

**FOUR-YEAR UNDER GRADUATE
PROGRAMME (CU-FYUGP)
BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	BASIC INORGANIC CHEMISTRY AND METALLURGY				
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	Concept of atom and molecule Constituents of the atom, Rutherford's model of the atom. Periodic table and classification of elements to different blocks, Basic knowledge of qualitative and quantitative analysis Titration and use of indicators				
Course Summary	This course is intended to provide basic knowledge in inorganic chemistry and nanochemistry. The student gets an understanding of the Bohr model of the atom and the modern quantum mechanical model of the atom through the first module of this course. Different types of chemical bonding are also included in the first module. General properties of the atom and the variation of these properties in the periodic table are also discussed in this course. Basic principles of analytical chemistry are included in the third module of this course which includes acid-base titration, redox titration, complexometric titration, and mixture analysis. This course also tries to explore processes in metallurgy including extraction of metals and alloy formation. To master the laboratory skills acid-base titration, and redox titration experiments are incorporated into this course structure.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To Understand the structure of atoms and rules regarding the arrangement of electrons in an atom.	U	C	Instructor-created exams / Quiz
CO2	To discuss the chemical bonding, theories of chemical bonding and predict molecular shapes using VSEPR theory	U	F	Class test /Assignment / Quiz

CO3	To Comprehend periodic properties, understand laws and the concept of the modern periodic table, and its implications	U	F	Class test /Assignment / Quiz
CO4	To Master the principle of volumetric analysis, understand the separation of cations in qualitative analysis	U	C	Class test /Assignment / Quiz
CO5	To Comprehend the process in metallurgy including extraction of metals and alloy formation	U	F	Class test /Assignment / Quiz
CO6	To Perform different titrations and execute open-ended experiments safely and effectively	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	Marks
I	Atomic structure and Chemical Bonding		15	34
	1	Bohr atom model, merits and its limitations, Heisenberg uncertainty principle, Louis de Broglie's matter waves – dual nature.	2	
	2	Schrödinger wave equation (Mention the equation and the terms in it), - Concept of orbitals, comparison of orbit and orbital.	2	
	3	Quantum numbers and their significance	1	
	4	Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle - Electronic configuration of atoms.	2	
	5	Chemical Bonding: Introduction – Type of bonds. Ionic bond, Covalent bond, Coordinate bond, and hydrogen bond (Intermolecular and intramolecular hydrogen bond with examples).	2	
	6	VSEPR theory: Shapes of BeCl ₂ , BF ₃ , CH ₄ , NH ₃ , H ₂ O, PCl ₅ , SF ₄ , ClF ₃ , XeF ₂ , SF ₆ , IF ₅ , XeF ₄ , IF ₇ and XeF ₆ . NH ₄ ⁺ , SO ₄ ²⁻	2	
	7	Valence Bond theory - Hybridisation involving s, p and d orbitals: SP (acetylene), SP ² (ethylene), SP ³ (CH ₄), SP ³ d (PCl ₅), SP ³ d ² (SF ₆)	2	
	8	Molecular Orbital theory: LCAO – Electronic configuration of H ₂ , B ₂ , C ₂ , N ₂ , O ₂ and CO – Calculation of	2	

		bond order and its applications.(Bond length and bond strength), Comparison of VB and MO theories		
II		Periodic Properties	5	10
	9	Name and symbol of elements, Law of triads, octaves, X-ray studies of Henry Mosley, Mosleys periodic law - Modern periodic law – Long form periodic table.	2	
	10	Periodicity in properties: Atomic and ionic radii, Ionization enthalpy - Electron affinity (electron gain enthalpy) – Electronegativity, valency, Oxidation number (Representative element), metallic and non-metallic character, inert pair effect,	3	
III		Analytical Chemistry	15	34
	11	Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Equivalent mass.	2	
	12	Methods of expressing concentration: Molality, molarity, normality, ppm, and mole fraction.	2	
	13	Dilution formula, Theory of volumetric analysis – Acid-base, redox, and complexometric titrations :	3	
	14	acid-base, redox, and complexometric indicators. Double burette method of titration: Principle and advantages.	2	
	15	Principles in the separation of cations in qualitative analysis	2	
	16	Common ion effect and solubility product and its applications in qualitative analysis –	2	
	17	Microanalysis and its advantages. Accuracy & Precision (mention only).	2	
IV		Metallurgy	10	20
	18	Ores and minerals, Concentration of ores – Calcination and roasting – Reduction to free metal.	2	
	19	Electrometallurgy – Hydrometallurgy. Refining of metals: Electrolytic refining, zone refining	2	
	20	Extractive metallurgy of Al, Fe	2	
	21	Alloys: Definition – Composition and uses of German silver, brass, bronze, gunmetal and alnico. Steel: Open hearth process (brief description only)	2	
	22	Classification of steel – Composition and uses of stainless steels, and applications of industrially important stainless steel types- (AISI Grade mention only)	2	
		Basic Inorganic Chemistry Practical: Acid-Base titrations and Redox titrations	30	

V		General Instructions For weighing electronic balance must be used. For titrations, double burette titration method should be used. Standard solution must be prepared by the student. Use a safety coat, gloves, shoes and goggles in the laboratory. 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		
		Importance of lab safety – Burns, Eye accidents, Cuts, gas poisoning, Electric shocks, Treatment of fires, Precautions and preventive measures. Weighing using electronic balance, Preparation of standard solutions.		
	I	Neutralization Titrations 1. Strong acid – strong base. 2. Strong acid – weak base. 3. Weak acid – strong base.		
	II	Redox Titrations - Permanganometry: 4. Estimation of oxalic acid. 5. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt Redox Titrations - Dichrometry 6. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt using internal indicator. 7. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt using external indicator. Redox Titrations - Iodimetry and Iodometry: 8. Estimation of iodine. 9. Estimation of copper		
	III	Open-ended experiments - Suggestions Iodometry: Estimation of chromium. Determination of acetic acid content in vinegar by titration with NaOH. Determination of alkali content in antacid tablets by titration with HCl. Determination of available chlorine in bleaching powder.		

References

1. C. N. R. Rao, *Understanding Chemistry*, Universities Press India Ltd., Hyderabad, 1999.
2. Manas Chanda, *Atomic Structure and Chemical Bonding*, 4th Edn., Tata McGraw Hill Publishing Company, Noida, 2007.
3. R. Puri, L. R. Sharma K. C. Kalia, *Principles of Inorganic Chemistry*, 31st Edn., Milestone Publishers and Distributors, New Delhi, 2013.
4. Satya Prakash, *Advanced Inorganic Chemistry*, Vol. 1, 5th Edn., S. Chand and Sons, New Delhi, 2012.

- W. U. Malik, G. D. Tuli, R. D. Madan, *Selected Topics in Inorganic Chemistry*, S. Chand and Co., New Delhi, 2010.
- J. D. Lee, *Concise Inorganic Chemistry*, 5th Edn., Oxford University Press, New Delhi, 2008.
- A. Cottrell, *An introduction to metallurgy*, 2nd Edn., University press, 1990.
- Jonathan Beddoes, J. Gordon Parr, *Introduction to stainless steels*, 3rd Edn., ASM International, 1999.
- J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Edn., Pearson Education, Noida, 2013.
- G. Svehla, *Vogel's Qualitative Inorganic Analysis*, 7th Edn., Prentice Hall, New Delhi, 1996.

Mapping of COs with PSOs and POs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2				2		1				1		
CO 2	2				2		1				1		
CO 3	1				2		1				1		
CO 4	1		1		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		✓	✓	