IPB UNIVERSITY
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
DEPARTEMEN KIMIA

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SYLLABUS

KIM1238
CHEMICAL SEPARATION AND ELECTROANALYSIS
3(3-0)

Pengesahan		Persetujuan		Penyusunan	
Tanggal	DD/MM/YYYY	Tanggal	DD/MM/YYYY	Tanggal	DD/MM/YYYY
Ketua Departemen (……..)		Kepala Divisi (……..)		Koordinator Mata Kuliah (……..)	

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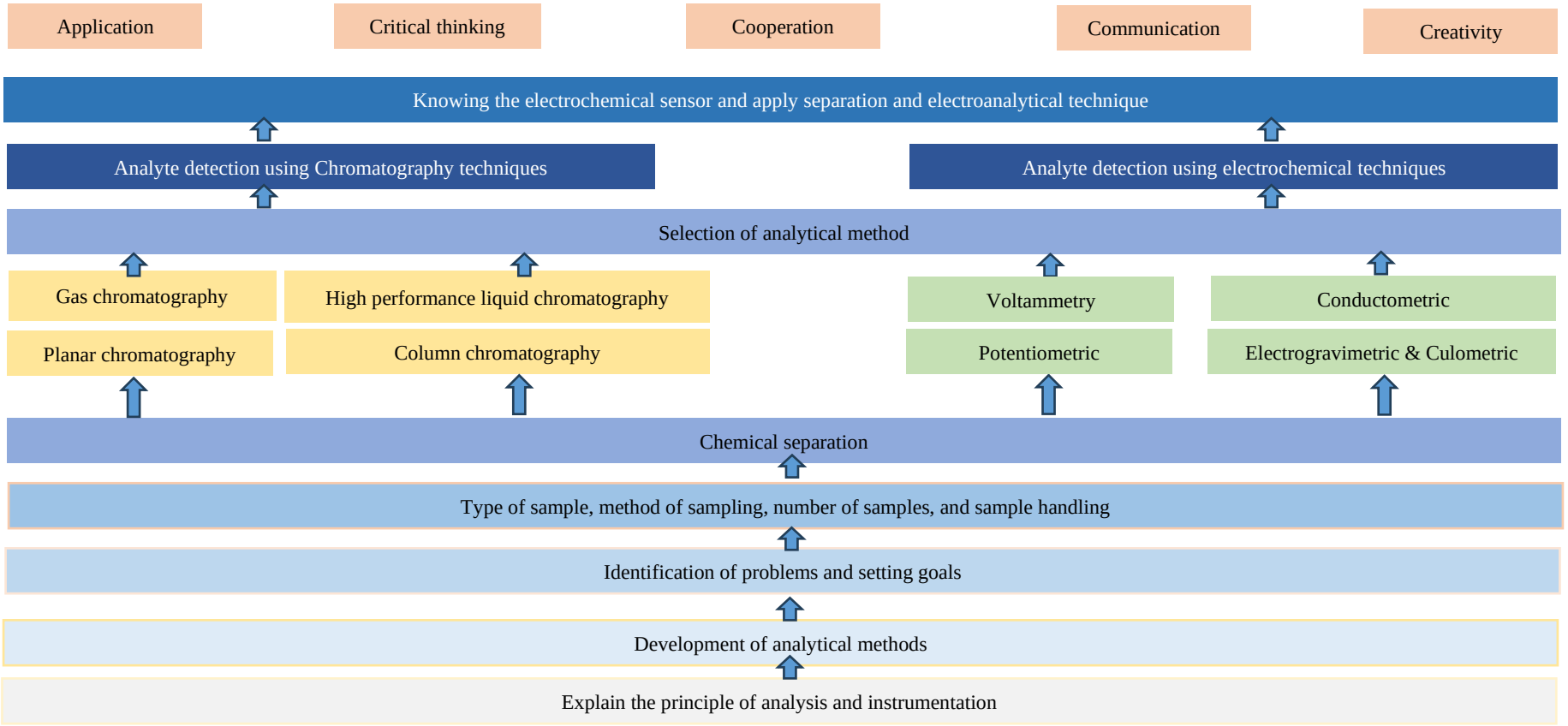
INSTRUCTIONAL ANALYSIS OF CHEMICAL SEPARATION AND ELECTROANALYSIS



