Course Specification

(Postgraduate Programs)

Course Title:	**Bio-inorganic Chemistry**
Course Code:	**CHM 6115**
Program:	**Master of science in chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☐Department	☐Track	
B.	☐Required		☒ Elective		
3. Level/year at which this course is offered: (Level 2/Year 1)					
4. Course General Description:					
This course provides students with an introduction to Molecular Structure and Function of bio-inorganic compounds, metals and non-metals in biology, and biological ligands for metal ions. The course will extend to cover sodium and potassium, magnesium phosphate metabolism and photoreceptors, copper chemistry, manganese chemistry, iron and oxygen, molybdenum, tungsten, vanadium, and chromium, molybdenum Enzyme families in the biological systems					
5. Pre-requirements for this course (if any):					
Inorganic Molecular Spectroscopy – CHM 6111					
6. Co-requirements for this course (if any):					
7. Course Main Objective(s):					
• **Recognize the metals and non-metals in biology.** • **Understand the Basic Coordination Chemistry in the biological system.** • **Be familiar with metals inside the biological systems.** • **Study and compare the role of metals in the cell and enzymes.** • **Evaluate the role of metals and non-metals in the biological system.**					

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100
2	E-learning		

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recall knowledge of selected metals and non-metals chemistry in biology.**	**K1. *Inorg*.; K2. *Inorg*.; K4. *Inorg***	• **Five hours/week lectures.** • **Self-study** • **Home-exam.**	• **Regular Exams** • **Assignments** • **Short Quizzes** • **Oral Discussion Participation.**
1.2	**To recognize the basic coordination chemistry and biological ligands in the biological system.**	**K1. *Inorg*.; K2. *Inorg*.; K4. *Inorg*.;**	• **Five hours/week lectures** • **Think and justify coordination**	• **Oral Discussion marks** • **Literatures Survey**

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
			chemistry and biological ligands, using available references (SDL) online. • Open discussion.	• Mini-seminar. Participation
1.3	To define the reactivity of sodium and potassium, magnesium phosphate metabolism and photoreceptors in biological system	K1. *Inorg.*; K2. *Inorg.*; K3. *Inorg.*;	• Five hours/week lectures. • Group Discussion on of reactivity of some elements metabolism and photoreceptors in biological system, using available references (SDL) online.	• Midterm. • Assignments. • Group Discussions. • Literatures Survey. • Mini-seminar. Participation.
1.4	To state the role Ca2+ and Mg2+, nickel enzymes, methyl-coenzyme, and photosynthetic oxidation.	K1. *Inorg.*; K2. *Inorg.*; K3. *Inorg.*;	• Five hours/week lectures. • Group Discussion using available references (SDL	• Assignments • Open Discussions. • Literatures Survey • Mini-seminar. Participation
2.0	**Skills**			
2.1	To analyze methods for studying metals	S1. *Inorg.*; S2. *Inorg.*; S3. *Inorg.*	• Lectures activity.	• Questions in Lectures.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	and ligands inside biological system.		• Self-study • Deep discussion on metals and ligands inside biological system. • Lectures activity.	• Short Quizzes and Exams. • Open Discussions. • Participation • Mini - seminar.
2.2	To evaluate the ligands and metals routes inside the biological system.	S1. *Inorg.*; S2. *Inorg.*; S3. *Inorg*.	• Practice some examples for some ligands and metals routes interpretation inside the biological system achieving. • Brainstorming. • Self-study.	• Questions in Lectures. • Participation • Oral Discussion • Short Quizzes.
2.3	To compare the metals and ligands role in the biological system functions.	S1. *Inorg.*; S4. *Inorg.*;	• Lectures • Oral Discussions. • Brainstorming. • Self-study	• Questions in Lectures. • Short Quizzes and Exams. • Oral Discussion. • Participation
2.4	To operate communication to Basic Coordination Chemistry in the biological system and its importance,	S1. *Inorg.*; S3. *Inorg.*; S4. *Inorg*.	• Group Discussion and Assignments • Introduce several examples of	• Oral Discussion, Quizzes, and Exams. • Giving marks for

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	accompanying writing of mini-Reports, operating electronic mail, and Network in communicating with others.		Basic Coordination Chemistry in the biological system, which will require reading, writing, and oral presentation in groups. Encourage students to use electronic mail to submit Home Exams and Assignments	Oral Discussion in Lectures. • Marks given for Assignments
3.0	**Values, autonomy, and responsibility**			
3.1	To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information.	V1. . *Inorg*.	• Brainstorming. • Exercises • Group Discussion. • Team work.	• Oral Discussion. • Group Discussion • Assignments.
3.2	To demonstrate his ability to the effectively collaboration and inter-professionalism in class discussions or team works, as well as independently.	V1. *Inorg*.; V2. *Inorg*.	• Small Group tasks • Open discussion at classroom. • Office hour guiding. • Group Presentation	• Participation • Homework's • Mini-project(s).

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
			of mini-projects	
...				

