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| **logoUniversity of Management & Technology**School of ScienceDepartment of Chemistry |
| CH-511 ADVANCED INORGANIC CHEMISTRY |
| **Lecture Schedule** |  | **Semester** |  |
| **Pre-requisite** | Graduate Standing | **Credit Hours** | 3 |
| **Instructor(s)** | Dr. Sohail Nadeem | **Contact****Moodle Link** |  |
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| **Office** |  | **Office Hours** |  |
| **Course Description** | This course describes the advanced concepts in bonding of molecules, the physical/chemical techniques such as diffraction methods, UV/Vis, IR, NMR, EPR *etc*. Topics related to the molecular symmetry and its applications to the spectroscopic studies have been included. Brief introduction of utilization of enzymes in inorganic chemistry and biochemistry of non metals have been discussed. Concepts of interfaces, symmetry of the molecules and computational chemistry have been discussed. |
| **Expected Outcomes** | Participants who successfully complete this course will learn and understand the advanced concepts of inorganic chemistry which includes;* Explain Symmetry elements and symmetry operations.
* Molecular vibrations and electronic spectra spin orbit coupling.
* Electronic States and Term Symbols electronic states for octahedral complexes, tanabe-sugano diagrams and spectra of d-block complexes.
* Identify the chemical and physical properties of transition metal complexes.
* Demonstrate an understanding of transition metal organometallics.
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| **Course Objectives:** | * To identify symmetry elements present in a given molecule/structure, and assign correct point group to the given molecule/structure.
* Apply the principles of symmetry to solve simple problems in chemical bonding, molecular vibrations, and electronic spectra of transition metal complexes.
* To cover the chemistry of the coordination compounds with emphasis on bonding, electronic spectra, & reaction mechanism.
* To cover the chemistry of organo-transition metal compounds with emphasis on reaction mechanism.
* Acquaintance with the current literature in inorganic chemistry
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| **Textbook(s)** |  1. Shriver and Atkins' Inorganic Chemistry, Fifth Edition, W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010. March 2009. Side Readings:2. J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (2008).3. James E House Inorganic Chemistry; Academic Press is an imprint of Elsevier 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA (2008).4. Wai-Kee Li Advanced Structural Inorganic Chemistry, Oxford University Press, 3 Great Clarendon Street, Oxford OX2 6DP. UK. 2008 |
| **Grading Policy** | * Assignments: 10%
* Midterms: 25%
 | * Presentation: 05%
* Case Study: 10%
* Final: 50%
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**Course Schedule**

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| **Week** | **Lecture #** | **TOPICS** | **CH** | **SECTIONS****Page #** |
| 1\* | 1 | Introduction to advanced inorganic chemistry, Bonding in Inorganic Compounds, Formation of the Elements (the Big Bang), The Detectable Elements, Subatomic Particles Involved in the Formation of the Elements, What’s Out There? Is There Enough Matter for the Formation of New Galaxies?, Keyhole Nebula in Carina, Contrasts with organic Chemistry, | 1 | (Shriver,01-16) |
| 2\* | 2 | Physical Techniques in inorganic chemistry, Diffraction methods, X-ray diffraction, Neutron diffraction, Absorption spectroscopy, UV/Vis, IR,  | 8 | (Shriver, 223-230) |
| 3\* | 3 | Physical Techniques in inorganic chemistry, Nuclear Magnetic Resonance (NMR), Eelctron paramagnetic Resonance (EPR), Mössbauer spectroscopy. | 8 | (Shriver, 230-240) |
| 4\* | 4 | Ionization-based techniques, Photoelectron spectroscopy, X-ray absorption spectroscopy, Mass spectrometry, Chemical analysis, Atomic absorption spectroscopy, CHN analysis, X-ray fluorescence elemental analysis, Thermal analysis. | 8 | (Shriver, 241-250 179-196) |
| 5\* | 5 | Molecular symmetry, An introduction to symmetry analysis, Symmetry operations, elements and point groups, Character tables, Applications of symmetry, Polar molecules, Chiral molecules, Molecular vibrations,  | 6 | (Shriver, 179-189) |
| 6\* | 6 | The symmetries of molecular orbitals, Symmetry-adapted linear combinations, The construction of molecular orbitals, The vibrational analogy, Projection operators.  | 6 | (Shriver 190-200) |
| 7\* | 7 | Electronic States and Term Symbols, electronic states for diatomic molecules and their consequences, electronic states for octahedral complexes,  | 11 | (Miessler Tarr 379-407) |
| 8\* | 8 | **(MID TERM EXAM)** |  |  |
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| 9\* | 9 | Interpretation of Spectra of d-metal ions, splitting of spectroscopic states, orgel diagrams, racah parameters and quantitative methods, the nephelauxetic effect, tanabe-sugano diagrams, charge transfer absorption.  | 18 | (House645-668) |
| 10\* | 10 | Electronic Absorption Spectra: Spectra of Octahedral and Tetrahedral complexes (d1 and d9) systems, Energy level diagrams d2-d8, spectrochemical series, remarks on intensities and line widths of charge transfer spectra | 15 | (Shriver 535-546) |
| 11\* | 11 | Ionic radii, John-Teller effects, Thermodynamic effect of d-orbital splitting; Formation constants of complexes octahedral vs Tetrahedral coordination. | 08 | (Shriver 515-546) |
| 12\* | 12 | Metal carbenes, metal carbynes, Synthesis, Chemical Reactions, bridging carbenes and carbynes, metathesis, oligomerizaiton and polymerization reactions of Alkenes. | 05 | (Shriver 250-251) |
| 13\* | 13 | Biological inorganic chemistry, The organization of cells, The physical structure of cells, Transport, transfer, and transcription, Sodium and potassium transport, Calcium-signalling proteins, Zinc in transcription, Selective transport and storage of iron. Iron-transport proteins in higher organisms. Release of iron from transferrin, Ferritin, the cellular Fe store.  | 26 | (Shriver 763-779) |
| 14\* | 14 | Oxygen transport and storage, Myoglobin, Haemoglobin, Other oxygen-transport systems, Reversible O 2 binding by small-molecule analogues. General considerations. | 26 | (Shriver 780-788) |
| 15\* | 15 | Iron–sulfur clusters, Copper electron-transfer centres Sensors, Iron proteins as sensors  | 26 | (Shriver 788-815) |
| 16\* | 16 | The principle of O2 sensing by prolyl oxygenases. Proteins that sense Cu and Zn levels. Biominerals, Common examples of biominerals. |  | (Shriver 788-815) |

**\* -** Tentative