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Course Name	:	Chemical Separation and Electroanalysis
Code/Credit	:	KIM1238 / 3(3-0)
Semester	:	Even (for 4th semester students)
Description	:	The scope of material discussed in this courses includes the understanding about principles of analysis and its applications, chromatographic instrumentation both planar chromatography, column chromatography, gas chromatography, and high performance liquid chromatography, electrophoresis, electroanalysis, potentiometric, electrogravimetry, culometric, polarography, voltammetry, conductometry, and the introduction of electrochemical sensors
Prerequisite course	:	KIM236
Learning outcomes	:	After attending this course students will: • mastering knowledge and able to explain: definition, principles of analysis, and chromatography instrumentation including planar chromatography, column chromatography, gas chromatography, and high performance liquid chromatography, electrophoresis, electroanalysis, potentiometric, electrogravimetry, culometric, polarography, voltammetry, conductometry, and its applications, as well as introduction to electrochemical sensors
Scope and Curriculum Map of Royal Society of Chemistry (RSC)	:	Chromatography; TLC, HPLC, GC, LC, ion exchange chromatography, size exclusion chromatography, detectors, electrochemical processes and potentials, polarography, electric properties of materials and solids
Division/Field	:	Analytical Chemistry
Lecturer	:	Prof. Dr. Irmanida Batubara, S.Si., M.Si. Dr. Dra. Eti Rohaeti, M.S. Dr. Drs. Deden Saprudin, M.Si. Rudi Heryanto, S.Si, M.Si Dr. Mohamad Rafi, S.Si., M.Si. Dr. Wulan Tri Wahyuni, S.Si, M.Si Zulhan Arif, S.Si, M.Si

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Table 1. Plan for Study

WEEK	LEARNING OUTCOME	TOPIC	METHOD	DURATION	STUDY EXPERIENCE	ASSESSMENT			REFERENCE
						CRITERIA	INDICATOR	%	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Able to explain: a. The definition and principle of separation by chromatographic techniques b. Distinguish the type of chromatography /chromatographic classification c. Determine the process and parameters of elution in chromatography d. Determine the migration process of components in chromatography e. Describe and determine column efficiency and band broadening f. Explain the theory of band widening g. Describe, define, and evaluate column resolution	Chromatography introduction: a. History and definition of chromatography b. Chromatographic classification c. Elution on chromatography d. Component migration e. Column efficiency and band broadening f. Band widening theory g. Column resolution	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	150 minutes	a. Gain insight and explanation about Chromatography as a separation technique b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	**Hard Skills:** Completeness and truth about: a. History and definition of chromatography b. Chromatographic classification c. Elution on chromatography d. Component migration e. Column efficiency and band broadening f. Band widening theory g. Column resolution **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions	a. >90% of students answered correctly the history and definition of chromatography questions b. >90% of students answered the chromatographic classification questions correctly c. >90% of students answered the elution questions on chromatography correctly d. >90% of students answered the component migration	6	1,2

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						and statements during interactive discussions	questions correctly e. >90% of students answered column efficiency questions correctly f. >90% of students answered the band widening theory questions correctly g. >90% of students answered the resolution questions correctly)		
2	Able to explain : a. The analytical techniques and how planar chromatography works b. The principle, mechanism, and separation process in	a. The analysis techniques and how planar chromatography works b. Paper chromatography c. Thin layer chromatography	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion	100 minutes	a. Gain insight and explanation of planar chromatography as a separation technique and its applications b. Interact between students and: (i) lecturer	**Hard Skills**: Completeness and truth about: a. Analysis techniques and how planar chromatography works b. Paper chromatography	a. >90% of students answered correctly about the analytical technique and how planar chromatograph y works	3.5	1,2

