

## PAPER-I: STRUCTURE AND BONDING OF INORGANIC COMPOUNDS

Semester	Subject Code	Category	Instruction Hours						Credits
			Lecture		Theory		Practical		
			Per Week	Per Semester	Per Week	Per Semester	Per Week	Per Semester	
I	21CPCH1A	Core	4	60	4	60	0	0	4

### COURSE OBJECTIVES

- ❖ To provide knowledge of basic and advanced concepts in bonding and enable the students to identify the structure and bonding of simple molecules.
- ❖ To provide an understanding of the various types of solid state packing, types of chemical forces, structure of inorganic chain cluster compounds and the bonding in boron compounds.

### COURSE OUTCOMES

- On the successful completion of course, students will be able to

CO Number	CO statement	Knowledge level
<b>CO1</b>	Gain the knowledge on hybridization, structure and bonding in inorganic molecules	<b>K2 &amp; K3</b>
<b>CO2</b>	Gain the knowledge on structure and packing in solids	<b>K2 &amp; K3</b>
<b>CO3</b>	Acquire knowledge about the crystal lattices and the diffraction methods	<b>K3</b>
<b>CO4</b>	Have a better understanding of boron compounds and clusters.	<b>K2 &amp; K4</b>
<b>CO5</b>	Notify different types of inorganic chains and cluster compounds	<b>K3 &amp; K4</b>

\*CO-Course Outcomes

Knowledge level K1-Remember; K2-Understand; K3-Apply; K4-Analyze

### **MAPPING WITH PROGRAM OUTCOMES:**

COS	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	M	M	S	M	S	M
<b>CO2</b>	M	S	M	S	M	M
<b>CO3</b>	M	M	S	S	M	M
<b>CO4</b>	M	M	S	S	M	S
<b>CO5</b>	M	M	M	M	S	S

**UNIT I: CHEMICAL BONDING****12 hours**

V.B. approach to bonding-Hitler-London, Pauling and Slater refinements, Concept of hybridization and structure of molecules, VSEPR theory shapes of molecules. M.O. approach to covalent bonding – symmetry and overlap of atomic orbitals – symmetry of molecular orbitals – sigma and pi bonding – energy levels in homo and heteronuclear diatomic systems – bond length, bond order and bond energy, Application to small molecules such as  $\text{BeCl}_2$ ,  $\text{BCl}_3$  and  $\text{CCl}_4$ ,  $\text{SF}_4$ , etc, ionic character in a covalent bond - The concept of multicentre bonding. Pseudo halogens: Structure and bonding in  $\text{ClF}_3$ ,  $\text{BrF}_3$ ,  $\text{BrF}_5$ ,  $\text{IF}_5$  and  $\text{IF}_7$ . Oxides and oxyacids of halogens, Bonding in Noble gas compounds –  $\text{XeCl}_2$ ,  $\text{XeF}_4$ ,  $\text{XeOF}_4$  and  $\text{XeF}_6$ .

**UNIT II: CHEMISTRY OF SOLID STATE I: STRUCTURE****12 hours**

Weak Chemical forces: van der Waals forces, Hydrogen bonding – Close packing of atoms and ions HCP and BCC types of packing voids – radius ratio – derivation – its influence on structures – Lattice energy – Born – Lande equation – Kapustinski equation – Madelung constant.

Representative structures of AB and  $\text{AB}_2$  types of compounds – rock salt, cesium chloride, wurtzite, zinc blende, rutile, fluorite, antiferite, cadmium iodide and nickel arsenide – Structure of graphite and diamond – Spinel – normal and inverse types and perovskite structures.

**UNIT III: CHEMISTRY OF SOLID STATE II: DIFFRACTION METHODS****12 hours**

Band theory of solids – non – stoichiometry- point defects – linear defects – effects due to dislocations-electrical properties of solids – conductor, insulator, semiconductor – intrinsic – impurity semiconductors – optical properties – lasers and phosphors – elementary study of liquid crystals.

