IPB UNIVERSITY
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
DEPARTEMEN KIMIA

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ONE SEMESTER COURSE PLAN (RPS)

KIM 216
INORGANIC CHEMISTRY: SOLIDS AND COORDINATION COMPOUNDS
3(3-0)

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SEMESTER LEARNING PLAN (RPS)

Course Name	:	Inorganic Chemistry: Solids and Coordination Compounds
Code/Credit	:	KIM216/3(3-0)[1)]
Semester	:	4 (even)
Description	:	This course is given to equip knowledge of acid-base theory and redox which also includes frontier orbital dynamics. Furthermore, it provides knowledge about the formula and structure of crystals, thermodynamics of ionic crystal formation, crystal defects, and molecular orbital theory in solid compounds, as well as types of solids based on their electrical conductivity. This course also equips students with knowledge about magnetism, as well as coordination compounds (covering structures and isomers, bond theory, electronic spectra, and reactions and mechanisms)
Prerequisites course	:	Inorganic Chemistry: Elements and Bonding
Learning Outcomes	:	After completing this course, students are able to 1. Describe the types of crystal structure and cell unit properties, determine the crystal phase type of ionic compounds, determine the stability of the crystal structure of ionic compounds using lattice energy, and divide compounds based on their conducting properties and magnetic properties 2. Explain the basic concepts of inorganic chemistry related to the sharing of electrons and electron transfer 3. Explain the concept of formation and isomers of coordination compounds 4. Explain the concepts of bonding and electronic spectra, as well as reactions involving coordination compounds
Scope and Curriculum map of the Royal Society of Chemistry Curriculum (RSC)	:	**Atomic Structure and the Periodic Table**: Magnetochemistry, periodicity hard and soft acid-base chemistry,

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		Inorganic Transition Metals: Transition metal properties as related to electronic structure; Complex ion formation, colored ions, catalysis, variable oxidation state due to partially filled d orbitals, Complex ions; coordination number, charge on the complex and oxidation state of the metal, Crystal field theory and valence shell theory, mechanism of reactions of metal complexes, Ligand substitution reactions; coordinate bonds, equations for ligand substitution reactions, including aqua complexes and redox reactions Bonding: Metallic and ionic solid state structure; radius ratio rule, ionic model; lattice energies and Born Haber cycles **Chemical changes; redox and acids**: Electrochemical processes and potentials, polarography, electric properties of materials and solids
Division/Field	:	Inorganic/Inorganic Chemistry
Lecturer	:	Sri Sugiarti, Charlena, Tetty Kemala, Noviyan Darmawan

[1)]Response/practicum activities are expressed in credits, not in the number of hours
[2)]Refer to the file of Chemistry Curriculum Map from RSC

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I. PLAN OF STUDY

WEEK OF	LEARNING OUTCOMES	TOPIC	METHOD	DURATION	STUDY EXPERIENCE	PENILAIAN			REFERENCES
						CRITERION	INDICATOR	BOBOT (%)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)
1-2	Can: a. Explain the types of solids and the crystal system of solids b. Determine the number of atoms in a crystal system, atomic coordination number, and atomic packing factor, c. Determine the type of hole (tetrahedral/octahedral) in a closed arranged structure d. Classify an atom or compound into specific types of ionic crystals	Solid Theory 1 includes: a. Types of solids b. 7 types of crystal systems, and 14 Bravais lattices, c. Metallic/metallic crystal structure (simple cube, face-centered cube, body-centered cube, hexagonal) and unit cell contents (number of atoms, APF, coordination number) d. Structure closed arrangement of cubes and hexagonal, equipped with the number and type of holes (tetrahedral/octahedral e. Types of ionic crystals	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	4,5 x 50 min	a. Gain insight and explanation of Solids Theory b. Interaction between: (i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	**Hard Skills:** Completeness and truth about: a. Types of solids and crystal structure b. Three-type crystal lattice densely arranged structure c. Classification of atoms or compounds based on their type of ionic crystal **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	a. >90% of students answered correctly about the types of solids and crystal systems b. >90% of students answered correctly about the contents of unit cells (APF, coordination numbers) c. >90% of students answered correctly about the type of hole in the meeting structure d. >90% of students answered correctly about the ionic crystal type of an atom or compound	10	1, 2, 3