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	paper chromatography c. The principles, mechanisms, and stages of separation in thin layer chromatography and distinguish between thin layer chromatography classifications d. The principle, mechanism, and separation process in two-dimensional chromatography e. Describe the applications of planar chromatography	d. Two-dimensional chromatography e. Planar chromatography applications	c. Review of Discussion Results		(ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	c. Thin layer chromatography d. Two-dimensional chromatography e. Planar chromatography applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	b. >90% of students answered paper chromatography questions correctly c. >90% of students answered the thin layer chromatography questions correctly d. >90% of students answered two-dimensional chromatography questions correctly e. >90% of students correctly explained the application of planar chromatography		
3	Able to explain and describe: a. The analytical techniques and	a.Analysis techniques and workings of classical column chromatography	Synchronous-Face to Face Lectures Outside the	100 minutes	a. Gain insight and explanation of classical column chromatography as	**Hard Skills:** Completeness and truth about:	a. >90% of students answered correctly the	3.5	1,2

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	workings of classical column chromatography b. The basis of separation in classical column chromatography c. Distinguish and explain the classification of column chromatography d. The applications of classical column chromatography	b. The basis of separation in column chromatography c. Column chromatographic classification d. Classic column chromatography applications	Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results		a separation technique and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	a. Analysis techniques and workings of classical column chromatography b. Basis of Separation on column chromatography c. Column chromatographic classification d. Classic column chromatography applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	analytical technique and how classical column chromatography works b. >90% of students answered the basic chromatography separation questions correctly c. >90% of students answered column chromatography classification questions correctly d. >90% of students correctly explained the application of column chromatography		
4	Able to explain and describe :	a. Definition, principle of	Synchronous-Face to Face Lectures	150 minutes	a. Gain insight and explanation of gas	**Hard Skills**:	a. >90% of students	6	1,2

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	a. The principle of separation and how gas chromatography works b. The components of gas chromatography instrumentation (including carrier gas systems, sample injection systems, column and column oven configurations, stationary phases, and detectors). c. The application of gas chromatography	separation, and how gas chromatography works b. Gas chromatography instrumentation (including carrier gas systems, sample injection systems, column and column oven configurations, stationary phase, and detectors) c. Gas chromatography applications	Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results		chromatography as a separation technique and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	Completeness and truth about: a. Definition, principle of separation, and how gas chromatography works b. Gas chromatography instrumentation (including carrier gas systems, sample injection systems, column and column oven configurations, stationary phase, and detectors) c. Gas chromatography applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements	answered correctly about the definition, principle of separation and how gas chromatography works b. >90% of students answered gas chromatography instrumentation questions correctly c. >90% of students correctly explained the application of gas chromatography		

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						during interactive discussions			
5	Able to explain and describe: a. The definition and principles of separation by high performance liquid chromatography (HPLC) b. The components of HPLC instrumentation (including mobile phase reservoirs and mobile phase treatment systems, pump systems, sample injection systems, HPLC columns, and HPLC detectors) c. Distinguish separation mechanisms in high performance partition chromatography, high performance adsorption chromatography, ion exchange chromatography and	a. Definition and principle of separation in high performance liquid chromatography (HPLC) b. HPLC instrumentation (including mobile phase reservoirs and mobile phase treatment systems, pump systems, sample injection systems, HPLC columns, and HPLC detectors) c. High performance partition chromatography, high performance adsorption chromatography, ion exchange chromatography and filtration chromatography d. HPLC application	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	250 minutes	a. Gain insight and explanation of high performance liquid chromatography and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	**Hard Skills:** Completeness and truth about: a. Definition, principle of separation, and how high performance liquid chromatography works b. HPLC instrumentation (including mobile phase reservoirs and mobile phase treatment systems, pump systems, sample injection systems, HPLC columns, and HPLC detectors) c. High performance partition chromatography, high performance adsorption chromatography, ion exchange chromatography	a. >90% of students answered correctly the definition, principle of separation on and how high performance liquid chromatography works b. >90% of students answered the high performance liquid chromatography instrumentation questions correctly c. >90% of students answered correctly the questions of high performance	10	1,2

