

Course Syllabus

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| 1 | Course title | Advanced Bioinorganic Chemistry | |
| 2 | Course number | 0303725 | |
| 3 | Credit hours | 3 (theory) | |
| | Contact hours (theory, practical) | 6 hrs/week (theory) | |
| 4 | Prerequisites/corequisites | - | |
| 5 | Program title | M.Sc. Chemistry | |
| 6 | Program code | 0303 | |
| 7 | Awarding institution | The University of Jordan | |
| 8 | School | Science | |
| 9 | Department | Chemistry | |
| 10 | Course level | Master Level | |
| 11 | Year of study and semester(s) | - | |
| 12 | Other department(s) involved in teaching the course | None | |
| 13 | Main teaching language | English | |
| 14 | Delivery method | <input checked="" type="checkbox"/> Face to face learning <input type="checkbox"/> Blended <input type="checkbox"/> Fully online | |
| 15 | Online platforms(s) | <input type="checkbox"/> Moodle <input checked="" type="checkbox"/> Microsoft Teams <input type="checkbox"/> Skype <input type="checkbox"/> Zoom <input type="checkbox"/> Others..... | |
| 16 | Issuing/Revision Date | 24-1-2024 | |



17 Course Coordinator:

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|----------------|-------------------|
| Name | Contact hours: |
| Office number: | Phone number: N/A |
| Email: | |

18 Other instructors:

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| Name: |
| Office number: |
| Phone number: |
| Email: |

19 Course Description:

An introductory as well as advanced aspect and methods in bioinorganic chemistry are all developed during the course. The course will provide students with a general overview of the many very fundamental tasks performed by inorganic elements like “Metal Ions in Proteins” and “Special Cofactors and Metal Clusters” in living organisms. Methods and theories with particular emphasis on enzymatic conversions and electron transfer will be discussed in view of its importance in bioinorganic chemistry. This goes along with the elucidation of model systems and technical applications of both, concepts learned from nature as well as biological systems.

20 Course aims and outcomes:



A- Aims:

At the successful completion of this course, you (the student) should be able to:

CLO1 Understand how metal ions interact with biological environments and how these interactions influence the properties of metal centres.

CLO2 Applies principles of coordination chemistry as well as principles of inorganic chemistry and organometallics to explain how nature tailors the properties of metal centres for specific applications.

CLO3 Analyse critical questions (asked by fellow students or the instructor) and engage in scientific discussion on bioinorganic chemistry-related topics.

CLO4 Demonstrate in written homework the ability to comprehend current problems in bioinorganic chemistry and answer specific scientific questions using the knowledge provided during the course.

CLO5 Understand current publications and reviews in bioinorganic chemistry in high-impact journals at the level that is required to present a self-selected topic to an audience in a conference-style seminar.

B- Students Learning Outcomes (SLOs):

SO-1. Problem Solving: Graduates will be able to apply mathematical and scientific knowledge to identify, formulate, and solve technical or scientific problems relevant to the discipline of chemistry.

SO-2. Design: Graduates will be able to use their understanding of chemistry concepts and principles to formulate and design systems, processes, procedures, or programs to meet desired goals and outcomes.

SO-3. Experimental Skills: Graduates will be able to design, conduct, and analyze experiments or test hypotheses, utilizing appropriate chemical techniques and scientific judgment to draw meaningful conclusions.

SO-4. Communication: Graduates will be able to communicate scientific information effectively and accurately to a range of audiences, including both technical and non-technical audiences.

SO-5. Ethics and Global Context: Graduates will understand and apply ethical and professional responsibilities in the context of the impact of technical and scientific solutions on global, economic, environmental, and societal issues.

SO-6. Teamwork: Graduates will be able to work effectively as part of a team, establishing goals, planning tasks, meeting deadlines, and analyzing risk and uncertainty in the context of chemistry-related projects and initiatives. SO-7. Handling Chemicals: An ability to apply the proper procedures for safe handling of chemicals..

| | | SO-1 | SO-2 | SO-3 | SO-4 | SO-5 | SO6 |
|---------------------------------------|-------|------|------|------|------|------|-----|
| Course Learning Outcomes (CLO) | CLO-1 | ✓ | ✓ | | | | |
| | CLO-2 | ✓ | ✓ | | | | |