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2-3	Can: a. Calculate the lattice energy of ionic solids using the Born-Haber cycle, the Born-Meyer equation and the Kapustinkii b. Determine the type of semiconductor (p, n) and distinguish semiconductors from superconductors c. Describe the types of magnets	Solid Chemistry includes:: a. Lattice energy (Born Haber cycle, Cpulomb's law, Madelung's constant equation, Born-Meyer equation, Kapustinkii equation) b. Semiconductor and superconductor c. Magnet includes diamagnetic, paramagnetic, ferrimagnetic, and ferromagnetic	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	4,5 x 50 min	a. Gain insights and explanations of lattice, semiconductor, and magnetic energy b. Interaction between: (i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	Hard Skills: Completeness and truth about: a. Calculation of ionic solids lattice energy b. Types of solids based on their conducting properties c. Solids **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	a. >90% of students answered correctly about calculating lattice energy using the Born-Haber cycle b. >90% of students answered correctly about the types of solids based on conductive properties c. >90% of students answered correctly about the type and nature of magnets	15	1, 2, 3
4-5	Can: a. Explain acid-base concepts and theories b. Determine the strength of acid-base both from the formula and from its structure c. Explain the effect of solvents on acid-base strength (leveling effect)	Acid-Base and Donor-Acceptor Chemistry includes: a. Concept and theory b. The strength of acid-base in terms of formula and structure c. Solvent Effect	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	6 x 50 min	a. Gain insight and explanation of acid-base theory and the correlation between structure and formulas for strength, hard and soft acid-base, and front group orbital theory (HOMO-LUMO) b. Interaction between: (i) Students and teaching materials	Hard Skills: Completeness and truth about: a. Ionic solids b. Types of solids based on their conducting properties c. Properties and types of	a. >90% of students answered correctly about determining the strength of acid-base based on its formula and structure, and the effect of solvents b. >90% of students	12,5	1, 2, 3

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	d. Explain the concepts of hard and soft acid-bases and group acid-bases based on hard-soft properties e. Explain the concept of acceptor donors and relate them to the theory of front group orbitals	d. Soft and hard acids and bases e. Orbital theory (HOMO-LUMO)			(ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	magnets of ionic solids **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	answered correctly about acid-base classification based on soft-hard properties c. >90% of students answered correctly about the interaction between HOMO and LUMO		
6-7	Can: a. Explain redox definitions b. Use reduction potential values to classify the properties and redox reactions of an atom or compound c. Explain the stability of redox reactions using the Nerst equation d. Explain the redox properties of an atom or compound using Latimer, Frost, and Pourboix diagrams e. Use redox mechanisms for element extraction	Electron transfer (Advanced Oxidation/Reduction) includes a. Definition b. Reduction potential, redox properties and reactions c. Nerst Equation d. Latimer, Frost, dan Pourboix diagrams Extraction of elements	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	6 x 50 min	a. Gain insight and explanation of redox definitions, properties and redox reactions of an atom or compound, Latimer, Frost and Pourboix diagrams, and how to extract elements b. Interaction between: (i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	Hard Skills: Completeness and truth about: a. Calculation of ionic solids lattice energy b. Types of solids based on their conducting properties c. Properties and types of magnets of ionic solids **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	a. >90% of students answered correctly about the definition, properties and redox reactions of an atom or compound b. >90% of students answered correctly about redox reaction stability c. >90% of students correctly answered the Latimer, Frost, and Pourboix diagramming of potential reduction values	12,5	2