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	filtration chromatography d. The HPLC application					and filtration chromatography d. HPLC application **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	partition chromatography, high performance adsorption chromatography, ion exchange chromatography, and filtration chromatography d. >90% of students correctly described the application of high performance liquid chromatography		
6	Able to explain and describe: a. The definition and principle of separation in electrophoresis b. The main instrumentation of electrophoresis	a. Definition and principle of separation by electrophoresis technique b. Main instrumentation in electrophoresis c. Factors affecting separation on electrophoresis	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion	150 minutes	a. Gain insight and explanation of zone and capillary electrophoresis and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials	**Hard Skills:** Completeness and truth about: a. Definition and principle of separation by electrophoretic technique b. Electrophoretic instrumentation	a. >90% of students answered correctly the definition and principle of separation using electrophoretic techniques	6	1,2

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	c. The factors that affect the separation on electrophoresis d. The separation mechanism in zone electrophoresis (paper and gel electrophoresis) e. The separation mechanism in capillary electrophoresis f. The application of electrophoresis	d. Zone electrophoresis e. Capillary electrophoresis f. Electrophoresis applications	c. Review of Discussion Results		c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	c. Factors affecting separation on electrophoresis d. Zone electrophoresis e. Capillary electrophoresis f. Electrophoresis applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	b. >90% of students answered the electrophoretic instrumentation questions correctly c. >90% of students answered correctly about Factors affecting separation in electrophoresis d. >90% of students answered the zone electrophoresis questions correctly e. >90% of students answered capillary electrophoresis questions correctly f. >90% of students correctly		

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							explained the application of electrophoresis		
7	Able to : a. Summarize and analyze information regarding the application of planar chromatography technique, classical column chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis sourced from the latest scientific articles b. Convey and explain application information Summarize and analyze information regarding the application of planar chromatography techniques, classical column chromatography, high	a. Study of scientific articles regarding the application of planar chromatography techniques, classical column chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis b. Presentation of application study results Summarize and analyze information regarding the application of planar chromatography techniques, classical column chromatography,	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	150 minutes	a. Gain the ability to understand and analyze information from scientific articles b. Interact between students and: lecturers and other students c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	**Hard skills:** a. Ability to understand and analyze the application of planar chromatography techniques, classical column chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or planar chromatography **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline accuracy and thoroughness in making questions and statements	Students correctly explain the application of planar chromatography techniques, classical column chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or planar chromatography	10	4

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	performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis sourced from the latest scientific articles in the form of presentations	high performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis				during interactive discussions			
Mid Semester Test									
8	Able to explain: a. The electrochemical cell b. The potential in an electroanalysis cell c. The electrode potential d. Determine the cell potential from the electrode potential e. The current in an electrochemical cell f. The types of electroanalysis methods	Electroanalysis introduction: a. Electrochemical cell b. Potential in electroanalysis cells c. Electrode potential d. Determine the cell potential from the electrode potential e. Current in an electrochemical cell f. Electroanalytical method type	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	150 minutes	a. Gain insight and explanation of electrochemical cells, potential in electroanalysis cells, electrode potential, determine cell potential from electrode potential, current in electrochemical cells, and types of electroanalysis methods b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials	**Hard Skills:** Completeness and truth about: a. Electrochemical cell b. Potential in electroanalysis cells c. Electrode potential d. Determine the cell potential from the electrode potential e. Current in an electrochemical cell f. Electroanalytical method type **Soft Skills:** a. liveliness b. Cooperation	a. >90% of students answered the electrochemical cell questions correctly b. >90% of students answered the potential questions in electroanalysis cells correctly c. >90% of students correctly explained the electrode potential	6	2

