FOUR-YEAR UNDER GRADUATE

PROGRAMME (CU-FYUGP)

BSc CHEMISTRY

Programme	B.Sc Chemistry				
Course Title	**COORDINATION CHEMISTRY**				
Type of Course	**MINOR**				
Semester	**I**				
Academic Level	**100-199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Classification of elements to different blocks, comparative study of s, p, d and f block elements based on electronic configuration. General idea about transition and inner transition elements, Concept of coordinate bond, valency. Concept of covalent bond, and organic compound. Theoretical and practical knowledge about volumetric analysis				
Course Summary	This course explains the characteristics of s, p, d and f block elements and familiarises some of the important compounds of main group elements. It also gives insight into coordination compounds and various theories to explain the bonding in coordination compounds. It covers the practical application of complex formation in quantitative analysis A brief discussion of Organometallic compounds, complexometric titration, preparation of complex compounds and colourimetry is also included in this course.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To Elucidate the trends in physical and chemical properties of s and p block elements	U	F	Instructor-created exams / Quiz
CO2	To Evaluate the general properties of transition metals and to distinguish between lanthanides and actinides	U	F	Class test /Assignment / Quiz
CO3	To Unlock the Complexity of Coordination Compounds: Structures, Properties, and Applications	U	F	Class test /Assignment / Quiz
CO4	To demonstrate different theories to explain the formation of coordination compounds	U	C	Class test /Assignment / Quiz

CO5	To explore the characteristics of organometallic compounds	U	F	Class test /Assignment / Quiz
CO6	To Perform complexometric titrations, colourimetry experiments and preparation of complex compounds.	Ap	P	Lab Work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Mark
I		**s & p BLOCK ELEMENTS**	**15**	**33**
	1	s block elements - General properties: Ionization Energy, Flame coloration, photoelectric effect, metallic character, hydration energy.	2	
	2	p-block elements: comparative study- halides, sulphates, carbonates and bicarbonates (solubility and thermal stability).	2	
	3	Oxidation number and inert pair effect, Comparison of Lewis acidity of boron halides.	1	
	4	Preparation, properties, structure and uses of Diborane, Boric acid, Borazine and Boron nitride. Structure and bonding of oxides of N (N_2O, NO, NO_2, N_2O_4) and S (SO_2 and SO_3)	3	
	5	Oxo acids of P (H_3PO_2,H_3PO_3, H_3PO_4) and Cl (HOCl, $HOCl_2$, $HOCl_3$,$HOCl_4$) (structure and acid strength).	2	
	6	Colour and bond dissociation energy of halogens. Interhalogen compounds: Preparation, properties uses and structure (One example each- ClF, ClF_3, ClF_5 and IF_7), Electropositive character of iodine	2	
	7	Pseudo halogen: Comparison of pseudo halogen (Cyanogen as example) and halogens. structure of poly halide ions (ICl_2^-, ICl_4^- and I_5^-). Noble gases: Isolation of noble gases: Dewar's method- Separation by charcoal adsorption method, Uses of He, and Ne	3	
		TRANSITION AND INNER TRANSITION ELEMENTS	**8**	**17**
	8	Transition Metals: General characteristics: Metallic character, oxidation states, size, density, melting	**2**	

		point, boiling point. ionization energy, colour, magnetic properties, catalytic properties		
II	9	non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows.	**2**	
	10	Lanthanides: Electronic configuration and general characteristics. Occurrence of lanthanides – Importance of beach sands of Kerala – Isolation of lanthanides from monazite sand – Separation by ion exchange method.	**2**	
	11	Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides. Actinides: Electronic configuration and general characteristics – Comparison with lanthanides [Mention only].	**2**	
III		**COORDINATION COMPOUNDS**	**15**	**34**
	12	Double salt and complex, ligand, type of ligands: (mono, bi, tri, tetra, hexa, ambidentate, chelate and macrocyclic ligands) coordination number,	**2**	
	13	Isomerism - structural and stereoisomerism, IUPAC Nomenclature of complexes,	**2**	
	14	Postulates of Werner's theory, EAN rule, application of co-ordination complexes in quantitative and qualitative analysis.	**2**	
	15	Theories of bonding, VBT (valence bond theory) , geometry of co-ordination numbers 4 and 6,	**2**	
	16	Limitations of VBT, Crystal field Theory: CFSE of low spin and high spin octahedral complexes, Factors affecting crystal field splitting.	**2**	
	17	Spectrochemical series, Crystal field splitting of d orbitals in Tetragonal and Square planar Complexes.	**2**	
	18	Magnetism (spin only magnetic moment) and colour (d-d transition),	**1**	
	19	Distorted octahedral complexes, merits and demerits of CFT.	**2**	
IV		**Organometallic Compounds**	**7**	**14**
	20	Definition – Classification based on the nature of metal-carbon bond, Zeise's salt. 18-electron rule.	**2**	
	21	Metal carbonyls - Mononuclear and Polynuclear carbonyls of Fe, Co and Ni (structure only) – Bonding in metal carbonyls.	**2**	

	22	Ferrocene: Preparation, properties and bonding (VBT only). Catalysis: Zeigler Natta catalyst in the polymerization and Wilkinson catalyst in the hydrogenation of alkene.	**3**	
V		**PRACTICAL :** **Complexometric titrations and Inorganic Preparations**	**30**	
	I	A minimum of 7 experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher 1. Estimation of zinc. 2. Estimation of magnesium. 3. Estimation of calcium. 4. Determination of total hardness of water.		
	II	Preparation of complex compounds 5. Preparation of tetramminecopper(II) sulphate. 6. Preparation of Nickel (II) dimethylglyoxime 7. Preparation of trithioureacopper(I) sulphate		
	III	Colorimetry 8. Verification of Beer-Lambert law for $KMnO_4$ & determination of concentration of the given solution. 9. Estimation of iron. 10. Estimation of chromium.		
	IV	**Open-ended experiments - Suggestions** 1. Preparation of double salt/Complex compounds. 2. Determination of alkali content in antacid tablets by titration with HCl. 3. Determination of available chlorine in bleaching powder. 4. Analysis of Ores		

References

1. J. D. Lee, *Concise Inorganic Chemistry*, 5th Edn., Wiley India Pvt. Ltd., 2008.
2. B. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, New Delhi, 2010.
3. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, *Inorganic Chemistry*, Pearson, 2006.
4. F. A. Cotton, G. Wilkinson, *Advanced Inorganic Chemistry*, 6th Edn., John Wiley, New York. 1999.
5. D. F. Shriver, P. W. Atkins, *Inorganic Chemistry*, 3rd Edn., Oxford University Press, 2009.
6. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, 1st Edn., Vikas Publishing House, New Delhi, 2001.
7. P. Powell, *Principles of Organometallic Compounds*, 2nd Edn., Chapman and Hall, London, 1988.

8. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Edn., Pearson Education, Noida, 2013.
9. D. N. Bajpai, O. P. Pandey, S. Giri, *Practical Chemistry; For I, II & III B. Sc. Students*, S. Chand & Company Ltd., New Delhi, 2012.

Mapping of COs with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2				2		1				1		
CO 2	2				2		1				1		
CO 3	2				2		1				1		
CO 4	2				2		1				1		
CO 5	1				2		1				1		
CO 6			2		1		1		1		2		

Correlation Levels :

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓		✓
CO6		✓	✓	