. Dr. Didik Prasetyoko. M,Sc.																																			
Learning Outcome	Learning Outcome Targeted From The Course																																							
	(LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles																																						
	(LO 5)	Able to show responsibility of their individual work by show the free plagiarism result																																						
	Learning Outcome of The Course																																							
	CP MK 1	Students can explain the types of publications																																						
Peta LO – CP MK	CP MK 2	Studen can use software such as word processors, reference manager, data processing, and picture processing.																																						
	<table border="1" style="width: 100%; border-collapse: collapse;"> <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> <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>												LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	CP MK 1			√		√					CP MK 2			√		√			
	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9																															
CP MK 1			√		√																																			
CP MK 2			√		√																																			
Subject Description																																								
The Topics Covered in The Subject	<i>Word processor, Optimasi MS-Word (Style, Table of Content, Caption, Reference Manager (Zotero, Mendeley), Origin (Gambar Vektor, Mengatur Gambar), Scopus, Thomson Reuters, pengiriman artikel (Journal Topic, Author Guide, Supplementary files)</i>																																							

Reference		1. www.sciencedirect.com, www.scopus.com; www.office.com, www.originlab.com, 2. www.zotero.org, www.mendeley.com, www.onenote.com					
		Support:					
Lecturer		Suprpto, M.Si. Ph.D.					
Pre-requisite		-					
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students can explain the types of publications	• Accuracy in explaining the importance of publication • Accuracy in explaining the type of publication • Describing the quality of the publication • Accuracy in explaining the quality of the researcher	Non-Test	Lecture, brainstorming 2x(2×50)	Lecture, brainstorming 2x(2×50)	• General definition of scientific work • Types of publication of scientific papers • Quality of publication (Index, IF, Quartile and the like) • Research quality	10
2-4	Students can use word processor software	• Accuracy in using Style,	Non-Test	Lecture, brainstorming, Practical training	Lecture, brainstorming,	Optimizing the use of software to write scientific papers	20

		Caption in MS-Word • Accuracy in displaying Table of Content (TOC), Index • Accuracy in utilizing citations in MS-Word • Accuracy using the Track Change system • The accuracy of using one note to create research logbooks stored in the cloud		2x(2×50) 2×50	Practical training 2x(2×50) 2×50	• MS Word • One note	
5-7	Students can use reference manager software	• Accuracy in making personal libraries for reference purposes • Accuracy in using Zotero and Mendeley	Non-Test	Lecture, brainstorming, Practical training 2x(2×50) 1x(2×50)	Lecture, brainstorming, Practical training 2x(2×50) 1x(2×50)	• Optimization of the use of software related to reference managers (Zotero, Mendeley)	20
8	Mid-Term Evaluation						

9-11	Students can use data processing	The accuracy in using Origin, MS Excel, MATLAB for data processing	Non-Test	Lecture, brainstorming, Practical training 3x(3×50) 1x(3×50)	Lecture, brainstorming, Practical training 3x(3×50) 1x(3×50)	Optimizing the use of software for data processing purposes (MS Excel, Origin, MATLAB)	20
12-13	Students can use image processing devices	Accuracy in using Origin, MS Excel, MATLAB for image processing	Non-Test	Lecture, brainstorming, Practical training 1x(2×50) 1x(2×50)	Lecture, brainstorming, Practical training 1x(2×50) 1x(2×50)	Optimizing the use of software for image processing purposes (MS Excel, Origin, MATLAB)	15
14-15	Students understand how to publish articles in international journals	The accuracy in explaining the structure of articles in international journals, rating good scientific articles, compiling a good flow of scientific articles, and describing the need for article complementary need in the registration of an article to an international journal	Non-Test	Lecture, brainstorming 2x(2×50)	Lecture, brainstorming 2x(2×50)	How to publish in international journals (structure of articles in international journals, logic flow in writing articles in international journals, comprehensiveness on publication in international journals)	15
15-16	Final Evaluation						



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**Kode
Dokumen**

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Course Disciplines		Credits		SEMESTER	Compilation date			
Structures and Reactivities of Inorganic Compound		SK185121	Inorganic Chemistry		2		I				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator		Head of Study Program				
		Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si., Ratna Ediati, MS., Ph.D			Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si.		Prof. Dr. Didik Prasetyoko. M,Sc.				
Learning Outcome	Learning Outcome Targeted From The Course										
	(LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles									
	(LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem									
	(LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon									
	(LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	Learning Outcome of The Course										
	CP MK 1	Students can correlate inorganic material's properties, structures, and reactivities.									
	CP MK 2	Students can determine factors that influence inorganic compound reactivities.									
	CP MK 3	Students can present an example of structures and their reactivities through their chosen journal, as well as their determining reactivity factors.									
Peta LO – CP MK											
		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			√	√				
Subject Description										
The Topics Covered in The Subject		• This course provides a similar view on the structure and reactivity of inorganic compounds • Calculating electrons on molecule nucleus to discover the reactivities of a molecule, acid-base molecule that influence reactivities, symmetrical orbital interactions in a reaction, predicting redox reactions, oxidation number in a molecule, substituent effects, steric effect, mechanochemistry interactions. • Journals with the topic of structure and reactivity that will be used to determine the determining factor for reactivity								
Reference		1. J.E. Huheey, “Inorganic Chemistry Principles of Structure and Reactivity”, edisi keempat, Harper and Row Publisher, New York, 1993. 2. B.E. Douglas, D.H. McDaniel, J.J. Alexander, “Concepts and Models of Inorganic Chemistry”, John Wiley & Sons 3. C.E. Housecroft, A.G. Sharpe,” Inorganic Chemistry”, edisi kedua, Pearson Education Limited, 2005 4. G.L. Miessler, D.A. Tarr, “Inorganic Chemistry”, edisi ketiga, Pearson Education International, Minnesota, 2001 5. J.E. House, “Inorganic Chemistry”, Academic Press, London, 2008. 6. D.F. Shriver, P.W. Atkins, “Inorganic Chemistry”, edisi kelima, W.H. Freeman and Company, Oxford, 2010. 7. Journals with the topic of structure and reactivity will be presented to determine the determinants of reactivity Support:								
Lecturer		Prof. Dr. rer. nat. Irmira Kris Murwani, MSi; Dra. Ratna Ediati, MS, PhD								
Pre-requisite		-								

Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students can determine the factors that affect the			Lectures on the relationship between	Lectures on the relationship	Introduction to the relationship between	

	reactivity of inorganic compounds			the structure and reactivity of inorganic compounds [2x50]	between the structure and reactivity of inorganic compounds [2x50]	the structure and reactivity of inorganic compounds	
2-3	Students can count the electrons in the central atom of the molecule to find out the reactivity of the molecule			Lectures and exercises on the calculation of electrons in the central atom of a molecule to determine the reactivity of molecules 2x [2x50]	Lectures and exercises on the calculation of electrons in the central atom of a molecule to determine the reactivity of molecules 2x [2x50]	Calculation of the electrons in the molecular center atom to determine the reactivity of the molecule	
4	Students can relate the acid-base properties of molecules that affect reactivity			Lecture on molecular acids and bases that affect reactivity [2x50]	Lecture on molecular acids and bases that affect reactivity [2x50]	The acid-base molecule which affects reactivity	
5	Students can determine the factors that affect the reactivity of inorganic compounds			Lecture on symmetric orbital interactions in reactions [2x50]	Lecture on symmetric orbital interactions in reactions [2x50]	Symmetric orbital interactions in reactions	
6-7	Students can present examples of structure and	Be able to determine the determining factor	Assignment 1	Discussion and presentation of	Discussion and presentation of	Presentation of examples of	20

	reactivity through selected journals and their determining factors for reactivity.	for reactivity in sample structure		examples of structure and reactivity through selected journals and their determining factor for reactivity. 2x [2x50]	examples of structure and reactivity through selected journals and their determining factor for reactivity. 2x [2x50]	structure and reactivity through selected journals and their determining factor for reactivity.	
8	Mid-Term Evaluation						30
9	Students can predict redox reactions in reactivity			Lectures on the prediction of redox reactions in reactivity [2x50]	Lectures on the prediction of redox reactions in reactivity [2x50]	• Predictions of redox reactions in reactivity	
10	Students can determine oxidation numbers that affect the reactivity of inorganic compounds			Lecture on the effect of oxidation numbers in molecules on their reactivity [2x50]	Lecture on the effect of oxidation numbers in molecules on their reactivity [2x50]	• Effect of the oxidation number in a molecule on its reactivity	
11	Students can determine the factors that affect the reactivity of inorganic compounds, namely substituent and steric effects that affect reactivity.			Lectures on the effects of substituents, steric effects on molecular reactivity [2x50]	Lectures on the effects of substituents, steric effects on molecular reactivity [2x50]	• Substituent effect, the steric effect on molecular reactivity	

12	Students can determine the mechanochemical factors that affect the reactivity of inorganic compounds			Lecture on mechanochemical interactions [2x50]	Lecture on mechanochemical interactions [2x50]	• Mechanochemical interactions	
13-15	Students can present examples of structure and reactivity through selected journals and their determining factors for reactivity.	• Be able to determine their determining factor for reactivity	• Assignment 2	Presentation and discussion of examples of structure and reactivity through selected journals and their determining factor for reactivity 2x [2x50]	Presentation and discussion of examples of structure and reactivity through selected journals and their determining factor for reactivity 2x [2x50]	• Presenting examples of structure and reactivity through selected journals their determining factor for reactivity	20
16	Final Evaluation						30

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FAKULTAS SAINS DAN ANALITIKA DATA DEPARTEMEN KIMIA										Kode Dokumen																			
	RENCANA PEMBELAJARAN SEMESTER																													
SUBJECT NAME	CODE	Course Disciplines	Credits		SEMESTER	Compilation date																								
Characterization of Inorganic Materials I	SK185122	Inorganic Chemistry	2		I																									
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer		RMK Coordinator		Head of Study Program																									
	Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si., Dr. Afifah Rosyidah, M.Si.		Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si.		Prof. Dr. Didik Prasetyoko. M,Sc.																									
Learning Outcome	Learning Outcome Targeted From The Course																													
	(LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon																												
	(LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach																												
	Learning Outcome of The Course																													
	CP MK 1	Students can utilize and develop inorganic materials characterization methods to obtain more in-depth information, in particular crystallography.																												
Peta LO – CP MK	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 10%; text-align: center;">LO 1</td> <td style="width: 10%; text-align: center;">LO 2</td> <td style="width: 10%; text-align: center;">LO 3</td> <td style="width: 10%; text-align: center;">LO 4</td> <td style="width: 10%; text-align: center;">LO 5</td> <td style="width: 10%; text-align: center;">LO 6</td> <td style="width: 10%; text-align: center;">LO 7</td> <td style="width: 10%; text-align: center;">LO 8</td> <td style="width: 10%; text-align: center;">LO 9</td> </tr> <tr> <td>CP MK 1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="text-align: center;">√</td> <td></td> <td style="text-align: center;">√</td> <td></td> </tr> </table>											LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	CP MK 1						√		√	
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9																				
	CP MK 1						√		√																					
Subject Description																														

The Topics Covered in The Subject		Inorganic material characterization using X-ray (XRD, XANES, EXAFS, XPS), performing XRD using treor, dicvol, fullprof, Rietveld, Rietica, and MAUD software.						
Reference								
		• S.E. Dann, ”Reactions and Characterization of Solids”, RSC London, 2000 • A.R. West, “Solid State Chemistry (bab III)”, 1992, John Wiley & Sons • M. Ladd, R. Palmer, “Structure Determination by X-Ray Crystallography”, Kluwer Academic/Plenium Publishers, 2003 • R. Jenkins, ”X-Ray Fluorescence Spectrometry”, John Wiley and Sons Inc, 1999 • V.E. Buhrke, R. Jenkins, D.K. Smith, “Preparation of Specimens for X-ray fluorescence and X-ray Diffraction Analysis”, Wiley-VCH, 1998						
		Support:						
Lecturer		Prof. Dr.rer.nat. Irminda Kris Murwani, MSi; Prof. Dr. Didik Prasetyoko, MSc						
Pre-requisite								
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)	
		Indicator	Criteria & Techniques					
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)	
1	Knowledgeable in the way to characterize inorganic material			Introduction to the characterization of inorganic materials with examples	Introduction to the characterization of inorganic materials with examples	Introduction of inorganic material characterization, visual observation and physical properties of inorganic material		
2	Knowledgeable in the way to characterize inorganic materials using X-ray			Lecture on the characterization of inorganic materials by X-ray diffraction	Lecture on the characterization of inorganic materials by	Characterization of inorganic materials by X-ray diffraction		

					X-ray diffraction		
3	Knowledgeable in the way of using a free download program for the interpretation of X-ray diffraction patterns			Lecture on the required programs and installment of a free download program for interpreting X-ray diffraction patterns	Lecture on the required programs and installment of a free download program for interpreting X-ray diffraction patterns	Another program that must be prepared to install a free download program for the interpretation of X-ray diffraction patterns	
4	Knowledgeable in the use of free download programs Treor and dicvol and powder cell to interpret X-ray diffraction patterns	Students can use the Treor and dicvol programs and powder cell for interpretation of X-ray diffraction patterns	Assignment 1	Practice on how to install and use the free download programs Treor and dicvol and powder cell to interpret X-ray diffraction patterns	Practice on how to install and use the free download programs Treor and dicvol and powder cell to interpret X-ray diffraction patterns	How to install and use the free download program Treor and dicvol and powder cell to interpret X-ray diffraction patterns	10
5	Knowledgeable in the use of Winplot and MAUD free download programs to interpret X-ray diffraction patterns			Practice on how to install and use Winplot and MAUD free download programs to interpret X-ray diffraction patterns	Practice on how to install and use Winplot and MAUD free download programs to	How to install and use Winplot and MAUD free download programs to interpret X-ray diffraction patterns	

					interpret X-ray diffraction patterns		
6-7	Knowledgeable in the use of Fullprof and Rietica free download programs for interpretation of X-ray diffraction patterns	Students can use the Fullprof and Rietica programs for the interpretation of X-ray diffraction patterns	Assignment 2	Practice on how to install and use the free download programs Fullprof and Rietica to interpret X-ray diffraction patterns	Practice on how to install and use the free download programs Fullprof and Rietica to interpret X-ray diffraction patterns	How to install and use the free download programs Fullprof and Rietica to interpret X-ray diffraction patterns	10
8	Mid-Term Evaluation						30
9-10	Knowledgeable in the way to characterize inorganic materials with single crystal X-Ray			Lecture on the characterization of inorganic materials with single crystal X-Ray	Lecture on the characterization of inorganic materials with single crystal X-Ray	Characterization of inorganic materials with single crystal X-Ray	
11-13	Knowledgeable in the way to characterize inorganic materials with XANES and EXAFS	Students can understand the characterization of inorganic materials with XANES and EXAFS	Quiz	Lecture on the characterization of inorganic materials with XANES and EXAFS	Lecture on the characterization of inorganic materials with XANES and EXAFS	Characterization of inorganic materials with XANES and EXAFS	20
14-15	Knowledgeable in the way to characterize inorganic materials with XPS and Mössbauer			Lecture on the characterization of inorganic materials	Lecture on the characterization of inorganic materials with	Characterization of inorganic materials with XPS and Mössbauer	

				with XPS and Mösbouer	XPS and Mösbouer		
16	Final Evaluation						30

Subject Description		This subject teaches the applications of information technology and communication in biochemistry researches.					
The Topics Covered in The Subject		Basic computation and technology information, genomic analysis, proteomic analysis, phylogenetic trees, biochemistry websites, biochemistry data processing software.					
Reference							
		1. A.D. Baxevanis, B. F. F. Ouellette (Editors), “Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins”, edisi ketiga, John Wiley & Sons Inc., 2004. 2. S.A. Krawetz, D.D. Womble, “Introduction to Bioinformatics: A Theoretical and Practical Approach”, edisi pertama, Humana Press, 2003 3. Articles from related journals.					
		Support:					
Lecturer		Adi Setyo Purnomo, MSc, PhD; Prof. Dr. Drs. Surya Rosa Putra, MS					
Pre-requisite							
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Understand the basic computing concepts	Accuracy in understanding the history and importance of bioinformatics		Lecture 1x(3x50)	Lecture 1x(3x50)	Introduction and history of bioinformatics	5
2	Understanding the basic computing concepts	Accuracy in describing websites for biochemistry		Lecture 1x(3x50)	Lecture 1x(3x50)	Introduction to Computing to Biochemistry	

3	Mapping genomic and proteomic research	Accuracy in understanding genomic analysis.		Lecture 1x(3x50)	Lecture 1x(3x50)	Genomic analysis	
4-5	Mapping genomic and proteomic research	Accuracy in understanding proteomic analysis	Quis I	Lecture 2x(3x50)	Lecture 2x(3x50)	Proteomic analysis	20
6	Mapping genomic and proteomic research	Accuracy in understanding the phylogenetic tree.		Lecture 1x(3x50)	Lecture 1x(3x50)	Phylogenetic tree	
7	Mapping genomic and proteomic research	Accuracy in understanding sequences		Lecture 1x(3x50)	Lecture 1x(3x50)	Sequence	
8	Mid-Term Evaluation						25
9-10	Using software for genomic and proteomic research.	Accuracy in using the web about nucleotides	Presentasi	Lecture 2x(3x50)	Lecture 2x(3x50)	Web Nukleotida Nucleotide Web	10
11-13	Using general software for data processing and making presentation materials.	Accuracy in using software to process data and make presentations	Presentasi	Lecture 2x(3x50)	Lecture 2x(3x50)	Software pengolahan data biokimia Biochemical data processing software	10
14-15	Using websites for biochemistry	Accuracy in using the web related to biochemistry	Presentasi	Lecture 2x(3x50)	Lecture 2x(3x50)	Web Situs Biokimia Biochemistry Web Site	10

15-16	Final Evaluation	25
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DEPARTEMEN KIMIA

Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Course Disciplines		Credits		SEMESTER		Compilation date	
Quantum Chemistry		SK185141	Physical Chemistry (Mandatory)		3		I			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator		Head of Study Program			
		Prof. Dr. Syafsir Akhlus, M.Sc., Nurul Widiastuti, M.Si., Ph.D., Dr. Yuly Kusumawati, M.Si.			Dr. Hendro Juwono. M.Si.		Prof. Dr. Didik Prasetyoko. M,Sc.			
Learning Outcome	Learning Outcome Targeted From The Course									
	(LO 1)	Show moral, ethical, responsibility and good personality in completing their duties								
	(LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon								
	(LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation								
	Learning Outcome of The Course									
	CP MK 1	Able to understand the concepts of Quantum Chemistry to explain the structures of atoms and molecules.								
Peta LO – CP MK										
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
	CP MK 1	√					√			√
Subject Description										

The Topics Covered in The Subject		Quantum theory, classic wavelength equation, Schrodinger particle equation in a box, postulates and principles of quantum mechanics, harmonic oscillator and vibration spectroscopy, rigid rotor and rotation spectroscopy, hydrogen atoms, atoms with many electrons, chemical bonds: molecules with single and double electrons, chemical bonds qualitative theories, Hartree Fock Roothaan method.					
Reference							
		Support:					
Lecturer		Nurul Widiastuti, PhD; Dr. Yuly Kusumawati, S.Si., M.Si					
Pre-requisite							
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students can explain the concept of quantum theory Students can explain the concept of the classical wave equation	Accuracy in explaining the concepts of quantum theory and classical wave equations	Quiz	Lectures and exercises	Lectures and exercises	Quantum theory, Classical wave equation	2
2	Students can explain and solve the Schrodinger equation of particles in the box	Accuracy in describing and solving the Schrodinger equation of particles in a box	Quiz	Lectures and exercises	Lectures and exercises	The Schrodinger equation of particles in a box	3

3	Students can explain the postulates and principles of quantum mechanics	Accuracy in explaining the postulates and principles of quantum mechanics	Quiz	Lectures and exercises	Lectures and exercises	Postulates and principles of quantum mechanics	2
4-5	Students can explain and solve harmonic oscillator equations and vibration spectroscopy	Accuracy in describing and solves equations of harmonic oscillators and vibrational spectroscopy	Quiz	Lectures and exercises	Lectures and exercises	Harmonic oscillator and vibration spectroscopy	4
6-7	Students can explain and solve the equations of the rigid rotor and rotational spectroscopy	Accuracy in describing and solves the equations of the rigid rotor and rotational spectroscopy	Quiz	Lectures and exercises	Lectures and exercises	Rigid rotor and rotational spectroscopy	4
8	Mid-Term Evaluation						20
9	Students can explain and solve the hydrogen atom equation	Accuracy in describing and solving the equation for the hydrogen atom	Assignment	Lectures and exercises	Lectures and exercises	Hydrogen atom	3
10	Students can explain and solve many-electron atomic equations	Accuracy in explaining the concept and analyzing the	Assignment	Lectures and exercises	Lectures and exercises	Many-Electron atom	3

		characterization results by using secondary ion mass spectroscopy (Secondary Ion Mass Spectroscopy)					
11	Students can explain and solve molecular equations with one and two electrons	Accuracy in describing and solving the equations of one- and two-electron molecules	Assignment	Lectures and exercises	Lectures and exercises	Chemical bond: A molecule with one and two electrons	2
12-13	Students can explain various theories on chemical bonds and their consequences on molecular properties	Accuracy in explaining the various theories on chemical bonding and its consequences for molecular properties	Assignment	Lectures and exercises	Lectures and exercises	Qualitative theory of chemical bonds	3
14-15	Students can explain the Hartree Fock method in determining atomic and molecular structures Students can compute using the HF method in determining atomic and molecular structures	• Accuracy in explaining the Hartree Fock method in determining atomic and molecular structures • Accuracy in performing computations using the HF method in determining atomic	Assignment	Lectures and exercises	Lectures and exercises	the Hartree Fock roothaan method	4

		and molecular structures					
15-16	Final Evaluation						20



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
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DEPARTEMEN KIMIA

Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Course Disciplines			Credits				SEMESTER	Compilation date
Advanced Physical Organic Chemistry		SK185151	Organic Chemistry			3				I	
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator				Head of Study Program	
		Prof. Dr. R.Y. Perry Burhan, M.Sc., Dr. Yulfi Zetra, MS.				Prof. Mardi Santoso, Ph.D.				Prof. Dr. Didik Prasetyoko. M,Sc.	
Learning Outcome	Learning Outcome Targeted From The Course										
	(LO 1)	Show moral, ethical, responsibility and good personality in completing their duties									
	(LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or macromolecular level based on the dynamic and energetic phenomenon									
	(LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	Learning Outcome of The Course										
	CP MK 1	Students can predict the physical and chemical properties of organic compounds based on both intramolecular and intermolecular properties.									
Peta LO – CP MK											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		CP MK 1	√					√		√	
Subject Description											

The Topics Covered in The Subject		Intramolecular properties: bond localizations and delocalizations, carbocation, carbanion, radical, carbene, acid-base. Intermolecular properties: reaction mechanisms and their determination (thermodynamics and reaction kinetics), reaction types (addition, elimination, substitution, rearrangement).						
Reference								
		Support:						
Lecturer		Prof. Dr. R.Y. Perry Burhan, MS; Dr. Yulfi Zetra, MS						
Pre-requisite								
Week-	The final ability of each learning stage	Scoring		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)	
		Indicator	Criteria & Techniques					
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)	
1,3	Students can explain and apply knowledge about intramolecular properties in organic compounds in a case study	Accuracy in explaining and applying knowledge of intramolecular properties in organic compounds in a case study	Assignment I	• Introductory lectures and brain-storming • Lectures and discussions • Task I	• Introductory lectures and brain-storming • Lectures and discussions • Task I	• Bond localization and delocalization • Carbocation • Carbanion • Radical • Carbine • Acid-base	10	
4-7	Students can explain and apply knowledge about the	Accuracy in explaining and applying	Assignment 2	• Lectures,	• Lectures,	• The reaction mechanism	10	

	properties between molecules in organic compounds in a case study	knowledge of the intermolecular properties of organic compounds in a case study		group discussion	group discussion	of organic compounds - Determining the thermodynamic factors in an organic compound reaction - Determining the kinetics factors in an organic compound reaction	
8	Mid-Term Evaluation						20
9-10	Students can explain and apply knowledge about the properties between molecules in organic compounds in a case study	Accuracy in explaining and applying knowledge of the intermolecular properties of organic compounds in a case study	Assignment 3	Lectures, group discussions	Lectures, group discussions	- Reaction mechanism of organic compounds - Determining the thermodynamic factors in a reaction of organic compounds - Determining the kinetics factors in a reaction of	10

						organic compounds	
11-15	Students can explain and apply knowledge about the types of reactions inorganic compounds and their influencing factors	• Accuracy in explaining and applying knowledge about the types of reactions inorganic compounds and their influencing factors	Task 4 (paper and presentation)	• Lectures, group discussions, • Paper assignments and presentations	• Lectures, group discussions, • Paper assignments and presentations	• Addition reactions • Elimination reaction • Substitution reactions • Reordering reaction • Thermodynamic factors, in addition, elimination, substitution, and PU reactions • Kinetics factors, in addition, elimination, substitution, and PU reactions	25
15-16	Final Evaluation						25

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FAKULTAS SAINS DAN ANALITIKA DATA DEPARTEMEN KIMIA										Kode Dokumen
	RENCANA PEMBELAJARAN SEMESTER										
SUBJECT NAME	CODE		Course Disciplines			Credits		SEMESTER	Compilation date		
Pre-Thesis	SK185201		General			2		II			
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer					RMK Coordinator		Head of Study Program			
						Prof. Dr. Didik Prasetyoko. M,Sc.		Prof. Dr. Didik Prasetyoko. M,Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	(LO 1)	Show moral, ethical, responsibility and good personality in completing their duties									
	(LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles									
	(LO 5)	Able to show responsibility of their individual work by show the free plagiarism result									
	Learning Outcome of The Course										
	CP MK	Students can compile and present a thesis research proposal.									
Peta LO – CP MK											
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	
	CP MK 1	√		√		√					
Subject Description											
The Topics Covered in The Subject	1. Compiling a thesis research proposal. 2. Presenting a thesis proposal in a thesis defense.										

