IPB UNIVERSITY
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
DEPARTEMEN KIMIA

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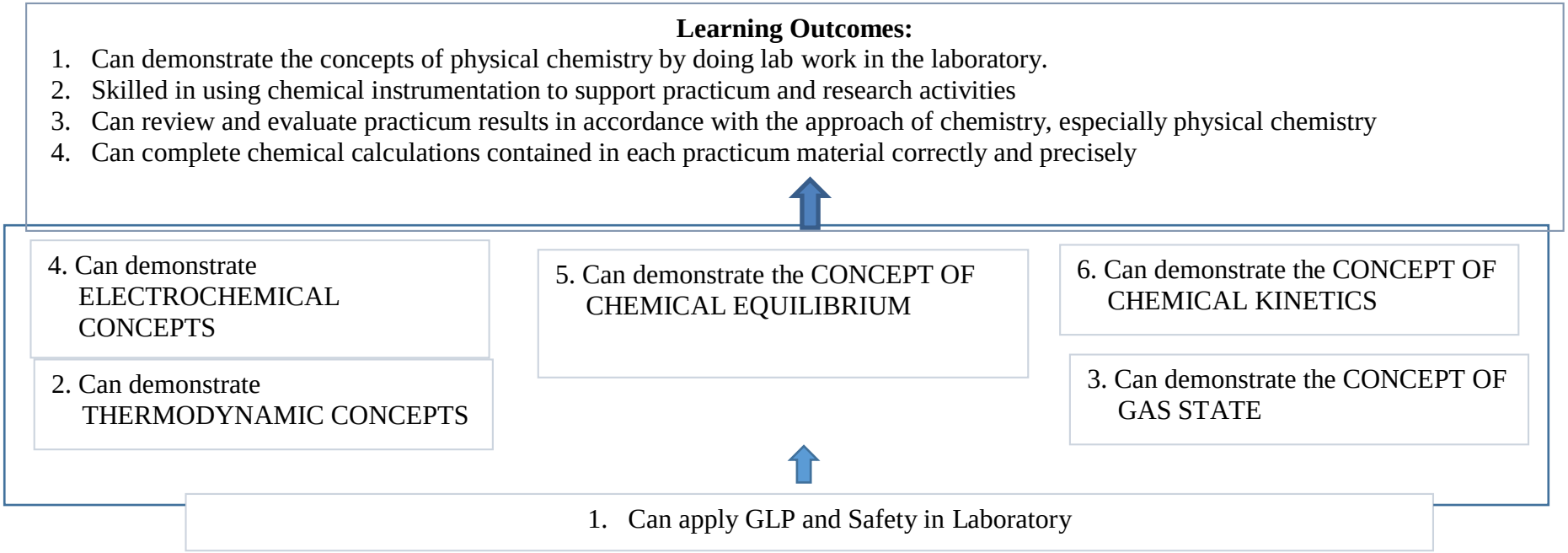
SEMESTER LEARNING PLAN

KIM 1345
PHYSICAL CHEMISTRY PRACTICUM
2 (2-0)

INSTRUCTIONAL ANALYSIS



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SEMESTER LEARNING PLAN

Course Name	:	Physical Chemistry Practicum
Code/Credit	:	KIM1345/2(2-0)
Semester	:	Even (Semester 4)
Description	:	This Physical Chemistry Practicum course is a compulsory course of the Chemistry Major Undergraduate Study Program related to Basic Chemistry courses that have been delivered in semester 2, as well as supporting other courses, such as Chemical Thermodynamics, Chemical Equilibrium, Quantum Chemistry and Spectroscopy, and Chemical Kinetics. This course is given to equip students to apply the basic concepts of Physical Chemistry by doing a practicum in the laboratory. The scope of the discussion and learning process is to use active learning through practicum and *cooperative learning*. The language of instruction used in this lecture is Indonesian.
Prerequisites course	:	KIM1105 Basic Chemistry
Learning Outcomes	:	1. Can demonstrate the concepts of physical chemistry by doing lab work in the laboratory. 2. Skilled in using chemical instrumentation to support practicum and research activities in the field of Physical Chemistry 3. Can review and evaluate practicum results in accordance with the approach of chemistry, especially physical chemistry 4. Can complete chemical calculations contained in each practicum material correctly and precisely.
Scope and Curriculum map of RSC Curriculum (RSC)2)	:	---
Division/Field	:	Physical Chemistry/Physical Chemistry
Lecturers	:	1. Dr. Henny Purwaningsih, MSi (Coordinator) 2. Dr. Trivadila, MSi 3. Drs. Ahmad Sjahriza, MSi