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							d. >90% of students answered correctly about the application of redox reactions for elemental extraction		
8-9	Can: a. Explains the history of the development of coordination compounds a. Naming coordination compounds based on IUPAC rules b. Determine the coordination number and structure of the coordination compound from the given example c. Describe the isomers that may be formed in coordination compounds	Coordination Chemistry I includes: a. The history of the discovery of coordination compounds b. Nomenclature of coordination compounds c. Coordination number and structure d. Isomerization	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	5 x 50 min	a. Gain insight and explanation of history, nomenclature, coordination numbers, and structure, as well as isomerization of coordination compounds b. Interaction between: (i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	Hard Skills: Completeness and truth about: a. Calculation of ionic solids lattice energy b. Types of solids based on their conducting properties c. Properties and types of magnets of ionic solids **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	a. >90% of students answered correctly about the history and nomenclature of coordination compounds b. >90% of students answered correctly about the coordination number and the structure of the coordination compound c. >90% of students answered correctly about the number and type of isomers of coordination compounds	10	1, 2, 3
9-11	Can: a. Describes experimental evidence of electronic structure	Coordination Chemistry II includes: a. Electronic structures, thermodynamic	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures	7 x 50 min	a. Gain insight and explanation of electronic structure, valence electron theory, ligand field	Hard Skills: Completeness and truth about:	a. >90% of students answered correctly about electronic	15	1, 2, 3

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	of coordination compounds, thermodynamic and magnetic data b. Explain electronic structure theory, valence electron theory, ligand field cleavage theory, and angular overlap. c. Explain the effects of ligand types on the concept of strong and weak ligand fields d. Describe the effects of Jahn Teller on the structure and reactivity of coordination compounds	data, and magnetism *b.* Valence electron theory, ligand field cleavage theory, and *angular overlap* c. Types of ligands d. The concept of the Jahn Teller effect	b. Class Interactive Discussion c. Review of Discussion Results		theory, *angular overlap,* types of ligands, and the Jahn Teller effect of compound coordination b. Interaction between: (i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	a. Electronic structure, thermodynamic data, magnetic properties of coordination compounds *b.* Electronic structure theory, valence electron theory, ligand field theory, and *angular overlap* c. Types of ligands and effects of Jahn Teller on coordination compounds **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	structure and its effect on the magnetic properties of coordination compounds *b.* >90%, students answered correctly about the properties of coordination compounds based on electronic structure theory, valence bond theory, and ligand field theory and determined the division of d orbitals according to *angular overlap* c. >90% of students answered correctly about d-orbital cleavage due to the Jahn Teller effect		
12-13	Can: a. Explain concepts and theories on the process of light absorption by transition compounds	Coordination Chemistry III includes: a. Light absorption by transition compounds	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion	6 x 50 min	a. Gain insight and explanation of light absorption processes, atomic quantum numbers of transition metals, and electronic spectra of	Hard Skills: Completeness and truth about: a. Electron transition due to light absorption process	a. >90% of students answered correctly about electron transition in coordination compounds	15	1, 2, 3

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	b. Determining the quantum number for a multielectron atom (term symbol) c. Describes the electronic spectrum for coordination compounds based on the Tanabe-Sugano diagram	b. Atomic quantum number multielectron (term symbol) c. Electronic spectrum based on Tanabe-Sugano diagram	c. Review of Discussion Results		coordination compounds b. Interaction between: (i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	b. Quantum number and term symbol of atom multielectron c. Electronic spectrum of coordination compounds **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	b. >90% of students answered correctly about the number of quantum numbers and the determination of term symbols of transition metal elements c. >90% of students correctly answered the Tanabe-Sugano plot diagram and the number of peaks that appear in the electronic spectrum of transition compounds		
14	Can: a. Describe substitution reactions and their mechanisms b. Explain the kinetics of the reaction stages of coordination compounds c. Describe the substitution reactions and reactivity of	Coordination Chemistry IV includes: a. Types of reactions in transition compounds b. Reaction kinetics c. Octhedral complex substitution reaction	Synchronous-Off-Network/Offline Face-to-Face Lectures include: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	3 x 50 min	a. Gain insight and explanation of the types of reactions and reactivity of coordination compounds, reaction kinetics, and complex reactivity with octahedral, flat quadrilateral, and tetrahedral geometries b. Interaction between:	Hard Skills: Completeness and truth about: a. The types of reactions involve their coordination and kinetic compounds b. Substitution reactions in complex compounds with	a. >90% of students answered correctly about the types of reactions involving coordination compounds and their kinetics b. >90% of students correctly answered the	10	1, 2, 3

