SEMESTER LEARNING PLAN

INORGANIC CHEMISTRY: ORGANOMETALS AND BIOINORGANICS
KIM 1315
3(3-0))

By:
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FACULTY OF MATHEMATICS AND NATURAL SCIENCES
BOGOR AGRICULTURAL UNIVERSITY
2023

SEMESTER LEARNING PLAN

Course Name	:	Inorganic Chemistry: Organometals and Bioinorganics
Code/Credit	:	KIM 1315/3 (3-0)
Semester	:	Odd (Semester 5)
Description	:	This course is given to equip students with knowledge about organometallic compounds: electron number, organometallic complex with dative ligands, organometallic reactions with catalysis, parallels between main group chemistry and organometals, cluster compounds, coordination polymer compounds and metal organic framework (MOF), The role of ensensial elements in biological systems (main group elements and transition group elements), bioinorganic Fe and Co, redox in biological systems, the role of calcium in biological systems, the role of metals in medical, inorganic toxicology and chemotherapy, and inorganic pollutants.
Prerequisite course	:	Inorganic Chemistry: Elements and Bonding; Inorganic Chemistry: Solids and Coordination Compounds
Learning outcomes	:	1. Can explain organometallic compounds: electron number, organometallic complexes with dative ligands, organometallic reactions with catalysts. 2. Can explain parallels between main group chemistry and organometallics 3. Can explain cluster compounds, coordination polymer compounds, and metal-organic framework (MOF) 4. Can explain in general the role of essential elements, bioinorganic Fe and Co, the role of calcium, magnesium, and redox processes in biological systems 5. Can explain the role of metals in medical, toxicology, and inorganic chemotherapy. 6. Can explain about inorganic pollutants
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. 4. Lippard, SJ. 1994. Principles of Bioinorganic Chemistry
Division/Field	:	Inorganic
Lecturers	:	**1. Dr. Tetty Kemala, M.Si** 2. Dr. Sri Sugiarti 3. Dr rar net Novian Darmawan 4. Dr. Charlena, MSi

I. LESSON PLAN

Week of	Learning Outcome	Topic	Method	Duration	Student Experience	ASSESSMENT			Reference
						Indicator	Criteria	(%)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Can explain the understanding of organometals, the importance and development of organometals, organic ligands and their naming, and electron numbers.	1. Lecture agrrement. 2. Understanding organometallic chemistry. 3. The significance of organometallic chemistry and its scope 4. History and background of organometallics. 5. Organic ligand and organologam designation 6. Number of electrons	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify organometallic, the significance and development of organometallic, organic ligands, their designation, and the number of electrons	The correctness in explaining organometals, the importance and development of organometals, organic ligands and their nomenclature, and electron numbers	Exam I	5	1, 2, 3
2-3	Can explain organometallic complexes with dative ligands and can explain organometallic forces with anionic ligands.	1. Carbonyl ligands (carbonyl ligand synthesis and carbonyl bond mode, carbonyl complex characterization, carbonyl ligand matching) 2. Phosphine ligan (phosphine complex: cis and trans, chiral phosphine ligands, phosphine ligand electronic, cone angle Tolman) 3. Amine ligands 4. Oxygen ligands 5. Dinitrogen ligands	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	225 min	Understand and identify organometallic complexes with dative ligands include: carbonyl ligands, the strength of the M-CO bond in the resulting complex, its synthesis, and its ligand equivalents, phosphine ligands, amine ligands, oxygen ligands, dinitrogen ligands, alkene ligands, arena ligands, organometallic	The completeness and correctness in explaining organometallic complexes with dative ligands include: carbonyl ligands, M-CO bond strength in the resulting complex, their synthesis, and their ligand equivalents, phosphine ligands, amine ligands, oxygen ligands, dinitrogen ligands, alkene ligands, arena ligands, organometallic	Exam I	7.5	1, 2, 3