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					c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	d. >90% of students correctly explained the problem of determining the cell potential from the electrode potential e. >90% of students correctly explained current in electrochemical cells f. >90% of students correctly explained the types of electroanalysis methods		
9	Able to explain: a. The working principle of potentiometric b. The electrodes on potentiometric (comparison	a. General principles of potentiometric b. Comparison electrode and indicator electrode on potentiometric c. Liquid-junction potential	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture	250 minutes	a. Gain insight and explanation of potentiometric techniques and their applications b. Interact between students and: (i) lecturer	**Hard Skills:** Completeness and truth about: a. General principles of potentiometric b. Comparison electrode and	a. >90% of students answered correctly the principle of potentiometric measurement	10	1,2

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	electrode and indicator electrode) c. The liquid-junction potential d. The instrumentation of potentiometric e. The direct potentiometric f. The potentiometric titration g. Determine the equilibrium constant with potentiometric techniques h. The potentiometric applications	d. Instrumentation on potentiometric e. Direct potentiometric f. Potentiometric titration g. Determination of the equilibrium constant by potentiometric h. Potentiometric applications	b. Class Interactive Discussion c. Review of Discussion Results		(ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	indicator electrode on potentiometric c. Liquid-junction potential d. Instrumentation on potentiometric e. Direct potentiometric f. Potentiometric titration g. Determination of the equilibrium constant by potentiometric h. Potentiometric applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	b. >90% of students answered the electrode questions on potentiometric correctly c. >90% of students answered the potential liquid-junction question correctly d. >90% of students answered potentiometric instrumentation questions correctly e. >90% of students answered the direct potentiometry questions correctly f. >90% of students answered potentiometric		

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							titration questions correctly g. >90% of students answered correctly the problem of determining the equilibrium constant with potentiometric h. >90% of students correctly explain potentiometric applications		
10	Able to explain: a. The effect of current on cell potential b. The selectivity of the electrolysis method c. The electrogravimetric methods with and without potential control d. The controlled potential coulometric method and coulometric titration	a. Effect of current on cell potential b. Selectivity of electrolysis method c. Electrogravimetric methods with and without potential control and their instrumentation d. Controlled potential coulometric methods and coulometric	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	100 minutes	a. Gain insight and explanation of electrogravimetry and colometry and their applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of	**Hard Skills:** Completeness and truth about: a. Effect of current on cell potential b. Selectivity of electrolysis method c. Electrogravimetric methods with and without potential control and their instrumentation d. Controlled potential	a. >90% of students answered correctly about the effect of current on cell potential b. >90% of students answered correctly the Selectivity of the electrolysis method	3.5	1,2

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	e. The application of electrogravimetry and colometry	titrations and their instrumentation e. Electrogravimetry and coulometric applications			understanding, opinion, agreement, and joint decision on a problem	coulometric methods and coulometric titrations and their instrumentation e. Electrogravimetry and coulometric applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	c. >90% of students answered the electrogravimetric method questions correctly and without potential control and instrumentation d. >90% of students answered the questions correctly about the method of controlled potential coulometrics and coulometric titrations and their instrumentation e. >90% of students correctly explained the application of electrogravimetry and colometry		

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11	Able to explain: a. The signal generation in voltammetry b.The instrumentation in voltammetry c. The hydrodynamic voltammetry d. The polarography e. The cyclic voltammetry f. The pulse voltammetry: normal pulse voltammetry, Differential pulse voltammetry, square-wave voltammetry, staircase voltammetry g. The discharge voltammetry h.The application of voltammetry	a. Signal generation in voltammetry b. Voltammetric instrumentation c. Hydrodynamic voltammetry d. Polarography e. Cyclic voltammetry f. Pulse voltammetry: normal pulse voltammetry, Differential pulse voltammetry, square-wave voltammetry, staircase voltammetry g. Discharge voltammetry h. Voltammetry applications	Synchronous-Face to Face Lectures Outside the Network/Offline include: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results	250 minutes	a. Gain insight and explanation of voltammetry and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	**Hard Skills:** Completeness and truth about: a. Signal generation in voltammetry b. Voltammetric instrumentation c. Hydrodynamic voltammetry d. Polarography e. Cyclic voltammetry f. Pulse voltammetry: normal pulse voltammetry, Differential pulse voltammetry, square-wave voltammetry, staircase voltammetry g. Discharge voltammetry h. Voltammetry applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in	a. >90% of students answered the signal generation questions in voltammetry correctly b. >90% of students answered the voltammetry instrumentation questions correctly c. >90% of students answered the hydrodynamic voltammetry questions correctly d. >90% of students answered polarography questions correctly e. >90% of students answered cyclic voltammetry	10	1,2,3