[11)]Tutorial/practicum activities are expressed in credits, not in the number of hours

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[2)]see Excel file: Chemistry Curriculum Map from RSC

Graduate Learning Outcomes (CPL) charged to Course Learning Outcomes (CPMK)

Learning Outcomes	A1	A2	A3	B1	B2	B3	B4	C1	C2
A. Knowledge	✕	✕	x						
B. Specific skills				✕	✕	✕	✕		
C. General Attitudes and Skills								✕	✕

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I. LESSON PLAN

WEEK OF	LEARNING OUTCOMES	TOPIC	METHOD	DURATION	STUDY EXPERIENCE	EVALUATION			REFERENCES
						CRITERION	INDICATOR	WEIGHT (%)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Can work in the laboratory by applying the principles of GOOD LABORATORY PRACTICES (GLP) and LABORATORY OCCUPATIONAL SAFETY AND HEALTH) for all experimental materials during the Midterm period	a. Introduction to Physical Chemistry Laboratory b. GLP c. Laboratory Safety d. Explanation of I-V Materials	Synchronous-/Offline Face-to-Face Lectures, including: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	3 × 60 minutes	a. Gain insight and explanation of GLP, Lab Safety, and Material I to V through visual learning b. Interact with students and: • Lecturers • Other students • Teaching materials	**No assessment criteria**	No assessment	None	
2-6	Can demonstrate THERMOCHEMICAL CONCEPTS through practicum activities in the laboratory	MATERIALS IA and IB, IA, and IB a. Calorimeter Setting	Practicum (8-10 students per group)	2 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor	MATERI IA 1. Knowing changes in the properties of calorimeters to heat. 2. Determine the calorimeter	a. >90% of students can take the IA Material quiz b. >90% of students can properly demonstrate	See Assessment Weights (Part III)	1-3

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		b. Determination of Hydrogen Bond Strength			abilities by using facilities and infrastructure supporting learning in **Chemical Thermodynamic Concepts** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	setting as the basis for subsequent experiments.	psychomotor work in the laboratory c. > 90% of students can prepare reports well using scientific writing rules d. >90 students can answer questions related to IA Material		
				2 × 60 min		MATERIAL IB 1. Shows that the strength of hydrogen bonds is less than the strength of covalent.	a. >90% of students can take the IB Material quiz b. >90% of students can properly demonstrate psychomotor	See Assessment Weights (Part III)	1-3

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						2. Shows that the bonds that occur from a reaction can be measured in strength.	work in the laboratory c. >90% of students can prepare reports well using scientific writing rules d. >90 students can answer questions related to IB Material		
2-6	Can demonstrate the STATE of GAS through practicum activities in the laboratory	IC MATERIALS Gaseous State: Determination of Vapor BJ and Gas Constant	Practicum (8-10 students per group)	2 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using the facilities and infrastructure supporting **learning in Gaseous State** available in the	IC MATERIAL Determining the molar mass of a volatile liquid using the ideal gas equation and van der Waals gas	a. >90% of students can take the IC Material quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. >90% of students can prepare reports well using	See Assessment Weights (Part III)	1-3

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					Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures		scientific writing rules d. >90 students can answer questions related to IC Material		
2-6	Can demonstrate the ELECTROCHEMICAL CONCEPT through practicum activities in the laboratory	MATERIAL IIA and IIB Electrochemical Concepts: a. Determination of Avogadro's number b. Transport Number Determination	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning **Electrochemistry Concepts** available in the Physical Chemistry Laboratory	MATERIAL IIA 1. Determining the number of Avogadro (N_o) 2. Practicing the concept of Avogadro's number (N_o)	a. >90% of students can take the Material IIA quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using	See Assessment Weights (Part III)	1-3

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					Soft Skills: a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures		scientific writing rules d. >90 students can answer questions related to Material IIA		
				3 × 60 min		MATERIAL IIB 1. Determine the number of Cu^{2+} and SO_4^{2-} transport 2. Get to know the visible light spectrophotometry method	a. >90% of students can take the IIB Material quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can	See Assessment Weights (Part III)	1-3