		6. Alkene ligands 7. Arene ligands 8. Organometallic strength with anionic ligands. 9. Alkyl complex, carbena complex, carbyne complex, nnolate metal complex, Phi allyl metal complex, Benzyl ɳ3 complex, hydride metal complex, amido complex, porphyrin, corine, and sulfonamide.			forces with anionic ligands, alkyl complexes, carbena complexes, carbuna complexes, enolate metal complexes, phi allyl metal complexes, benzyl ɳ3 complexes, hydride metal complexes, amido, porphyrin, corine, and bisulfonamide complexes	forces with anionic ligands, alkyl complexes, carbena complexes, carbuna complexes, enolate metal complexes, phi allyl metal complexes, benzyl ɳ3 complexes, Metal hydride complex, amido complex, porphyrin, corine, and bisulfonamide.			
3-4	Can explain organometallic reactions	1. Reactions involving the addition or loss of ligands, including ligand dissociation and substitution, oxidative addition, reductive elimination, replacement by nucleophilic (nucleophilic displacement) 2. Reactions involving ligand modification include insertion, carbonyl insertion (alkyl migration), hydride elimination, abstraction	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify reactions involving the addition or loss of ligands, including ligand dissociation and substitution, oxidative addition, reductive elimination, nucleophilic displacement, Reactions involving ligand modification include insertion, carbonyl insertion (alkyl migration), hydride elimination, abstraction. Catalysis reactions studied include catalytic	Correctness in explaining reactions involving the addition or loss of ligands, including ligand dissociation and substitution, oxidative addition, reductive elimination, replacement by nucleophilic (nucleophilic displacement), reactions involving ligand modification include insertion, carbonyl insertion (alkyl migration), hydride elimination, abstraction.	Exam I	7.5	1,2,3

					deuteration, hydroformylation, Mosanto process, Wacker process, Wilkinson hydrogenation, and olefin metathesis	Catalysis reactions studied include catalytic deuteration, hydroformylation, Mosanto process, Wacker process, Wilkinson hydrogenation, and olefin metathesis			
	EXAM 1							20	
4-5	Can explain catalyst performance	Catalysis reactions studied include catalytic deuteration, hydroformylation, Mosanto process, Wacker process, Wilkinson hydrogenation, and olefin metathesis.		150 min			Exam II	5	
5-6	Can explain the chemical alignment of the main group with organometals and metal cluster compounds	1. Isoelectronics between atoms of major groups and organocomplexes of metals 2. Limitation 3. The concept of isolobal molecular fragments 4. Metal-metal bonding 5. Overview of borane cluster compounds 6. Metalaborane and carborane	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	225 min	Understand and identify the chemical alignment of the main group with organometals and compound metal clusters	The correctness in explaining chemical alignment of the main group with organometals and compound metal clusters	Exam II	7.5	1, 2, 3
7	Can explain about coordination polymers and metal-organic framework (MOF)	1. Introduction: Coordination polymers and metal-organic framework (MOF) 2. Zeolite	Synchronous-face-to-face lectures/offline include: lectures,	150 min	Understand and identify coordination polymers and organic metal	Clear explanation about coordination polymers and organometal framwork (MOFs)	Exam II	7.5	1, 2, 3

		3. Metal-organic frameworks (MOF): secondary unit of development, network synthesis 4. Fuel cell 5. MOF 5	interactive discussions		framework (MOFs)				
	EXAM II (MIDTERM)							20	
8	Can explain about essential chemical elements in biological systems	1. The main group of metals is essential in biological systems. 2. Non-metal group 3. Transition metal group	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify metal elements essential main groups, nonmetals and transition metal groups in biological systems	Completeness and correctness in explaining essential main group metal elements, nonmetallic groups, and transition metal groups in biological systems	Exam III	5	1, 2, 3
9	Can explain about bioinorganic iron and cobalt in biological systems	1. Fe bioinorganic 2. Co bioinorganic	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify bioinorganic iron and cobalt in biological systems	Completeness and correctness in explaining bioinorganic iron and cobalt in biological systems	Exam III	7.5	1, 2, 3
10	Can explain redox in biological systems (bianorganic magnesium)	1. Photosynthesis 2. Chlorophyll and reactions on chlorophyll 3. Magnesium in biological systems 4. The role of magnesium in DNA and other synthesis 5. Respiration	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify photosynthesis, chlorophyll, and reactions on chlorophyll, magnesium in biological systems, the role of magnesium in DNA synthesis and others and respiration	Completeness and correctness in explaining photosynthesis, chlorophyll and reactions on chlorophyll, magnesium in biological systems, the role of magnesium in DNA synthesis and others and respiration	Exam III	7.5	1, 2, 3