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						making questions and statements during interactive discussions	questions correctly f. >90% of students answered the pulse voltammetry questions correctly g. >90% of students answered the discharge voltammetry questions correctly h. >90% of students correctly explained the application of voltammetry		
12	Able to explain: a. The principle of conductometrics b. Distinguish between the conductivity of solutions, the conductivity of types, and the conductivity of equivalents	a. Conductometric principle b. The conductivity of the solution, the conductivity of the type, and the conductivity of the equivalent c. Instrumentation in conductometry	Synchronous-Face to Face Lectures Outside the Network/Offline includes: a. Lecture b. Class Interactive Discussion	50 minutes	a. Gain insight and explanation of conductometry and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials	**Hard Skills:** Completeness and truth about: a. Conductometric principle b. The conductivity of the solution, the conductivity of the type, and the	a. >90% of students answered the conductometric principle questions correctly b. >90% of students answered the	2	

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	c. The instrumentation in conductometry d. The shape of the conductometric titration curve e. The conductometric applications	d. Conductometric titration e. Conductometric applications	c. Review of Discussion Results		c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	conductivity of the equivalent c. Instrumentation in conductometry d. Conductometric titration e. Conductometric applications **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline accuracy and thoroughness in making questions and statements during interactive discussions	questions about Conductivity of solution, specific conductivity, and equivalent conductivity c. >90% of students correctly explained conductometric instrumentation problems d. >90% of students correctly explained the conductometric titration problem e. >90% of students correctly explained the conductometric application		
13	Able to explain:	a. Introduction and definition of	Synchronous-Face to Face Lectures	100 minutes	a. Gain insight and explanation of	**Hard Skills:**	a. >90% of students	3.5	5,6

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	a. The definition of electrochemical sensors and biosensors b. The components of electrochemical sensors and biosensors c. The principle of signal generation in several examples of electrochemical sensors and biosensors that have been applied	electrochemical sensors and biosensors b. Components of electrochemical sensors and biosensors (molecular identifiers and transducers) c. Generation of signals in electrochemical sensors and biosensors	Outside the Network/Offline include: a. Lecture b. Class Interactive Discussion c. Review of Discussion Results		voltammetry and its applications b. Interact between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	Completeness and truth about: a. Definition of electrochemical sensors and biosensors b. electrochemical sensors and biosensors (molecular recognition and transducers) c. Generation of signals in electrochemical sensors and biosensors **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	answered correctly the definition of electrochemical sensors and biosensors b. >90% of students answered correctly the sensor components and electrochemical biosensors c. >90% of students correctly explained the principle of signal generation in several examples of applied electrochemical sensors and biosensors		
14	Able to: a. Summarize and analyze information regarding the	a. Study of scientific articles regarding the application of potentiometric,	Synchronous-Lectures in the network (online) include:	150 minutes	a. Gain the ability to understand and analyze information	**Hard skills:** Ability to understand and analyze the application of	Students correctly explain the application of potentiometric,	10	7