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							answer questions related to IIB Material		
2-6	Can demonstrate the CONCEPT OF ELECTROLYTE SOLUTION through practicum activities in the laboratory	MATERIAL IIIA Buffer effects of ionic strength on pH buffers	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning the **Concept of Electrolyte Solution available** in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline	MATERIAL IIIA 1. Describes the effect of the ionic environment on pH buffers. 2. Demonstrate the use of pH meters and glass electrodes. 3. Measures the weak acid dissociation constant.	a. >90% of students can take the Material IIIA quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material IIIA	See Assessment Weights (Part III)	1-3

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					e. Compliance in working according to procedures				
2-6	Can demonstrate the CONCEPT OF SURFACE AND COLLOIDAL CHEMISTRY through practicum activities in the laboratory	MATERIAL IIIA Gibbs equation	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning **Surface and Colloidal Chemistry Concepts** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline	1. Can explain any of the phenomena that occur on the surface 2. Can calculate surface excess using the Gibbs equation	a. >90% of students can take the Material IIIB quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% students can answer questions related to Material IIIB	See Assessment Weights (Part III)	1-3

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					e. Compliance in working according to procedures				
2-6	Can demonstrate the CONCEPT OF CHEMICAL KINETICS through practicum activities in the laboratory	MATERIAL IV A and IVB a. Speed of Reaction between Peroxydisulfate and Iodide b. Arrhenius Equation and Activation Energy	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning of **Chemical Kinetics Concepts** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working	MATERIAL IVA a. Shows how the reaction speed varies with the concentration of the reagent. b. Shows the estimates used in the differential method. c. Determine the order of the reaction and calculate its rate constant at a certain temperature.	a. >90% of students can take the IVA Material quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to IVA Material	See Assessment Weights (Part III)	1-3

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					according to procedures				
				3 × 60 min		MATERIAL IVB 1. Show how the reaction rate depends on temperature. 2. Calculate the activation energy (E_a) by using the Arrhenius equation.	a. >90% of students can take the IVB Material quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to IVB Material	See Assessment Weights (Part III)	
2-6	Can demonstrate the CONCEPT OF CHEMICAL KINETICS through	MATERIAL V Kinetics of ester hydrolysis	Practicum (8-10 students per group)	6 × 60 min	**Hard Skills** Gain experience in practicing science empirically	a. Can determine the constant rate of methyl	a. >90% of students can take the	See Assessment	1-3

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	practicum activities in the laboratory				involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning of **Chemical Kinetics Concepts** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	acetate hydrolysis reaction b. Can estimate the amount of activation energy of methyl acetate hydrolysis reaction	Material V quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students answer questions related to Material V	Weights (Part III)	
7	Can: a. review and evaluate the experimental results of Materials I to V	MATERIALS I to V	• Presentation • Group discussion • Cooperative learning	6 × 60 min	**Hard Skills** Gain experience in: (i) presenting a result involving empirical data, (ii) reviewing and	a. Can make presentations b. Can conduct studies and	a. >90% of the group can present the results of the experiment well	See Assessment Weights (Part III)	1-3

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	using a chemical approach b. present the results of the study and evaluate it well				evaluating the resulting data to support learning in the field of **Physical Chemistry** **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Leadership	evaluations of empirical data supported by knowledge that has been possessed	b. >90% of groups make presentation materials well, systematically, and interestingly c. >90% of students have interactive discussions		
8	Can work in the laboratory by applying the principles of GLP and LABORATORY OCCUPATIONAL SAFETY AND HEALTH for all Final Exam session experimental materials	a. GLP b. Lab Safety c. Explanation of Materials VI to X	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results		a. Gain insight and explanation of GLP, Lab Safety, and Material I to V through visual learning b. Interact with students and: • Lecturers • Other students • Teaching materials	**No assessment criteria**	No assessment	None	

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9-13	Can demonstrate the CONCEPT OF CHEMICAL KINETICS through practicum activities in the laboratory	MATERIAL VI Kinetics of Ester Saponification	Practicum (8-10 students per group)	6 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting the learning of **Chemical Kinetics Concepts** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	1. Study the kinetics of ester saponification. 2. Determine the order of the ester saponification reaction. 3. Determines the magnitude of its ionic conductivity.	a. >90% of students can take the Material VI quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material VI	See Assessment Weights (Part III)	1-3