Reference		
	Support:	
Lecturer		
Pre-requisite	-	



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DEPARTEMEN KIMIA

CODE Dokumen

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster		Credits		SEMESTER		Compilation date		
PRE-THESIS		SK185201	Kimia Organik		2	0	II				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator		Head of Study Program				
							Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.				
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 3	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles									
	LO 5	Able to show responsibility of their individual or team work by show the free plagiarism result									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	Students are able to compile and present a thesis research proposal									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									
Subject Description											
The Topics Covered in The Subject		Preparation of thesis research proposals, presentation of proposals written in the proposal session									

References		Utama:					
		▪					
		Pendukung:					
Lecturer		Chemistry Master Program Lecturer Team					
Mata Kuliah syarat							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
				Kuliah <i>Small group discussion</i> [TM: 2×(2×50’)] [BM: 2×(2×50’)]	Responsi <i>Small group discussion</i> [TM: 2×(2×50’)] [BM: 2×(2×50’)] [PT: 1x(1x60’)]		



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DEPARTEMEN KIMIA

CODE Dokumen

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster		Credits		SEMESTER		Compilation date		
ELECTROANALYSIS		SK185211	Kimia Organik		2	0	II				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator			Head of Study Program			
								Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 7	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	LO 8	Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the accurate and innovative theoretical, experimental or computational approach									
	LO 9	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	Students are able to perform chemical analysis using electroanalysis method (P4)									
Peta CPL – CP MK											
		CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	
	CP MK 1										
Diskripsi Singkat MK											

The Topics Covered in The Subject		Electrode interface reaction, quantitative test using potentiostatic method, quantitative test using potentiodynamic method, material characterization using electrochemical impedance spectroscopy method, non-aqueous electrolysis					
References		Utama:					
		▪ Wang, J., “Analytical Electrochemistry”, 3rd edition, John Wiley & Sons, New Jersey, 2006.					
		Pendukung:					
		Bard, A.J. and Faulkner, R.L., “Electrochemical Methods: Fundamental and Applications”, John Willey and Sons, New York, 2001					
Lecturer		Suprpto, PhD; Dr.rer.nat. Fredy Kurniawan; MSi, Yatim Lailun nikmah, PhD					
Mata Kuliah syarat							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students are able to explain interfacial reactions that are affected by mass transfer and charge transfer			Lecture Face to face [TM: 2×(2×50’)] [BM: 2×(2×50’)]	Responsi <i>Small Group discussion</i> [TM: 2×(2×50’)] [BM: 2×(2×50’)] [PT: 1x(1x60’)]		
2-4	Students are able to apply the concept of potentiostatic analysis for quantitative testing			Face to face 3x(2x50)			

5-7	Students are able to apply potentiodynamic concepts for qualitative and quantitative tests	Individual and group assessment		Group discussion			20%
8	Mid Semester Evaluation						30%
9-10	Students are able to analyze the effect of electrode modification on sensitivity and selectivity of electrode			Face to face and Group discussion			
11-13	Students are able to design input-output models of potentiodynamic measurement methods for qualitative and quantitative tests in both aqueous and non-aqueous solvents.			Face to face, Group discussion and presentation			
14	Students are able to interpret the measurement results using the electrochemical impedance spectroscopy method			Presentation			20%
15-16	Final Semester Evaluation						30%



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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster			Credits		SEMESTER	Compilation date		
MICRO PROJECT		SK185212	Kimia Analitik			2	0	II			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program			
		Yatim Lailun Ni'mah, Ph. D						Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 4	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills at the national/international level through a research object									
	LO 7	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	LO 9	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	Students are able to design and conduct a laboratory experiment, analyse on the experiment being performed, and write an experiment report									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									
Subject Description											

The Topics Covered in The Subject		Design an experiment, review a journal, conducting an experiment, analyzing experiment results, writing an experiment report.					
References		Utama:					
		▪					
		Pendukung:					
Lecturer		Dr.rer.nat. Fredy Kurniawan, Msi					
Mata Kuliah syarat							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students are able to determine the topic of the experiment for the Master's research plan	The accuracy in determining experimental topics that support the Master's research plan		Kuliah Small Group discussion [TM: 2×(2×50')] [BM: 2×(2×50')] • Lecture & brainstorming, group discussion • Assignment: find a topic according to the Master's research plan	Responsi Small Group discussion [TM: 2×(2×50')] [BM: 2×(2×50')] [PT: 1x(1x60')]		10%

2	Students are able to make experimental designs	The accuracy of planning the experimental flow		• Lecture & brainstorming, group discussion • Assignment: find a topic according to the Master's research plan			10%
3-7	Students are able to conduct experiments in the laboratory	The accuracy of conducting an experiment according to a predetermined experimental flow		Practice in the laboratory			20%
8	Mid Semester Evaluation						10%
9	Students are able to analyze the experiments	The accuracy of analyzing the experiments		Practice in the laboratory			10%
10-13	Students are able to make improvements to the experiments	The accuracy of analyzing the experiments		Practice in the laboratory			10%
14	Students are able to present the experiments	The accuracy of presenting the experiments		Presentation			10%
15	Students are able to make reports of the experiments	The accuracy of making experiments' reports		• Lecture & brainstorming, group discussion			10%

				● Assignment: find a topic according to the master's research plan			
16	Final Semester Evaluation						30%



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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster		Credits		SEMESTER		Compilation date		
SEPARATION AND SPECIATION		SK185213	Kimia Analitik		2	0	II				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator			Head of Study Program			
		Suprpto, Ph. D						Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 6	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 7	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	- Students having the general idea on the concepts of chemical separation as a basis to analyse chemical specimens. - Students having the general idea on how to implement chemistry speciations that are related to assessing the environment and materials toxicit (P4).									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									
Diskripsi Singkat MK											

The Topics Covered in The Subject		1. The concepts and working principles of solvent extraction, column chromatography, gas chromatography, and high performance liquid chromatography. 2. Physicochemistry properties, toxicity, chemical specimen bioavailabilities and distributions in nature and in living beings. 3. Quantitative and qualitative analysis based on a chemical specimen of an element.					
References		Utama:		▪			
		Pendukung:					
Lecturer		Suprpto, PhD					
Pre-requisite							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students are able to explain the concept of chemical separation			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')]		
2-5	Students are able to classify separations based on phase differences, polarity, adsorption, and precipitation			Lecture			

6-7	Students are able to apply chemical separation techniques	Individual and group assessment		Group discussion			20%
8	Mid Semester Evaluation						30%
9	Students are able to understand the concept of species and chemical speciation			Lecture and group discussion			
10-14	Students are able to design separation applications in chemical speciation techniques			Lecture, group discussion, and presentation			20%
15-16	Final Semester Evaluation						30%



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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster		Credits		SEMESTER	Compilation date			
THERMAL ANALYSIS		SK185214	Kimia Analitik		2	0	II				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator		Head of Study Program				
		Yatim Lailun Ni'mah, Ph. D					Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.				
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 6	Able to develop the concept of structure, properties and substance changes at the micro or macro molecular level based on the dynamic and energetic phenomenon									
	LO 7	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	LO 8	Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the accurate and innovative theoretical, -experimental or -computational approach									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	- Students are able to review and solve problems, both qualitatively and quantitatively, in particular those that are related to thermal analysis, and also able to use thermal based instruments. - Students have the experience to plan thermal based analysis, and are able to express their ideas or suggestions orally or in written forms									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									

Diskripsi Singkat MK							
The Topics Covered in The Subject	Further applications of TG, DSC and DTA data include deconvolution of the superimposed endotherm, the kinetics of the decomposition of TG, TMA, DMA and their applications.						
References	Utama:						
	▪ R. Speyer, “Thermal Analysis of Materials”, Marcel Decker, Inc, 1994, New York.						
	Pendukung:						
	J. Wang, ”Electroanalytical Chemistry,” Wiley VCH, USA, 2000.						
Lecturer	Yatim Lailun Ni’mah, PhD; Dr.rer.nat. Fredy Kurniawan, MSi; Suprpto, PhD						
Pre-requisite							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1	Students understand the application of the Thermal Analysis course lesson plan for one semester			Lecture Small group discussion [TM: 2×(2×50’)] [BM: 2×(2×50’)] Tutorial, discussion	Responsi Small group discussion [TM: 2×(2×50’)] [BM: 2×(2×50’)] [PT: 1x(1x60’)]		
2	Students can explain TGA and its further applications			Tutorial, discussion		TGA and its further applications	10%

3	Students can explain DTA and its further applications			Tutorial, discussion		DTA and its further applications	10%
4	Students can explain DSC and its further applications			Tutorial, discussion		DSC and its further applications	10%
5, 6	Students can explain TMA and its further applications			Tutorial, Discussion		TMA and its further applications	10%
7	Students can explain DMA and its further applications			Tutorial, discussion		DMA and its further applications	10%
8	Mid Semester Evaluation						20%
9, 10	Students can explain deconvolution from endotherm superimposed			Lecture, discussion		Deconvolution from endotherm superimposed	
11, 12	Students can explain the kinetics of TGA decomposition			Lecture, discussion		TGA decomposition kinetics	
13, 14	Students can differentiate between applying TGA, DTA, DSC, TMA and DMA			Lecture, discussion		The differences between TGA, DTA, DSC, TMA and DMA and their applications	

15, 16	Final Semester Evaluation	30%
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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster			Credits		SEMESTER	Compilation date		
CHARACTERIZATIONS OF INORGANIC MATERIALS II		SK185221	Kimia Inorganik			3	0	II			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program			
		Prof. Dr. rer. nat. Irmina Kris muwarni						Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 2	Show a spirit of independence, team work, leadership and entrepreneurship									
	LO 7	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	LO 9	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	Students are able to use and develop the inorganic materials characterization methods in order to obtain a more in depth information, in particular those that involve thermal properties, morphology, surface, and porosity.									
Peta CPL – CP MK											
		CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	
	CP MK 1										
Diskripsi Singkat MK											

The Topics Covered in The Subject		- Thermal properties characterization and morphology analysis of the solids, where they are being conducted using TGA-DTA and SEM/TEM, N2 adsorption and desorption, and TPD. - Characterization using other spectroscopy methods (FT-IR, Raman UV-Visible, NMR, MS).					
References		Utama: - S.E. Dann, "Reactions and Characterization of Solids" RSC London, UK, 2000 - West, A.R., "Solid State Chemistry (bab III)", 1992, John Wiley & Sons K. Nakamoto, "Infrared and Raman Spectra of Inorganic and Coordination Compounds", Wiley-Interscience Publication G. Engelhardt, D. Michel, "High-Resolution Solid-State NMR of Silicates and Zeolites", 1987, John Wiley & Sons T. Allen, "Powder Sampling and Particle Size Determination", Elsevier, 2003 - Z.H. Gross, "Mass Spectrometry", Springer, 2004 J. Goldstein, D. Newbury, D. Joy, C. Lyman, P. Echlin, E. Lifshin, L. Sawyer, J. Michael, "Scanning Electron Microscopy and X-Ray Microanalysis", Springer, 2003 Pendukung:					
Lecturer		Prof. Dr. Didik Prasetyoko, MSc; Ratna Ediati, Ph.D					
Pre-requisite							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)

1	Knowing how to characterize the thermal properties and morphology of inorganic materials			Small group discussion [TM: 2×(2×50')] [BM: 2×(2×50')] Lecture on introduction of the characterization of thermal properties and morphology of inorganic materials with examples	Responsi Small group discussion [TM: 2×(2×50')] [BM: 2×(2×50')] [PT: 1x(1x60')]	Introduction to the characterization of thermal and morphological properties of inorganic materials	
2, 3	Understanding how to characterize the thermal properties of inorganic materials using DTA, TGA, DSC, DTG	Students can understand the characterization of thermal properties of inorganic materials using DTA, TGA, DSC, DTG		Lecture on the characterization of thermal properties of inorganic materials using DTA, TGA, DSC, DTG		Characterization of thermal properties of inorganic materials using DTA, TGA, DSC, DTG	10%
3, 4	Understanding the morphology of inorganic materials by SEM, TEM			Lecture on observation of the morphology of inorganic materials by SEM, TEM		Observation of the morphology of inorganic materials by SEM, TEM	
5-7	Understanding the surface properties and porosity of inorganic materials with the gas desorption adsorption method and TPD	Students can understand how to characterize the surface properties and porosity of inorganic materials using the gas desorption adsorption method and TPD		Lecture on how to characterize the surface properties and porosity of inorganic materials using gas desorption		Characterization of surface properties and porosity of inorganic materials using gas desorption adsorption and TPD methods	10%

				adsorption and TPD methods			
8	Mid Semester Evaluation						30%
9-11	Knowing how to characterize inorganic materials using UV-Vis, FT-IR, Raman			Lecture on the characterization of inorganic materials with UV-Vis, FT-IR, Raman		Characterization of inorganic materials using UV-Vis, FT-IR, Raman	
11-13	Knowing how to characterize inorganic materials by using NMR	Students are able to understand the characterization of inorganic materials with NMR, including solid NMR		Lecture on the characterization of inorganic materials by NMR, including solid NMR		Inorganic material characterization by NMR, including solid NMR	20%
14-15	Knowing how to characterize inorganic materials with MS			Lecture on the characterization of inorganic materials with MS		Characterization of inorganic materials by MS	
16	Final Semester Evaluation						30%



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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster	Credits		SEMESTER	Compilation date		
PROPERTIES AND PERFORMANCE OF MATERIALS		SK185222	Kimia Inorganik	2	0	II			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program			
		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.				Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course								
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties							
	LO 6	Able to develop the concept of structure, properties and substance changes at the micro or macro molecular level based on the dynamic and energetic phenomenon							
	LO 8	Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the accurate and innovative theoretical, experimental or computational approach							
	LO 9	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation							
	Learning Outcome Mata Kuliah (CPMK)								
	CP MK 1	- Students are able to determine the structures, physically, mechanically, or chemically, of a material, as well as determining the performance of a material whose properties are already recognized. - Students are able to link the structures, properties, and performance of a material based on the basic concepts of the structures and properties of kinetics-thermodynamics of molecules. - Students are able to express their ideas or suggestions both orally or in written forms.							
Peta CPL – CP MK									
	CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9

	CP MK 1									
Diskripsi Singkat MK										
The Topics Covered in The Subject	● Introduction to a variety of materials : ceramics, composites, plastics, steel. ● The structures of materials and conducting tests to see their resistance towards heat by thermal analysis (DTA/TGA/DSC), their physical and mechanical properties (BM, stress, strain, dll.), and their chemical properties (reactivities : chromatography, similar properties). ● The uses of materials according to their suitabilities, for example, composites are suitable to use as a body of a ship or airplane, ceramics are suitable to use as a cutting material to cut through hard objects, etc.									
References	Utama:									
	1. A.R. West, “Solid State Chemistry (bab IV)”, John Wiley & Sons, 1992 2. J.C. Bernier, “Chemical Processing for Electronic Ceramics: A Challenge, Material Science and Engineering”, A109, 233, 1989. 3. D.W. Richerson, “Modern Ceramic Engineering”, edisi kedua, Marcel Dekker, New York ▪									
	Pendukung:									
Lecturer	Dr. Fahimah Martak. MSi; Prof. Dr. Didik Prasetyoko, MSc									
Pre-requisite										
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)			
		Indicator	Criteria & Techniques							
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)			

1, 2	Knowing several types of materials			Kuliah <i>Small group discussion</i> [TM: 2×(2×50')] [BM: 2×(Lecture on introduction of several types of materials: ceramics, composites, plastics, steel)]	Responsi <i>Small group discussion</i> [TM: 2×(2×50')] [BM: 2×(2×50')] [PT: 1×(1×60')]	Introduction of several types of materials	
3, 4	Able to determine the structure and thermal properties of materials			Lecture on the structure of materials and their properties to heat through thermal analysis (DTA / TGA / DSC)		Thermal analysis (DTA / TGA / DSC)	
5	Able to determine the structure and physical properties of materials			Lecture on the correlation between the structure and physical properties of materials		Physical properties of the material	
6, 7	Able to determine the structure and mechanical properties of materials	Able to determine the correlation between the structure and mechanical properties of materials		Presentation and discussion on the correlation between structure and mechanical properties including BM, stress, strain etc.		Mechanical properties of the material	20%
8	Mid Semester Evaluation						30%

9, 10	Able to determine the structure and chemical properties of materials			Lecture on the relationship between the structure and chemical properties of materials including reactivity: chromatography, acidity properties		Chemical properties of the material	
11, 12	Able to relate the structure, properties and performance of materials based on the basic concepts of molecular structure and thermodynamic-kinetics properties			Lecture on the relations of structure, properties and performance of materials based on the basic concepts of structure and properties of molecular thermodynamics-kinetics		Structure, properties and performance of materials	
13, 14	Able to correlate the structure, properties and performance of materials based on the basic concepts of molecular structure and thermodynamic-kinetics properties	Able to correlate the structure, properties and performance of materials based on the basic concepts of structure and properties of molecular thermodynamics-kinetics		Presentation and discussion on the relations of structure, properties and performance of materials based on the basic concepts of structure and molecular thermodynamic-kinetics properties		Structure, properties and performance of materials	20%

15	Able to express perspectives or ideas verbally and in writing	Ability to compile a journal manuscript		Lecture and discussion on the structure, properties and performance of materials		Structure, properties and performance of materials	
16	Final Semester Evaluation						30



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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster			Credits		SEMESTER	Compilation date		
INORGANIC SOLIDS		SK185223	Kimia Inorganik			2	0	II			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer				RMK Coordinator		Head of Study Program			
		Prof. Fahimah Martak						Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 6	Able to develop the concept of structure, properties and substance changes at the micro or macro molecular level based on the dynamic and energetic phenomenon									
	LO 8	Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the accurate and innovative theoretical, experimental or computational approach									
	LO 9	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	- Students are able to determine the crystal structure, type, and lattice energy. - Students are able to determine the system of crystal and symmetrical solids.									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									
Diskripsi Singkat MK											

The Topics Covered in The Subject	• Types of crystal structures, cation: coordinated anion number, ionic radius, ion size trends, radius ratio, covalent arrangements, metal crystals, ionic crystals, interactions between atoms, atom radius, molecule structure, types of bonds, silicates, Born-haber cycle, lattice energy. • Seven crystal systems, index Miller, interplanar distance, fraction coordinates, ionic and covalent solids, simple solids crystal structures, polyhedral representations. • Close packing structures, hcp, fcc, density, tetrahedral and octahedral holes, body and primitive centered structures, crystal solids, lattice and cell units, 2-dimensional planar lattices. • Symmetry, proper rotation, mirror planes, inversion, improper axis, symmetrical translations						
References	Utama:						
	1. U. Müller, “Inorganic Structural Chemistry“, second edition, John Wiley and Sons, England, 2006						
	2. L.E. Smart, Moore, "Solid State Chemistry. An Introduction", fourth edition.						
	3. J.E. Huheey, “Inorganic Chemistry principles of Structure and Reactivity", fourth edition, Harper and Row Publisher, New York, 1993						
	Pendukung:						
Lecturer	Dr. Afifah Rosyidah, MSi.; Dr. Fahimah Martak MSi						
Pre-requisite							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)

				Kuliah <i>Small group discussion</i> [TM: 2×(2×50')] [BM: 2×(2×50')]	Responsi <i>Small group discussion</i> [TM: 2×(2×50')] [BM: 2×(2×50')] [PT: 1x(1x60')]		
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RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster	Credits		SEMESTER	Compilation date				
ADVANCED BIOCHEMISTRY		SK185231	Kimia Inorganik	3	0	II					
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program					
		Adi Setyo Purnomo, Ph. D				Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.					
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 1	Show moral, ethical, responsibility and good personality in completing their duties									
	LO 4	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills at the national/international level through a research object									
	LO 8	: Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the accurate and innovative theoretical, experimental or computational approach									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	Understand the in vitro synthesis of biomolecules with and without enzymes, biomolecular bios pathways, biomolecule structure and function, and several case studies									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									
Diskripsi Singkat MK											

The Topics Covered in The Subject		Biomolecule biosynthesis pathways, biomolecule structures and functions, gene structures and functions.					
References		Utama:					
		Pendukung:					
Lecturer		Adi Setyo Purnomo, MSc, PhD; Prof. Dr. Drs. Surya Rosa Putra, MS					
Pre-requisite							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1-4	Determine the biosynthetic pathway of biomolecules	Accuracy in explaining biomolecular biosynthetic pathways		Kuliah <i>Small group discussion</i> [TM: 2×(2×50’)] [BM: 2×(2×50’)]	Responsi <i>Small group discussion</i> [TM: 2×(2×50’)] [BM: 2×(2×50’)] [PT: 1x(1x60’)]	Biomolecular biosynthetic pathways	20%
5-7	Determine the in vitro synthesis of biomolecules with and without enzymes.	Accuracy in explaining the in vitro synthesis of biomolecules with and without enzymes.		Lecture		Gene structure and function	
8	Mid Semester Evaluation						25%

9-11	Knowing the structure and function of biomolecules.	Accuracy in explaining the structure and function of biomolecules		Lecture		Structure and function of biomolecules.	20%
12-15	Understand multiple case studies	Accuracy in understanding several case studies		Presentation		Related Journal Presentations	10%
16	Final Semester Evaluation						25%



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FAKULTAS SAINS DAN ANALITIKA DATA
DEPARTEMEN KIMIA

CODE Dokumen

RENCANA PEMBELAJARAN SEMESTER

SUBJECT NAME		CODE	Subject Cluster		Credits		SEMESTER		Compilation date		
MICROORGANISM METABOLISMS		SK185232	Kimia Organik		30		II				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer			RMK Coordinator			Head of Study Program			
		Adi Setyo Purnomo, Ph. D						Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcome	Learning Outcome Targeted From The Course										
	LO 6	Able to develop the concept of structure, properties and substance changes at the micro or macro molecular level based on the dynamic and energetic phenomenon									
	Learning Outcome Mata Kuliah (CPMK)										
	CP MK 1	Understanding the types of beneficial microorganisms, developing the function of microorganisms in the metabolic pathways of biomolecules, knowing the metabolic pathways of biomolecules by microorganisms, utilizing microorganisms in biochemical processes, several case studies									
Peta CPL – CP MK											
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9
		CP MK 1									
Diskripsi Singkat MK											

The Topics Covered in The Subject		Biotechnology, tissue culture, nucleic acids, plasmids, genetic engineering, bioplastics, biopigments					
References		Utama:					
		▪					
		Pendukung:					
Lecturer		Adi Setyo Purnomo, MSc, PhD; Prof. Dr. Drs. Surya Rosa Putra, MS					
Pre-requisite							
Week-	The final ability of each learning stage	Penilaian		Learning Forms; Learning methods; Student Assignment; [Estimated time]		Learning materials [References]	Score Rating (%)
		Indicator	Criteria & Techniques				
(1)	(2)	(3)	(4)	Tatap Muka (5)	Daring (6)	(7)	(8)
1, 2	Knowing the metabolic pathways of biomolecules by microorganisms	The accuracy in explaining the metabolic pathways of biomolecules by microorganisms		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')]	Biotechnology	
3, 4	Knowing the types of microorganisms that are useful	Accuracy in explaining tissue culture		Lecture		Plant tissue isolation method	15%
5, 6	Knowing the types of beneficial microorganisms	Accuracy in describing nucleic acids and plasmids		Lecture		Nucleic Acids and Plasmids	

7	Developing the function of microorganisms in the metabolic pathways of biomolecules	Accuracy in explaining genetic engineering		Lecture		Genetic Manipulation	
8	Mid Semester Evaluation						25%
9, 10	Applying microorganisms in biochemical processes.	Accuracy in explaining the application of microorganisms in bioplastics.		Lecture		Bioplastics	
11-13	Applying microorganisms in biochemical processes.	Accuracy in explaining the application of microorganisms in biopigments		Lecture		Biopigment	15%
14, 15	Understand multiple case studies.	Accuracy in understanding several case studies		Presentation		Case Studies	10%
16	Final Semester Evaluation						25%



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DEPARTMENT OF CHEMISTRY

**Kode
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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
STATISTICAL THERMODYNAMICS		SK 185242	Physical Chemistry	3	0	II	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Dr. Hendro Juwono M.Si., Drs. Lukman Atmaja M.Si., Ph.D		Dr. Hendro Juwono M.Si.		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	A.5 (LO 2)	Show a spirit of independence and team work in completing their duties									
	C.1 (LO 6)	Able to develop the concept of structure, properties, and substance changes at the micro- or macromolecular level based on the dynamic and energetic phenomenon									
	C.4 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine, and medical, in order to develop the research, industry and employment creation									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Students are able to employ the basic concepts of atom structures and molecules to predict the properties 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 Short Description											