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	octahedral complexes b. Describes the reactions of substitution and reactivity of flat quadrilateral and tetrahedral complexes	d. Substitution reactions of flat quadrilateral complexes (trans effect) and tetrahedral			(i) Students and teaching materials (ii) Students and lecturers (iii) College students c. Obtain conformity /understanding of opinions, agreements, and joint decisions on a problem	an octahedral, flat quadrilateral (trans effect), and tetrahedral geometries **Soft Skills:** a. Actiness b. Cooperation c. Responsibility d. Discipline accuracy and thoroughness in making questions and statements during interactive discussions	question of substitution reactions involving octahedral, flat quadrilateral, and tetrahedral complexes		

II. ASSESSMENT DESIGN

No	Learning outcomes	TEST			
		1	Midterm	3	Final
1	Able to explain the types of crystal structure and cell unit properties, determine the crystal phase type of ionic compounds,	√			

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	determine the stability of the crystal structure of ionic compounds using lattice energy, and divide compounds based on their conducting properties and magnetic properties				
2	Able to explain the basic concepts of inorganic chemistry related to electron sharing, and electron transfer		√		
3	Able to explain the concept of formation and isomers of coordination compounds			√	
4	Able to explain the concepts of bonding and electronic spectrum, as well as reactions involving coordination compounds			√	√

[3)]Choose one

III. ASSESSMENT WEIGHTS

Evaluation Criteria	Score Range	Weighting (%)	Information
Exam 1	0-100	25	Individual score
Midterm Exam	0-100	25	Individual score
Exam 3 Final Semester Exam	0-100 0-100	25 25	Individual score Individual score
Inorganic Chemical Score: Solids and Coordination Compounds/KIM 216/ cr 3(3-0)		**100**	

IV. REFERENCES

1. Gary L. Miessler, Donald A. Tarr. 2004. Inorganic Chemistry. 3rd Ed. Prentice-Hall, Inc. Upper Saddle River, NJ 07458
2. Shriver DF, Atkins PW. 1999. Inorganic Chemistry. 3rd Ed. W.H. Freeman and company. 41 Madison avenue, NY 10010.
3. Bowser JR, 1993. Inorganic Chemistry. Brooks/Cole Publishing Company. Pacific Grove, CA 93950.

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ONLINE LEARNING ACTIVITY PLAN

1	Online learning week of	2
2	Course Name	Inorganic Chemistry: Solids and Coordination Compounds
3	Code/Credit	KIM 216/3(3-0)
4	Nama Pengembang Developer Name	Sri Sugiarti and Team
5	Expected final capability	Able to explain the types of crystal structure and cell unit properties, determine the crystal phase type of ionic compounds, determine the stability of the crystal structure of ionic compounds using lattice energy, and divide compounds based on their conducting properties and magnetic properties
6	Online learning week of	7
7	Course Name	Inorganic Chemistry: Solids and Coordination Compounds
8	Code/Credit	KIM 216/3(3-0)
9	Name of developer	Sri Sugiarti and Team
10	Expected final capability	Able to explain the basic concepts of inorganic chemistry related to the shared use of electrons, and electron transfer
11	Online learning week of	13
12	Course Name	Inorganic Chemistry: Solids and Coordination Compounds
13	Code/Credit	KIM 216/3(3-0)
14	Nama Pengembang	Sri Sugiarti and Team
15	Expected final capability	Able to explain the concepts of bonding and electronic spectrum, as well as reactions involving coordination compounds

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