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9-13	Can demonstrate the CONCEPT OF CHEMICAL EQUILIBRIUM through lab work in the laboratory	MATERIALS VIIA and VIIB a. Change in Standard Gibbs Free Energy (ΔG^O) and Equilibrium Constant (K) b. Effect of Temperature and Concentration on Galvanic Cells	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning in the **Concept of Chemical Equilibrium** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	MATERIAL VIIA Can determine the change in standard Gibbs free energy and equilibrium constant for the following reactions: $Zn + Cu^{2+} \leftrightharpoons Zn^{2+} + Cu$	a. >90% of students can take the Material VIIA quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material VIIA	See Assessment Weights (Part III)	
				3 × 60 min		MATERIAL VIIB	a. >90% of students can	See Assessm	

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						1. Compiling the device of Galvanic cells from $Zn + Cu^{2+} \leftrightharpoons Zn^{2+} + Cu$ 2. Observing the effect of concentration on galvanic cell potential 3. Observing the effect of temperature on galvanic cell potential	take the Material VIIB quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material VIIB	ent Weights (Part III)	
9-13	Can demonstrate the BASIC CONCEPTS OF QUATERNUM MECHANICS in practicum activities in the laboratory	MATERIAL VIII A Application of Particles in a 1D Box: Determination of the Length of	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially	MATERIAL VIIIA Determining the length of polyene compounds through a 1D	a. >90% of students can take the Material VIIIA quiz b. >90% of students can properly	See Assessment Weights (Part III)	

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		Polyene Compounds			psychomotor abilities by using facilities and infrastructure supporting learning **Basic Concepts of Quantum Mechanics** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	box system model	demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material VIIIA		
9-13	Can demonstrate the CONCEPT OF IONIC SOLUTION through practicum activities in the laboratory	MATERIAL VIII B Determination of Salt Solubility by Conductometry	Practicum (8-10 students per group)	3 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using	MATERIAL VIIIB Apply the concept of conductivity of solutions to determine the solubility of salts that are	a. >90% of students can take the Material VIIIB quiz b. >90% of students can properly demonstrate	See Assessment Weights (Part III)	1-3

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					facilities and infrastructure supporting learning the **Concept of Ionic Solution** available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	difficult to dissolve at a certain temperature	psychomotor work in the laboratory c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material VIIIB		
9-13	Can demonstrate the CONCEPT OF CHEMICAL THERMODYNAMICS through practicum activities in the laboratory	MATERIAL IX Entropy and Enthalpy of Melting	Practicum (8-10 students per group)	6 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive, effective, and especially psychomotor abilities by using facilities and infrastructure supporting learning	a. Introduces the difference in the cooling curve of pure liquid and solution. b. Shows freezing point drop events caused by	a. >90% of students can take the Material IX quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory	See Assessment Weights (Part III)	1-3

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					Chemical Thermodynamic Concepts available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	the addition of solutes. c. Calculate the entropy and freezing entropy of a substance using the Van't Hoff equation.	c. 90% of students can prepare reports well using scientific writing rules d. >90% of students can answer questions related to Material IX		
9-13	Can demonstrate the CONCEPT OF PHASE DIAGRAM through lab work in the laboratory (Case study of Phase Diagram 2 and 3 components)	MATERIAL X Phase Diagram: 2-Component System Phase Diagram 3-Component System Phase Diagram	Practicum (8-10 students per group)	6 × 60 min	**Hard Skills** Gain experience in practicing science empirically involving cognitive abilities, effective, and especially psychomotor abilities by using learning support facilities and infrastructure of the **concept of PHASE DIAGRAM**	a. Can create phase 2 diagrams of benzoic acid components: naphthalene b. Can determine the critical point (temperature and composition) of a	a. >90% of students can take the Material X quiz b. >90% of students can properly demonstrate psychomotor work in the laboratory c. 90% of students can prepare reports well	See Assessment Weights (Part III)	1-3