Study Material: Subject matter		Discussion review, molecules with many atoms/polyatomic, molecular condition distribution, internal energy and entropy, canonical partition function, thermodynamic function, molecular partition function, free energy average, heat capacity, state function, liquid phase molecular interaction, residual entropy, and equilibrium constant					
Reference		Main:					
		1. P. W. Atkins and J. de Paula, “Physical Chemistry”, 9th edition, W.H. Freeman & Co, New York, 2009.					
		Supporting:					
		1. D. A. McQuarrie, “Quantum Chemistry”, 2nd edition, University Science Books, California, 2007.					
Supporting Lecturer		Dr. Hendro Juwono M.Si., Drs. Lukman Atmaja M.Si., Ph.D					
Pre-Requisite 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	Students are able to understand and employ the partition function in molecules with many atoms/polyatomic	• The accuracy, The order/ logic, The calculations in solving chemical problems related to the partition function of molecules with many atoms/ polyatomic	Technical : Quiz Criteria :	Lecture and exercise 2x(2x50’’)		• partition function in molecules with many atoms/polyatomic	5

2	Students are able to understand and employ the internal energy function in homo/heteronuclear molecules	The accuracy, The order/ logic, The calculations in solving chemical problems related to the application of internal energy function in homo/heteronuclear molecules	Technical : Assignment Criteria :	Lecture and exercise 2x(2x50")		Internal energy function in homo/heteronuclear molecules	5
3	Students are able to understand and employ the entropy concept in homo/heteronuclear molecules	The accuracy, The order/ logic, The calculations in solving chemical problems related to the entropy concept in homo/heteronuclear molecules	Technical : Assignment Criteria :	Lecture and exercise 2x(2x50")		The entropy concept in homo/heteronuclear molecules	5
4	Students are able to understand and employ the entropy concept in homo/heteronuclear molecules	The accuracy, The order/ logic, The calculations in solving chemical problems related to the spectra of complex atom	Technical : Quiz Criteria :	Lecture and exercise 2x(2x50")		The entropy concept in homo/heteronuclear molecules	10
5	Students are able to understand the magnitude of the canonical ensemble	The accuracy, The order/ logic, The calculations in solving chemical problems	Technical : Assignment Criteria :	Lecture and exercise 2x(2x50")		the magnitude of the canonical ensemble	5

		related to the magnitude of the canonical ensemble					
6	Students are able to understand and employ the theory of the partition function and its thermodynamics	The accuracy, The order/ logic, The calculations in solving chemical problems related to the theory of the partition function and its thermodynamics	Technical : Criteria :	Lecture and exercise 2x(2x50")		the theory of the partition function and its thermodynamics	10
7	Students are able to understand and employ the theory of the partition function with its thermodynamics to independent molecules	The accuracy, The order/ logic, the calculations in solving chemical problems related to the theory of the partition function with its thermodynamics to independent molecules	Technical : Assignment Criteria :	Lecture and exercise 2x(2x50")		the theory of the partition function with its thermodynamics to independent molecules	5
8	Mid-term evaluation						25
9-10	Students are able to understand and apply the thermodynamic function of molecular properties	The accuracy, the order/ logic, the calculations in solving chemical problems related to the theory and the application of the	Technical : Assignment Criteria :	Lecture and exercise 4x(2x50")		the thermodynamic function of molecular properties	10

		thermodynamic function of molecular properties					
11	Students are able to understand and apply the thermodynamic function and the partition function of molecules	The accuracy, the order/ logic, the calculations in solving chemical problems related to the application of the thermodynamic function and the partition function of molecules	Technical : Assignment Criteria :	Lecture and exercise 2x(2x50")		the thermodynamic function and the partition function of molecules	10
12-13	Students are able to understand and apply the concepts of the partition function and thermodynamics to heat capacity, average energy, and molecular state equations	The accuracy, the order/ logic, the calculations in solving chemical problems related to the partition function and thermodynamics to heat capacity, average energy, and molecular state equations	Technical : Quiz Criteria :	Lecture and exercise 4x(2x50")		the partition function and thermodynamics to heat capacity, average energy, and molecular state equations	15
14	Students are able to understand and apply the concepts of the molecular interactions in liquid phase,	The accuracy, the order/ logic, the calculations in solving chemical problems related to the	Technical : Quiz and Assignment Criteria :	Lecture and exercise 2x(2x50")		the molecular interactions in liquid phase, residual entropic, and	5

	residual entropic, and equilibrium constant.	molecular interactions in liquid phase, residual entropic, and equilibrium constant.				equilibrium constant.	
15-16	End-term evaluation						7.5



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**Kode
Dokumen**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
MOLECULAR COMPUTATIONAL CHEMISTRY		SK 185243	Physical Chemistry	3	0	II	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Dr. Hendro Juwono M.Si., Drs. Lukman Atmaja M.Si., Ph.D, Dr. Yuly Kusumawati S.Si, M.Si.		Dr. Hendro Juwono M.Si.		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	A.2 (LO 1)	Show moral, ethical, responsibility and good personality in completing their duties									
	A.5 (LO 2)	Show a spirit of independence and team work in completing their duties									
	C.3 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	C.4 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Familiarizing the use of software to predict the physical and chemical properties and able to make decisions amongst the different properties obtained									
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		1. Types of molecular computation methods: Ab-initio, HF, DFT, QM/MM 2. Mechanical molecules.					
Reference		Main:					
		1. P. W. Atkins and J. de Paula, “Physical Chemistry”, 9th edition, W.H. Freeman & Co, New York, 2009.					
		Supporting:					
		1. D. A. McQuarrie, “Quantum Chemistry”, 2nd edition, University Science Books, California, 2007.					
Supporting Lecturer		Dr. Hendro Juwono M.Si., Drs. Lukman Atmaja M.Si., Ph.D, Dr. Yuly Kusumawati S.Si, M.Si.					
Pre-Requisite 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	Students are able to explain numerical methods as the basis of calculations in computational chemistry calculations	• The accuracy in analogizing the understanding of numerical methods for solving computational chemistry calculations	Technical : Quiz Criteria :	Lecture and exercise 2x(2x50’’)		• Reviewing about numerical method for computational chemistry	3

2	Students are able to explain kinds of methods/approaches in computational chemistry calculations	The accuracy in explaining methods/approaches in computational chemistry calculations	Technical : Quiz Criteria :	Lecture and exercise 2x(2x50")		Computational method solving approach: ab-initio, DFT, QM/MM	3
3-4	Students are able to explain the concept of molecular mechanics Students are able to calculate and analyze the calculated result using the concept of molecular mechanics	The accuracy of completing calculations and explaining the results of calculations using the concept of molecular mechanics	Technical : Quiz and practical assignment Criteria :	Lecture, assignment, practice 4x(2x50")		Molecular mechanics, force fields	3
5	Students are able to explain the concept of the Monte Carlo simulation Students are able to calculate and analyze the calculated result using the Monte Carlo simulation	The accuracy in describing molecule and its solid structure using Chems sketch and Avogadro	Technical : Practice/ assignment Criteria :	Lecture and practice 2x(2x50")		Monte Carlo simulation	3
6-7	Students are able to explain the concept of molecular dynamics simulation Students are able to calculate and analyze the calculated result using the concept of molecular dynamics simulation	The accuracy in calculating and analyzing the results of calculations using the concept of molecular dynamics simulation	Technical : Practice/ assignment Criteria :	Lecture and exercise 4x(2x50")		Molecular dynamics simulation	3

8	Mid-term evaluation						20
9	Students are able to explain the application of quantum chemistry concepts in computational chemistry calculations	The accuracy in explaining the application of quantum chemistry concepts in computational chemistry calculations	Technical : Assignment/ practice Criteria :	Lecture, exercise, practice 2x(2x50")		Quantum Mechanics for Computational Chemistry	3
10	Students are able to calculate and analyze the results of geometric optimization and frequency calculations using the concept of quantum mechanics	The accuracy in calculating and analyzing the results of geometric optimization and frequency calculations using the concept of quantum mechanics	Technical : Assignment/ practice Criteria :	Lecture, exercise, practice 2x(2x50")		Quantum mechanical calculations I: Geometrical optimization and frequency calculation	3
11-12	Students are able to calculate and analyze the results of the electronical property calculations using the concept of quantum mechanics	The accuracy in calculating and analyzing the results of the electronical property calculations using the concept of quantum mechanics	Technical : Assignment/ practice Criteria :	Lecture, exercise, practice 4x(2x50")		Quantum mechanical calculations II: The electronical properties	3
13-15	Students are able to calculate and analyze the calculated results of transition state to determine the reaction	The accuracy in calculating and analyzing the calculated results of transition state to determine the	Technical : Assignment/ practice Criteria :	Lecture, exercise, practice 6x(2x50")		Quantum mechanical calculations II: The transition state	3

	mechanism using the concept of quantum mechanics	reaction mechanism using the concept of quantum mechanics					
15-16	End-term evaluation						20



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
ADVANCED ORGANIC SYNTHESIS		SK 185251	Organic Chemistry	3	0	II	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Prof. Dr. Mardi Santoso, Arif Fadlan D.Sc		Prof. Dr. Mardi Santoso		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	A.5 (LO 2)	Show a spirit of independence and team work in completing their duties									
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	C.3 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Students are able to think critically on the organic chemical reactions and synthesis strategies, as well as carrying out synthesis for the researched organic compounds.									
	CP MK 2	Students are able to express their ideas or suggestions orally or in written forms.									
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		√								
Course Short Description											

Study Material: Subject matter		Reviewing in detail the reactions that occur in organic chemicals and using the correct synthesis strategy, study case in synthesis the researched chemical compounds.					
Reference		Main:					
		Supporting:					
Supporting Lecturer		Prof. Dr. Mardi Santoso, Arif Fadlan D.Sc					
Pre-Requisite 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 explain and demonstrate the process of organic compound reactions and the disconnection of organic compound	• The accuracy in explaining and demonstrating the process of organic compound reactions and the disconnection of organic compound	Technical : Assignment I Criteria :	Introduction lecture and brainstorming (3x50") Lecture and discussion 2x(3x50") Assignment I [BT+BM:(1+1)x(3x60")		• Reactions in organic compounds • Disconnections in organic compounds	10

4-7	Students are able to explain and demonstrate the strategy of organic synthesis	The accuracy in explaining and demonstrating the strategy of organic synthesis	Technical : Assignment II Criteria :	Lecture and group discussion 4x(3x50")		the strategy of organic synthesis (from synthons to the targeted molecules)	15
8	Mid-term evaluation						25
9-15	Students are able to explain, demonstrate, and apply knowledge of organic compound synthesis strategies to produce the desired target compounds in a case study	The accuracy in explaining, demonstrating, and applying knowledge of organic compound synthesis strategies to produce the desired target compounds in a case study	Technical : Assignment III (paper work and presentation) Criteria :	Lecture and study group 7x(3x50")		Study cases about the targeted compounds	25
15-16	End-term evaluation						25



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
NATURAL PRODUCT ORGANIC CHEMISTRY		SK 185251	Organic Chemistry	3	0	II	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Prof. Dr. Taslim Ersam, M.S., Sri Fatmawati, M.Sc, Ph.D.		Prof. Dr. Mardi Santoso		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	B.1 (LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles									
	C.3 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	C.4 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Students are able to develop the ideas and activities critically through plant chemosystematics approach in planning a sustainable research and then deciding a plant from a biological variety of tropical rainforest.									
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		The chemical backgrounds of plants through chemosystematics approach and taxonomy; metabolism variations and phylogenetics diagram correlation; biogenesis pathway in forming secondary metabolite compounds; grouping secondary metabolite compounds (alkaloids, terpenoids, flavonoids, and steroids); chemical compound separation techniques through extraction, fractionation; bioactivity tests and determining structures.					
Reference		Main:					
		Supporting:					
Supporting Lecturer		Prof. Dr. Taslim Ersam, M.S., Sri Fatmawati, M.Sc, Ph.D.					
Pre-Requisite 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)
1-2	Students are able to explain the chemical background of plants	• The accuracy in explaining the chemical background of plants	Technical : Criteria :	Introduction lecture and brainstorming (3x50") Lecture and discussion (3x50")		• The chemical background of plants by chemosystematics approach • The chemical background of plants by taxonomy approach	

3-4	Students are able to explain the variation in plant metabolism and its relationship with phylogenetic diagram	The accuracy in explaining the variation in plant metabolism and its relationship with phylogenetic diagram	Technical : Assignment I Criteria :	Lecture and group discussion 2x(3x50") Assignment I [BT+BM:(1+1)x(3x60")]		- Variation in plant metabolism - Phylogenetic diagram	10
5-6	Students are able to explain the biogenesis pathway for the formation of secondary metabolite compounds	The accuracy in explaining the biogenesis pathway for the formation of secondary metabolite compounds	Technical : Assignment II Criteria :	Lecture and group discussion 2x(3x50") Assignment II BT+BM:(1+1)x(2x60")		Biogenesis pathway for the formation of secondary metabolite compounds	10
7	Students are able to explain and classify secondary metabolite compounds, namely derivatives of alkaloids, terpenoids, flavonoids and steroids.	The accuracy in explaining and classifying secondary metabolite compounds, namely derivatives of alkaloids, terpenoids, flavonoids and steroids.	Technical : Criteria :	Lecture and group discussion (3x50")		Kinds of secondary metabolites (derivatives of alkaloids, terpenoids, flavonoids and steroids)	
8	Mid-term evaluation						25
9-10	Students are able to explain and classify secondary metabolite compounds, namely derivatives of alkaloids, terpenoids, flavonoids and steroids.	The accuracy in explaining and classifying secondary metabolite compounds, namely derivatives of alkaloids,	Technical : Assignment III Criteria :	Lecture and study group 2x(3x50") Assignment III BT+BM:(1+1)x(3x60")		Kinds of secondary metabolites (derivatives of alkaloids, terpenoids, flavonoids and steroids)	15

		terpenoids, flavonoids and steroids.					
11-14	Students are able to explain and perform separation techniques (by extraction, fractionation, purification), bioactivity assays, and structure elucidation.	The accuracy in explaining and performing separation techniques (by extraction, fractionation, purification), bioactivity assays, and structure elucidation.	Technical : Assignment IV Criteria :	Lecture and study group (3x50") Assignment IV BT+BM:(1+1)x(1x60") Laboratory works (4x160")		• Separation techniques (extraction, fractionation, purification) • Bioactivity assay • Structure elucidation	20
15-16	End-term evaluation						20



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SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
ORGANIC GEOCHEMISTRY		SK 185253	Organic Chemistry	3	0	II	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Prof. Dr. R.Y. Perry Burhan, M.Sc., Dr. Yulfi Zetra, M.S.		Prof. Dr. Mardi Santoso		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	B.2 (LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem									
	C.1 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or macromolecular level based on the dynamic and energetic phenomenon									
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	C.4 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Students are able to evaluate molecules for new sediments, old sediments, and how natural oil is produced.									
	CP MK 2	Students are able to understand how organic materials inside the Earth is being produced, biogenic chemical compositions, organic materials deposition system, how humate compounds are formed, coal and kerogen, natural gas composition and how it is formed, molecular evaluation for new sediments, the roles of molecules for old sediments and in forming crude oil.									
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				√			√		√

Course Short Description							
Study Material: Subject matter		Organic materials production inside the Earth, biogenic chemical composition, organic materials deposition system, the production of humate compounds, kerogen, and coal; natural gas composition and how it is formed, molecular evaluation for new sediments, the roles of molecules on old sediments and the production of crude oil.					
Reference		Main:					
		Supporting:					
Supporting Lecturer		Prof. Dr. R.Y. Perry Burhan, MS; Dr. Yulfi Zetra, MS					
Pre-Requisite 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)

1-2	Students are able to explain the production process of organic compounds in the Earth	The accuracy in explaining the chemical background of plants	Technical : Criteria :	Lecture and discussion 2x(3x50") Lecture and discussion (3x50")		The production process of organic matters	
3-4	Students are able to explain the biogenic composition of organic matters in the Earth	The accuracy in explaining the biogenic composition of organic matters in the Earth	Technical : Assignment I Criteria :	Lecture and group discussion 2x(3x50") Assignment I [BT+BM:(1+1)x(2x60")]		the biogenic composition of organic matters in the Earth	15
5-6	Students are able to explain the organic material deposition system	The accuracy in explaining the organic material deposition system	Technical : Criteria :	Lecture and group discussion 2x(3x50")		the organic material deposition system	
7	Students are able to explain the formation process of humic compounds, coal and kerogen	The accuracy in explaining the formation process of humic	Technical : Criteria :	Lecture and group discussion (3x50")		The formation process of humic compounds, coal and kerogen	

		compounds, coal and kerogen					
8	Mid-term evaluation						25
9	Students are able to explain the formation process of humic compounds, coal and kerogen	The accuracy in explaining the formation process of humic compounds, coal and kerogen	Technical : Criteria :	Lecture and group discussion (3x50")		The formation process of humic compounds, coal and kerogen	
10-11	Students are able to explain the formation process and chemical compositions of crude oil	The accuracy in explaining the formation process and chemical compositions of crude oil	Technical : Assignment 2 Criteria :	Lecture and group discussion 2x(3x50") Assignment 2 BT+BM:(1+1)x(2x60")		The formation process and chemical compositions of crude oil	15
12-13	Students are able to explain the process and results of molecular evaluation for new sediments	The accuracy in explaining the process and results of molecular evaluation for new sediments	Technical : Assignment 3 Criteria :	Lecture and group discussion 2x(3x50") Assignment 2 BT+BM:(1+1)x(1x60")		The molecular evaluation for new sediments	20
14-15	Students are able to explain the molecular role of old sediments and the formation of crude oil.	The accuracy in explaining the molecular role of old sediments and the formation of crude oil.	Technical : Criteria :	Lecture and group discussion 2x(3x50")		The molecular role of old sediments and the formation of crude oil.	
15-16	End-term evaluation						25

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCES AND ANALYTICAL DATA DEPARTMENT OF CHEMISTRY										Kode Dokumen
SEMESTER LEARNING PLAN											
COURSE (MK)	CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data					
BIOANALYTICS	SK 185311	Analytical Chemistry	2	0	III	07 Januari 2020					
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)						
	Dr. Yatim Lailun Ni'mah, M.Si.		Suprpto, M.Si., Ph.D.		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.						
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	A.2 (LO 1)	Show moral, ethical, responsibility and good personality in completing their duties									
	C.1 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or macromolecular level based on the dynamic and energetic phenomenon									
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Students are able to explain the analysis techniques for biological materials and combining it with classical and/or instrumental 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											

Study Material: Subject matter		Cholesterol, carbohydrate, and protein tests classically and instrumentally based on the standard methods: AOAC and ASTM.					
Reference		Main:					
		1. A. Manz, N. Pamme, D. Iossifidis, "Bioanalytical Chemistry", Mainland Press, Singapore, 2004 2. ASTM 3. AOAC					
		Supporting:					
Supporting Lecturer		Yatim Lailun Ni'mah, PhD					
Pre-Requisite 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	Students are able to explain the basic concepts of sampling, sample preparation and analysis of biological materials		Technical : Criteria :	Lecture			

2-7	Students are able to explain the analysis techniques of biological materials: protein, carbohydrates, fatty acids, and vitamins using classical techniques		Technical : Criteria :	Lecture, group discussion, and presentation			10
8	Mid-term evaluation						25
9-13	Students are able to explain the analysis techniques of biological materials: protein, carbohydrates, fatty acids, and vitamins using instrumental techniques		Technical : Criteria :	Lecture, group discussion, and presentation			10
14	Students are able to describe the history, the initial research and the main reference and leading edge research in the field of bioanalytic.		Technical : Criteria :	Presentation			20
15-16	End-term evaluation						30



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Kode Dokumen

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data			
ELECTROCHEMISTRY SENSORS		SK 185312	Analytical Chemistry	3	0	III	07 Januari 2020			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)				
		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.		Suprpto, M.Si., Ph.D.		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.				
Learning Outcomes (LO)	LO-PRODI Charged to The Course									
	A.2 (LO 1)	Show moral, ethical, responsibility and good personality in completing their duties								
	C.1 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or macromolecular level based on the dynamic and energetic phenomenon								
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry								
	Course Learning Outcomes (LO MK)									
	CP MK 1	The students are able to apply the knowledge of fabrication system and data acquisition based on the tests using Electrochemistry Sensors (P4).								
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		The basic concepts of electrochemistry sensors, classifying Electrochemistry Sensors based on the examined parameters, the general ways of fabricating electrochemical sensors, active materials and modifying electrochemical sensors, applications of electrochemical sensors.					
Reference		Main:					
		1. T.C. Pearce, S.S. Schiffman, H. T. Nagle, J.W. Gardner (editors), "Handbook of Machine Olfaction", Wiley VH, Weinheim, 2003. 2. Y. Fraden, "Handbook of Modern Sensor", Springer Verlag, New York, 2010.					
		Supporting:					
		1. Wang, J., "Electroanalytical Chemistry", Wiley VCH, USA, 2000.					
Supporting Lecturer		Dr.rer.nat. Fredy Kurniawan, M.Si					
Pre-Requisite 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	Students are able to explain the basic concepts of electrochemical sensors		Technical : Criteria :	Lecture			

2-4	Students are able to classify electrochemical sensors based on the parameters tested		Technical : Criteria :	Lecture			10
2-4	Students are able to classify electrochemical sensors based on the parameters tested		Technical : Criteria :	Lecture			10
5-7	Students are able to apply general techniques of electrochemical sensor fabrication	Individual and Group Assessments	Technical : Criteria :	Group discussion			20
8	Mid-term evaluation						30
9-10	Students are able to design active ingredients and modify electrochemical sensor		Technical : Criteria :	Lecture and group discussion			
11-14	Students are able to design electrochemical sensor applications in the fields of food, health and the environment		Technical : Criteria :	Lecture, group discussion, presentation			20
15-16	End-term evaluation						30



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DEPARTMENT OF CHEMISTRY

**Kode
Dokumen**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
BIOSYNTHESIS		SK 185331	Biochemistry	3	0	III	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Adi Setyo Purnomo, M.Sc., Ph.D., Prof. Dr. Drs. Surya Rosa Putra, MS		Adi Setyo Purnomo, M.Sc., Ph.D.		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	C.1 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or macromolecular level based on the dynamic and energetic phenomenon									
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	C.3 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	Course Learning Outcomes (LO MK)										
	CP MK 1	The students are able to understand the biosynthetic and biotransformation pathways of biomolecules, as well as several case studies									
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		Bioorganic biosynthesis pathways, biomolecule biotransformation, primary and secondary metabolism pathways, biosynthesis techniques.					
Reference		Main: 1. Herbert, R.B., "The Biosynthesis of Secondary Metabolites", Springer, 1989. 2. Richard J. Petroski, Susan P. McCormick, "Secondary-Metabolite Biosynthesis and Metabolism", Springer, 1992.					
		Supporting: 3.					
Supporting Lecturer		Adi Setyo Purnomo, MSc, PhD; Prof. Dr. Drs. Surya Rosa Putra, MS					
Pre-Requisite 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)

1-2	Students are able to understand the biosynthesis pathways of biomolecules	The accuracy in explaining the metabolic pathways of biomolecules by microorganisms	Technical : Criteria :	Lecture 2x(3x50")		The primary metabolic pathways	
3-4	Students are able to understand the biosynthesis pathways of biomolecules	The accuracy in explaining tissue cultures	Technical : Quiz 1 Criteria :	Lecture 2x(3x50")		The secondary metabolic pathways	15
5-7	Students are able to understand the biosynthesis pathways of biomolecules	The accuracy in explaining nucleic acids and plasmids	Technical : Criteria :	Lecture 3x(3x50")		Biosynthetic techniques	
8	Mid-term evaluation						25
9-10	Students are able to understand the biotransformation pathways of biomolecules	The accuracy in explaining the application of microorganism in bioplastics	Technical : Criteria :	Lecture 2x(3x50")		The biosynthetic pathways of poly ketone	
11-12	Students are able to understand the biotransformation pathways of biomolecules	The accuracy in explaining the application	Technical : Quiz 2 Criteria :	Lecture 2x(3x50")		The biosynthetic pathways of terpenes and steroids	15

		of microorganism in biopigment					
13-14	Students are able to understand the biotransformation pathways of biomolecules		Technical : Criteria :	Lecture 2x(3x50")		The biosynthetic pathways of alkaloids	
15	Students are able to understand some case studies	• The accuracy in understanding some case studies	Technical : Presentation Criteria :	Presentation 1x(3x50")		Case studies	10
15	End-term evaluation						25



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Dokumen**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data				
STRUCTURE DETERMINATION OF ORGANIC COMPOUNDS		SK 185351	Organic Chemistry	3	0	III	07 Januari 2020				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)					
		Prof. Dr. Taslim Ersam, M.S.		Prof. Dr. Mardi Santoso		Prof.Dr. Didik Prasetyoko S.Si., M.Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	A.5 (LO 2)	Show a spirit of independence and team work in completing their duties									
	B.2 (LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communication skills in solving a chemistry-related problem									
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	C.3 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach									
	Course Learning Outcomes (LO MK)										
	CP MK 1	Students are able to develop their way of thinking critically and dynamically in producing alternative solutions to real life problems based on their experience of combining the spectra data when determining compound structures.									
	CP MK 2	Students have the knowledge on deciding the signal characteristics contained in a spectrum in order to identify the basic framework and particular functional groups, which in the end they combine both to construct a compound structure.									
	CP MK 3	Students are able to make a decision by taking advantage of the data analysis used and use the decision made in everyday life.									
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										
Study Material: Subject matter	The basic theory of spectroscopy (review) HS, HMBC, HMQC, COSY, DEPT. Study case using secondary data from the journal and its analysis. Determining a structure by combining the spectrum data obtained from different researches on xanthone and flavonoid. Presenting the analysis in front of the class at the end of the course in a group.									
Reference	Main:									
	1.									
	Supporting:									
	2.									
Supporting Lecturer	Prof. Dr. Taslim Ersam, MS.									
Pre-Requisite 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)			