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	application of potentiometric, electrogravimetric and culometric techniques, polarography and voltammetry, conductometric, or electrochemical sensors sourced from the latest scientific articles b. Convey and explain application information Summarize and analyze information regarding the application of potentiometric, electrogravimetric and culometric techniques, polarography and voltammetry, conductometry, or electrochemical sensors sourced from the latest scientific articles in the form of presentations	electrogravimetric and culometric techniques, polarography and voltammetry, or conductometry b. Presentation of application study results Summarizing and analyzing information regarding the application of potentiometric, electrogravimetric and culometric techniques, polarography and voltammetry, or conductometrics	a. Presentation b. Class Interactive Discussion c. Review of Discussion Results		from scientific articles b. Interact between students and: lecturers and other students c. Obtain conformity/understanding of understanding, opinion, agreement, and joint decision on a problem	potentiometric, electrogravimetric and culometric techniques, polarography and voltammetry, or conductometry **Soft Skills:** a. liveliness b. Cooperation c. responsibility d. discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	electrogravimetric and culometric techniques, polarography and voltammetry, or conductometry		
Final Exam									

Pengesahan		Persetujuan		Penyusunan	
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Table 2. Plan for Assignment

WEEK	TOPIC	OBJECTIVE	DESCRIPTION	ASESSEMENT CRITERIA
1	Chromatography introduction: History and definition of chromatography, Chromatographic classification, Elution on chromatography, Component migration, Column efficiency and band broadening, Band widening theory, Column resolution			
2	Analysis techniques and how planar chromatography works			
3	Analysis techniques and workings of			

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	classical column chromatography			
4	Definition, principle of separation, and how gas chromatography works, Gas chromatography instrumentation			
5	Definition and principle of separation in high performance liquid chromatography (HPLC), HPLC instrumentation			
6	Definition and principle of separation by electrophoresis technique, the electrophoresis instrumentation			
7	Study of scientific articles regarding the application of planar chromatography techniques, classical column			

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	chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis, Presentation of application study results, Summarize and analyze information regarding the application of planar chromatography techniques, classical column chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis			

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8	Introduction to electroanalysis: Electrochemical cell, Potential in electroanalysis cells, Electrode potential, Electroanalytical method type			
9	General principles of potentiometric, Instrumentation and application on potentiometric			
10	Principle of electrogravimetric methods and coulometric titrations, the instrumentation and application of electrogravimetric and coulometric			
11	Signal generation in voltammetry, type of voltammetry, Voltammetry instrumentation and applications			
12	Principle of Conductometric, the instrumentation and			

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	applications of conductometric			
13	Introduction and definition of electrochemical sensors and biosensors, Components and generation of signals in electrochemical sensors and biosensors			
14	Study of scientific articles regarding the application of potentiometric, electrogravimetric and culometric techniques, polarography and voltammetry, or conductometry Presentation of application study results Summarizing and analyzing information regarding the application of potentiometric,			

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	electrogravimetric and culometric techniques, polarography and voltammetry, or conductometrics			

Table 3. Plan for Assesemeent

Learning Outcomes	Assignment	Assignment					Exam	
		Resume	Midterm paper	Final term paper	Present ation	Quiz	Mid	Final
Mastering knowledge and able to explain definitions and principles of analysis with chromatography techniques, distinguishing types of chromatography, elution parameters in chromatography and theoretical aspects of chromatography							√	
Mastering knowledge and able to explain the definition of the principles of analysis, instrumentation, and application of planar chromatography							√	
Mastering knowledge and able to explain the definition, principles of analysis, instrumentation, and application of classical column chromatography							√	
Mastering knowledge and able to explain the definition, principles of analysis, instrumentation, and application of gas chromatography							√	
Mastering knowledge and able to explain definitions, principles of analysis and high performance liquid chromatography instrumentation, distinguish separation mechanisms in partition chromatography, adsorption, ion exchange and size exclusion, as well as high performance liquid chromatography applications							√	