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					available in the Physical Chemistry Laboratory **Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Compliance in working according to procedures	mixture using a 2-component phase diagram c. Can create 3-component phase diagrams d. Can determine the solubility of materials based on 3-component phase diagrams	using scientific writing rules d. >90% of students can answer questions related to Material X		
14	Can: a. review and evaluate the experimental results of Materials VI to X using a chemical approach b. present the results of the	MATERIALS VI to X	• Presentation • Group discussion • Cooperative learning	6 × 60 min	**Hard Skills** Gain experience in: (i) presenting a result involving empirical data, (ii) reviewing and evaluating the resulting data to support learning in the field of **Physical Chemistry**	a. Can make presentations b. Can conduct studies and evaluations of empirical data supported by knowledge that has been possessed	a. >90% of the group can present the results of the experiment well b. >90% of groups make presentation materials well, systematically	See Assessment Weights (Part III)	

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	study and evaluate it well				**Soft Skills:** a. Activeness b. Cooperation c. Responsibility d. Discipline e. Leadership		, and interestingly c. >90% of students have interactive discussions		
FINAL EXAM									

II. ASSESSMENT DESIGN

No	Course Learning Outcomes	Weekly Tasks	Performance Evaluation	Report Writing	Presentation	Exam	
						Midterm	Final
1.	Can demonstrate the concepts of physical chemistry by doing lab work in the laboratory.	-	√	-	-	-	-
2.	Skilled in using chemical instrumentation to support practicum and research activities in the field of Physical Chemistry	-	√	-	-	-	-
3.	Can review and evaluate practicum results in accordance with the approach of chemistry, especially physical chemistry	√	-	√	√	-	-
4.	Can complete chemical calculations contained in each practicum material correctly and precisely.	√	-	√	-	√	√

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III. RATING WEIGHTS

Assessment Criteria	Score Range	Score Weight (%)	Information
Weekly Task Assessment **Work Plan** • Punctuality in completing tasks • Compatibility of work materials and procedures with Practicum Guidelines	40-85	2.5	Individual score
Pre-Lab Tasks • Punctuality in completing tasks; • Completeness and clarity of answers;	0-100	2.5	Individual score
Practicum Assessment **Quiz** • Evaluation of students' readiness of knowledge and understanding of practicum material is carried out through quizzes (10-15 minutes) before practicum begins.	0-100	7.5	Individual score
Work • Performance evaluation in the form of skills in using chemical instrumentation related to practicum material is carried out through Work Assessment	40-85	35	Individual score
Report • Evaluation of the report is carried out on the knowledge, understanding, and application of basic concepts of physical chemistry as well as the ability to analyze the results obtained during practicum	50-85	15	Individual score
Presentation Assessment • Systematics and content of presentation; • Accuracy of delivery; • Good use of language; • Ability to respond to questions (whether or not appropriate); • Attitude in material delivery (eye contact, posture, neat appearance) • Clarity of presentation (voice volume and intonation)	60-85	7.5	Group score

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Exam Assessment • The cognitive abilities of students in this practicum are also evaluated based on the level of knowledge/introduction (C1), understanding (C2), application (C3), and analysis (C4) to complete chemical calculations contained in the practicum material • The composition of questions in the student cognitive ability evaluation activity for each level is 25%, with the assessment weight for the C4 > C3 > C2 > C1 question models • The exam question model consists of: i. MODEL 1, establishes TRUE or FALSE from a series of statements related to the subject matter topic being tested. ii. MODEL 2, choose the right one from several answer options provided for statements/questions related to the subject matter. iii. MODEL 3, answering independently to a question/question related to the subject matter tested. • The composition of each question model to the weight of the overall score is: 20% MODEL 1, 30% MODEL 2, and 50% MODEL 3. Midterm Final	 0-100 0-100	 15 15	 Individual score Individual score
Grade Criteria A > 85 75 < AB ≤ 85 65 < B ≤ 75 60 < BC ≤ 65 50 < C ≤ 60 40 < D ≤ 50 E < 40			
Score of PHYSICAL CHEMISTRY PRACTICUM/KIM 1345 2 (0-2)		**100**	