Difference between point group and space group – screw axis – glide plane – symmetry elements – relationship between molecular symmetry and crystallographic symmetry – The Concept of reciprocal lattice – X-ray diffraction by single crystal – rotating crystal – powder diffraction. Neutron diffraction: Elementary treatment – comparison with X-ray diffraction – Electron diffraction –Basic principle – Crystal Growth methods: From melt and solution (Hydrothermal, Gel methods).

**UNIT IV: BORON COMPOUNDS AND CLUSTERS****12 hours**

Chemistry of boron – Preparation, properties and structure of boranes, higher boranes - types of boranes closo, nido, arachno. ( $B_2H_6$ ,  $B_4H_{10}$ ,  $B_5H_{11}$ ,  $B_6H_{10}$ ,  $B_{10}H_{14}$ ) linear and cyclic borazines ( $B_3N_3H_6$ ), boron nitrides  $(BN)_x$  and borates ions — STYX numbers, Wade's rules .

Carboranes ( $C_2B_9H_{11}^{2-}$ ), Metallocarboranes ( $1,2-C_2B_{10}H_{12}$ ) – preparation, properties and Structure – a general study. Metal clusters: Chemistry of low molecularity metal clusters only – Structure of  $Re_2Cl_8$ ; multiple metal – metal bonds.

**UNIT V: INORGANIC CHAIN AND CLUSTER COMPOUNDS****12 hours**

Types of inorganic polymers – comparison with organic polymers – silanes, higher silanes ( $Si_2H_6$ ,  $Si_4H_{10}$ ) – multiple bonded systems – silicon carbides, siloxanes. P–N compounds, cyclophosphazenes and cyclophosphazanes – S–N compounds –  $S_4N_4$ ,  $S_4N_4H_4$  and  $(SN)_x$ .

Isopoly acids – polyvanadates, polymolybdates, polytungstates – heteropolyacids and their salts – structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyrosilicates – one dimensional, two dimensional and three dimensional silicates – silazenes - preparation, properties and structure.

**Distribution of Marks:** Theory-80% and Problems-20%

**TEXT BOOKS**

S.No	Authors	Title	Publishers	Year of publication
1.	J.E. Huheey	Inorganic Chemistry – Principles, Structure and Reactivity	Harper Collins, New York, IV Edition	1993
2.	D. E. Douglas, D.H. McDaniel and J. J. Alexander	Concepts and Models in Inorganic Chemistry	3 <sup>rd</sup> Ed	1994
3.	M. C. Day, J. Selbin	Theoretical Inorganic Chemistry	2 <sup>nd</sup> Ed, East West Press	1985
4.	L. Pauling	The Nature of the Chemical Bond	3 <sup>rd</sup> Ed., Cornell University Press	1960
5.	F.A. Cotton and G. Wilkinson	Advanced Inorganic Chemistry – A Comprehensive Text	John Wiley and Sons, V Edition	1988

6.	D.F. Shriver, P.W. Atkins	Inorganic Chemistry	3 <sup>rd</sup> Ed	1999
7.	A.G. Sharpe	Inorganic Chemistry	Pearson Education	2008
8.	N. H. Ray	Inorganic Polymers	Academic Press	1978
9.	A. R. West	Basic Solid State Chemistry	John Wiley	1991
10.	E. L. Mutteri	Polyhedral Boranes	Academic Press, NY	1975

### **REFERENCE BOOKS**

<b>S.No</b>	<b>Authors</b>	<b>Title</b>	<b>Publishers</b>	<b>Year of publication</b>
1.	S.F.A. Kettle	Coordination Chemistry	EIBS	1973
2.	K. Burger	Coordination Chemistry	Burter Worthy	1973
3.	K.F. Purcell and J.C. Kotz	Inorganic Chemistry	WB Saunders Co., USA	1977

### **TEACHING METHODOLOGY:**

- PowerPoint presentation
- Models
- Group discussion
- Seminar and Assignments
- Animated videos
- Board and chalk

### **SYLLABUS DESIGNERS:**

1. Dr. T. Gomathi, Assistant Professor, Department of Chemistry
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