C. Course Content:

No	List of Topics	Contact Hours
1.	***An Overview of Metals and Selected Nonmetals in Biology***: Essential Elements and the Essential Metal Ions, An Idiosyncratic View of the Periodic Table.	4
2.	***Basic Coordination Chemistry for Biologists:*** Types of Chemical Bonds, Hard and Soft Ligands, Coordination Geometry, Redox Chemistry.	4
3.	***Biological Ligands for Metal Ions***: Insertion of Metal Ions into Metallo-proteins, Chelatase, The Terminal Step in Tetra pyrrole Metallation Iron-Sulfur cluster Formation, More Complex Cofactors- MoCo, FeMoCo, P-clusters, H-clusters, and CuZ, siderophores.	5
4.	***Methods to Study Metals in Biological Systems: Introduction, Magnetic Properties, Electron Paramagnetic Resonance (EPR) Spectroscopy, Mössbauer Spectroscopy, NMR Spectroscopy, Electronic and Vibrational Spectroscopies, Circular Dichroism and Magnetic Circular Dichroism, Resonance Raman Spectroscopy, Extended X-Ray Absorption Fine Structure (EXAFS), X-Ray Diffraction.***	4
5.	***Sodium and Potassium: Transport across Membranes, Sodium versus Potassium, Potassium Channels, Sodium Channels, The Sodium-Potassium Atpase, Sodium/Proton Exchangers. Magnesiume Phosphate Metabolism and Photoreceptors: Magnesium-Dependent Enzymes,***	5
6.	***Phosphoryl Group Transfer Kinases, Phosphoryl Group Transfer–Phosphatases, Stabilisation of Enolate anions -, Magnesium and Photoreception***	3
7.	***Calcium: Comparison of Ca2+ and Mg2+ , The discovery of a Role for Ca2+ Other than as a Structural Component, Regulation and Signalling, Ca2+***	3
8.	***Nickel and Cobalt: Nickel Enzymes, Methyl-Co-enzyme M Reductase, Cobalt amine and Cobalt Proteins, B12-Dependent Isomerases, B12-Dependent Methyltransferases.***	4
9.	***Copper Chemistry: Copper-Containing Enzymes in Oxygen Activation and Reduction, The Role of Cupper in iron Metabolism.***	3

10.	*Manganese Chemistry: Photosynthetic Oxidation of Water-Oxygen Evolution, Mn2+ and Detoxification of Oxygen Free Radicals, Nonredox di-Mn Enzymes – Arginase,*	4
11.	*Zinc: Mononuclear Zinc Enzymes, Multinuclear and Co-catalytic Zinc Enzymes, Zinc Fingers DNA- and RNA-Binding Motifs*	2
12.	*Iron and Oxygen: The Biological Importance of Iron, Biological Functions of Iron-Containing Proteins, Haemo-proteins.*	2
13.	*Molybdenum, Tungsten, Vanadium, and Chromium: Mo and W Chemistry, Molybdenum Enzyme Families, The Xanthine Oxidase Family, The Sulfite Oxidases and DMSO Reductases*	2
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Class Activities (Open Discussion, Mini-reports, Oral Presentation, solving questions)	weekly	30 %
2.	Midterm Exam	9th week	30 %
3.	Final Exam	Around 17 th week	40 %
4.	Total		100 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	*Biological Inorganic Chemistry, A New Introduction to Molecular Structure and Function*, R. Crichton, 2nd Ed., The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK, (2012). ISBN: 9780444537829 *Bioinorganic Chemistry*, I. Bertini,; H. B. Gray, S. Lippard, J. S. Valentine, University Science Books, Mill Valley, California (1994), ISBN 0-935702-57-1.
Supportive References	None

Electronic Materials	• **American Chemical Society (Relevant Journals)** • **Saudi Digital Library**
Other Learning Materials	• **Blackboard** • **Multimedia associated with the textbook and the relevant websites.**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology equipment (Projector, smart board, software)	**The rooms are equipped with data show, Smart Board, Wi-Fi access.**
Other equipment (Depending on the nature of the specialty)	**None**

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct: Questionnaire.**
	Course Responsible	**Direct: Course e-Portfolio. Indirect: Second examiner checklist-Course report.**
	Peer Reviewer	**Direct: Questionnaire. Indirect: External assessor report.**
Effectiveness of students' assessment	**Program Leaders**	**Direct: Course e-Portfolio. Indirect: Course report.**

Assessment Areas/Issues	Assessor	Assessment Methods
Quality of learning resources	Students	Indirect: Second examiner checklist- Course report.
	Faculty (Academic Advisory- GCC)	Direct: course Entrance/Exit. Indirect: Observations - Accreditation review.
	Program Leaders	Direct: Course e-Portfolio. Indirect: Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	
The extent to which CLOs have been achieved	Course Responsible	Direct: Exams - Course e-Portfolio. Indirect: Second examiner checklist- Course report
	Program Leaders	Indirect: Exams.
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	COUNCIL OF CHEMISTRY DEPARTMENT
REFERENCE NO.	10 (NO. 2/10)
DATE	21/04/1444- 15/11/2022