	EXAM III							20	
11	Can explain calcium roles	1. The role of Ca in biological systems 2. Regulation of Ca in the body 3. The role of Ca in muscle contraction 4. Calmodulin	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify the role of Ca in biological systems, regulation of Ca in the body, role of Ca in muscle contraction, and Calmodulin	Completeness and correctness in explaining the role of Ca in biological systems, regulation of Ca in the body, the role of Ca in muscle contraction, and calmodulin	Exam IV	5	1, 2, 3
12	Can explain the role of metals in medical, toxicology, and inorganic chemotherapy	1. The role of metals in medicine. 2. Toxicology 3. Inorganic chemotherapy	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify the role of metals in medical, toxicology, and inorganic chemotherapy.	Completeness and correctness in explaining of the role of metals in medical, toxicological, and inorganic chemotherapy	Final Exam	5	1, 2, 3
13.	Can explain about inorganic pollutants	1. Mercury 2. Lead 3. Arsenic 4. Cadmium	Synchronous-face-to-face lectures/offline include: lectures, interactive discussions	150 min	Understand and identify inorganic pollutants related to mercury, lead, arsenic, and cadmium.	Completeness and correctness in explaining inorganic pollutants related to mercury, lead, arsenic, and cadmium	Final Exam	5	1, 2, 3
14.	Can explain about phenomena of the existence of elements in biological systems through video assignments	Video exposure about: 1. The role of Fe on Hb 2. The role of Fe in Mb 3. The role of Co on the coenzyme B12 4. The role of Mg in chlorophyll 5. The role of Ca in muscle contraction 6. The role of P in biological systems	Interactive in the form of video presentations by students is carried out offline/online	150 min	Understand and identify essential elements in biological systems in the form of videos	Completeness and correctness in explaining the understanding of essential elements in biological systems in the form of videos	Presentation	5	1, 2, 3

	EXAM IV (FINAL)								

II. ASSESSMENT DESIGN

No	Learning Outcomes	Assignment (Small Project)	Exam			
			Exam 1	Exam 2 (Midterm)	Exam 3	Exam 4 (Final)
1	Can explain organometallic compounds: electron number, organometallic complexes with dative ligands, organometallic reactions with catalysts.		√			
2	Can explain parallels between main group chemistry and organometallics		√	√		
3	Can explain cluster compounds, coordination polymer compounds, and metal-organic framework (MOF)			√		
4	Can explain in general the role of essential elements, bioinorganic Fe and Co, the role of calcium, magnesium, and redox processes in biological systems	√			√	
5	Can explain the role of metals in medicine, toxicology, and inorganic chemotherapy.					√
6	Can explain about inorganic pollutants					√

III. GRADING WEIGHTS

Assessment Criteria	Score Range	Score Weight (%)	Information
Assignment (Small Project)	70–100	20	Group score
Lecture Assessment:			
Exam 1	0–100	20	Individual score
Exam 2 (Midterm)	0–100	20	Individual score
Exam 3	0–100	20	Individual score
Exam 4 (Final)	0–100	20	Individual score
Inorganic Chemical Score:		**100**	

IV. SMALL PROJECT ASSIGNMENT GRADING RUBRIC[4)]

Score Range	Individual Resume Assessment Criteria
≥ 90	If students can: - Create small projects of teaching materials in the form of videos with excellent systematics - Making small projects very effective, very efficient, very precise, and very appropriate to the theme - Deliver small projects on time - Have a good delivery attitude, neat, and polite - The video is exactly 5 minutes long.
80--<90	If students can: - Create small projects of teaching materials in the form of videos with good systematics - Make small projects effective, efficient, precise, and in accordance with teaching materials - Deliver small projects on time - Videos longer than 5 minutes, max 7 minutes
70--<80	If students can: - Develop small projects with less systematics - Arrange small projects inappropriately and not in accordance with the material - The submission of tasks was not timely - Videos less than 5 minutes long or longer than 7 minutes

[44)]The grading rubric can be adjusted to the assigned task

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.
4. Lippard, SJ. 1994. Principles of Bioinorganic Chemistry

ONLINE LEARNING ACTIVITY PLAN

1	Offline learning week of	7
2	Course name	Inorganic Chemistry: Organometals and Bioinorganics
3	Code/Credit	KIM 1315/3(3-0)
4	Name of developer	Tetty Kemala and Team
5	Learning outcomes	Able to explain
6	Online learning week of	14
7	Course name	Inorganic Chemistry: Organometals and Bioinorganics
8	Code/Credit	KIM 1315/3(3-0)
9	Name of developer	Tetty Kemala dan Tim
10	Learning outcomes	Able to explain

Online Learning Materials

Week of	Topics covered	Teaching materials and learning activities	References and other sources
7			
14			