1-4	Students are able to explain the basic theory of spectroscopy (review) which includes MS, HMBC, HMQC, COSY, DEPT and the use of coupling constants (<i>J</i>)	The accuracy in explaining the basic theory of spectroscopy (review) which includes MS, HMBC, HMQC, COSY, DEPT and the use of coupling constants (<i>J</i>)	Technical : Assignment 1 Criteria :	Lecture and discussion [TM: 4x(3x50'')] Assignment 1 [BT+BM:(1+1)x(4x60'')]		- The basic theory of MS - The basic theory of HMBC - The basic theory of HMQC - The basic theory of COSY, DEPT and the use of coupling constants (<i>J</i>)	10
5-7	Students are able to solve the problem of determining the structure of organic compounds using secondary data from journals	The accuracy in solving the problem of determining the structure of organic compounds using secondary data from journals	Technical : Assignment 2 Criteria :	Lecture and discussion [TM: 3x(3x50'')] Assignment 2 [BT+BM:(1+1)x(3x60'')]		Journals about determining the structures of organic compounds	15
8	Mid-term evaluation						20
9-12	Students are able to determine the structure of the organic compound in the form of xanthenes and flavonoid derivatives from the resulted research	The accuracy in determining the structure of the organic compound in the form of xanthenes and flavonoid derivatives from the resulted research	Technical : Assignment 3 Criteria :	Lecture and discussion [TM: 4x(3x50'')] Assignment 3 [BT+BM:(1+1)x(4x60'')]		IR, NMR, MS, GC spectra obtained from the analysis of organic compounds	25

13-15	Students are able to present their work in determining the structure of the organic compound	• The accuracy and clarity in presenting their work in determining the structure of the organic compound	Technical : Presentation Criteria :	Discussion [TM: 3x(3x50'')]		• The result of structure determination	10
15	End-term evaluation						20

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SEMESTER LEARNING PLAN																															
COURSE (MK)	CODE	Course disciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Data																									
THESIS	SK 185401		6	0	IV	07 Januari 2020																									
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)																										
					Prof.Dr. Didik Prasetyoko S.Si., M.Sc.																										
Learning Outcomes (LO)	LO-PRODI Charged to The Course																														
	A.2 (LO 1)	Show moral, ethical, responsibility and good personality in completing their duties																													
	B.1 (LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles																													
	B.3 (LO 5)	Able to show responsibility of their individual work by show the free plagiarism result																													
	C.2 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry																													
	Course Learning Outcomes (LO MK)																														
	CP MK 1	Students are able to compile and present the results of thesis research																													
LO – LO MK Map	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;"></td> <td style="width: 10%;">LO 1</td> <td style="width: 10%;">LO 2</td> <td style="width: 10%;">LO 3</td> <td style="width: 10%;">LO 4</td> <td style="width: 10%;">LO 5</td> <td style="width: 10%;">LO 6</td> <td style="width: 10%;">LO 7</td> <td style="width: 10%;">LO 8</td> <td style="width: 10%;">LO 9</td> </tr> <tr> <td>CP MK 1</td> <td style="text-align: center;">√</td> <td></td> <td style="text-align: center;">√</td> <td></td> <td style="text-align: center;">√</td> <td></td> <td style="text-align: center;">√</td> <td></td> <td></td> </tr> </table>												LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	CP MK 1	√		√		√		√		
	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	1. Laboratory research 2. Publication 3. Compiling thesis research report 4. Presenting the written report orally
Reference	Main: 2. Supporting: 4.
Supporting Lecturer	Lecturer teams of Master program of Chemistry
Pre-Requisite Courses	



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DEPARTMENT OF CHEMISTRY

**Document
Code**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date		
GREEN CHEMISTRY		SK 185301	General	2	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)			
		Dr. Afifah Rosyidah, M.Si.; Drs. Eko Santoso, M.Si.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcomes (LO)	LO-PRODI Charged to The Course								
	B.3 (LO 5)	Able to show responsibility of their individual work by show the free plagiarism result							
	Course Learning Outcomes (COURSE LO)								
	COURSE LO 1	Students are able to understand the knowledge of green chemistry on undergoing research in the field of energy, health, environment, and othe related fields.							
	COURSE LO 2	Students have a deep knowledge on the correlations between green chemistry and their physical properties and macroscopic chemical substances.							
	COURSE LO 3	Students are able to think critically on green chemistry to solve life problems in the related fields, such as developing materials for renewable energy sources, health, and analysis methods							
LO - Course LO MAP									
	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
COURSE LO 1					√				
COURSE LO 2					√				
COURSE LO 3					√				

Course Short Description	-						
Study Material: Subject Matter	Introduction to Green Chemistry, Waste Prevention and Processing, The 12 Pillars of Green Chemistry, Environment Toxicology, The Implementations of Green Chemistry in the Industry, The Implementations of Green Chemistry in Solving Industrial Problems, Environment Issues and Climates that support Green Chemistry, Environmentally Friendly Energy and Chemicals, The Chemical Processes that support Green Chemistry.						
Reference	Primary:		1. E. Lichtfouse, J. Schwarzbauer, D. Robert, “Green Materials for Energy, Products and Depollution”, Springer, London, 2013 2. A. Valavanidis., T. Vlachogianni, “Green Chemistry and Green Engineering, From Theory to Practice for Protection of the Environment and Sustainable Development”, Synchrona Themata, Aehens, 2012 3. European Commission, DG Environment, “Analysis of the Evolution of Waste Reduction and the Scope of Waste Prevention”, Arcadis, 2010 4. F. M. Kerton, “Alternative Solvents for Green Chemistry”, The Royal Society of Chemistry, Cambridge, 2009 5. J. Clark, J., D. Macquarrie, “Handbook of Green Chemistry and Technology”, Blackwell Publishing, Oxford, 2002.				
	Secondary:						
Lecturer	Dr. Afifah Rosyidah, M.Si.; Drs. Eko Santoso, M.Si.						
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	Able to understand the principles for reducing or eliminating waste	• The accuracy in explaining waste classification		Lecture Quiz [TM: 2x(2x50’)]		• Waste classification based on the type of compound	Take part in Quiz-1

3-4	Able to understand the 12 Pillars of Green Chemistry	The accuracy in explaining the 12 Pillars of Green Chemistry		Lecture Class discussion Quiz [TM: 2x(2x50'')]		- Waste Prevention - Economical atom - Synthesis with harmless chemicals - Harmless chemical design - Safer solvents and auxiliary compounds - Energy efficiency design - The use of renewable basic materials - Reduce the reaction stage - Catalyst - Breakdown Design - Spontaneous analysis for pollution prevention - Naturally safe chemicals to prevent accidents	Take part in Quiz-1
5	Quiz-1						25
6	Students are able to understand and explain environmental toxicology	The level of accuracy in using environmentally friendly solvents		Lecture Discussion Quiz [TM: 1x(2x50'')]		The use of environmentally friendly solvents	Take part in Mid-semester Evaluation
7	Students are able to understand and implement green chemistry to challenges and solutions in the industry			Lecture Discussion Quiz [TM: 1x(2x50'')]		Selection of an environmentally friendly process	Take part in Mid-semester

							Evaluation
8	Mid-semester Evaluation						25
9, 10	Understanding the Climate Issues that Support Green Chemistry	The accuracy in describing the climate that supports green chemistry		Lecture Quiz [TM: 2x(2x50'')]		The use of non-toxic reagents	
11	Energy and Green Chemistry	The accuracy in describing the relation between energy and green chemistry		Lecture [TM: 1x(2x50'')]		Utilization of alternative energy	
12, 13	Principles of chemical processes that are supported by Green Chemistry	The accuracy in describing the principle during the process in reaction that supported by green chemistry		Lecture Quiz [TM: 2x(2x50'')]			15
14, 15	Green chemistry to solve life's problems such as developing materials for renewable energy, health, analytical methods, and others.	The accuracy in describing green chemistry to solve daily life problem such as the development of material for renewable energy, health, analysis methods, etc		Lecture Discussion Presentation [TM: 2x(2x50'')]			
16	Final Semester Evaluation						20

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SEMESTER LEARNING PLAN											
COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date					
ELECTIVE	SK 185302	General	2	0	III						
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)						
	-		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.						
Learning Outcomes (LO)	LO-PRODI Charged to The Course										
	B.3 (LO 5)	Able to show responsibility of their individual or team work by show the free plagiarism result									
	Course Learning Outcomes (COURSE LO)										
LO - Course LO MAP		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	
	COURSE LO 1	-	-	-	-	-	-	-	-	-	
Course Short Description	-										
Study Material: Subject Matter	-										
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							
3							
4							
5							
6							
7							
8	Mid-semester Evaluation						
9							
10							
11							

12							
13							
14							
15							
16	Final Semester Evaluation						

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCES AND ANALYTICAL DATA DEPARTMENT OF CHEMISTRY					Document Code		
SEMESTER LEARNING PLAN									
COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date		
NANOMATERIALS FOR SENSORS		SK 185313	Analytical Chemistry	2	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)			
		Dr.rer.nat. Fredy Kurniawan, Msi		Suprpto, PhD		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcomes (LO)		LO-PRODI Charged to The Course							
		B.1 (LO 3)	Able to collect, document and analyze data and information and develop them using logical thinking based on scientific principles						
		C.3 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry						
		D.1 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation						
		Course Learning Outcomes (COURSE LO)							

		Students are able to understand how nanomaterials work for sensors in various analytical techniques									
LO - Course LO MAP											
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	
	COURSE LO 1			√				√		√	
Course Short Description	-										
Study Material: Subject Matter	Nanomaterial applications using fluorescence spectrometry technique, voltammetry, amperometry, potentiometry, Quartz Crystal Microbalance, Surface Plasmon Resonance, LSPR, Spectroscopy impedance.										
Reference	Primary:										
	Secondary:										
Lecturer	Dr.rer.nat. Fredy Kurniawan, MSi; Suprpto, PhD; Yatim Lailun Nikmah, PhD										
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 understand nanomaterial applications using fluorescent spectrometry techniques	• The accuracy in finding the appropriate journal articles • The accuracy in reviewing and analyzing journals articles were obtained • The accuracy in describing the content of the article journal that discussed		Lectures Presentation Discussions [TM: 2x(2x50'')]			10
3, 4	Students are able to understand nanomaterial applications using voltammetry techniques	• The accuracy in finding the appropriate journal articles • The accuracy in reviewing and analyzing journals articles were obtained • The accuracy in describing the content of the article journal that discussed		Lectures Presentation Discussions [TM: 2x(2x50'')]			10
5, 6	Students are able to understand nanomaterial applications using amperometry techniques	• The accuracy in finding the appropriate journal articles • The accuracy in reviewing and analyzing journals articles were obtained • The accuracy in describing the content		Lectures Presentation Discussions [TM: 2x(2x50'')]			10

		of the article journal that discussed					
7	Students are able to apply nanomaterials in the laboratory	The accuracy in doing the laboratory practice		Laboratory Practice [TM: 1x(2x50')]			
8	Mid-semester Evaluation						30
9, 10	Students are able to understand nanomaterial applications using potentiometry techniques	- The accuracy in finding the appropriate journal articles - The accuracy in reviewing and analyzing journals articles were obtained - The accuracy in describing the content of the article journal that discussed		Lectures Presentation Discussions [TM: 2x(2x50'')]			10
11	Students are able to understand nanomaterial applications using the Quartz Crystal Microbalance technique	- The accuracy in finding the appropriate journal articles - The accuracy in reviewing and analyzing journals articles were obtained - The accuracy in describing the content of the article journal that discussed		Lectures Presentation Discussions [TM: 1x(2x50'')]			10
12	Students are able to understand nanomaterial applications using the Surface	The accuracy in finding the appropriate journal articles		Lectures Presentation Discussions			10

	Plasmon Resonance (SPR) technique	• The accuracy in reviewing and analyzing journals articles were obtained • The accuracy in describing the content of the article journal that discussed		[TM: 1x(2x50'')]			
13	Students are able to understand nanomaterial applications using the Localized Surface Plasmon Resonance (LSPR) technique	• The accuracy in finding the appropriate journal articles • The accuracy in reviewing and analyzing journals articles were obtained • The accuracy in describing the content of the article journal that discussed		Lectures Presentation Discussions [TM: 1x(2x50'')]			10
14	Students are able to understand nanomaterial applications using impedance spectroscopy techniques	• The accuracy in finding the appropriate journal articles • The accuracy in reviewing and analyzing journals articles were obtained • The accuracy in describing the content of the article journal that discussed		Lectures Presentation Discussions [TM: 1x(2x50'')]			15

	COURSE LO 2				√					
	COURSE LO 3									
Course Short Description	-									
Study Material: Subject Matter	1. XPS (X-Ray Photoemission Spectrophotometry), XPS related UPS, AES), Flow injection analysis, Surface plasmon resonance (SPR), quartz crystal microbalance (QCM), adsorption analysis. Measurement modification based on ATR, DR and fibre optic modules. 2. Study case									
Reference	Primary:									
	1. J. Homola, “Surface Plasmon Resonance Based Sensors”, Springer Verlag, Berlin, 2006. 2. C. Steinem, A. Janshoff, “Piezoelectric Sensors”, Springer Verlag, Berlin, 2007.									
	Secondary:									
	1. J. Wang, ”Electroanalytical Chemistry,” Wiley VCH, USA, 2000.									
Lecturer	Yatim Lailun Ni’mah, Ph.D.; Suprpto, Ph.D.; Dr.rer.nat. Fredy Kurniawan, M.Si.									
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 know the lecture plan for the semester						
2	Students are able to explain basic instruments	• Conformity with the concept • Question and answer		Tutorial Discussions		• Basic Instruments	
3, 4	Students are able to explain the principles, the procedure, and the results of XPS	• Conformity with the concept • Question and answer		Tutorial Discussions		• The principles, the procedure, and the results of XPS	5
5, 6, 7	Students are able to explain and apply different principles, procedures, and the results of XPS-related (UPS, AES)	• Conformity with the concept • Question and answer		Tutorial Discussions		• The principles, the procedures, and the results of XPS-related (UPS, AES)	15
8	Mid-semester Evaluation						30
9	Students are able to explain the principles, the procedures, and the results of flow injection analysis	• Conformity with the concept • Question and answer		Lecture Discussions		• The principles, the procedures, and the results of flow injection analysis	
10	Students are able to explain the principles, the procedures, and the results of the surface plasmon resonance (SPR)	• Conformity with the concept • Question and answer		Lecture Discussions		• The principles, the procedures, and the results of the surface plasmon resonance (SPR)	15
11	Students are able to explain the principles, the procedures, and the results of QCM (Quartz crystal microbalance)	• Conformity with the concept • Question and answer		Lecture Discussions		• The principles, the procedures, and the results of the QCM (Quartz crystal microbalance)	
12	Students are able to explain the principles, the	• Conformity with the concept		Lecture Discussions		• The principles, the procedures, and the	

	procedures, and the results of the adsorption analysis	• Question and answer				results of the adsorption analysis	
13, 14	Students are able to apply theories in chemical instrumentation with their respective research	• Conformity with the concept • Question and answer		Lecture Discussions		• Modification of measurement based on ATR, DR, and fiber optic modules. Case study	20
15, 16	Final Semester Evaluation						30

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCES AND ANALYTICAL DATA DEPARTMENT OF CHEMISTRY					Document Code		
SEMESTER LEARNING PLAN									
COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date		
CORROSION ANALYSIS		SK 185315	Analytical Chemistry	2	0	III			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)			
		Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.		Suprpto, PhD		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.			
Learning Outcomes (LO)		LO-PRODI Charged to The Course							
		A.5 (LO 2)	Show a spirit of independence and team work in completing their duties						
		C.3 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry						
		C.4 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach						
		D.1 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation						
		Course Learning Outcomes (COURSE LO)							

		COURSE LO 1	Students are able to correctly explain the type of corrosion and its control methods							
		COURSE LO 2	Students are able to design and analyze case studies of corrosion creatively in teamwork and present them							
		COURSE LO 3	Students are able to operate instruments related to corrosion testing using the Echem program							
LO - Course LO MAP										
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
	COURSE LO 1		√					√		√
	COURSE LO 2							√		√
	COURSE LO 3								√	
Course Short Description	-									
Study Material: Subject Matter	1. The fundamentals of corrosion: what corrosion is, electrochemical review, types of corrosion, corrosion control and testing. Corrosion analysis: types of corrosion, corrosion control system, measurement, and data processing. 2. Industrial study case.									
Reference	Primary:									
	1. Jones, D. A., "Principles and prevention of corrosion", Second edition, Prentice-Hall, Inc., USA, 1996. 2. "Echem user's guide & using chart & scope software for electrochemistry", Version 1.5, PowerLab System, 1999. 3. Perez, N., "Electrochemistry and corrosion science", Kluwer Academic, Boston, 2004. 4. Marcus, P., Mansfeld, F., "Analytical methods in corrosion science and engineering", CRC Press Taylor & Francis, 2006. 5. Wang, J., "Analytical electrochemistry", Jons Wiley & Sons, 2006. 6. Popov, B. N., "Corrosion engineering: principles and solved problems", Elsevier, 2015.									
	Secondary:									
	<li value="2">Kurniawan, F., Madurani, K.A., "Electrochemical and optical microscopy study of red pepper seed oil corrosion inhibition by self-assembled monolayers (SAM) on 304 SS", Progress in Organic Coatings, vol. 88, p. 256-262, 2015.									

	3. Firdausi, S., Kurniawan, F., “Corrosion inhibition by tihonia diversifolia (Hemsl) A. Gray leaves extract for 304 SS in hydrochloric acid”, Journal of Physics: Conference Series, vol.710, p. 012042, 2016.						
Lecturer	Prof. Dr.rer.nat. Fredy Kurniawan, M.Si.						
Pre-Requisite Courses	-						
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assesmen t 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 type of corrosion according to case studies in Industry correctly	• Able to explain		Lectures Discussions [TM: 2x(2x50’’)]		• The general theory of corrosion, mechanism of corrosion, types of corrosion	
3, 4	Students are able to correctly explain the control method according to case studies in Industry	• Able to explain and present		Lectures Discussions Presentations [TM: 2x(2x50’’)]		• Corrosion control mechanisms and types of corrosion control methods	20
5, 6, 7	Students are able to formulate, analyze and carefully solve problems of metal corrosion and effective control methods	• Able to explain		Lectures Group Discussions Presentations [TM: 2x(2x50’’)]		• Case studies of corrosion problems and their solutions	
8	Mid-semester Evaluation						30
9, 10	Students are able to operate instruments related to corrosion testing using the Echem program and obtain data and process them	• Able to explain		Laboratory practice Presentations [TM: 2x(2x50’’)]		• Operating instruments related to corrosion testing using the Echem program and obtaining data and	

	properly using the Origin program					processing them properly using the Origin program	
11, 12, 13, 14	Students are able to explain and present the results of teamwork in the laboratory	Able to perform literature studies, laboratory practice, and presentations		Laboratory practice Group discussions Presentations [TM: 4x(2x50'')]		Formulating the problems, solving the problems, and presenting the results of laboratory practice	20
16	Final Semester Evaluation						30

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCES AND ANALYTICAL DATA DEPARTMENT OF CHEMISTRY					Document Code	
SEMESTER LEARNING PLAN								
COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date	
CONDUCTIVE POLYMERS		SK 185316	Analytical Chemistry	2	0	III		
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)		
		Suprpto, PhD		Suprpto, PhD		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.		
Learning Outcomes (LO)		LO-PRODI Charged to The Course						
		C.3 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry					
		C.4 (LO 8)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach					

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 structure of monomer/polymer molecule for common conductive polymer			Lecture [TM: 1x(2x50'')]			
2, 3, 4	Students are able to draw the general method of conductive polymery synthesis			Lecture [TM: 3x(2x50'')]			
5, 6, 7	Students are able to understand the principles of doping-dedoping	• Individual and group assesments		Group discussions			20
8	Mid-semester Evaluation						30
9, 10	Students are able to apply conductive polymer	• Question and answer		Group discussions [TM: 2x(2x50'')]			
11, 12, 13, 14	Students are able to describe the history, the initial research, the main references, and the cutting-edge research of conductive polymers	• Question and answer		Group discussions Presentations [TM: 4x(2x50'')]			20
15, 16	Final Semester Evaluation						30



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FACULTY OF SCIENCES AND ANALYTICAL DATA
DEPARTMENT OF CHEMISTRY

**Document
Code**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date			
ORGANOMETALLIC CHEMISTRY		SK 184654	Inorganic Chemistry	2	0	III				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)				
		Dra. Ratna Ediaty, MS, PhD		Prof. Dr.rer.nat. Irmira Kris Murwani, M.Si.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.				
Learning Outcomes (LO)	LO-PRODI Charged to The Course									
	C.2 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon								
	C.3 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry								
	D.1 (LO 9)	Able to explain science and technology problems related to structure and chemical change through problems through the accurate and innovative theoretical, -experimental or -computational approach								
	Course Learning Outcomes (COURSE LO)									
	COURSE LO 1	Students are able to understand the types of organometallic and their properties								
	COURSE LO 2	Students are able to explain the latest developments research about organometallic								
LO - Course LO MAP										
		LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
	COURSE LO 1						√			√
	COURSE LO 2						√	√		√
Course Short Description	-									
Study Material: Subject Matter	1. Bonds on organometallic compounds for stable electrons configuration.									

