# Master of Science, Chemistry
## M. Sc. Chemistry, Semester – I

| Course Code | PS01CCHE51 | Title of the Course | **Inorganic Chemistry** |
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| Total Credits of the Course | 4 | Hours per Week | 4 |

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| Course Objectives: | 1. To be able to use Crystal Field Theory to understand the magnetic properties of coordination compounds. To be able to describe the stability of metal complexes by the use of Nephelauxetic series and electronic parameters from them.<br>2. To review the basic concepts of electronic states of transition metal complexes. The learners should be able to apply theories of chemical bonding, electronic structure and magnetic properties of coordination complexes to identify the occurrence, active site structure and functions of some transition metal ions.<br>3. To develop an understanding of calculation of Dq, B and ß parameters<br>4. To clarify the concept of magnetic properties like magnetic susceptibility and magnetic moments.<br>5. To understand the effect of an external magnetic field when any transition metal complex comes under its influence. |

| Course Content | | |
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| Unit | Description | Weightage* (%) |
| 1. | ***Coordination Chemistry: I***<br>Concept of crystal field theory (CFT) and ligand field theory (LFT), Splitting of d-orbitals in various stereochemistry, Tetragonal elongation and compression in octahedral complexes, Nephelauxetic series, derivation of terms for closed subshell; derivation of terms for $f^2$ configurations, Correlation diagrams for octahedral and tetrahedral stereochemistry of $d^1$, $d^2$, $d^8$ and $d^9$ systems. | 25% |
| 2. | ***Coordination Chemistry: II***<br>Tanabe-Sugano diagram for octahedral and tetrahedral stereochemistry of $d^1$ to $d^9$ systems, Determination of Crystal Field Splitting Energy and electronic parameters for octahedral and tetrahedral complexes, Charge Transfer transitions. Molecular orbital energy level diagram for the octahedral and tetrahedral complexes. | 25% |
| 3. | ***Magnetochemistry: I***<br>Magnetic susceptibility: Sources of paramagnetism, diamagnetic susceptibility, Pascal constants and constitutive corrections, | |

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| | Langevin equation, Van Vleck's formula, antiferromagnetism, Types of antiferromagnetism, antiferromagenetic exchange pathways, Ferromagnetism and magnetic domains, molecular field theory of ferromagnetism, magnetic sublattice, ferrimagnetism and canting. | 25% |
| 4. | ***Magnetochemistry: II***<br>Spin-orbit coupling, Lande's interval rule, quenching of orbital magnetic moment by crystal field, spin-orbit coupling on A and E terms, spin-orbit coupling on T term, Spin paring: spin paring in octahedral complexes; spin paring in non-octahedral complexes; some aspects of spin pairing and cross over region.<br>***Chemistry of lanthanides and actinides:***<br>Term symbols, spectral and magnetic properties of the compounds of lanthanides and actinides; use of lanthanide compounds as shift Reagents. | 25% |

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| Teaching-Learning Methodology | A student-centered approach, which actively engages the students in the learning process, is critical of skills which result in healthy behavior are to be fostered and developed.<br>The course with Inorganic Chemistry aims to make the students proficient in coordination and magneto chemistry through the transfer of knowledge in the classroom as well as in the laboratory. Inorganic Chemistry program is designed to encourage the learning strategies that could be incorporated in a comprehensive approach that includes self-directed learning, cooperative learning, and peer education.<br>In the classroom, this will be done through blackboard and chalk lectures, charts, power point presentations, and the use of audiovisual resources that are available on the internet such as virtual lab.<br>The process of effective learning to a great extent will be based on teacher's experiences, identifying the slow learners and individual attention of the teacher towards them.<br>A variety of approaches to teaching learning process, including lectures, seminars, tutorials, peer teaching and learning, practicum and research establishments will be adopted.<br>Problem-solving skills and higher-order skills of reasoning and analysis will be encouraged through teaching strategies.<br>A feedback method with more anonymity will be preferred.<br>An interactive mode of teaching will be used.<br>The students will be encouraged to participate in the discussions and deliver seminars on the course related topics. A problem solving approach will be adopted wherever suitable. |

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| Evaluation Pattern |

| Sr. No. | Details of the Evaluation | Weightage |
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| 1. | Internal Written / Practical Examination (As per CBCS R.6.8.3) | 15% |
| 2. | Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3) | 15% |
| 3. | University Examination | 70% |

| Course Outcomes: Having completed this course, the learner will be able to | |
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| 1. | Understand the concept of Crystal field theory (CFT) and Ligand field theory (LFT). |
| 2. | Understand the splitting of d-orbitals in various stereochemistry. |
| 3. | Determine the term symbols and derivation of terms for $f^2$ configurations. |
| 4 | Explain correlation diagrams for octahedral and tetrahedral stereochemistry and Tanabe-Sugano diagram for octahedral and tetrahedral stereochemistry |
| 5 | Understand the Charge Transfer transition. |
| 6 | Understand the concept of Molecular orbital theory for the octahedral and tetrahedral complexes. |
| 7 | Calculate the electronic parameters. |
| 8 | Interpret of electronic spectra of coordination compounds. |
| 9 | Understand the magnetic susceptibility and various types of magnetism. |
| 10 | Calculate Pascal constants and constitutive corrections. |
| 11 | Derive Langevin equation and Van Vleck’s equation for determining experimental effective magnetic moments. |
| 12 | Understand the quenching of orbital magnetic moment by crystal field. |
| 13 | Understand the spin-orbit coupling on T, A and E terms and Spin paring |
| 14 | Explain Term symbols, spectral and magnetic properties of the compounds of lanthanides and actinides. |

| Suggested References: |
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| Sr. No. | References |
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| **1** | Electronic absorption spectroscopy and related techniques, **By: D.N. Sathyanarayana** |
| **2** | Introduction to ligand fields, **By B.N. Figgis** (1967) |
| **3** | Introduction to Magnetochemistry, **By: Alan Earshaw** (1968) |
| **4** | Elements of Magnetochemistry, **By: Dutta and Syamal** (1993) |
| **5** | Modern Aspects of Inorganic Chemistry, **By: Emeleus and Sharpe** (1996) |
| **6** | Advanced Inorganic Chemistry, **By: F.A. Cotton, Wilkinson, Murillo and Bochmann** (1999) |
| **7** | Inorganic Chemistry**, By: A. G. Sharpe** (1981) |
| **8** | Inorganic Chemistry, **By: James E. Huheey, Eilen A. Keiter, Richard L. Keiter** Publication: Harper Collins |
| **9** | Inorganic Chemistry, **By: Shriver and Atkins** |
| **10** | InorganicChemistry, **By: Gary Wulfsberg** |
| **11** | Inorganic electronic structure and spectroscopy (2013) Volume I: Methodology Volume II: Applications and case studies **By: Edward I. Solomon, A. B. P. Lever** |
| **12.** | Concise Inorganic Chemistry, **By: J.D. Lee** |

| On-line resources to be used if available as reference material |
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| On-line Resources |
| www.nptel.ac.in |
| www.swayam.gov.in |
| www.epgp.inflibnet.ac.in (e-PG pathshala) |
| www.ndl.iitkgp.ac.in (National Digital Library) |