BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2018-2019
COURSE HANDOUT (PART-II)

Date:02-08-2018

In addition to part I (General handout for all courses appended to the timetable) this portion gives further details regarding the course.

Course No. : **CHEM F214**
Course Title : **Inorganic Chemistry I**
Instructor-in-charge : **SUROJIT PANDE**

1. Course Description:

The course is designed in consideration to growing the basic level knowledge and understanding in inorganic chemistry. It includes electronegativity, detail study of acid-base chemistry, non-aqueous solution chemistry, concept of redox chemistry, shape and structure of inorganic covalent molecules using VSEPR model and bonding of ionic compounds in solid state. It includes the chemistry of halogen and noble gases and main group elements. There will have thorough discussion of chemistry of macromolecules containing inorganic chains, rings and cages.

2. Scope and Objective of the Course:

The course provides a comprehensive survey of the concepts involved in the study of the VSEPR Model, VB Theory, Ionic Crystal Structure, Structure of Complex Solids, Electronegativity, Acid-Base Chemistry, Chemistry in Aqueous and Non-Aqueous Solvents, Periodicity, Chemistry of transition metals, Halogens and Noble Gases, Inorganic Chains, Rings, Cages and Clusters. This course will attempt to provide the students with sufficient basic knowledge of the structure and reactivity of inorganic systems to ensure a more comprehensive understanding.

By the end of semester, you will be able to learn –

- Different scales to define electronegativity; rationalization of unusual reactivity
- Shape and structure of different covalent molecules and ionic compounds
- Measures of acid-base strength in gas and solution phase; Relation between hardness and softness, Symbiosis
- Chemistry of protonic and aprotic solvents; Redox stability; Diagrammatic presentation of potential data
- Use (or not) of d orbitals by nonmetals; Reactivity and d orbital participation
- Positively charged halogens; Pseudohalogens
- Numerous examples in nature of inorganic chains, rings and cages – their structures and chemistry

3. Text Book:

T1. Inorganic Chemistry by Huheey J. E., Keiter, E. A. Keiter, R. L . Keiter, O. K. Medhi, 4th ed., Pearson Education

4. Reference Books:

R1. Inorganic Chemistry by Shriver & Atkins, (4th edition)

R2. Advanced Inorganic Chemistry by Cotton F.A., Wilkinson G., Murillo, C.A., Bochmann, M., 6th ed., John Wiley and Sons, Ne w York (2003).

5. Course plan:

Lecture no.	Broad topics	Major portions to be covered	Reference (Chapter & Page no. of T1)
1	Introduction	Description of the course: Objective and prospects; Course contents; Outcome; Evaluation pattern and some important points related to the course	
	Learning Outcomes: (i) Clarification of overall course content and evaluation component		
2-6	Concepts of inorganic chemistry	Electronegativity, Acid-base chemistry, A generalized acid-base concept, Measures of acid-base strength	Chapter 5: p 155-169 Chapter 8: p 220-227 Self-study (p 228-236) p 237-243
	Learning Outcomes: (i) To define electronegativity, advances in electronegativity *(ii)* Concept of acid and bases, importance of different forces between atoms and ions in determining chemical properties *(iii)* Important aspects of each type of forces: relative strength, how rapidly it decreases with increasing distance, directional or not		
7-9	Various concepts of inorganic chemistry	Hard and soft acids and bases, Symbiosis, Chemistry of aqueous and nonaqueous solvents, Summary of protonic and aprotic solvents, Molten salts	Chapter 9: p 246-257 Self-study (p257-260)
	Learning Outcomes: (i) Complete understanding of acids or bases in terms of hard or soft *(ii)* Hardness, softness in solving chemical properties *(iii)* Acids and bases are closely related subjects of redox and coordination chemistry *(iv)* To analyze the solvation effects and anomalies in acid-base chemistry *(v)* Identification of conjugate acid-base pairs		
10-13	Concepts of redox chemistry	Electrode potentials, electromotive forces, Trends in standard potentials, Nernst Equation, Redox Stability, Latimer and Frost diagram, Ellingham diagram, Electrochemistry of the halogens and pseudohalogens	Chapter 9: p 260-265 Chapter 12: p. 367; Chapter 13: p. 379-389 and Class notes/ ref. book