	2. Varieties of ligands, which cover carbon monoxide, phosphine and its compounds, hydride and its dihydrogen complex, 1-alkyl, alkenyl, alkynyl and anyl ligands, 2-alkene ligands, unconjugated dienes, butadienes, cyclobutadienes, cyclooctatetraene, benzene, allyl, cyclopentadiene, carbenes, alkane, agostic hydrogen and noble gas, dinitrogen and monoxide nitrogen compounds, -d block carbonyl, metallocene. 3. Reactions: ligand substitution, oxidative addition and reductive elimination, metathesis bonds, 1,1-migratory insertion reaction, 1,2-insertions and 1-hydride elimination, cyclometalation. 4. Organometallic compounds application as a homogenous catalyst, such as alkene metathesis, hydroformylation, Wacker oxidation from alkene, Ziegler-Natta polymerization, metallocene polymerization, asymmetric oxidation, and many others.						
Reference	Primary: 1. S. Komiya, "Synthesis of Organometallic Compounds. A Practical Guide (Inorganic Chemistry-A Textbook Series)", John Wiley and Sons, 1997 2. G.B. Stringfellow, "Organometallic Vapor-Phase Epitaxy. Theory and Practice", edisi kedua, Elsevier, 1999 (http://www.sciencedirect.com/science/book/9780126738421) 3. Shriver, Atkins, "Inorganic Chemistry", edisi kelima, W.H. Freeman and Company, Oxford, 2010 4. J.E. Huheey, E.A. Keiter, R.L. Keiter, "Inorganic Chemistry, Principles of Structure and Reactivity", edisi keempat, Harper Collins College Publishers, London 1993 5. G.L. Miessler, D.A. Tarr, "Inorganic Chemistry", edisi ketiga, Pearson Education International, Minnesota 2001 6. J.E. House, "Inorganic Chemistry", Academic Press, London, 2008 Secondary:						
Lecturer	Dra. Ratna Ediaty, MS, PhD						
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	Able to know about organometallic compounds (basic organometallic chemistry of s-block, p-block, and d-block metals)			Lectures [TM: 1x(2x50'')]		• Organometallic bond	
2	Able to know the ligands of carbon monoxide, phosphines and their compounds, hydrides, and dihydrogen complexes in organometallic compounds			Lectures [TM: 1x(2x50'')]		• Carbon monoxide ligands • phosphines and their compounds • hydrides and dihydrogen complexes	
3	Able to know the 1-alkyl ligands. - alkenyl, - alkynyl and aryl, 2-alkene, non-conjugated diene in organometallic compound			Lectures [TM: 1x(2x50'')]		• 1-alkyl ligands. • - alkenyl, - alkynyl and aryl, 2-alkene, non-conjugated diene	
4	Able to know butadiene, cyclobutadiene, cyclooctatetraene, benzene, allyl, cyclopentadiene in organometallic compounds			Lectures [TM: 1x(2x50'')]		• butadiene, cyclobutadiene, cyclooctatetraene, benzene, allyls, cyclopentadiene	
5	Able to know about carbenes ligands, alkanes, agostic hydrogen, and noble gases in organo-metal compounds			Lectures [TM: 1x(2x50'')]		• Carbenes ligands, alkanes, agostic hydrogen, and noble gases	
6	Able to know about dinitrogen ligands and nitrogen monoxide compounds, -d-block carbonyl, metallocene			Lectures [TM: 1x(2x50'')]		• Dinitrogen ligands and nitrogen monoxide compounds, -d-block carbonyl, metallocene	

7	Able to know about the substitution, addition, oxidation, and reductive elimination of organometallic compounds reaction			Lectures [TM: 1x(2x50'')]		Ligand substitution reactions, oxidative addition and reductive elimination, metathesis bonds	
8	Mid-semester Evaluation						50
9	Able to know about the insertion, elimination and cyclomelation reactions in organometallic			Lectures [TM: 1x(2x50'')]		1,1-Migratory insertion, 1,2-Insertions and 1-hydride elimination, and cyclomethylation reaction.	
10	Able to know about the metathesis reaction of alkenes			Lectures [TM: 1x(2x50'')]		alkene metathesis, hydroformylation	
11	Able to know about the Wacker oxidation principle			Lectures [TM: 1x(2x50'')]		Wacker oxidation of alkenes, Ziegler-Natta polymerization	
12	Able to know about the Metallocene polymerization			Lectures [TM: 1x(2x50'')]		Metallocene polymerization, asymmetric oxidation, and others.	
13, 14, 15	Able to express ideas orally and in writing regarding organometallic compounds	Know about organometallic compounds (basic organometallic		Presentation Assignment [TM: 3x(2x50'')]		Journal of Organometallic Chemistry, Science Direct Online	20

		chemistry of s-block, p-block, and d-block metals)					
16	Final Semester Evaluation						30

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCES AND ANALYTICAL DATA DEPARTMENT OF CHEMISTRY					Document Code
SEMESTER LEARNING PLAN							
COURSE (MK)	CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date	
CATALYSIS	SK 185322	Inorganic Chemistry	2	0	III		
AUTHORIZATION / LEGALIZATION	RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)		
	Prof. Dr. rer. nat. Irmina Kris Murwani, MSi; Dra. Ratna Ediati, MS, PhD		Prof. Dr.rer.nat. Irmina Kris Murwani, M.Si.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.		
Learning Outcomes (LO)	LO-PRODI Charged to The Course						
	A.5 (LO 2)	Show a spirit of independence and team work in completing their duties					
	C.2 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon					
	C.3 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry					
	D.1 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation					
	Course Learning Outcomes (COURSE LO)						
	COURSE LO 1	Students are able to understand the types of catalysts and their properties					

		COURSE LO 2 Students are able to explain the latest developments research about catalyst									
LO - Course LO MAP											
			LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9
		COURSE LO 1							√		√
		COURSE LO 2		√				√			√
Course Short Description		-									
Study Material: Subject Matter		1. Structure analysis in determining the molecule equatuons of organic compounds. 2. Basic measurement theories and principles of spectroscopies UV-Vis, IR, MS, NMR. 3. Identification study case of spectrum UV-Vis, IR, MS, NMR (Integrated problems)									
Reference		Primary:									
		1. M. Beller, A. Renken, R.A. van Santen (editor), “Catalysis: From Principles to Applications”, Wiley-VCH, Weinheim, 2012									
		Secondary:									
		1. D. Murzin, T. Salmi, “Catalytic Kinetics“, Elsevier. (http://www.sciencedirect.com/science/book/9780444516053) 2. S.D. Jackson, J.S.J. Hargreaves, D. Lennon, “Catalysis in Application”, RSC, 2003. 3. V.J. Inglezakis, S.G. Pouloupoulos, “Adsorption, Ion Exchange and Catalysis Design of Operations and Environmental Applications“, Elsevier, 2006 (http://www.sciencedirect.com/science/book/9780444527837)									
Lecturer		Prof. Dr. rer. nat. Irmina Kris Murwani, MSi; Dra. Ratna Ediati, MS, PhD									
Pre-Requisite Courses		-									
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment				Learning Design; Learning Method;		Learning Material [Reference]			

		Indicator	Criteria and Technical	Student Assignment; [Estimated Time]			Assessment Portion (%)
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Able to know about the definition of catalyst and its history			Introductory lectures [TM: 1x(2x50'')]		Catalysis in perspective (history of catalysis)	
2	Students are able to distinguish catalysis reactions for homogeneous and heterogeneous catalysts			Lectures [TM: 1x(2x50'')]		Homogeneous and heterogeneous catalyst	
3	Able to explain the kinetics of the catalysis reaction for heterogeneous catalysts and homogeneous reactions			Lectures [TM: 1x(2x50'')]		The kinetics in homogeneous catalyst	
4, 5	Able to explain the kinetics of the catalysis reaction for heterogeneous catalysts and homogeneous reactions			Lectures [TM: 2x(2x50'')]		Kinetics in heterogeneous catalysts	
6, 7	Students are able to demonstrate the fragmentation process in organic molecules	Differentiating catalyzed reaction for homogeneous catalysts and heterogeneous catalysts		Presentation Discussions [TM: 2x(2x50'')] Assignment 1		Basics of catalysis reaction techniques	20
8	Mid-semester Evaluation						30
9, 10	Students are able to explain the catalysis process including its mechanism and reactivity			Lectures Discussions [TM: 2x(2x50'')]		Chemical catalytic reactivity for homogeneous catalysts	

11, 12	Students are able to explain the catalysis process including its mechanism and reactivity			Lectures Discussions [TM: 2x(2x50'')]		• Chemical catalytic reactivity for biocatalysis	
13	Students are able to explain the catalysis process including its mechanism and reactivity			Lectures Discussions [TM: 1x(2x50'')]		• Chemical Catalytic Reactivity for Electrocatalysis	
14, 15	Students use H-NMR, C-NMR, MS, IR and UV-Vis spectrum data to determine the structure of organic compounds	• Describing the catalysis process including its mechanism and reactivity		Presentation Discussions [TM: 2x(2x50'')] Assignment 2		• Catalysis reactivity	20
16	Final Semester Evaluation						30

		INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS) FACULTY OF SCIENCES AND ANALYTICAL DATA DEPARTMENT OF CHEMISTRY					Document Code	
SEMESTER LEARNING PLAN								
COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date	
COORDINATION CHEMISTRY		SK 185323	Inorganic Chemistry	2	0	III		
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)		
		Prof. Dr.rer.nat. Irminda Kris Murwani, MSi; Dr. Fahimah Martak, M.Si.		Prof. Dr.rer.nat. Irminda Kris Murwani, M.Si.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.		
Learning Outcomes (LO)		LO-PRODI Charged to The Course						
		C.2 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon					

6. J.E. Huheey, E.A. Keiter, R.L. Keiter, O.K. Medhi, "Inorganic Chemistry: Principles of Structure and Reactivity", Pearson Education, 2006

Secondary:

Lecturer Prof. Dr.rer.nat. Irmina Kris Murwani, MSi; Dr. Fahimah Martak, M.Si.

Pre-Requisite Courses

-

Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assessment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Able to know about the formation of complexes from crystal field theory and ligand fields and their electronic spectra			Lecture [TM: 1x(2x50'')]		Crystal Field Effects & Crystal Field Assumption Theory	
2	Able to know about the formation of complexes from crystal field theory and ligand fields and their electronic spectra			Lecture [TM: 1x(2x50'')]		Splitting field of crystal on the octahedral geometry and tetrahedral-diagram splitting field of qualitative crystal and complex high-spin and low-spin	
3	Able to know about the formation of complexes from crystal field theory and ligand fields and their electronic spectra			Lecture [TM: 1x(2x50'')]		CFSP and the factors that influence it	

4	Able to know about the formation of complexes from crystal field theory and ligand fields and their electronic spectra	Students possess the formation complex with crystals or ligands field knowledge		Quiz 1 [TM: 1x(2x50')]		CFSE Computing	20
5	Able to know about the formation of complexes from crystal field theory and ligand fields and their electronic spectra			Lecture [TM: 1x(2x50'')]		Crystal field splitting, spectrochemical series.	
6	Able to know about the stability and magnetic properties of complex compounds			Lecture [TM: 1x(2x50'')]		Stabilitating the oxidation level that is not normal in coordination compounds.	
7	Able to know about the stability and magnetic properties of complex compounds			Lecture [TM: 1x(2x50'')]		Ligand field theory, d orbital splitting in a low symmetry environment	
8	Mid-semester Evaluation						30
9	Able to know the Jahn-Teller effect and its interpretation			Lecture [TM: 1x(2x50'')]		Effects of Jahn-Teller, the interpretation of the spectra of electronics including spectra transfer charge	
10	Able to know the Jahn-Teller effect and its interpretation			Lecture [TM: 1x(2x50'')]		Dia - parafero - magnetic and antiferromagnetic nephelauxetic series	

11	Able to know the Jahn-Teller effect and its interpretation			Lecture [TM: 1x(2x50'')]		The damping of orbital angular moment, spinorbit, and copling	
12	Able to know the Jahn-Teller effect and its interpretation			Lecture [TM: 1x(2x50'')]		Ligand Substitution in Complex Metals	
13	Able to know and analyze the reactions of complex compounds			Lecture [TM: 1x(2x50'')]		The substitution reactions, the effect of trans and electrons transfer, the photochemical reaction of chromium complex, and ruthenium	
14	Able to know and analyze the reactions of complex compounds	Students know about complex magnetic compounds and complex substitution reactions		Quiz 2 [TM: 1x(2x50'')]		The molecular fluxional of iso- and heteropoly acids	20
15	Able to know and analyze the reactions of complex compounds			Lecture [TM: 1x(2x50'')]		Complex Compounds Reaction Mechanisms	
16	Final Semester Evaluation						30



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FACULTY OF SCIENCES AND ANALYTICAL DATA
DEPARTMENT OF CHEMISTRY

**Document
Code**

SEMESTER LEARNING PLAN

COURSE (MK)		CODE	Course disiplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date																														
POROUS MATERIALS		SK 185324	Inorganic Chemistry	2	0	III																															
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program (PRODI)																															
		Prof. Dr. Didik Prasetyoko, MSi; Dra. Ratna Ediaty, MS, PhD		Prof. Dr.rer.nat. Irmira Kris Murwani, M.Si.		Prof. Dr. Didik Prasetyoko, S.Si., M.Sc.																															
Learning Outcomes (LO)	LO-PRODI Charged to The Course																																				
	B.2 (LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communciation skills at the national/intarnationa level through a research object																																			
	C.2 (LO 6)	Able to develop the concept of structure, properties and substance changes at the micro- or marcomolecular level based on the dynamic and energetic phenomenon																																			
	C.3 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry																																			
	D.1 (LO 9)	Able to build a chemical knowledge especially in the energy, environmental, marine and medical in order to develop the research, industry and employment creation																																			
	Course Learning Outcomes (COURSE LO)																																				
	COURSE LO 1	Students are able to understand the types of porous materials and their properties																																			
	COURSE LO 2	Students are able to explain the latest developments in research about porous materials																																			
LO - Course LO MAP	<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>COURSE LO 1</td><td></td><td></td><td></td><td>√</td><td></td><td>√</td><td></td><td></td><td>√</td></tr><tr><td>COURSE LO 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td>√</td></tr></table>								LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	COURSE LO 1				√		√			√	COURSE LO 2							√		√
	LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9																												
COURSE LO 1				√		√			√																												
COURSE LO 2							√		√																												
Course Short Description	-																																				
Study Material: Subject Matter																																					

	The porous materials that will be covered are structures, properties and applications of metal organic framework, mesoporous silicate, metal oxides with regular pores, carbon, and zeolite.						
Reference	Primary:						
	1. D. W. Bruce, D. O'Hare, R.I. Walton, “Porous Materials”, edisi pertama, John Wiley & Sons, 2011.						
	Secondary:						
Lecturer	Prof. Dr. Didik Prasetyoko, MSi; Dra. Ratna Ediati, MS, PhD						
Pre-Requisite Courses	-						
Session	Learning outcomes of each learning stage (Sub-LOMK)	Assessment		Learning Design; Learning Method; Student Assignment; [Estimated Time]		Learning Material [Reference]	Assessment Portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face Class (5)	Online Class (6)	(7)	(8)
1	Students have knowledge of the structure, properties, characterization, and application of several porous materials			Lectures Discussions [TM: 1x(3x50’’)]		• Introduction to porous materials	
2	Students have knowledge of the structure, properties, characterization, and application of mesoporous silicates			Lectures Discussions [TM: 1x(3x50’’)]		• Structures, properties, and applications of mesoporous silicates	
3, 4	Students have knowledge of the structure, properties,			Lectures Discussions [TM: 2x(3x50’’)]		• Structures, properties, and	

	characterization, and application of zeolites.					applications of zeolite	
5	Students have knowledge of the structure, properties, characterization, and application of regular porous metal oxides			Lectures Discussions [TM: 1x(3x50'')]		Structure, properties and applications of regular porous metal oxides	
6, 7	Students are able to develop ideas related to porous materials (zeolites and aluminosilicates)	Able to explain the latest developments on porous materials		Presentation Discussions Assignment 1 [TM: 2x(3x50'')]		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.	
8	Mid-semester Evaluation						30
9, 10	Students have knowledge of the structure, properties, and applications of several organic metal frameworks.			Lectures Discussions [TM: 2x(3x50'')]		Structure, properties, and applications of organic metal framework	
11, 12	Students have knowledge of the structure, properties, characterization, and application of carbon.			Lectures Discussions [TM: 2x(3x50'')]		Structure, properties, and applications of carbon	
13, 14, 15	Students are able to develop ideas related to porous materials (organic metal framework and carbon)	Able to explain the latest developments regarding porous materials		Presentation Discussions Assignment 2 [TM: 3x(3x50'')]		Recent developments in porous materials (organic metal	20

						framework and carbon)	
16	Final Semester Evaluation						30

Study Material: Subject matter	1. Reactions on solids (between solids, solid to gas reaction, interconnected chemical reactions). 2. Forming solids from a gas phase (transporting and depositing steam chemicals, aerosol process). 3. Forming solids from liquid or melting state (glass, precipitation, biomaterial, solvothermal, sole-gel). 4. Preparing and modifying inorganic polymers (the general aspects, polysiloxanes (silicones), polyphosphazenes, polysilanes, polymers that contain metal). 5. Template method synthesis (synthesis porous materials), synthesis nano materials.						
References	Primary:						
	1. U. Schubert, N. Husing, “Synthesis of Inorganic Material”, Wiley, 2012						
	Secondary:	1. S. Komiya, “Synthesis of Organometallic Compounds”, John Wiley & Sons, New York, 1997 2. H. Amouri, M. Gruselle, “Chirality in Transition Metal Chemistry”, John Wiley & Sons, Ney York, 2008 3. W. Henderson, J.C. McIndoe, “ Mass Spectrometry of Inorganic, Coordination and Organometallic Compounds”, John Wiley & Sons, New York, 2005					
Lecturer	Prof. Dr. Drs. Djoko Hartanto, M.Si; Dr. Afifah Rosyidah, M.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 understand the synthesis reactions on solids		Technical: Lecture Criteria: 	Lecture [TM: 1×(2×50')]		• Reaction between solids	
2	The students should be able to understand the synthesis reactions on solids		Technical: Lecture Criteria: 	Lecture [TM: 1×(2×50')]		• Gas-solid reactions	
3	The students should be able to understand the synthesis reactions on solids		Technical: Lecture Criteria: 	Lecture [TM: 1×(2×50')]		• Intercalation reaction	
4	The students should be able to understand how solids are formed from a gas phase		Technical: Lecture Criteria: 	Lecture [TM: 1×(2×50')]		• Transporting and depositing steam chemicals	

5	The students should be able to understand how solids are formed from a gas phase	•	Technical: Lecture Criteria:	Lecture [TM: 1×(2×50')]		• Aerosol process	
6	The students should be able to understand how solids from liquid or melting state	•	Technical: Lecture Criteria:	Lecture [TM: 1×(2×50')]		• Glass and precipitation	
7	The students should be able to understand how solids from liquid or melting state	•	Technical: Lecture, presentation, assignment 1 Criteria:	Lecture [TM: 1×(2×50')]		• Biomaterial and solvothermal	20
8	Mid Semester Evaluation						30
9,10	The students should be able to understand how solids from liquid or melting state	•	Technical: Lecture, exercise Criteria: •	Lecture [TM: 2×(2×50')]		• Sol-gel	
11	The students should be able to understand the synthesis of inorganic polymer	•	Technical: Lecture Criteria: •	Lecture [TM: 1×(2×50')]		• Polysiloxane	

12	The students should be able to understand the synthesis of inorganic polymer	•	Technical: Lecture Criteria:	Lecture [TM: 1×(2×50')]		• Polyphosphazenes & Polysilanes	
13	The students should be able to understand the synthesis of inorganic polymer	•	Technical: Lecture, presentation, assignment 2 Criteria:	Lecture [TM: 1×(2×50')]		• Polymer containing metal	20
14	The students should be able to understand the synthesis of nanomaterials	•	Technical: Lecture Criteria:	Lecture [TM: 1×(2×50')]		• Synthesis with template method (porous materials)	
15	The students should be able to understand the synthesis of nanomaterials	•	Technical: Lecture Criteria:	Lecture [TM: 1×(2×50')]		• Synthesis of nanomaterial	
16	End Semester Evaluation						30



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CHEMISTRY DEPARTMENT

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SEMESTER LEARNING PROGRAMME

COURSE (MK)		CODE	Course Diciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date			
ENERGY STORAGE MATERIALS		SK 185326	Inorganic Chemistry	3	0	III	1 March 2021			
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program				
		Prof. Hamzah Fansuri, M.Si., Ph.D.		Dra. Ratna Ediaty, M.S., Ph.D.		Prof. Dr. Didik Prasetyoko, M. Sc.				
Learning Outcomes (LO)	LO-PRODI Charged to the Courses									
	C.4 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right intrument and the substance side effect in order to develop the chemistry								
	D.2 (LO 9)	Able to build a chemical knowledge especially in the energy, enviromental, marine and medical in order to develop the research, industry and empolyment								
	Course Learning Outcomes (LO MK)									
	LO MK 1	After taking this subject, students will have the knowledge on the properties, structures, and reactivities of materials used as energy storing media. Some of these examples are battery, hydrogen storage, and fuel cells, as well as their characterization and testing methods.								
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 subject covers the basic concepts on energy storage materials in its everyday life applications such as battery, hydrogen container, fuel cells, and super capacitors. The scope of this subject is the theories and their developments, material properties, design, and fabricating the energy storage.									

		This subject is aimed at postgraduate students, however, it could also be taken by undergraduate students as an optional subject. Furthermore, this subject is also open to students from other department who either are at their undergraduate 7th semester or other postgraduate students. This subject is delivered in English as introduction, although in the latter stages, the lessons are given multilingually (in English and Indonesian). The learning method used is student centered learning (SCL) based interactive method.					
Study Material: Subject matter		This lecture describe the basic concept of energy storage materials for application in battery, hydrogen storage, fuel cell and super capacitor. The scope of this lecture include material characteristic, design, and fabricating their energy storage. This lecture was design for postgraduate student (master student) but also can be taken for undergradute student in final year as optional course. Furthermore, this lecture are open for the 7th semester or higher or for postgraduate student in other department in ITS. This lecture using english for the introduction. However, in learning process still possible to use bilingual language (Indonesian-English). The interactive method based on student centered learning (SCL) was used as learning method in this lecture .					
References		Primary: 1. D. W. Bruce, D. O'Hare and R. I. Walton (editors), "Energy Materials, Inorganic Materials Series", John Wiley & Sons, 2011 2. R. A. Huggins, "Energy Storage", Springer, New York, 2010 Secondary: 1. R. Zito, "Energy Storage: A New Approach", Scrivener Publishing, Salem-Massachusetts, 2010. 2. Y. Brunet (editor), "Energy Storage", ISTE Ltd., London, 2011 3. Artikel-artikel ilmiah yang terkait dengan topik-topik perkuliahan					
Lecturer		Prof. Hamzah Fansuri, M.Si., 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]	Assesmen t portion (%)
		Indicator	Criteria and Technical				
(1)	(2)	(3)	(4)	Face-to-face class (5)	Online (6)	(7)	(8)
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15-16	Mid Semester Evaluation						
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		•				•	
31-32	End Semester Evaluation						25



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SEMESTER LEARNING PROGRAMME

COURSE (MK)		CODE	Course Diciplines (RMK)				Semester Credit Units		SEMESTER	Compilation Date	
MODERN CERAMICS		SK 185327	Inorganic Chemistry				2	0	III	2 March 2021	
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer						RMK Coordinator		Head of Study Program	
		Dr. Afifah Rosyidah, MSi						Dra. Ratna Ediati, M.S., Ph.D.		Prof. Dr. Didik Prasetyoko, M. Sc.	
Learning Outcomes (LO)	LO-PRODI Charged to the Courses										
	C.1 (LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communciation skills at the national/intarnationa level through a research object									
	C.4 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right intrument and the substance side effect in order to develop the chemistry									
	D.1 (LO 8)	Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the acurate and inovative theoretical, -experimental or -computational approach									
	D.2 (LO 9)	Able to build a chemical knowledge especially in the energy, enviromental, marine and medical in order to develop the research, industry and empolyment creation									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Students are able to differentiate the type of ceramics.									
	LO MK 2	Students are able to think critically on the uses of modern ceramics to solve real life problems based on their understanding of combination of spectra data to determine the compound structure									
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							
Study Material: Subject matter		The concepts of advanced processing to increase the ceramic reliabilities, wet forming process, electronic ceramic manufacturing process, composite ceramic process, thin film deposition process for electronics, nano ceramic process, membrane ceramic process, and structurized ceramics.					
References		Primary: 1. H. Elssner, G. Hoven, P. Kiessler, R. Wellner, R. Wert, "Ceramics and Ceramic Composites Engineering", edisi ketiga, John Wiley & Sons, New York, 1999.					
		Secondary: 2. A.G. King, "Ceramic Technology and Processing", William Andrew Publishing/ Noyes, 2002. 3. J.G.P. Binner, "Advanced Ceramic Processing and Technology", William Andrew Publishing/Noyes, 1990. 4. D.E Clark, B.K. Zaitos, "Corrosion of Glass, Ceramics and Ceramic Superconductors", William Andrew Publishing/Noyes, 1992. 5. F. Shi, "Ceramic Materials—Progress in Modern Ceramics", InTech Croatia, 2012					
Lecturer		Dr. Afifah Rosyidah, MSi					
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)

1-3	The students should be able to understand the manufacturing process, the terms and properties of modern ceramics.	The level of understanding for grouping the manufacturing processes, terms and properties of modern ceramics based on the types of components	Technical: Lecture Criteria:	Lecture [TM: 3×(2×50')]		Grouping the manufacturing processes, terms and properties of modern ceramics based on the types of components	
4,5	The students should be able to understand the wetting process of modern ceramics	The level of understanding for the wetting process of modern ceramics	Technical: Lecture and discussion Criteria	Lecture and discussion [TM: 2×(2×50')]		The wetting process of modern ceramics	10
6,7	The students should be able to understand the process of manufacturing electronic ceramics	The level of understanding for the process of manufacturing electronic ceramics	Technical: Group discussion Criteria:	Lecture and discussion [TM: 2×(2×50')]		The process of manufacturing electronic ceramics	20
8	Mid Semester Evaluation						20
9-10	The students should be able to understand the process of manufacturing composite ceramics	The level of understanding for the process of	Technical: Lecture, group discussion Criteria:	Lecture and group discussion [TM: 2×(2×50')]		The process of manufacturing modern ceramics and process of composite ceramics	10

		manufacturing composite ceramics					
11	The students should be able to understand the manufacturing process of thin film deposition for electronic ceramics	The level of understanding for the manufacturing process of thin film deposition for electronic ceramics	Technical: Lecture, group discussion Criteria:	Lecture and group discussion [TM: 2×(2×50')]		Manufacturing process of thin film deposition for electronic ceramics	5
12, 13	The students should be able to understand the manufacturing process of nano-ceramics	The level of understanding for the manufacturing process of nano-ceramics	Technical: Group discussion Criteria:	Lecture and group discussion [TM: 2×(2×50')]		The manufacturing process of nano-ceramics	10
14,15	The students should be able to understand the manufacturing process and characterization of structured ceramics	The level of understanding for the manufacturing process and characterization of structured ceramics	Technical: Group discussion Criteria:	Lecture and group discussion [TM: 2×(2×50')]		The manufacturing process and characterization of structured ceramics	10
16	End Semester Evaluation						30



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
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CHEMISTRY DEPARTMENT

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Code**

SEMESTER LEARNING PROGRAMME

COURSE (MK)		CODE	Course Diciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date				
PHYSICAL INORGANIC CHEMISTRY		SK 185328	Inorganic Chemistry	2	0	III	2 March 2021				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program					
		Prof. Dr.rer.nat Irmina Kris Murwani, Prof. Dr. Djoko Hartanto		Dra. Ratna Ediaty, M.S., Ph.D.		Prof. Dr. Didik Prasetyoko, M. Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to the Courses										
	B.1 (LO 2)	Show a spirit of independence, team work, leadership and entrepreneurship									
	C.1 (LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communciation skills at the national/intarnationa level through a research object									
	C.4 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right intrument and the substance side effect in order to develop the chemistry									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Students are able to differentiate the between the electron transfer reaction, protons, and their pairs.									
	LO MK 2	Students are able to determine the molecule activation mechanism									
	LO MK 3	Students are able to identify the determinant factors of reactivities, thermodynamics, and radical kinetics in an organometallic compound									
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							
Study Material: Subject matter		Electron transfer reaction, transfer reaction of proton-electron pair in hydrogen and hydride, oxygen atom transfer. Activation and oxygen bond mechanisms on the centre atom transition, hydrogen molecule activation, CO ₂ activation, nitrogen monoxide chemical bond and redox species linkages, ligand substitution in complex metals, inorganic radical reactivities in liquid solutions, thermodynamics, kinetics and mechanisms of organometallic radical reactions, metal-carbon-hydrogen bond activations.					
References		Primary:					
		1. A. Bakac, "Physical Inorganic Chemistry", Wiley, 2010					
		Secondary:					
		2. U. Müller U, "Inorganic Structural Chemistry", edisi kedua, John Wiley and Sons, 2006					
		3. J.E. Huheey, "Inorganic Chemistry principles of Structure and Reactivity", edisi keempat, Harper and Row Publisher, New York, 1993.					
Lecturer		Prof. Dr.rer.nat Irmina Kris Murwani, Prof. Dr. Djoko Hartanto					
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 differentiate between the electron transfer reaction, protons, and their pairs		Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Electron transfer reaction	
2	The students should be able to differentiate between the electron transfer reaction, protons, and their pairs	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Electron pairs transfer reaction in hydrogen •	
3	The students should be able to differentiate between the electron transfer reaction, protons, and their pairs	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Electron pairs transfer reaction in hydride •	
4	The students should be able to differentiate between the electron transfer reaction, protons, and their pairs	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Oxygen transfer atom •	
5	The students should be able to understand the mechanism of activation molecule	• Understand the mechanism of activation molecule	Technical: Assignment 1 Criteria:	Lecture, discussion [TM: 1×(2×50')]		• The mechanism of activation molecule and oxygen bond the transition center	20

6	The students should be able to understand the mechanism of activation molecule	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• The mechanism of activation molecule and oxygen bond the transition center	
7	The students should be able to understand the mechanism of activation molecule	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Activation of hydrogen molecule	
8	Mid Semester Evaluation						30
9	The students should be able to understand the mechanism of activation molecule	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• CO ₂ activation	
10	The students should be able to understand the mechanism of activation molecule	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• The chemistry bond of nitrogen monoxide and the redox reaction	
11	The students should be able to understand the mechanism of activation molecule	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• The chemistry bond of nitrogen monoxide and the redox reaction	
12	The students should be able to understand the mechanism of activation molecule	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Ligand substitution and metal complex	

13	The students should be able to understand the determinant factor of reactivity in organometallic compound	•	Technical: Assignment 2 Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Inorganic radical reactivity in liquid solution	20
14	The students should be able to understand the thermodynamic factor and radical kinetic in organometallic compound	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Thermodynamic, kinetic and radical mechanism reaction in organometallic	
15	The students should be able to understand the thermodynamic factor and radical kinetic in organometallic compound	•	Technical: Criteria:	Lecture, discussion [TM: 1×(2×50')]		• Bond activation of metal-carbon-hydrogen	
16	End Semester Evaluation						30



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
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SEMESTER LEARNING PROGRAMME

COURSE (MK)		CODE	Course Diciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date				
BIODEGRADATION		SK 185332	Biochemistry	3	0	III	2 March 2021				
FAUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program					
		Adi Setyo Purnomo, MSc, PhD		Adi Setyo Purnomo, MSc, PhD		Prof. Dr. Didik Prasetyoko, M. Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to the Courses										
	B.2 (LO 3)	Able to collect, document and analyze data and information and develop them using logical thingking based on scientific principles									
	C.4 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right instrument and the substance side effect in order to develop the chemistry									
	D.2 (LO 9)	Able to build a chemical knowledge especially in the energy, enviromental, marine and medical in order to develop the research, industry and empolymnt creation									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Understanding of biodegradation principles and techniques, mechanism of pollutand biodegradation, also the use of microbes in the process of biodegradation									
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 subjecy covers organic pollutant biodegradation process performed by microorganism.									
Study Material: Subject matter		Biodegradation processes, types of biodegradation, biodegradation techniques, biodegradation mechanisms, biodegradation in contaminated environments.									

