Department of Chemistry, College of Basic Science and Humanities

Class: B. Sc. 1st Year Honours 1st semester

Course Code: CHC1101 **Course Title: Physical Chemistry**

Lesson Plan

Unit No	Name of the Chapter	Topic Title	No. of Lectures	Name of the Faculty
1	The Gaseous State	General introduction	2	Dr .S. Muni
		Maxwell-Boltzmann distribution of molecular velocities	3	
		Kinetic gas equation	3	
		Behaviour of real gases	5	
2	Liquid State	Structure of liquids and properties	5	Dr. S. Muni
		Liquid crystals	2	
		Molecular weight by colligative properties	4	
	Colligative Properties	Anomalous molecular weight of solutes	4	Dr(Mrs) N. Swain
		Introduction to solid state	1	
3	Solid State	Crystal systems	1	Dr. S. Muni
		Laws of crystallography and X-ray diffraction	5	
		Lattice energy, band theory and defects	3	
		General introduction	3	
4	Chemical Kinetics	Kinetics of reactions	4	Dr(Mrs) N. Swain
		Determination of order of reactions	3	
		Concept of collision theory and transition state theory	4	

Course Break Up

Unit – 1 **Chapter Name: The Gaseous State**

Name of the Faculty: Dr. S. Muni

Lecture No.	Details of the topic to be covered
1.	States of matter, state variables
2.	Postulates of kinetic theory of gases and molecular velocity
3.	Maxwell-Boltzmann distribution of molecular velocities, nature of distribution curve and effect of temperature on distribution
4.	Root mean square velocity, most probable velocity, average velocity and relation between them
5.	Collision number, mean free path, collision diameter, specific heat of gases, C_p/C_v ratio for monoatomic gases
6.	Average kinetic energy of molecules
7.	Derivation of all the laws of gases, Equipartition principle of energy
8.	van der Waals equation of state and discussion of van der Waals equation
9.	Critical constants of a gas
10.	The P-V isotherm of CO_2
11.	van der Waals equation and the critical state
12.	Law of corresponding state
13.	Liquefaction of gases based on Joule-Thomson effect

Unit – 2 **Chapter Name: Liquid state**

Name of the Faculty: Dr. S. Muni

1.	Theories on structure of liquids
2.	Structural difference from solid, liquid and gas
3.	Vapour pressure and Surface tension
4.	Parachor and its application
5.	Viscosity
6.	Introduction to liquid crystals
7.	Types of liquid crystals and their classification

Unit – 2 **Chapter Name: Colligative properties**

Name of the Faculty: Dr(Mrs) N.Swain

1.	General idea on colligative properties	
2.	Roult's law	
3.	Osmotic Pressure and laws of osmotic pressure	
4.	Elevation of boiling point and lowering of freezing point	
5.	Thermodynamic derivation of colligative properties	
6.	Thermodynamic derivation of colligative properties contd.	
7.	Anomalous molecular weight of solutes due to dissociation and association	
8.	Isotonic solutions	

Unit – 3 **Chapter Name: Solid state**

Name of the Faculty: Dr. S. Muni

Lecture No.	Details of the topic to be covered
1.	The Study of crystal, types of crystal symmetry elements in crystal
2.	Space lattice, unit cell, Crystal systems
3.	Law of constant interfacial angle, Law of rational indices, Law of symmetry
4.	Lattice planes and dimension, X-ray diffraction by crystal
5.	Bragg's equation derivation.
6.	Crystal structure of NaCl, KCl ionic solids (AB type),
7.	Lattice energy and its calculation.
8.	Qualitative treatment of Band theory of solids,
9.	Point defects in solids - Frenkel defects
10.	Schottky defects

Unit – 4 **Chapter Name: Chemical Kinetics**

Name of the Faculty: Dr. (Mrs.) N. Swain

Lecture No.	Details of the topic to be covered
1.	Basic principles of chemical reaction, rate of reaction
2.	Factors affecting rate of reaction
3.	Order and molecularity of reaction
4.	Kinetics of zero and first order reactions
5.	Radioactive decay as first order reaction, half-life period, pseudo first order reaction
6.	Pseudo first order reaction (continued)
7.	Kinetics of second order reaction
8.	Differential method, method of integration
9.	Fractional change method, Ostwald's isolation method, graphical method
10.	Postulates of collision theory, concept of activation energy
11.	Calculation of activation energy and Arrhenius equation
12.	Transition state theory
13.	Expression for the rate constant based on equilibrium constant and thermodynamic aspects
14.	Simple opposing reaction of the type, $A \rightleftharpoons B$

Course Code: CHC1102 **Course Title: Inorganic Chemistry – I**

Lesson Plan

Unit No	Name of the Chapter	Topic Title	No. of Lectures	Name of the Faculty
1	Atomic Structure	Introduction , theories of atom	4	Mr .S. R. Panda
		Schrödinger's wave equation, significance of Ψ Ψ ^{2}, quantum numbers	2	
		Different wave functions and shapes of orbital	3	
		Contour boundary and probability diagrams.	1	
		Rules for filling electrons in various orbitals electronic configuration	3	
2	Periodicity of Elements	Periodic properties : Effective nuclear charge, shielding effect, atomic radii	4	Dr.H. S.Sahoo
		Ionic radii, covalent radii, ionization enthalpy, and applicationsof ionization enthalpy.	6	
		Electronegativity and its variation	3	
3	Chemical Bonding-I	General characteristics,Types of ions, size effect, radius ratio rule ,	4	Dr(Mrs) S. Jena
		Born-Landé equation, lattice energy, Born-Haber cycle , Madelung constant	4	
		Lewis structure, Valence Bond theory (Heitler-London approach),	4	
		hybridization ,Resonance ,Molecular orbital theory	4	
		(VSEPR) theory, polarizability, Fajan's rule, Ionic character in covalent compounds	2	
4	Chemical bonding-II	Qualitative idea of valence bond and band theories, defects in solids, dipole-dipole interactions	5	
		van der Waals forces, ion-dipole forces, Hydrogen bonding	4	
4	Oxidation – Reduction	Redox equations, Standard Electrode Potential	2	Dr(Mrs) S. Jena
		redox stability in water , Frost Latimerdiagrams, Pourbaix diagrams	2	
		extraction of the metals.	2	