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IV. ASSESSMENT RUBRIC

Score Range	Work Plan Assessment Criteria
75-85	If students can compile work plans systematically, easy to **read, easy** to understand and understand**, made in accordance with work procedures in the practicum guide**, include **time management, prepare a place to record** practicum data**, prepare a place to do** calculations, prepare **a place to** take notes **Things to note**
65-75	If students can prepare work plans in **a NOT systematic, NOT easy to read,** NOT easy to understand and understand**, made in accordance with work procedures in the practicum guide**, include **time management, prepare a place to record** practicum result data**, prepare a place to do calculations,** Set up a place to record **things that need to be noted**
55-65	if students can prepare work plans in a NOT **systematic** manner, NOT easy to read, NOT easy to understand and understand**, made NOT** in accordance with work procedures in the practicum guide**, including** time management**, preparing a place to record practicum result data,** preparing a place to do **calculations**, **Set** up a place to record **things that need to be noted**
40-55	If students can prepare work plans in **a NOT systematic** manner, NOT easy to read, NOT easy to **understand and understand**, made NOT in accordance with work procedures in the **practicum guide, DO NOT include** time management**, prepare a place to record data on practicum results** DO NOT prepare a place to perform **calculations,** prepare a place to record **things that need to be recorded**
	Work Assessment Criteria
75- 85	If students can demonstrate work **in accordance with work procedures (SOP),** can **operate/use simple chemical equipment/instrumentation**, apply **GLP and K3 Laboratory principles** at work
65-75	If students can demonstrate work **in accordance with work procedures (SOP),** can **operate/use simple chemical equipment/instrumentation**, **DO NOT** apply **GLP and K3 Laboratory principles** at work
55-65	If students can demonstrate work in **accordance with work procedures (SOP), LESS SKILLED in operating/using simple chemical equipment/instrumentation**, **NOT** applying **GLP and K3 Laboratory principles** in working
40-55	If students **CANNOT** demonstrate work in **accordance with work procedures (SOPs), are LESS SKILLED in operating/using simple chemical equipment/instrumentation**, **DO NOT** apply **GLP and K3 Laboratory principles** at work
	Report Assessment Criteria
75- 85	If students can compile reports **well, easy to** read, and easy to **understand and understand**, the data of practicum **results reported are in accordance with the results obtained, chemical calculations** are carried out correctly and precisely**, discussions** are prepared in accordance with the study and evaluation **of the data obtained, using the principles of physical**

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	chemistry in conducting studies and evaluations, **conclusions** are made in accordance with objectives, results, and discussions; **The library** used is less than 10 years
65-75	If students **are NOT** can compile reports properly**, NOT easy to** read, NOT easy to **understand and understand, the data of practicum** results reported are in accordance with the results obtained, chemical calculations **are carried out correctly and precisely**, discussions **are prepared in accordance with the study and evaluation of the data obtained**, **using physical chemistry principles** in conducting studies and evaluations, conclusions **are made in accordance with objectives, results, and discussions; The library** used is less than 10 years.
50-65	If students **are NOT** can compile reports **properly**, NOT easy to read, NOT **easy to understand and understand, the** reported practicum **data is NOT in accordance with the results obtained,** chemical calculations **are carried out correctly and precisely**, discussions **are prepared in accordance with the study and evaluation of the data obtained, DO NOT use physical chemistry principles** in conducting studies and evaluations, **conclusions** are made in accordance with objectives, results, and discussion; **The library** used is less than 10 years.
	Presentation Assessment Criteria
75-85	If students can present material with **good systematics**, timeliness **of delivery,** good language use, **ability to** answer questions well / precisely**, and** good and clear **material delivery attitude**.
65-74	If students can present material with **good systematics**, the timeliness **of delivery** is NOT APPROPRIATE**, the use** of language is NOT good**, the ability to** answer questions well/precisely**, and the attitude of delivering material is** NOT good and NOT clear**.**
60-65	If students can present material with **NOT good systematics, timeliness of delivery** is NOT APPROPRIATE**, use of** NOT good language**, ability to** answer questions NOT well/precisely**, attitude of material delivery** is NOT good and NOT clear**.**

V. REFERENCES

1. Atkins P, de Paula J. 2006. *Physical Chemistry*. 8th Ed. New York: WH Freeman and Co.
2. Bird T. 1987. *Penuntun Praktikum Kimia Fisik untuk Universitas*. Jakarta: Penerbit PT Gramedia.
3. Daniels F, Mathews JH, Williams JW, Bender P, Alberty RA. 1956. *Experimental Physical Chemistry*. New York: McGraw-Hill Book Company, Inc.
4. Patel NH *et al*. 2010. College Practical Chemistry. Mumbay:Himalayan Publishing House