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		Adi Setyo Purnomo, MSc, PhD					
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 understand the principal of biodegradation	Accuracy in explaining the principal of biodegradation	Technical: Criteria:	Lecture [TM: 2x(3x50")]		- Lecture contract - Principal of biodegradation	

3	The students should be able to understand the techniques of biodegradation	• Accuracy in explaining the techniques of biodegradation	Technical: Criteria:	Lecture [TM: 1x(3x50'')]		• The techniques of biodegradation •	
4,5	The students should be able to understand the mechanism of pollutant biodegradation	• Accuracy in explaining the mechanism of DDT biodegradation	Technical: Quiz 1 Criteria:	Lecture [TM: 2x(3x50'')]		• The mechanism of DDT (dichloro diphenyl trichloroethana) biodegradation •	15
6,7	The students should be able to understand the mechanism of pollutant biodegradation	• Accuracy in explaining the mechanism of aldrin and dieldrin biodegradation	Technical: Criteria:	Lecture [TM: 2x(3x50'')]		• The mechanism of aldrin and dieldrin biodegradation	
8	Mid Semester Evaluation						20
9-11	The students should be able to understand the mechanism of pollutant biodegradation	• Accuracy in explaining the mechanism of dye biodegradation	Technical: Quiz 2 Criteria: •	Lecture [TM: 3x(3x50'')]		• The mechanism of dye biodegradation •	15
12-15	The students should be able to understand the use of microbes in biodegradation	• Completing microproject using microorganism for biodegradation	Technical: Microproject Criteria:	Lecture , practice [TM: 3x(3x50'')] Presentation [TM: 1x(3x50'')]		• Micro projects •	25
16	End Semester Evaluation						25

		1. T.P. Coultate, “Food the Chemistry of Its Components”, Royal Society of Chemistry, 1993.					
		Secondary:					
		2. L.H. Mayer, “Food Chemistry”, edisi keempat, Reinhold Publishing Comp, New York. 3. O.R. Fennema, “Principle of Food Science”, 1978					
Lecturer		Adi Setyo Purnomo, MSc, PhD; Sri Fatmawati, MSc., PhD					
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 understand the food fortification methods	• Accuracy in explaining the food fortification methods	Technical: Criteria:	Lecture [TM: 2×(3×50’)]		• Lecture contract, protein fortification (enzymatic, tecturation)	
3	The students should be able to understand the food fortification method	• Accuracy in explaining the food fortification methods	Technical: Criteria:	Lecture [TM: 1×(3×50’)]		• Milk and the processed product	
4,5	The students should be able to understand the food fortification method	• Accuracy in explaining the egg fortification and the processed products	Technical: Quiz 2 Criteria:	Lecture [TM: 1×(3×50’)]		• Egg and the processed product	15
6	The students should be able to understand the food fortification method	• Accuracy in explaining the meat fortification	Technical: Criteria:	Lecture [TM: 1×(3×50’)]		• Meat and the processed product	

		and the processed products					
7	The students should be able to understand the food fortification method	• Accuracy in explaining the fruits fortification and the processed products	Technical: Criteria:	Lecture [TM: 1×(3×50')]		• Fruit and the processed product	
8	Mid Semester Evaluation						20
9	The students should be able to understand the food fortification method	• Accuracy in explaining the vegetables fortification and the processed products	Technical: • Criteria:	Lecture [TM: 1×(3×50')]		• Vegetables and the processed product	
10,11	The students should be able to understand the food fortification method	• Accuracy in explaining the drink fortification and seasoning	Technical: Criteria:	Lecture [TM: 2×(3×50')]		• Seasoning, drink product (tea, coffee, chocolate, alcohol)	
12,13	The students should be able to understand the study case	• Accuracy in understanding the study case	Technical: Criteria:	Presentation [TM: 2×(3×50')]		• Study case	15
14,15	The students should be able to completing the food fortification micro project	• Completing the food fortification micro project	Technical: Micro project Criteria:	Discussion, practice [TM: 1×(3×50')] Presentation [TM: 1×(3×50')]		• Micro projects	25
16	End Semester Evaluation						10



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				
BIOASSAY		SK 185334	Biochemistry	3	0	III	2 March 2021				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program					
		Adi Setyo Purnomo, MSc, PhD; Sri Fatmawati, MSc, PhD		Adi Setyo Purnomo, MSC, PhD.		Prof. Dr. Didik Prasetyoko, M. Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to the Courses										
	B.1 (LO 2)	Show a spirit of independence, team work, leadership and entrepreneurship									
	C.4 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right intrument and the substance side effect in order to develop the chemistry									
	D.2 (LO 9)	Able to build a chemical knowledge especially in the energy, enviromental, marine and medical in order to develop the research, industry and empolymnt									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Able to understand the principles and types of bioassay, performing bioassay and completing the given study case									
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 subject covers the principles, types, and bioassay techniques.									
Study Material: Subject matter		Bioassay principles, types of bioassay, bioassay techniques, and antimicrobial and antioxidants.									

References		Primary:					
		Methods in Natural Product Research and Drug Development”, Springer Verlag, 1999 L. Bohlin, J.G. Bruhn (editor), “Bioassay.					
		Secondary:					
		The related article/journal					
Lecturer		Adi Setyo Purnomo, MSc, PhD; Sri Fatmawati, MSc, PhD					
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 understand the principal and types of bioassay	• Accuracy in explaining the principal of bioassay	Technical: Criteria:	Lecture [TM: 2×(3×50’)]		• Lecture contract, principal of bioassay	
3	The students should be able to understand the principal and types of bioassay	• Accuracy in explaining the types of bioassay	Technical: Criteria:	Lecture [TM: 1×(3×50’)]		• The types of bioassay	
4,5	The students should be able to understand the principal and types of bioassay	• Accuracy in explaining the techniques of bioassay	Technical: Quiz 1 Criteria:	Lecture [TM: 2×(3×50’)]		• The techniques of bioassay	15
6,7	The students should be able to understand the principal and types of bioassay	• Accuracy in explaining the microbial bioassay	Technical: Criteria:	Lecture [TM: 2×(3×50’)]		• Antioxidant	

8	Mid Semester Evaluation						20
9-10	The students should be able to understand the principal and types of bioassay	• Accuracy in explaining the antioxidant bioassay	Technical: Criteria: •	Lecture [TM: 2×(3×50')]		• Antimicrobial	
11,12	The students should be able to understand the study case	• Accuracy in understanding the study case	Technical: Criteria:	Presentation [TM: 2×(3×50')]		• Study case	15
13-15	The students should be able to understand and doing the bioassay	• Completing the micro project	Technical: Microproject Criteria:	Discussion and practice [TM: 2×(3×50')] Presentation [TM: 1×(3×50')]		• Micro project	25
16	End Semester Evaluation						25



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CHEMISTRY DEPARTMENT

**Document
Code**

SEMESTER LEARNING PROGRAMME

COURSE (MK)		CODE	Course Diciplines (RMK)	Semester Credit Units		SEMESTER	Compilation Date				
SURFACE STRUCTURE AND ANALYSIS		SK 185341	Physical Chemistry	3	0	III	2 March 2021				
AUTHORIZATION / LEGALIZATION		RPS Development Lecturer		RMK Coordinator		Head of Study Program					
		Dr. Ir. Endah Mutiara M.P., MSi; Nurul Widiastuti, PhD; Dr. Yuly Kusumawati, S.Si., M.Si		Dr. Hendro Juwono, M.Si.		Prof. Dr. Didik Prasetyoko, M. Sc.					
Learning Outcomes (LO)	LO-PRODI Charged to the Courses										
	C.1 (LO 4)	Able to provide alternative solutions armed with leadership attitudes, creativity and communciation skills at the national/intarnationa level through a research object									
	C.4 (LO 7)	Able to develop concepts, theories and methods on the analysis and synthesis of chemical substances by consider the right intrument and the substance side effect in order to develop the chemistry									
	D.1 (LO 8)	Able to create a chemical mindset and take advantage of science and technology in their fields in solving problems through the acurate and inovative theoretical, -experimental or -computational approach									
	D.2 (LO 9)	Able to build a chemical knowledge especially in the energy, enviromental, marine and medical in order to develop the research, industry and empolymnt creation									
	Course Learning Outcomes (LO MK)										
	LO MK 1	Mastering the theoretical concepts and functions of instruments used to characterize material structures on the surface.									
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		-					
Study Material: Subject matter		Definitions, properties and their phenomenons on the surface, surface morphology and hardness, molecule interactions on the surface using electromagnetic waves, spectroscopy analysis on the surface (FTIR, LEED, RHEED, SIMS, XPS, AES), imaging analysis on the surface (SEM, TEM, AFM, STM), surface contact angle analysis.					
References		Primary:					
		Secondary:					
		1.					
Lecturer		Dr. Ir. Endah Mutiara M.P., MSi; Nurul Widiastuti, PhD; Dr. Yuly Kusumawati, S.Si., M.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)
1-2	The students should be able to explain the definition of surface and the difference of properties/phenomena from bulky state of materials	Accuracy in explaining the definition of surface and the difference of properties/phenomena from bulky state of materials	Technical: Quiz Criteria:	Lecture and discussion [TM: 4×(2×50')]		Definition, properties and phenomena of surface	3
3	The students should be able to explain and analyze the parameter that influence the morphology and the roughness of surface	Accuracy in explaining, creativity in writing and presentation, group cohesiveness	Technical: Criteria:	Discussion [TM: 2×(2×50')]		the parameter that influence the morphology and the roughness of surface	3

4	The students should be able to explain the surface molecular interaction with the electromagnetic wave	Accuracy in explaining surface molecular interaction with the electromagnetic wave	Technical: Quiz Criteria:	Lecture, discussion [TM: 2×(2×50')]		Surface molecular interaction with the electromagnetic wave	3
5	The students should be able to explain the concept and analyze the result from FTIR characterization on the surface materials	Accuracy in explaining concept and analyze the result from FTIR characterization on the surface materials	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 2×(2×50')]		Surface spectroscopy analysis : FTIR	3
6,7	The students should be able to explain the concept and analyze the result from surface diffraction characterization : XRD, LEED< RHEED	Accuracy in explaining the concept and analyze the result from surface diffraction characterization : XRD, LEED< RHEED	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 4×(2×50')]		Surface spectroscopy analysis : Diffraction	3
8	Mid Semester Evaluation						20
9	The students should be able to explain the concept and analyze the result from characterization with XPS and AES	Accuracy in explaining the concept and analyze the result from characterization with XPS and AES	Technical: Quiz, assignment, presentation Criteria: •	Lecture, discussion [TM: 2×(2×50')]		Surface spectroscopy analysis II: XPS and Auger Electron	3
10	The students should be able to explain the concept and analyze the result from characterization with Secondary Ion Mass Spectroscopy	Accuracy in explaining the concept and analyze the result from characterization with	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 2×(2×50')]		Surface spectroscopy analysis II: Secondary Ion Mass Spectroscopy	2

		Secondary Ion Mass Spectroscopy					
11,12	The students should be able to explain the concept and analyze the result from characterization with SEM and TEM	• Accuracy in explaining the concept and analyze the result from characterization with SEM and TEM	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 4×(2×50')]		• Surface imaging analysis I : SEM and TEM	3
13	The students should be able to explain the concept and analyze the result from characterization with STM	• Accuracy in explaining the concept and analyze the result from characterization with STM	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 2×(2×50')]		Surface imaging analysis II : STM	2
14	The students should be able to explain the concept and analyze the result from characterization with AFM	• Accuracy in explaining the concept and analyze the result from characterization with AFM	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 2×(2×50')]		Surface imaging analysis III : AFM	2
15	The students should be able to explain the concept and analyze the result from contact angle with statically and dynamically to determine the change of surface mechanism phenomena	• Accuracy in explaining concept and analyze the result from contact angle with statically and dynamically to determine the change of surface mechanism phenomena	Technical: Quiz, assignment, presentation Criteria:	Lecture, discussion [TM: 2×(2×50')]		• Analysis of static analysis and dynamic of surface contact angle	3

16	End Semester Evaluation	20
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Study Material: Subject matter		Membrane materials; membrane processes such as microfiltration, ultrafiltration, reverse osmosis, pervaporation, dialysis, gas separation, as well as their applications in the field of energy, environment, health, and food; membrane synthesis methods review, by using either inorganic membranes or organic polymer membranes; study case on separation and purification problems; literature study in developing synthesis methods on membrane materials in giving an alternative solution in separation and purification; review conclusions on synthesis methods on membrane materials in giving solutions to a problem.					
References		Primary:					
		Secondary:					
Lecturer		Nurul Widiastuti, PhD					
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 explain the definition of membrane materials (C2)	Report of literature study	Technical: Personal assignment 1 : Literature study of one type of membrane materials Criteria:	Lecture [TM: 2×(2×50')]		Membrane materials : polymer, inorganic, mixed matrix membrane	5

3-5	The students should be able to explain the correlation between the synthesis process and the properties of the membrane (C3)	Resume	Technical: Personal assignment 2 : Writing resume of one membrane materials and the synthesis process from literature study Criteria:	Lecture, discussion [TM: 2×(2×50')]		Process of membrane synthesis : ultrafiltration, reverse osmosis, pervaporation, dialysis, gas separation and its application in the sector of energy, environment, medical and food.	5
6,7	The students should be able to write literature review of membrane synthesis method(C4)	Writing review paper	Technical: Personal assignment 3 : Writing literature review of membrane synthesis method related with assignment 2 Criteria:	Lecture, discussion [TM: 2×(2×50')]		Review of membrane synthesis method (inorganic membrane, organic polymer membrane)	10
8	Mid Semester Evaluation						15
9,10	The students should be able to analysis the problem of separation and purification (C4)	Study case analysis	Technical: Personal assignment 4 : Study case analysis	Lecture, discussion [TM: 2×(2×50')]		Study case analysis of separation and purification	5

			Criteria: •				
11,12	The students should be able to arrange the idea for the development of membrane synthesis method (C5)	• Draft of scientific article	Technical: Personal assignment 5 : The draft of scientific article related to the idea of membrane synthesis method Criteria:	Lecture, discussion [TM: 2×(2×50')]		• Literature study of the material membrane synthesis method development for an alternative in separation and purification	5
13,14	The students should be able to recommend the membrane synthesis method from literature study (C5)	• Presentation of final project	Technical: Presentation, personal assignment of final project Criteria:	Lecture, discussion [TM: 2×(2×50')]		• Recommendation of membrane synthesis/preparation based on literature study	20 25
15,16	End Semester Evaluation						15

Study Material: Subject matter		The fundamentals of carbon materials, carbon materials engineering and applications, carbon materials for advanced technologies.					
References		Primary:					
		1. Michio Inagaki dan Kang Feiyu, “Carbon Materials Science and Engineering from Fundamental to Applications”, 2006, Tsinghua University Press					
		Secondary:					
		2. Timothy D. Burchell, “Carbon Materials for Advanced Technologies”, 1999, Pergamon, Amsterdam					
Lecturer		Nurul Widiastuti, PhD; Lukman Atmaja, 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 explain the structure and texture of carbon materials	Accuracy in explaining the structure and texture of carbon materials	Technical: Ability to explain the structure and texture of carbon materials in discussion and writing. Criteria:	Lecture and discussion [TM: 2×(2×50’)]		- Fundamental of carbon materials: The bonding of carbon-carbon, group of carbon, correlation of carbon with the neighboring atom - The structure of carbon materials, nano-texture and micro-texture (agglomeration)	Include mid-semester evaluation

3-5	The students should be able to develop the structure and pore of carbon materials	• Accuracy in analysis (assessed in rubric system)	Technical: Ability to analysis : completing the assesment of development structure and pore, modify the structure of carbon materials (presentation and discussion) Criteria:	Lecture and discussion [TM: 3×(2×50')]		• Development of structure of carbon with thermal treatment (carbonization and graphitization) • Development of carbon materials nanostructure • New technique for carbonization • Development of materials carbon structure • Acceleration of graphitization • Development of carbon pore materials • Modification of carbon materials	20
6,7	The students should be able to manipulating the carbon structure	• Accuracy in analysis (assessed in test and writing)	Technical: Ability to analysis : completing the assesment of development structure and pore, modify the structure of carbon materials (presentation and discussion)	Lecture and discussion [TM: 2×(2×50')]		• Manipulation of carbon structure: polyglass like carbon, crystalline block graphite, high-oriented-graphite, non-graphitizing, glass-like carbon, carbon fiber, porous carbon, composite based on carbon	Include mid-semester evaluation

			Criteria:				
8	Mid Semester Evaluation						20
9,10	The students should be able to develop the structure and texture of carbon materials from coal, biomass and waste	•	Technical: Criteria: •	Lecture and discussion [TM: 2×(2×50')]		• Carbon derived from coal • Activated carbon from biomass and biomass waste	Include final-semester evaluation
11	The students should be able to correlate the manipulation structure and the texture of carbon materials with the application.	• Discussion • Presentation • Reviewing paper (assesment with rubic system)	Technical: Ability to evaluate the result of literature study and find the idea to develop the research Criteria:	Lecture and discussion [TM: 1×(2×50')]		• Intercalation compund: high conductivity compound, electrochemical function, catalytic function, gas adsorption, gas storage • Carbon materials for environmental remediation	10 10 20
12-14	The students should be able to design the structure and texture of carbon materials for advanced technology	•	Technical: Criteria:	Study case [TM: 3×(2×50')]		• Carbon materials for otomotif application • Carbon materials for energy storage • Adsorbent for natural gas vehicle storage • Adsorption in refrigerator and heat pump	

						• Carbon for lithium battery • Carbon for fusion energy application • Carbon for fision reactor application	
15,16	End Semester Evaluation						20

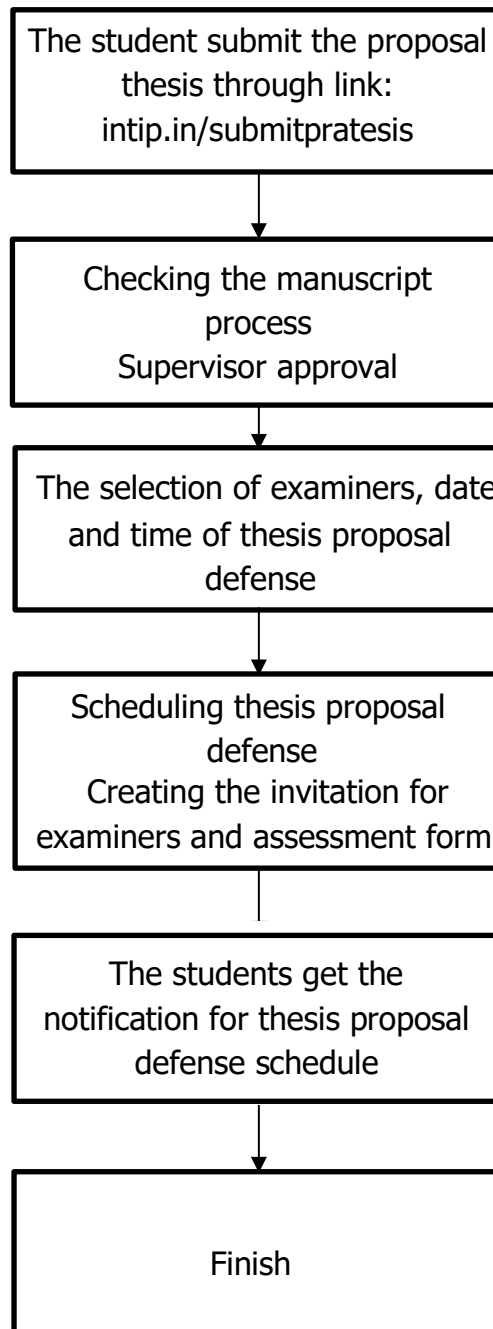


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FACULTY OF SCIENCE AND DATA ANALYTICS
CHEMISTRY DEPARTMENT

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: kimia@its.ac.id, <http://www.its.ac.id/kimia>

