

Subject Code: 1RI3000102	Subject Title: Essentials of Disciplinary Research Subject-1 Subject Sub-Title: Theory and Applications of Coordination Chemistry
Pre-requisite Subject	

Objectives of course: Developing Strong Research Background for effective research during Ph.D

Learning outcomes: Scholars will be updated with current research field.

Teaching Scheme (Credit Distribution)				Assessment Scheme (Weightage)	
Lecture	Tutorial	Practical	Credit	Hall Exam	Continuous Evaluation
4	--	--	4	60%	40%

Continuous evaluation is based on number of assignments/tutorials/presentations/laboratory practicals/small projects as per the instruction by the concerned supervisors.

Unit	Content	Lecture	Wt. (%)
1	Theories of coordination compounds: Theories of coordination compounds - VB theory, CFT - splitting of d orbitals in ligand fields and different symmetries, Chelate effect, Macrocyclic ligand, Bonding in Coordination Complexes, CFSE, factors affecting the magnitude of $10 Dq$, evidence for crystal field stabilization, spectrochemical series, Jahn-Teller distortion, Nephelauxetic effect, MO theory, octahedral, tetrahedral and square planar complexes, bonding and molecular orbital theory, experimental evidence for pi bonding.	6	30%
2	Electronic spectra and magnetism: Electronic spectra and magnetism: Microstates, terms and energy levels for $d^1 - d^9$ ions in cubic and square fields - selection rules - band intensities and band widths, Orgel and Tanabe-Sugano diagrams, evaluation of $10 Dq$ and β for octahedral complexes of cobalt and nickel - charge transfer spectra - magnetic properties of coordination compounds - change in magnetic properties of complexes in terms of spin orbit coupling, temperature independent paramagnetism, spin cross over phenomena, determination of magnetic susceptibility.	6	30%
3	Applications of Coordination Chemistry: Synthesis, structural, electrochemical, theoretical (DFT), catalytic, luminescence, corrosion and biological studies of Semicarbazones, Thiosemicarbazones and Schiff base derived ligands and their metal complexes, Palladium-Catalyzed Suzuki-Miyaura Coupling reactions. New reported applications of coordination chemistry.	10	40%

List of References:

Text Books:

1. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry, Principles of Structure and Reactivity, 4th Edition, Harper Collin College Publishers, 1993.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 4 th & 5th Edns, Wiley Interscience, New York, 1998.
3. R.S. Drago, Physical Methods in Inorganic Chemistry, 3rd Edition, Wiley Eastern, 1992.
4. J. Lewis, R.G. Wilkins, Modern Coordination Chemistry, Inter Science Publisher, 1960.
5. D. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry, Oxford University Press, Oxford, 1994.
6. K. Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part A & Part B, 2nd Edn, Wiley. 2009
7. G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3rd Edn, Pearson Prentice Hall, 2005
8. J. E. House, Inorganic Chemistry, Elsevier, 2008.
8. J. R. Lakowicz, Principles of Fluorescence Spectroscopy, Springer, 3rd Ed. 2006.
9. B. Valuer, Molecular Fluorescence, Wiley-VCH, 2002.
10. N. J. Turro, Modern Molecular Photochemistry, University Science Books, 1991.

Subject Code: 1RI3000103	Subject Title: Essentials of Disciplinary Research Subject-2 Subject Sub-Title: Characterization and Instrumentation Techniques
Pre-requisite Subject	

Objectives of course: Developing sound knowledge of Characterization and Analysis for research.

Learning outcomes: Scholars can analyze the data by their effective course knowledge.

Teaching Scheme (Credit Distribution)				Assessment Scheme (Weightage)	
Lecture	Tutorial	Practical	Credit	Hall Exam	Continuous Evaluation
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Continuous evaluation is based on number of assignments/tutorials/presentations/laboratory practicals /small projects as per the instructions by the concerned supervisors.

Unit	Content	Lecture	Wt. (%)
1	Analytical Techniques: Principle, Instrumentation and applications of microscopic techniques like Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM). Magnetic susceptibility and dipole moment measurement, Elemental analysis, Cyclic voltammetric analysis, Conductivity measurement, pH Measurement.	6	25%
2	Molecular Spectroscopy Principle, Instrumentation and applications of Infra-red spectroscopy (IR), UV-Vis spectroscopy, nuclear magnetic resonance spectroscopy (^1H , ^{13}C -NMR), two-dimensional NMR spectroscopy, Electron Spin resonance spectroscopy (ESR), Electrospray ionisation mass spectrometry (ESI-MS).	6	25%
3	Diffraction and Scattering Principle, Instrumentation and applications of X-ray diffraction techniques (XRD) and X-ray scattering techniques, Single-Crystal-XRD. Software involved in data reduction and solution for Single-Crystal-XRD, IUCr paper writing.	6	25%
4	Chromatography Techniques Principle, theory, instrumentation and applications of Gass Chromatorgrahy, (GC), high performance liquid chromatography (HPLC), Ultra high performance liquid chromatography (UHPLC), liquid Chromatography-nuclear magnetic resonance (LC-NMR), liquid chromatography-mass spectrometry (LC-MS).	6	25%

List of References:

1. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E. M. McCash, 4th Edition, Tata McGraw-Hill Education, 1994.
2. Molecular Quantum Mechanics, P. W. Atkins and, Ronald S. Friedman, 4th Edition, Oxford University Press, 2010.
3. Spectra of Atoms and Molecules, P. F. Bernath, 2nd Edition, Oxford University Press, 2005.
4. Electron Energy-Loss Spectroscopy in the Electron Microscope, R. F. Egerton, 3rd Edition, Springer, 2011.
5. Scanning Probe Microscopy and Spectroscopy, R. Wiesendanger, Cambridge University Press, 1994.
6. Materials Characterization, Introduction to Microscopic and Spectroscopic Methods, Y Leng, 2nd Edition, Wiley, 2008.
7. Introduction to macromolecular crystallography, Alexander McPhearson, Wiley-Liss, 2003.
8. Crystals and crystal structures, Richard Tilley, John Wiley & Sons, 2006
9. "Analytical Chemistry" by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.
10. Beginners Guides to UPLC: Ultra-Performance Liquid Chromatography By Douglas R. McCabe, Eric S. Grumbach & Joseph C. Arsenault.
11. LC/MS: A practical Users' Guide by Marvin C. McMaster.
12. LC-NMR and other Hyphenated NMR Technique overview and application
13. Supercritical Fluid Chromatography by Colin F. Poole
14. Fundamentals of analytical chemistry, Douglas Skoog, Donald West, F. Holler, Stanley Crouch, 9th Edition, Cengage Learning, 2013
15. Materials Characterization, Introduction to Microscopic and Spectroscopic Methods, Y Leng, 2nd Edition, Wiley, 2008.