	Learning Outcomes: (i) Clear and complete idea of the electronic structure of elements and chemical reactions *(ii)* A firm and quantitative basis of oxidation and reduction processes through electrochemical reactions *(iii)* To discuss complete idea of Latimer, Frost, and Ellingham diagram, different oxidation state and EMFs of different groups		
14-15	Structure of molecules	The Covalent Bond: VSEPR Model and VB Theory	Chapter 6: p171-182
	Learning Outcomes: (i) Preliminary analysis of covalent bonding *(ii)* A simple rule for predicting molecular structure *(iii)* A brief understanding on symmetry		
16-20	Ionic bonding and the solid state	The ionic bond, Lattice energy, Size effects, Covalent character in predominantly ionic bonds, Imperfections in crystals, Conductivity in ionic Solids, Solid held together by covalent bonding	Chapter 4: p72-114
	Learning Outcomes: (i) Heart of modern inorganic chemistry: structure and bonding *(ii)* Methods of rationalizing and predicting structures *(iii)* Explain how ionic and covalent bonds are formed between atoms *(iv)* Name molecular and ionic compounds and compare/contrast the properties of molecular and ionic compounds		
21-23	The chemistry of the main group elements: periodicity	Periodicity: First and second row anomalies, The use of *p* orbitals in pi-bonding, The us e of *d* orbitals by nonmetals, Periodic anomalies of the nonmetals and post-transition metals	Chapter 10: p267-290
	Learning Outcomes: (i) Fascinating aspect of inorganic chemistry: diversity of reactions and structures encountered in the chemistry *(ii)* To systematize elemental relationships in the periodic table *(iii)* Describe the arrangement of elements in the periodic table and relate the arrangement to electronic configuration, bonding, and properties.		
24-27	The chemistry of halogens and the noble gases	Noble gas chemistry: Fluorides, bonding other compounds of xenon, Bond strengths in noble gas compounds, Halogens in positive oxidation states, Polyhalide ions, Fluorine-oxygen chemistry, Oxyacids of heavier halogens, Halogen oxides and oxyfluorides, Halogen cations, Halides, Pseudohalogens	Chapter 12: p343-367
	Learning Outcomes: (i) Discuss physical and chemical properties of halogens *(ii)* Different limiting factor with regard to which noble gas compounds form *(iii)* To discuss high electronegativity, activity of the halogens, high effective nuclear charge *(iv)* Harmful effect of halogens to biological organisms in sufficient quantities		

28-36	Inorganic chains, rings, and cages	Catenation, Heterocatenation, Silicate minerals, Intercalation chemistry, One dimensional conductors, Isopoly anions, Heteropoly anions; Borazines, Phosphazenes, Phosphazene polymers, Other heterocyclic inorganic systems, Homocyclic inorganic systems; Boron cage compounds- Boranes, Carboranes, Metallacarboranes, Structure prediction for heteroboranes and organometallic clusters	Chapter 11: p292-338
	Learning Outcomes: (i) Chemistry of nonmetals: their propensity to form chains, rings, and cages *(ii)* Most metals show less tendency to form compounds of this type, and the length of the chains and size of the ring thus formed are restricted *(iii)* A complete and detailed discussion on different metals which show tendency to form compounds of this type		
37-39	Inorganic clusters	Metal clusters, Dinuclear compounds, Trinuclear clusters, Tetranuclear clusters, Hexanuclear clusters, Polyatomic Zintl anions and cations, Chevrel phases, Infinite metal chains	Chapter 13: p395-406
	Learning Outcomes: (i) Properties of individual metals in various oxidation states *(ii)* Stability of different oxidation states, similarity, and differences *(iii)* Complete discussion on metal clusters, binuclear, trinuclear, tetranuclear, and hexanuclear clusters		
40-41	Concept of nuclear chemistry	Concept, Nature of radiations, Nuclear vs. chemical reactions, Radioactive decay	Lecture slide and class note
	Learning Outcomes: (i) Identification of alpha rays, beta rays, gamma rays, positrons, antineutrino, and neutrino *(ii)* Fundamental of rate of change and half life in the context of nuclear decay *(iii)* Describe the different types of radioactivity and explain how they are used in the health field		

5. Evaluation scheme:

Components	Duration	%Weightage	Date and Time	Remark
Mid-semester examination	90 min	30	11/10 2:00 - 3:30 PM	Closed book
Continuous evaluation	------	30		Closed book[#]
Comprehensive examination	180 min	10+30	12/12 FN	Closed and open book[$]

[$]The Comprehensive Examination will have a closed book quiz portion with 10% weightage and an open book descriptive section with 30% weightage.

***Chamber Consultation Hour**:* Chamber # 3268-G, Timing to be announced in the class

***Notices**:* Notices will be put up on the Nalanda only.

Make-up Policy: Make-up for the Mid-Sem & Comprehensive exam will be granted only for genuine cases**.**

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