

**UNIVERSITY OF MADRAS**  
**M.Sc. DEGREE PROGRAMME IN CHEMISTRY**  
**SYLLABUS WITH EFFECT FROM 2023-2024**

<b>Title of the Course</b>	<b>BIO-INORGANIC CHEMISTRY</b>						
<b>Paper No.</b>	<b>Elective I</b>						
<b>Category</b>	<b>Elective</b>	<b>Year</b>	I	<b>Credits</b>	4	<b>Course Code</b>	424E1A
		<b>Semester</b>	I				
<b>Instructional hours per week</b>	<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>		<b>Total</b>		
	4	1	-		5		
<b>Prerequisites</b>	<b>Basic knowledge of chemistry</b>						
<b>Objectives of the course</b>	<p>To understand the role of trace elements.          To understand the biological significance of iron, sulphur.          To study the toxicity of metals in medicines.          To have knowledge on diagnostic agents.          To discuss on various metalloenzymes properties.</p>						
<b>Course Outline</b>	<b>UNIT-I: Essential trace elements:</b> Selective transport and storage of metal ions: Ferritin, Transferrin and siderophores; Sodium and potassium transport, sodium and potassium ion pumps (Heart), Calcium signalling proteins. Metalloenzymes: Zinc enzymes– carboxypeptidase and carbonic anhydrase. Iron enzymes–catalase, peroxidase. Copper enzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.						
	<b>UNIT-II: Transport Proteins:</b> Primary, secondary and tertiary structure of proteins, Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin. Biological redox system: Cytochromes- Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.						
	<b>UNIT-III: Nitrogen Fixation</b> -Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase-redox property - Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function.						
	<b>UNIT-IV: Metals in medicine:</b> Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer drugs. Chelation therapy; Cancer treatment. Metals in radio diagnosis - Technetium Imaging Agents; Gadolinium, radio therapy and magnetic resonance imaging, MRI Imaging Agents. temperature and critical magnetic Field.						
	<b>UNIT-V: Enzymes</b> -I Enzymes - Nomenclature and classification, chemical kinetics, the free energy of activation and the effects of catalysts, kinetics of enzyme catalyzed reactions – Michaelis - Menten equation - Effect of pH, temperature on enzyme reactions, Factors contributing to the catalytic efficiency of enzymes.						

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Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
<b>Recommended Text</b>	<ol style="list-style-type: none"> <li>Williams, D.R. –Introduction to Bioinorganic chemistry.</li> <li>F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry, Royal Society of Chemistry, Monograph for Teachers-31</li> <li>K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co., USA.</li> <li>G.N. Mughherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993.</li> <li>R. Gopalan, V. Ramalingam, <i>Concise Coordination Chemistry</i>, S. Chand, 2001.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>M. Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996)</li> <li>M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.</li> <li>R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.</li> <li>R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.</li> <li>T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.</li> </ol>
<b>Website and e-learning source</b>	<ol style="list-style-type: none"> <li><a href="https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html">https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html</a></li> <li><a href="https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html">https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html</a></li> </ol>
<p><b>Course Learning Outcomes (for Mapping with POs and PSOs)</b>                  Students will be able:  <b>CO1:</b> The students will be able to analyses trace elements.  <b>CO2:</b> Students will be able to explain the biological redox systems.  <b>CO3:</b> Students will gain skill in analyzing the toxicity in metals.  <b>CO4:</b> Students will have experience in diagnosis.  <b>CO5:</b> Learn about the nitrogen fixation and photosynthetic mechanism.</p>	

**CO-PO Mapping (Course Articulation Matrix)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>CO 1</b>	S	S	S	S	M	S	S	S	S	M
<b>CO 2</b>	M	S	S	S	S	M	S	S	S	S
<b>CO 3</b>	S	S	M	S	S	S	S	M	S	S
<b>CO 4</b>	M	S	S	S	S	M	S	S	S	S
<b>CO 5</b>	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

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**Level of Correlation between PSO's and CO's**

<b>CO /PO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3
<b>Weightage</b>	15	15	15	15	15
<b>Weighted percentage of Course Contribution to Pos</b>	3.0	3.0	3.0	3.0	3.0

**3 – Strong, 2 – Medium, 1 - Low**