SOP FOR THESIS PROPOSAL DEFENSE SUBMISSION



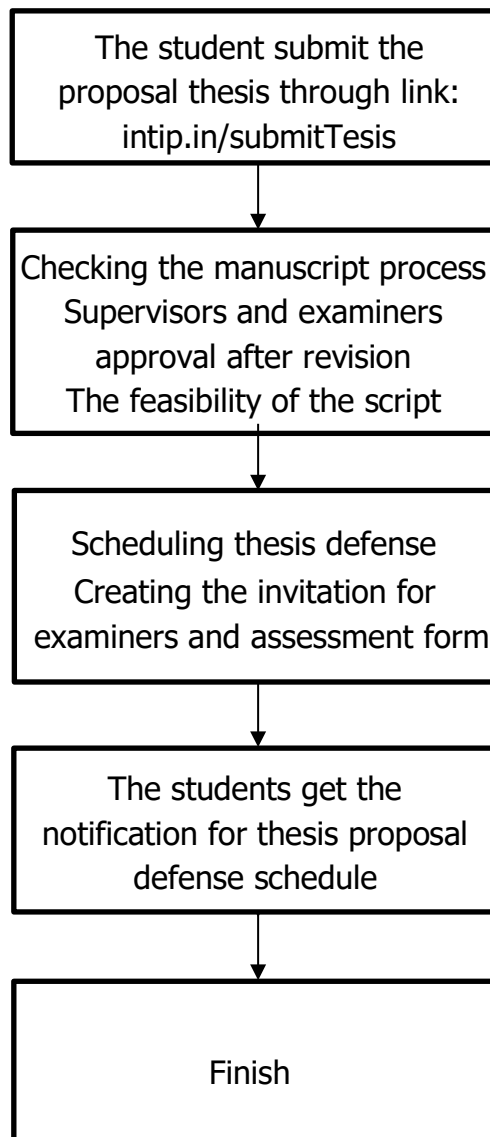


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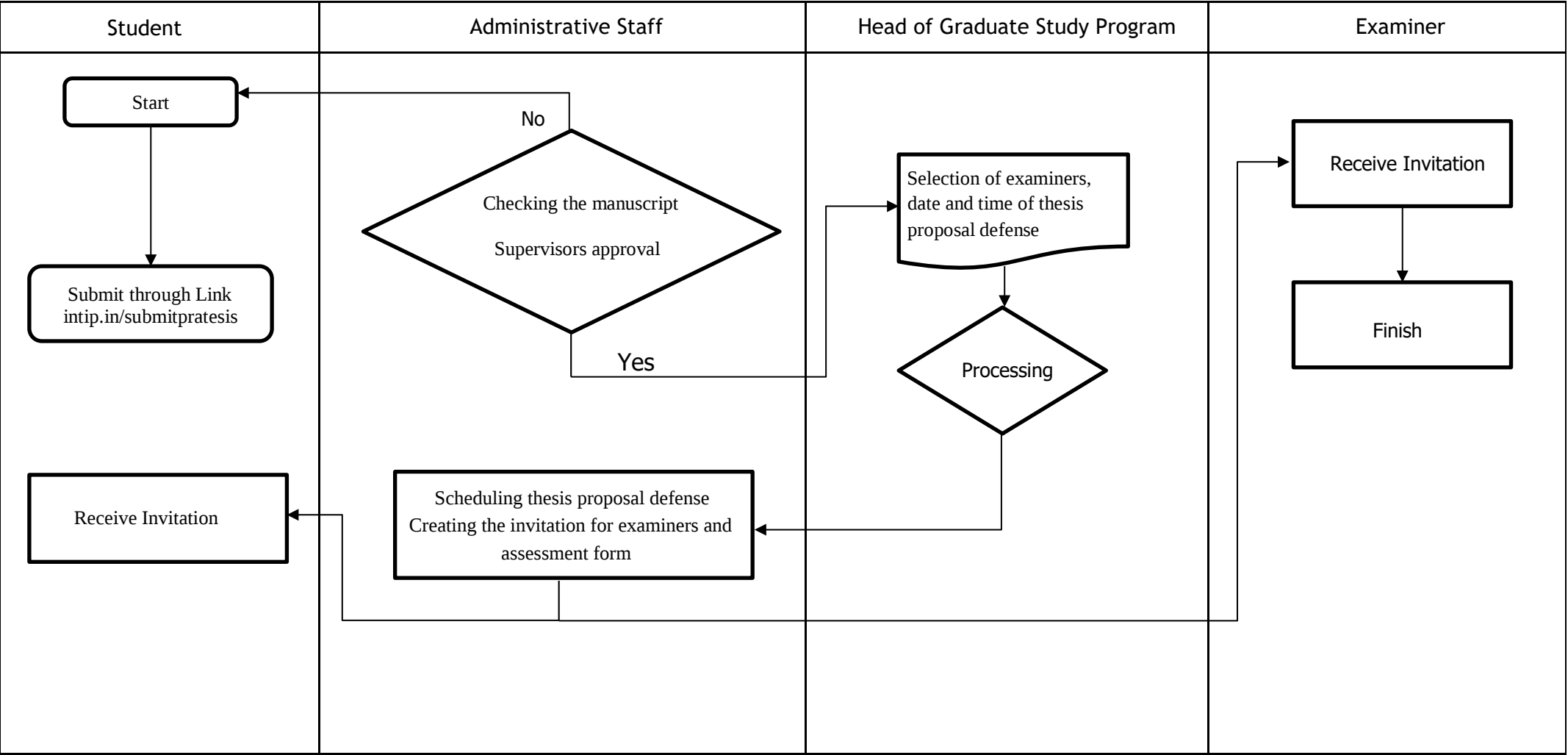
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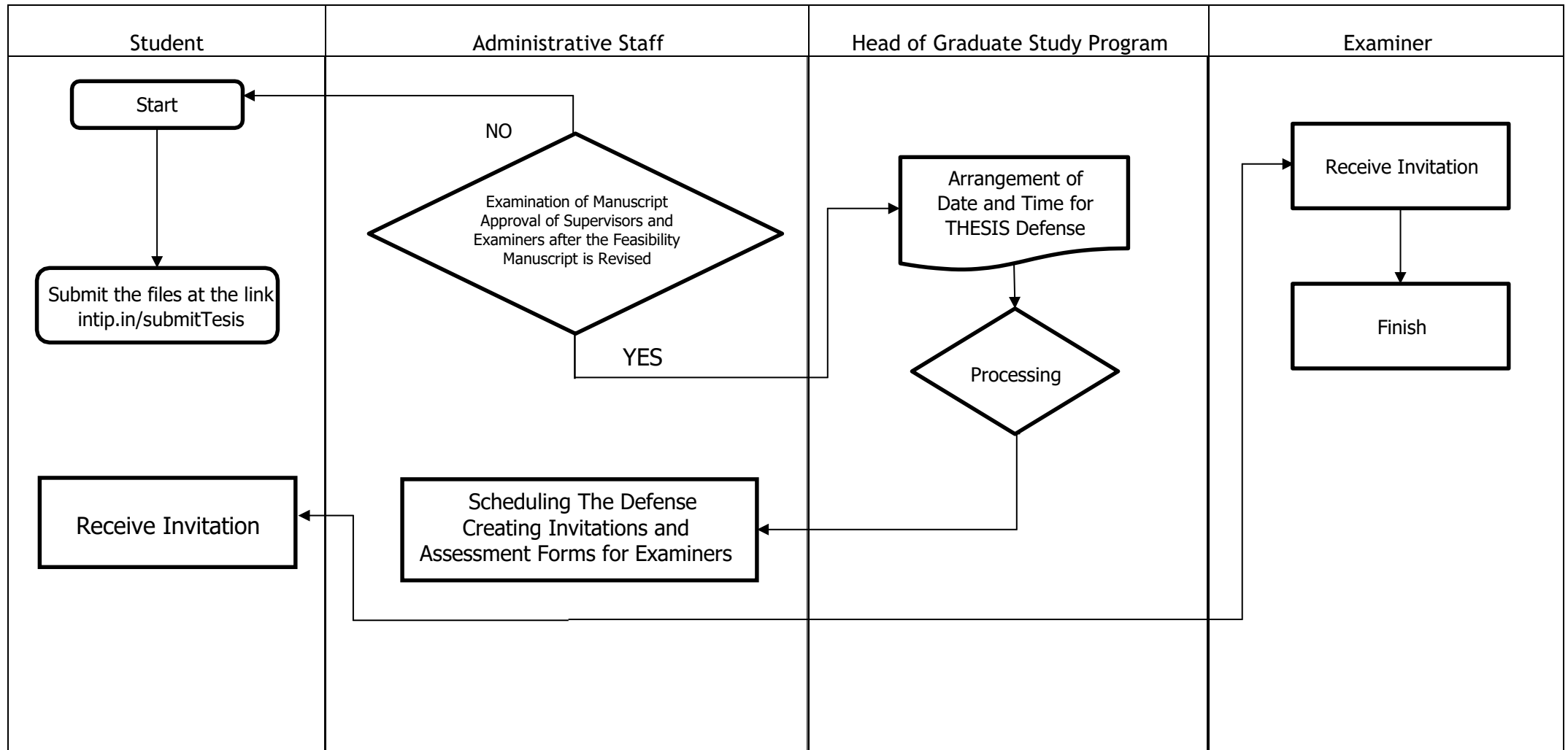
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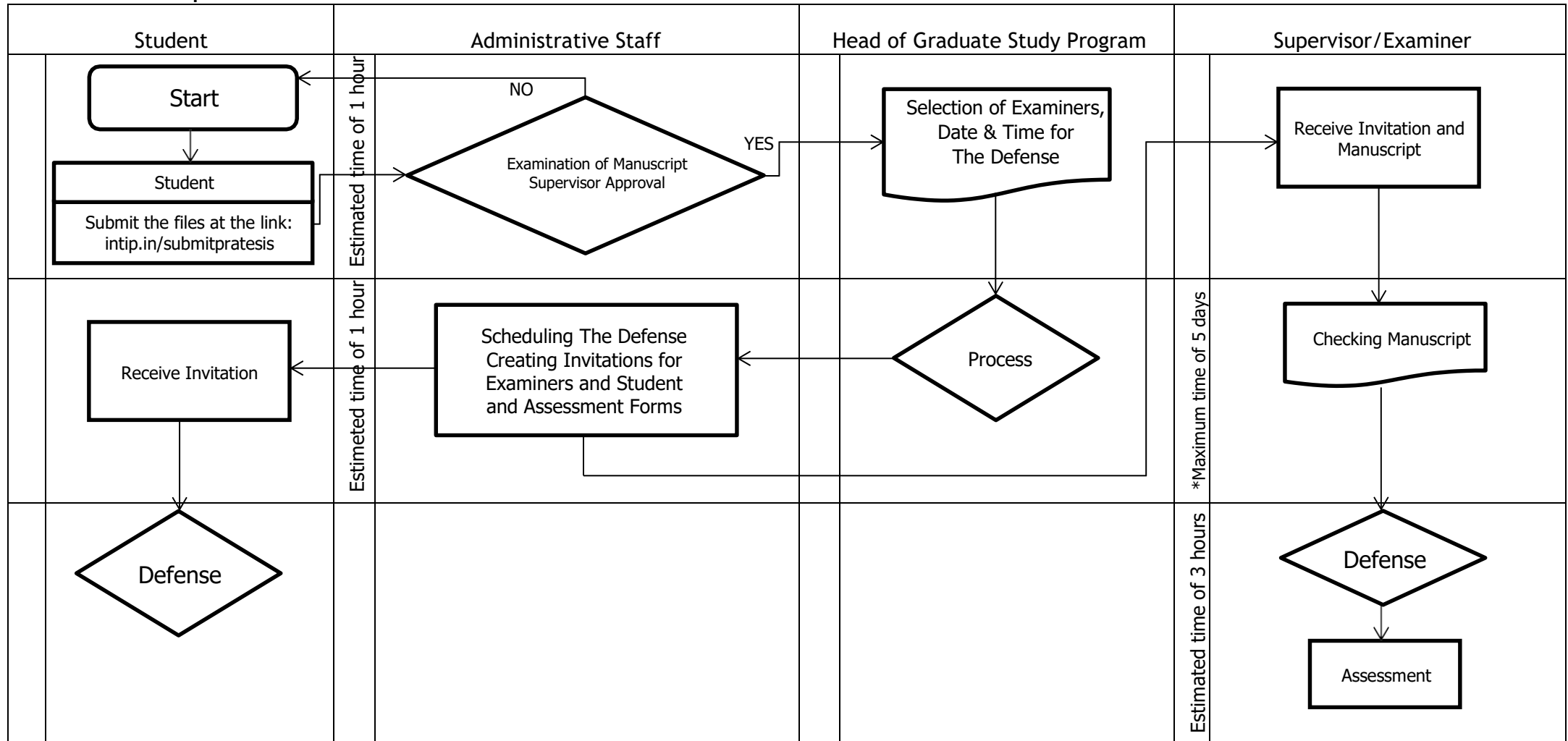
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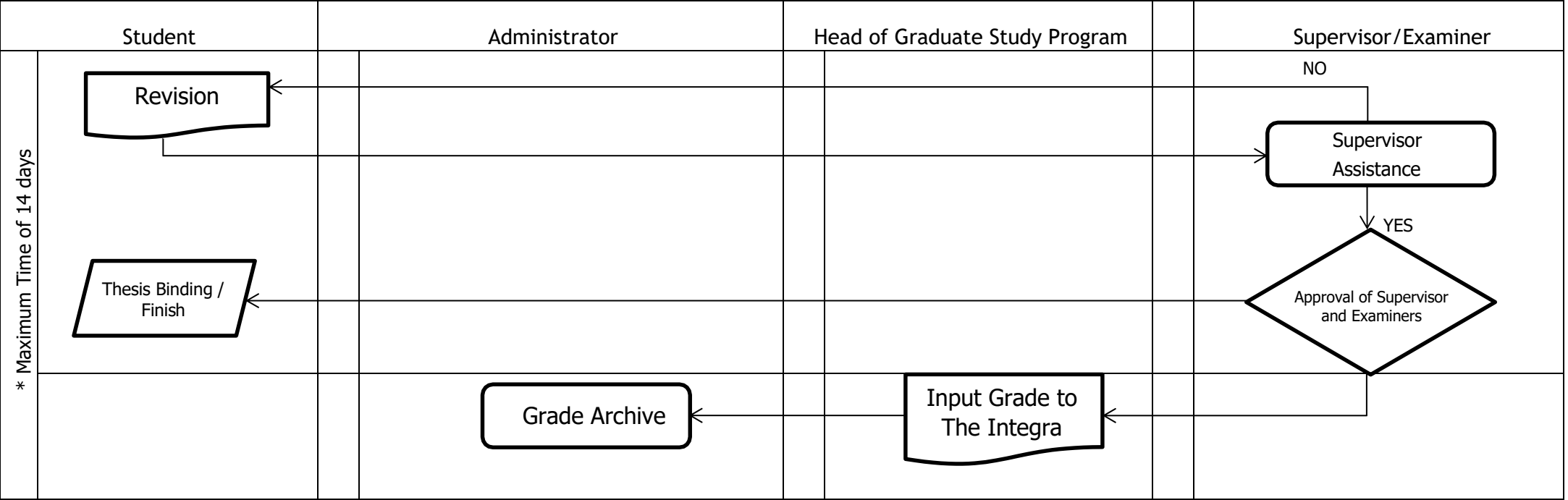


SOP for THESIS Submission



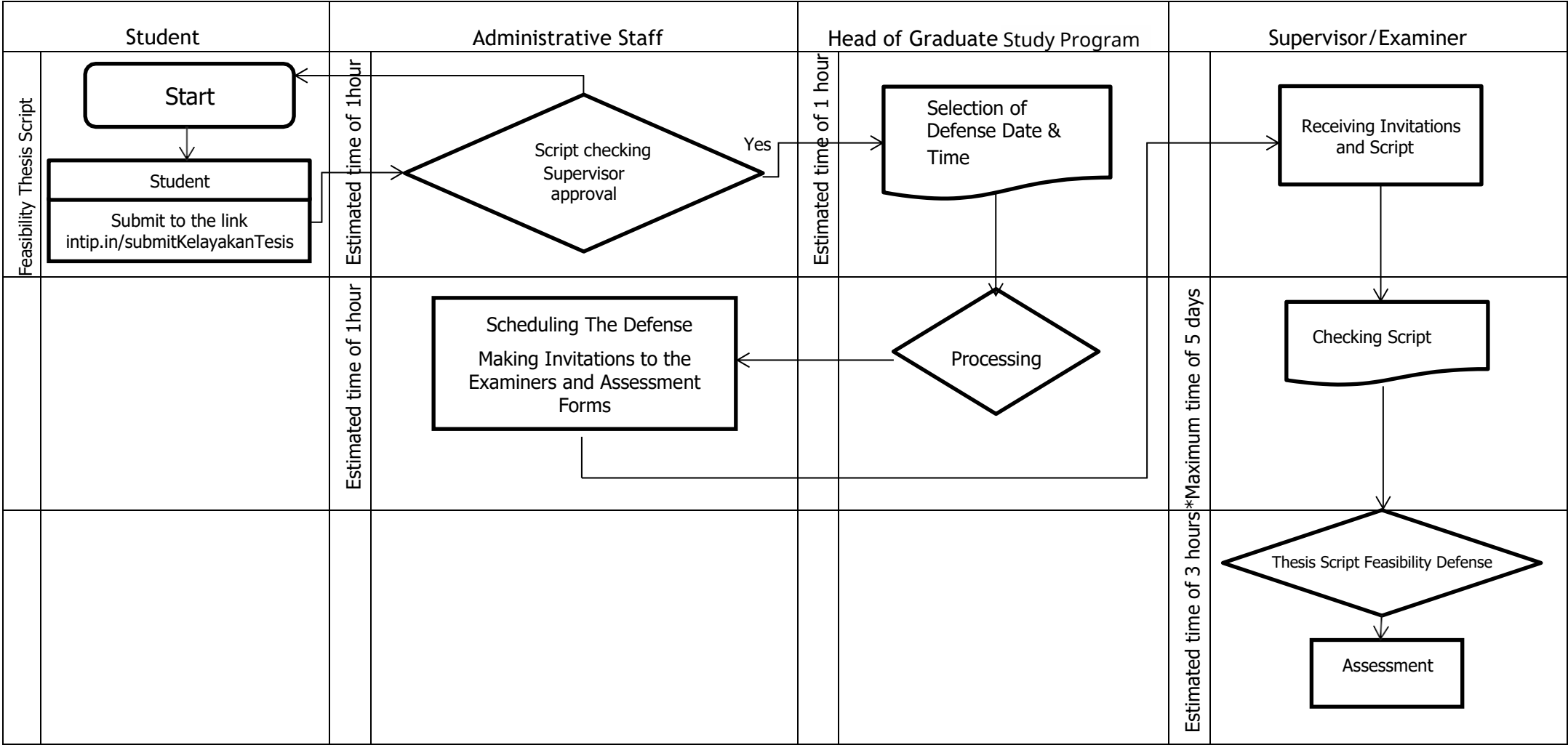
SOP for Thesis Proposal Defense

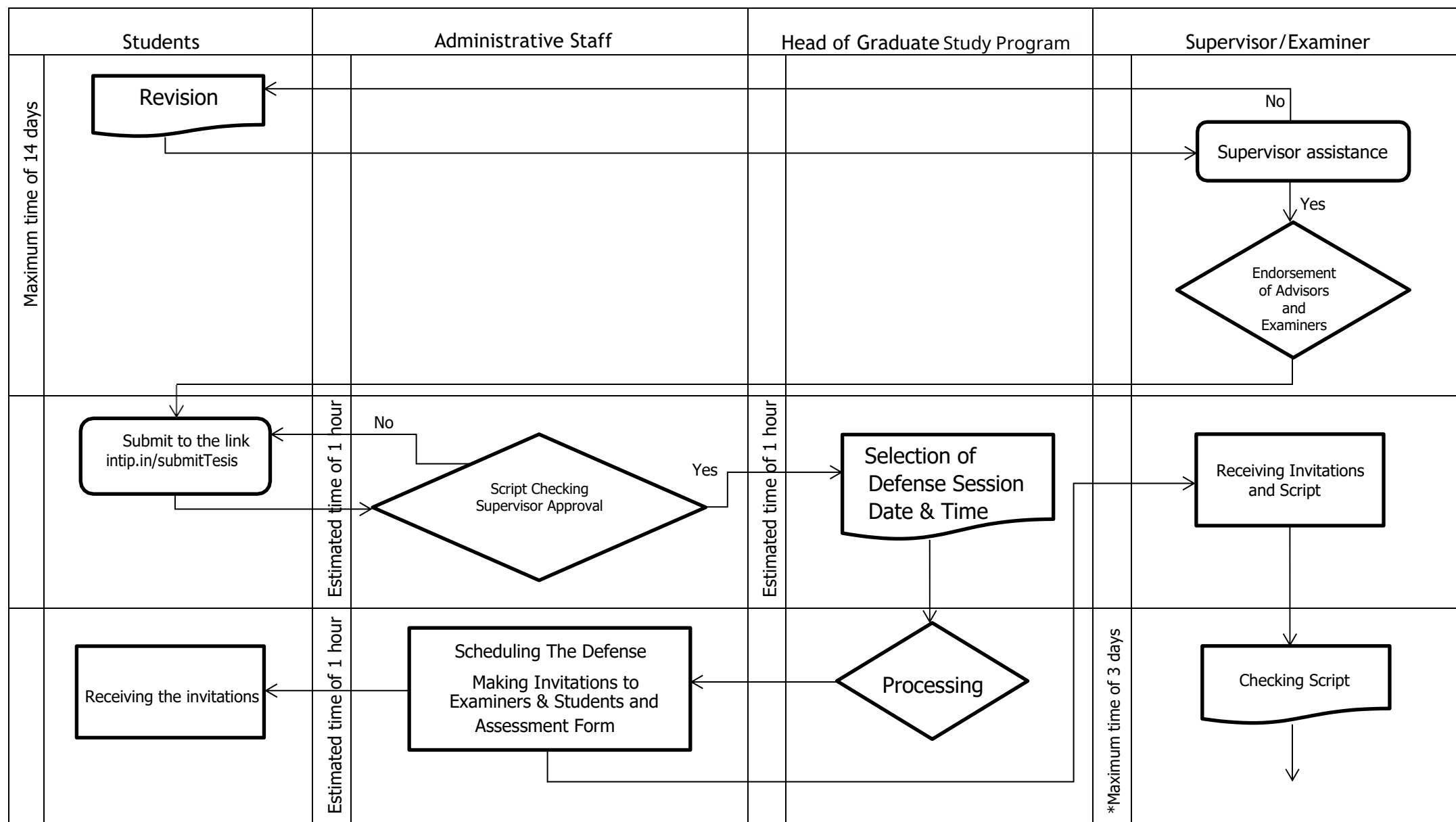


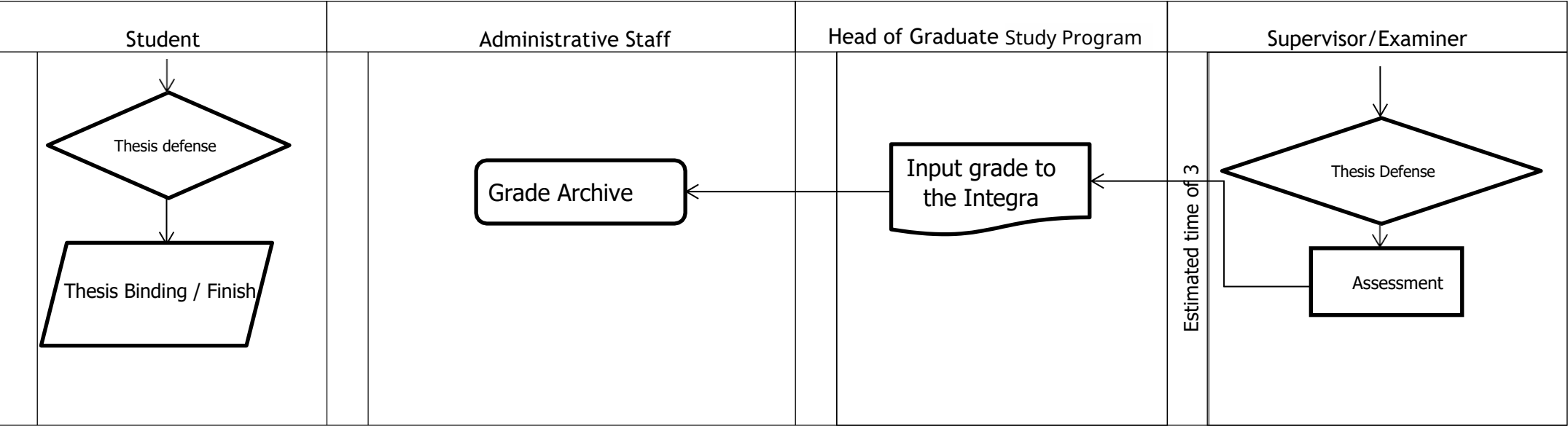


- * If the process exceeds the maximum limit, the proposal trial is repeated
- * During the proposal defense, revised points should be written in the defense official report
- * Submission Scheme using Approval
- * The total time required in this cycle is 28 days

SOP of Thesis Defense







- * At the time of the feasibility defense session, points to be corrected are written in the defense session minutes
- * Application flow using Approval
- * The topic in the thesis defense can be different from the topic in the proposal thesis defense
- * The time interval between the pre-test defense and the thesis defense is at least 2 months



THIS SECTION EXPLAIN
THE THESIS WRITING TEMPLATE

TESIS - SK185401

JUDUL JUDUL JUDUL JUDUL JUDUL JUDUL
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NAMA MAHASISWA
0121000000000

DOSEN PEMBIMBING
Prof. Dr. Nama Pembimbing, S.Si., M.Sc.

PROGRAM MAGISTER
BIDANG KEAHLIAN KIMIA
DEPARTEMEN KIMIA
FAKULTAS SAINS DAN ANALITIKA DATA
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA



THESIS - SK185401

RESEARCH TITLE

NAME

0121000000000

SUPERVISOR

Prof. Dr. Nama Pembimbing, S.Si., M.Sc.

MAGISTER PROGRAM

..... CHEMISTRY

CHEMISTRY DEPARTMENT

FACULTY OF SCIENCE AND DATA ANALYTICS

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

SURABAYA

2020

LEMBAR PENGESAHAN TESIS

Tesis disusun untuk memenuhi salah satu syarat memperoleh gelar
Magister Sains (M.Si.)

di

Institut Teknologi Sepuluh Nopember

Oleh:

NAMA MAHASISWA

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ABSTRAK

Pengembangan sintesis bahan mikropori saat ini memprioritaskan konsep kimia ramah lingkungan atau *green chemistry*. Untuk mengurangi dampak penggunaan bahan kimia, kaolin Bangka digunakan sebagai bahan baku alami alternatif yang memiliki toksisitas rendah, harga murah, dan kelimpahan tinggi. Sintesis zeolit NaA dari kaolin Bangka dimulai dengan aktivasi melalui kalsinasi pada suhu 650°C selama 2 jam. Aktivasi ini menghasilkan metakaolin dengan fasa amorf sebagaimana yang ditunjukkan oleh pola difraksi sinar-X. Hasil analisis dengan XRF menunjukkan bahwa metakaolin yang dihasilkan dari perlakuan termal sebagian besar terdiri dari Si dan Al dengan rasio Si/Al=1,38 dan komponen logam minor lainnya. Komposisi metakaolin tersebut sesuai untuk digunakan sebagai sumber untuk sintesis zeolit NaA. Sintesis zeolit NaA dilakukan dengan cara mencampurkan metakaolin dan larutan NaOH dengan perbandingan 1g/25mL, diikuti dengan kristalisasi pada suhu 100°C selama 24 jam. Sampel padatan dipisahkan melalui filtrasi. Filtrat yang dihasilkan digunakan kembali untuk sintesis zeolit NaA diikuti dengan penambahan metakaolin. Konsentrasi NaOH awal divariasikan 2, 3, 4, 5, dan 6 M dan kristalisasi dilakukan pada suhu dan waktu konstan yaitu 100°C dan 24 jam.