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Mastering knowledge and able to explain the definition, principles of analysis and instrumentation of zone and capillary electrophoresis, explain the factors that affect separation in electrophoresis, separation mechanisms in zone and capillary electrophoresis, and electrophoretic applications							√	
Able to summarize, analyze information, and convey information in the form of presentations regarding the application of planar chromatography techniques, classical column chromatography, high performance liquid chromatography, gas chromatography, zone electrophoresis or capillary electrophoresis sourced from the latest scientific articles	√		√		√			
Mastering knowledge and able to explain about electrochemical cells, cell potential and electrode potential, current in electrochemical cells, and types of electroanalysis methods								√
Mastering knowledge and able to explain the definition, analysis principles and potentiometric instrumentation								√
Mastering knowledge and able to explain the definition, principles of analysis and electrogravimetric and colometry instrumentation								√
Mastering knowledge and able to explain definitions, principles of analysis and polarography and voltammetry instrumentation								√
Mastering the knowledge and able to explain the definition, principles of conductometric analysis and instrumentation								√
Mastering knowledge and able to explain the definition, components, and measurement principles of electrochemical sensors								√
Able to summarize, analyze information, and convey information in the form of presentations regarding the application of potentiometric, electrogravimetric and culometric techniques, polarography and voltammetry, conductometrics, and electrochemical sensors sourced from the latest scientific articles	√			√	√			

Table 4. Distribution of Asessement

Assesment Criteria	Range	%	Note

Pengesahan		Persetujuan		Penyusunan	
Tanggal	DD/MM/YYYY	Tanggal	DD/MM/YYYY	Tanggal	DD/MM/YYYY
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Presentation	70-100	20	Group score
Quiz	0-100	10	Individual score
Exam Assesment: Mid Final	 0-100 0-100	 35 35	 Individual score Individual score
Score Chemical Separation and Electroanalysis/KIM238/3(3-0)		**100**	

Table 5. Assesment Criteria

Range	Assesment Criteria (Group Presentation)
90	if students able to: - Develop presentation materials based on the latest scientific articles with excellent systematics and topics appropriate to the teaching materials - Arrange presentations with pictures and illustrations that are attractive and clearly visible - Arrange presentations with clear writing, and are arranged effectively and efficiently - Turn in assignments on time - Deliver presentations with clear intonation and show good manners during presentations - Answer questions clearly and correctly in the discussion session
80	if students able to: - Develop presentation materials based on the latest scientific articles with good systematics and topics that are appropriate to the teaching materials - Arrange presentation shows with pictures and illustrations that are clearly visible but less attractive - Arrange presentations with clear writing, but less effective and efficient - Turn in assignments on time - Delivering presentations with unclear intonation but showing a good attitude during the presentation - Not all questions can be answered correctly during the presentation but are unable to explain
70	if students able to: - Arranging presentation materials based on the latest scientific articles with good systematics and topics that are appropriate to the teaching materials - Arrange presentation shows with pictures and illustrations that are not clearly visible and less attractive - Arrange presentations with unclear writing, and less effective and efficient

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	- Turn in assignments on time - Delivering presentations with unclear intonation and showing unfavorable attitudes during presentations - Not all questions can be answered clearly and correctly during the presentation

Reference:

1. Skoog DA, West DM, Holler FJ, Crouch SR. 2014. Fundamental of Analytical Chemistry. 9th Ed. Belmont (CA): Brooks/Cole.
2. Skoog DA, Holler FJ, Crouch SR. 2018. Principle of Instrumental Analysis. 7th Ed. Boston (US): Cengage Learning.
3. Wang J. 2006. Analytical Electrochemistry. 3rd Ed. New Jersey (CA): John Wiley & Sons, Inc.
4. Recent scientific articles on the applications of planar chromatography, classical column, gas chromatography, high performance liquid chromatography, and electrophoresis
5. Hulanicki A, Glab S, Ingman F. 1991. Chemical sensors definitions and classification. Pure & Appl. Chem 63 (9): 1247-1250.
6. Recent scientific articles on electrochemical sensors and biosensors
7. Recent scientific articles on potentiometric, electrogravimetric and culometric applications, polarography and voltammetry, conductometric, and electrochemical sensors

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