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|--|-------|--|---|--|---|---|---|
| | CLO-3 | | ✓ | | | | |
| | CLO-4 | | ✓ | | | ✓ | |
| | CLO-5 | | | | ✓ | ✓ | ✓ |



21. Topic Outline and Schedule:



| Week | Lecture | Topic | Student Learning Outcome | Learning Methods (Face to Face/Blended / Fully Online) | Platform | Evaluation Methods | Resources |
|------|---------|---|--------------------------|--|-----------|--------------------|-----------------------------|
| 1 | 1,2 | Introduction to bioinorganic chemistry, general terms, how and why does nature select inorganic elements? Inorganic Elements and evolution | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |
| 2 | 3,4 | Basic biological Coordination Chemistry. Kinetic and spectroscopic characteristics of bioinorganic systems. | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |
| 3 | 5,6 | Stroll through the periodic system. Systematic overview over tasks and examples of inorganic elements in biology | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |
| 4 | 7,8 | Ion transport: membranes, energy, channels, pumps | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |
| 5 | 9,10 | Biom mineralization : the hard part of bioinorganic chemistry | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |
| 6 | 11,12 | Nanoparticles, Inorganic structural elements in proteins, RNA & DNA, Lewis acid catalysis | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |
| 7 | 13,14 | Bioinorganic coordination chemistry II – transition metals: <i>apply coordination chemistry of redox active metal ions to explain properties of these metal centers</i> | SO1,SO2 | Face to Face | Classroom | MID+Final | Required book in section 25 |



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| 8 | 15,16 | Electron transport in biology – iron sulfur clusters, enzymes for respiration, photosynthesis and related pathways | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | HW+Final | Required book in section 25 |
| 9 | 17,18 | Oxygen transport – metal-oxygen coordination in proteins | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | HW+Final | Required book in section 25 |
| 10 | 19,20 | Oxygen activation and processing by cytochromes | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | HW+Final | Required book in section 25 |
| 11 | 21,22 | Small molecule activation and conversion by metalloenzymes – photosynthetic water splitting | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | HW+Final | Required book in section 25 |
| 12 | 23,24 | Radicals and Bioorganometallic Chemistry – from RNA to DNA and from Vitamin B12 to methanogens and methanotrophs | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | HW+Final | Required book in section 25 |
| 13 | 25,26 | Biological conversion and formation of hydrogen and nitrogen–hydrogenases and nitrogenases | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | Seminar+Final | Required book in section 25 |
| 14 | 27,28 | Metal pharmacology: uptake storage toxicity | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | Seminar+Final | Required book in section 25 |
| 15 | 29,30 | Metals in medicine: anti cancer agents, diabetes, arthritis, radionuclides and related applications | SO1,SO2 , SO4, SO6 | Face to Face | Classroom | Seminar+Final | Required book in section 25 |

22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:



| Evaluation Activity | Mark | Topic(s) | SLOs | Period (Week) | Platform |
|---------------------|------|----------------------|---------|---------------------|-------------------|
| Midterm | 30 | As per Sec. 21 above | 1,2 | Week 10 | In the department |
| Seminar+Homework | 20 | As per Sec. 21 above | 1,2,4,6 | Last weeks | In the department |
| Final Exam | 50 | As per Sec. 21 above | 1,2 | End of the semester | In the department |

23 Course Requirements

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24 Course Policies:

A- Attendance policies: All students are expected to follow the of attendance policies of the University of Jordan, absences exceeding 15% of total number of class meeting (6-hour classes) will result in F grade or course drop.

B- Absences from exams and handing in assignments on time: University rules and regulations regarding make-up exams.

C- Health and safety procedures: N/A

D- Honesty policy regarding cheating, plagiarism, misbehaviour: University rules and regulations.

E- Grading policy: University rules and regulations

F- Available university services that support achievement in the course: N/A

25 References:

A- Required book (s), assigned reading and audio-visuals:

- 1- Ivano Bertini, Harry B. Gray, Edward I. Stiefel, Joan Selverstone Valentine, Biological Inorganic Chemistry – Structure & Reactivity “

B- Recommended books, materials, and media:

1. Inorganic Chemistry, by Catherine E. Housecroft and Alan G. Sharpe, 5th edition, Pearson, 2018. Page 1098 / chapter 29 / The trace metals of life

26 Additional information:

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Name of course coordinator: *Prof. Dr.*
Head of Curriculum Committee/Department
Head of Department
Head of Curriculum Committee/Faculty
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