Kata kunci : kaolin, sintesis, zeolit NaA, filtrat, penggunaan kembali

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ABSTRACT

The development of the micropore materials synthesis is currently prioritizing the concept of environmentally friendly chemical process or green chemistry. To reduce the impact of using chemicals, Bangka kaolin is used as an alternative natural raw material that has low toxicity, low prices, and high abundance. Synthesis of NaA zeolite from Bangka kaolin begins with activation through calcination at 600°C for 2 hours. This activation produces an amorphous metakaolin as shown by the XRD pattern. Based on the results of the XRF technique, metakaolin produced from thermal treatment consists mainly of Si and Al with a ratio of Si/Al=1.38 and other minor metal components. The metakaolin composition is suitable for use as a source for the synthesis of NaA zeolite. Synthesis of NaA zeolite was done by mixing metakaolin and NaOH solution at a ratio of 1g/25mL, followed by crystallization at 100°C for 24 hours. Solid samples are separated by filtration. The resulting filtrate was reused for the subsequent synthesis of NaA zeolite with the addition of metakaolin. The initial NaOH concentration varied 2, 3, 4, 5, and 6 M and crystallization were carried out at a constant temperature and time of 100°C and 24 hours respectively. The synthesis product was characterized by FTIR, XRD, and SEM spectroscopy. Optimal results with the highest levels of purity, crystallinity, and CBC values reaching 339.7 meq / 100g are obtained by the sample synthesized from the first stage filtrate with an initial NaOH concentration of 3 M.

Keywords: kaolin, synthesis, zeolite NaA, filtrate, reuse

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CONTOH

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CONTOH

BAB 1

PENDAHULUAN

1.1 Latar Belakang

Zeolit NaA ($\text{Na}_{12}\text{Al}_{12}\text{Si}_{12}\text{O}_{48} \cdot 27\text{H}_2\text{O}$) adalah senyawa aluminosilikat berpori dengan berbagai sifat yang sangat baik, seperti tidak beracun, porositas tinggi, stabilitas termal pada suhu tinggi, kemampuan pertukaran ion tinggi, saringan molekuler fungsional, dan ramah lingkungan (Su dkk., 2016). Berbagai keunggulan sifat tersebut menjadikan zeolit NaA digunakan secara luas dalam berbagai aplikasi industri maupun rumah tangga. Dalam industri deterjen, zeolit NaA berfungsi sebagai pelunak air, adsorben untuk mengurangi kadar air dan penukar ion (Ayele dkk., 2016). Selain itu zeolit NaA juga digunakan sebagai adsorben gas atau adsorben logam berat (Feng dkk., 2018; Wang dkk., 2018; Zayed dkk., 2017), sebagai katalis (Ng dkk., 2017) dan sebagai bahan membran (Liu dkk., 2020; Shihzian & Ashrafzadeh, 2015).

1.2 Rumusan Masalah

Pada sintesis zeolit NaA dari kaolin, dihasilkan filtrat sebagai sisa penyaringan padatan zeolit yang dihasilkan. Umumnya filtrat sisa sintesis dibuang sebagai limbah, padahal menurut Lin dkk. (2015) yang telah melakukan sintesis zeolit NaA dari bahan baku abu layang, konsentrasi alkalin yang ada pada filtrat tidak jauh berkurang dari konsentrasi alkalin awal. Untuk mengurangi limbah yang dihasilkan dalam proses sintesis, maka filtrat digunakan kembali sebagai bahan untuk sintesis selanjutnya. Potensi penggunaan filtrat dipelajari dengan mengoptimasi konsentrasi awal NaOH yang digunakan untuk sintesis, tahap penggunaan ulang filtrat, dan rasio metakaolin yang ditambahkan terhadap filtrat. Konsentrasi awal NaOH divariasikan dari 2; 3; 4; 5; dan 6 M dan penggunaan ulang filtrat dilakukan hingga 3 kali.

1.3 Tujuan

Penelitian ini bertujuan untuk :

1. Memperoleh material zeolit NaA yang disintesis menggunakan kaolin Bangka dari filtrat hasil sintesis sebelumnya dengan variasi NaOH awal,

tahap pengulangan penggunaan (*reuse*) filtrat, waktu *aging*, dan suhu kristalisasi.

2. Menentukan karakteristik zeolit NaA yang dihasilkan meliputi struktur, kristalinitas, morfologi, serta nilai *CBC*.

1.4 Batasan Masalah

Batasan masalah pada penelitian ini adalah optimasi beberapa parameter dalam sintesis zeolit NaA dari kaolin Bangka menggunakan filtrat sisa sintesis sebelumnya terhadap karakteristik material yang dihasilkan. Variasi yang digunakan adalah konsentrasi NaOH awal, tahap pengulangan penggunaan (*reuse*) filtrat, waktu *aging*, dan suhu kristalisasi.

1.5 Manfaat Penelitian

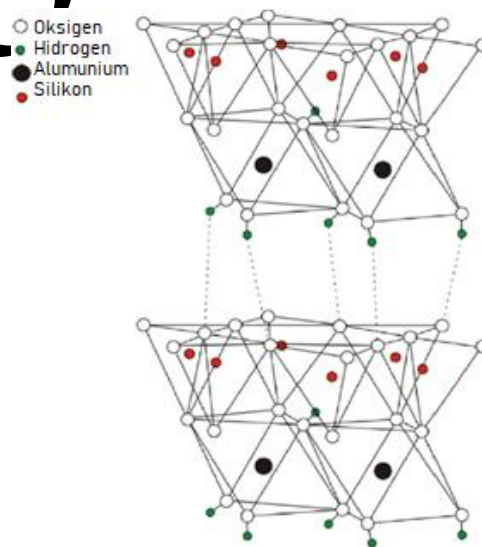
Manfaat dari penelitian ini adalah untuk memberikan informasi mengenai penggunaan kembali filtrat pada proses sintesis zeolit NaA dari kaolin Bangka, serta pengembangan ilmu pengetahuan dan teknologi tentang metode sintesis material dengan metode ramah lingkungan.

BAB 2

KAJIAN PUSTAKA

2.1 Kaolin

Komponen utama dari kaolin adalah kaolinit. Kaolin utamanya terbentuk dari dekomposisi feldspar, granit, dan aluminium silikat atau secara umum melalui proses pelapukan. Proses pembentukan kaolin disebut kaolinisasi. Kaolin dapat ditemukan dalam warna putih, abu muda, atau sedikit berwarna. Struktur kaolinit terdiri dari lapisan silika tetrahedral dan aluminium oktahedral secara berselang-seling, yang membentuk lapisan mineral lempung dengan perbandingan 1:1 (Brigatti, 2013) sebagaimana ditunjukkan pada Gambar Error! No text of specified style in document..1. Lapisan yang berdekatan dihubungkan oleh gaya van der Waals dan ikatan hidrogen. Ikatan antar lapisan ini menginduksi akses terbatas ke grup aluminat interlamellar (Al-OH) yang dapat digunakan untuk reaksi. (Cheng dkk., 2012).



Gambar Error! No text of specified style in document..1 Struktur kaolinit (Cheng dkk., 2012)

Tabel **Error! No text of specified style in document..1**Perbandingan beberapa bahan baku alami untuk sintesis zeolit NaA

No	Bahan Baku Alami	Perlakuan	Kandungan (% berat)		Referensi
			SiO ₂	Al ₂ O ₃	
1	Chrysotile dan Abu sekam padi Brazil	Kalsinasi dan perlakuan asam	tanpa keterangan	tanpa keterangan	(Petkowicz dkk., 2008)
2	<i>Clinoptilolite tuffs</i> Iran	Pencucian	66,03	12,41	(Kazemian dkk., 2009)
3	<i>Halloysite</i> China	Alkali fusi	46,15	38,7	(Zhao dkk., 2010)
4	Kaolin Jordan	Kalsinasi	53,86	32,45	(Gougazeh and Buhl 2014)
5	Abu sekam padi	Kalsinasi	95,54	0,78	(Bohra dkk., 2014)
6	Abu daun bawang	Perlakuan asam, kalsinasi	7,09	0	(Ng dkk., 2017)
7	Abu layang	Alkali fusi	48,9	40,26	(Feng dkk., 2018)
8	<i>Coal gangue</i>	Alkali fusi	70,01	20,24	(Chen and Lu 2018)
9	<i>Coal fly ash</i>	Langsung	44,93	22,16	(Iqbal dkk., 2019)
10	Silika gel bekas dan sampah alumunium	Langsung	~100	~100	(El-Nahas dkk., 2020)

BAB 3

METODOLOGI PENELITIAN

3.1 Alat dan Bahan

3.1.1 Alat

Alat yang digunakan dalam penelitian ini antara lain peralatan gelas, *hotplate*, stirrer (pengaduk magnetik), tanur, oven, neraca analitik, termometer, instrumen *X-Ray Fluorescence*, *X-Ray Diffractometer* Phillips Expert, FTIR Shimadzu, Instrumen SEM-EDX Hitachi Flexsem 1000, dan AAS thermofischer.

3.1.2 Bahan

Bahan-bahan yang diperlukan dalam penelitian ini adalah kaolin Bangka, NaOH p.a (Merck), NaCl p.a (Merck), $\text{NaCl}_2 \cdot 2\text{H}_2\text{O}$ p.a (Ajax Chemical), kertas saring Whatman No.42 (Merck), dan air terdeionisasi (aqua DM).

3.2 Prosedur Sintesis

3.2.1 Aktivasi kaolin

Zeolit NaA disintesis dari kaolin dengan metode tanpa templat. Tahap awal dimulai dengan proses aktivasi kaolin melalui metode kalsinasi pada suhu 650°C selama 2 jam untuk membentuk fasa metakaolin yang bersifat lebih aktif. Metakaolin yang diperoleh kemudian dianalisis menggunakan XRF untuk mengetahui kandungan unsur yang terdapat di dalamnya dan menentukan rasio $\text{SiO}_2/\text{Al}_2\text{O}_3$ yang digunakan pada sintesis.

3.2.2 Sintesis zeolit NaA dari filtrat dengan variasi konsentrasi NaOH awal dan variasi tahap penggunaan kembali filtrat

Sintesis zeolit NaA membutuhkan larutan alkali sebagai prekursor sintesis yaitu sumber Na_2O . Sintesis dilakukan menurut metode yang digunakan oleh Gougazeh (2014). Penyiapan NaOH sebagai prekursor alkali dilakukan melalui pembuatan masing-masing sebanyak 500mL NaOH dengan konsentrasi 2 sampai 6M dengan cara melarutkan padatan NaOH menggunakan aqua DM. Selanjutnya 2 gram metakaolin ditambahkan pada 50 mL larutan NaOH masing-masing konsentrasi dengan rasio solid/liquid sebesar 1,0g/25mL sambil dilakukan pengadukan selama 15 menit pada suhu ruang. Campuran yang diperoleh kemudian dikristalisasi pada suhu 100°C selama 24 jam. Hasil sintesis disaring dengan

menggunakan penyaring Buchner dan filtrat yang diperoleh ditampung untuk digunakan sebagai prekursor alkalin dalam sintesis zeolit NaA tahap berikutnya. Padatan yang diperoleh dicuci dengan aqua DM hingga mencapai pH 8 dan dikeringkan pada suhu 100 °C selama 12 jam. Prosedur ini diulangi sampai penggunaan filtrat tahap 3. Padatan hasil sintesis dari larutan NaOH awal dinotasikan sebagai ZA, dan hasil sintesis dari filtrat dinotasikan dengan F. Variasi dilakukan dalam bentuk konsentrasi awal NaOH (x) dan tahap penggunaan ulang filtrat (y). Untuk lebih jelasnya tabel parameter sintesis ditampilkan pada Tabel **Error! No text of specified style in document..2.**

Tabel **Error! No text of specified style in document..2** Kode sampel sintesis dengan variasi konsentrasi NaOH awal dan tahap penggunaan kembali filtrat

Tahap Ulang Filtrat Konsentrasi NaOH	NaOH awal	Filtrat ke-1	Filtrat ke-2	Filtrat ke-3
2 M	ZA-2M	F1-2M	F2-2M	F3-2M
3 M	ZA-3M	F1-3M	F2-3M	F3-3M
4 M	ZA-4M	F1-4M	F2-4M	F3-4M
5 M	ZA-5M	F1-5M	F2-5M	F3-5M
6 M	ZA-6M	F1-6M	F2-6M	F3-6M

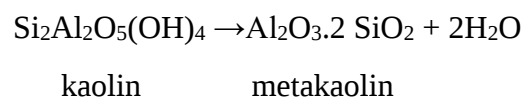
BAB 4

HASIL DAN PEMBAHASAN

4.1 Aktivasi Kaolin

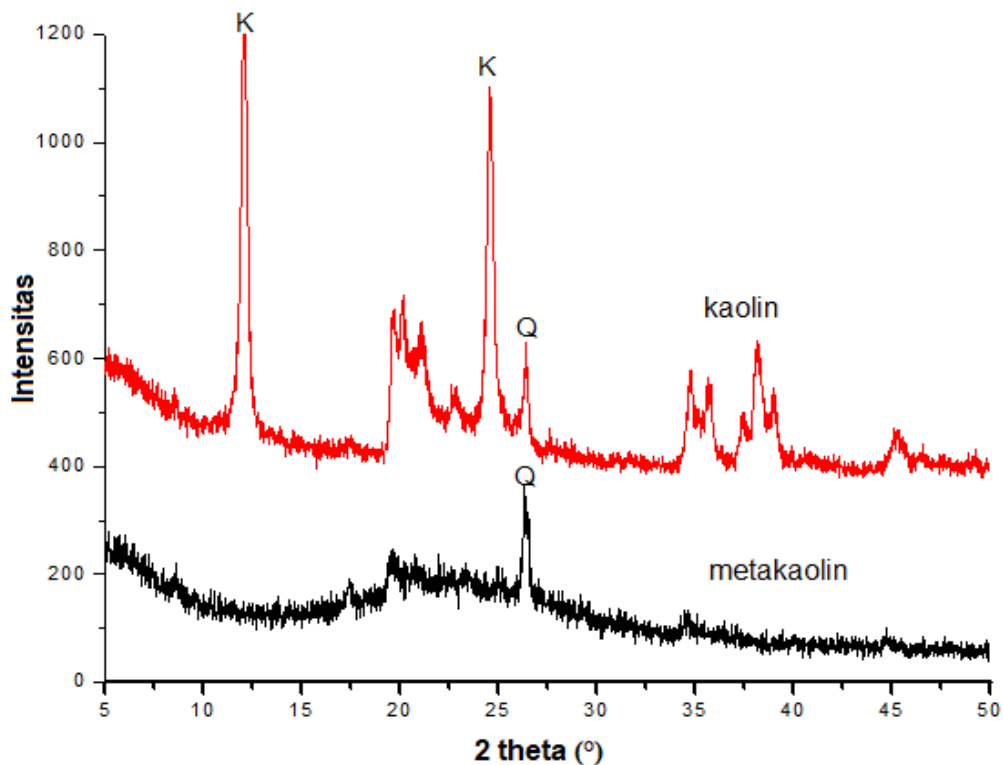
Metakaolin yang berbentuk amorf dapat diperoleh dengan melakukan kalsinasi suhu 400-650°C. Kalsinasi di bawah 400°C hanya akan menghilangkan molekul air yang teradsorpsi pada permukaan eksternal kaolin, dan jika dilakukan pada suhu di atas 700°C akan mengakibatkan terbentuknya struktur pinnel (Cheng dkk., 2012). Proses aktivasi kaolin Bangka-Belitung dilakukan melalui kalsinasi pada suhu 650°C selama 2 jam menurut metode yang digunakan oleh Gougazeh & Buhl (2014) pada kaolin Jordania. Prosedur ini dipilih karena karakteristik kandungan kaolin Bangka mirip dengan kaolin Jordania sebagaimana dilaporkan oleh Safitri (2019).

Proses kalsinasi pada suhu 400-650°C mengakibatkan terjadinya dehidroksilasi kaolin, yaitu hilangnya molekul air yang terserap pada kisi-kisi kristal dari mineral kaolin membentuk metakaolin. Kaolin yang memiliki struktur kristalin berubah menjadi silika dan alumina amorf. Adapun reaksi perubahan fasa dari kaolin menjadi metakaolin menurut Johnson dan Arshad (2014) adalah :



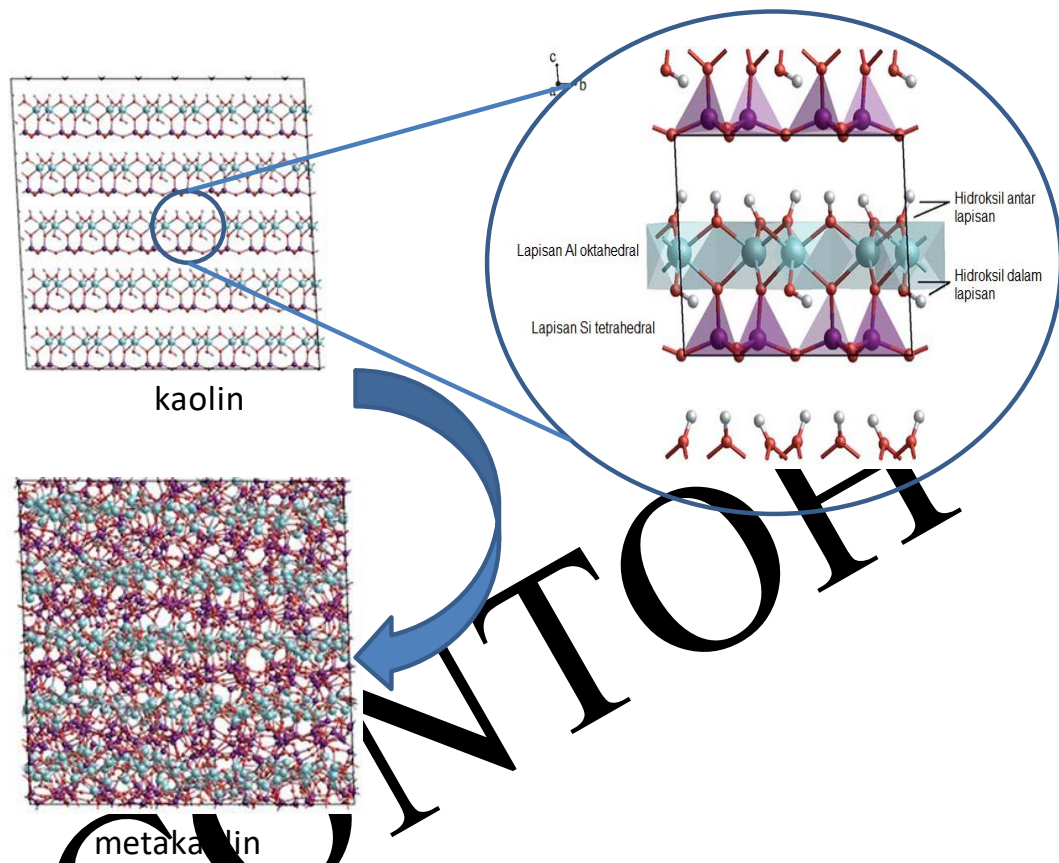
Keberhasilan proses aktivasi kaolin Bangka dapat diamati melalui karakterisasi dengan difraktometer sinar-X (XRD) yang ditampilkan pada Gambar **Error! No text of specified style in document..2**. Perbandingan antara kedua pola XRD menunjukkan bahwa setelah kalsinasi terjadi perubahan fasa menjadi metakaolin aluminosilika amorf, ditandai dengan hilangnya puncak-puncak karakteristik kaolinit pada sudut 2θ 12,34° dan 24,64°. Hasil ini mirip dengan yang dilaporkan oleh Gougazeh & Buhl (2014), namun pada metakaolin yang dihasilkan masih terdapat puncak di sudut 2θ 26,46°. Puncak tersebut menandai terdapatnya impuritis berupa fasa kuarsa yang secara umum ditemukan pada metakaolin. Selain

kuarsa, fasa mika juga masih sering ditemukan sebagai impuritis dalam pembentukan metakaolin (Ayele dkk., 2016).



Gambar **Error! No text of specified style in document..2** Difraktogram sinar-X kaolin sebelum dan setelah kalsinasi 650°C selama 2 jam

Perubahan fasa menjadi bentuk amorf akan meningkatkan reaktivitas material sebagai bahan dasar sintesis zeolit. Metakaolin lebih reaktif daripada kaolin dan mineral lain dapat berubah menjadi bentuk oksidanya. Dalam struktur kaolin atom Al terkoordinasi secara oktahedral pada dua simpul oksigen dari lapisan SiO_4 tetrahedral menjadi satu gugus (OH) di satu sisi dan tiga gugus (OH) secara paralel di sisi yang lain. Sedangkan dalam metakaolin, atom Al berubah konfigurasinya menjadi koordinasi tetrahedral sebagaimana dalam struktur zeolit sehingga metakaolin lebih reaktif jika digunakan sebagai bahan sintesis zeolit (Loiola dkk., 2012). Pemodelan struktur kaolin dan metakaolin yang diperoleh setelah dehidroksilasi diilustrasikan pada Gambar **Error! No text of specified style in document..3**.



Gambar **Error! No text of specified style in document.** 3 Perubahan struktur kaolin menjadi metakaolin (Sperinck dkk., 2011)

BAB 5

KESIMPULAN DAN SARAN

5.1 Kesimpulan

Sintesis zeolit NaA dari kaolin Bangka telah berhasil dilakukan dengan menggunakan filtrat hasil sintesis sebelumnya. Aktivasi kaolin melalui kalsinasi pada suhu 650°C selama 2 jam mampu menghasilkan metakaolin dengan fasa amorf. Teknik XRF mengungkapkan bahwa metakaolin yang diperoleh sebagian besar tersusun atas Si dan Al dengan rasio $Si/Al=1,38$ dan beberapa oksida logam minor lainnya. Variasi terhadap kondisi sintesis dilakukan pada konsentrasi NaOH awal dan tahap penggunaan ulang filtrat. Konsentrasi NaOH yang digunakan adalah 2, 3, 4, 5, dan 6 M, sedangkan penggunaan ulang filtrat dilakukan hingga 3 tahap.

Hasil optimasi menunjukkan alkalinitas medium yaitu konsentrasi 3 M dibutuhkan untuk memperoleh zeolit NaA dengan kristalinitas dan kemurnian yang tinggi. Penggunaan konsentrasi NaOH yang lebih tinggi dari optimum menginisiasi terbentuknya pengotor berupa hidroksisodalit. Penggunaan *filtrat* secara berulang dengan hasil kristal NaA yang baik dapat dilakukan sampai 2 kali tahapan. Efektivitas penggunaan ulang filtrat pada tahapan yang lebih lanjut terus berkurang, yang ditunjukkan dengan tingkat kristalinitas dan kemurnian zeolit NaA yang lebih rendah. Hal ini diakibatkan oleh berkurangnya konsentrasi alkali pada larutan prekursor. Uji *Cation Binding Capacity* (CBC) juga membuktikan nilai CBC yang diperoleh sebanding dengan kemurnian dan kristalinitas zeolit NaA. Zeolit NaA dari *filtrat* tahap 1 konsentrasi 3M (F1-3M) memiliki nilai CBC tertinggi sebesar 339.7 meq/100g.

Bentuk lain dalam sintesis ramah lingkungan adalah sintesis pada suhu rendah sehingga mengurangi konsumsi energi. Sintesis pada suhu rendah dapat dilakukan dengan menambahkan tahapan *aging* pada proses sintesis. Investigasi lebih lanjut menunjukkan bahwa waktu *aging* selama 3 hari dan kristalisasi pada suhu kamar dapat menghasilkan zeolit NaA dengan kristalinitas yang tinggi dan ukuran partikel yang lebih kecil. Dengan demikian, produksi zeolit NaA dari kaolin Bangka menggunakan *filtrat* yang digunakan kembali sebagai prekursor dapat

menjadi alternatif yang baik untuk meminimalkan dampak lingkungan dan mengurangi biaya sintesis.

5.2 Saran

Dalam rangka upaya lebih lanjut dalam sintesis ramah lingkungan, perlu dikaji kembali kondisi sintesis apabila dilakukan penambahan larutan alkali pada filtrat yang akan digunakan dalam sintesis. Dengan mengetahui proses dan kondisi yang tepat diharapkan penggunaan ulang filtrat dapat melalui tahapan yang lebih panjang atau bahkan penggunaan ulang filtrat dapat berlangsung secara kontinyu.

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LAMPIRAN

CONTOH

BIOGRAFI PENULIS

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