Course Break Up

Unit – 1 **Chapter Name: Atomic Structure**

Name of the Faculty: Mr. S. R. Panda

Lecture No.	Details of the topic to be covered
1.	Introduction, postulates Bohr's theory,and its limitation
2.	Electromagnetic spectrum and its types ,explanation for hydrogen spectrum
3.	Wave concept of atomic theory, de Broglie concept and equation
4.	Heisenberg's Uncertainty Principle ,and its significance, problems on it
5.	Derivation of Schrödinger's wave equation, .
6.	significance of Ψ & Ψ ^{2} , Quantum numbers and their significance.
7.	Normalized and orthogonal wave functions. Sign of wave functions ,
8.	Radial and angular wave functions for hydrogen atom.
9.	Radial and angular distribution curves , Shapes of s, p, d and f orbitals.
10.	Contour boundary and probability diagrams
11.	.Pauli's Exclusion Principle, Hund's rule of maximum multiplicity,
12.	Aufbau's principle and its limitations,electronicconfiguratoion of elements
13.	Variation of orbital energy with atomic number, problems

Unit – 2 **Chapter Name: Periodicity of Elements**

Name of the Faculty: Dr.H. S. Sahoo

Lecture No.	Details of the topic to be covered
1.	Periodic properties : Effective nuclear charge and its application
2.	Periodic properties : shielding effect and its application, Slater rules
3.	Periodic properties : atomic radii and its application
4.	Variation of atomic radii, shielding effect and effective nuclear charge
5.	Periodic properties : ionic radii and its application
6.	Periodic properties : covalent radii and its application
7.	Periodic properties : ionization of energy, definition and its application
8.	Successive ionization enthalpies and factors affecting ionization energy
9.	Electron gain enthalpy, trends of electron affinity

10.	Comparison of ionization energy and electron affinity
11.	Electronegativity: definition and application
12.	Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales.
13.	Variation of electronegativity with bond order, partial charge,hybridization, group electronegativity, Sanderson's electron density ratio.

Unit – 3 **Chapter Name: Chemical Bonding-I**

Name of the Faculty: Dr.(Mrs) S. Jena

Lecture No.	Details of the topic to be covered
1.	Introduction to chemical bonding , its types
2.	General characteristics, types of ions, size effects
3.	radius ratio rule and its limitations
4.	Packing of ions in crystals
5.	Born-Landé equation with derivation
6.	Kapustinskii expression
7.	ImportanceofKapustinskii expression for lattice energy. Madelung constant
8.	Born-Haber cycle and its application, Solvation energy
9.	Lewis structure, Valence Bond theory (Heitler-London approach)
10.	Energetics of hybridization, equivalent and non-equivalent hybrid orbitals
11.	Bent's rule
12.	F 2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given)
13.	HCl, BeF_2, CO_2,
14.	Formal charge, Valence shell electron pair repulsion theory (VSEPR),
15.	shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding and bond lengths
16.	Covalent character in ionic compounds, polarizing power and polarizability.
17.	Fajan's rules and consequences of polarization
18.	Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Unit – 4 **Chapter Name: Chemical Bonding- II**

Name of the Faculty: Dr.(Mrs) S. Jena

Lecture No.	Details of the topic to be covered
1.	Qualitative idea of valence bond and band theories.
2.	Conductors, Semiconductors and insulators
3.	defects in solids,schottkydefect
4.	Frenkeldefect
5.	van der Waals forces, ion-dipole forces,
6.	dipole-dipole interactions
7.	Induced dipole interactions, Instantaneous dipole-induced dipole interactions.
8.	Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment)
9.	Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Unit – 4 **Chapter Name: Oxidation – Reduction**

Name of the Faculty: Dr.(Mrs) S. Jena

Lecture No.	Details of the topic to be covered
1.	Redox equations, Standard Electrode Potential and use of redox potential data
2.	analysis of redox cycle
3.	redox stability in water
4.	Frost Latimerdiagrams
5.	Pourbaix diagrams
6.	Principles involved in the extraction of the metals.

Class: B. Sc. 1st Year generic 1st semester

Course Code: CHG1101 Course Title: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbon

Lesson Plan

Unit No	Name of the Chapter	Topic Title	No. of Lectures	Name of the Faculty
1	Atomic Structure	Introduction , theories of atomic structure	4	Dr(Mrs) S. Jena
		Schrödinger's wave equation, significance of Ψ & Ψ^2, quantum numbers	2	
		Different wave functions and shapes of orbital	3	
		Principles for filling the electrons in orbitals	4	
2	Chemical Bonding and molecular structure	Ionic bonding	7	Dr. H. S. Sahoo
		Covalent bonding	7	
3	Fundamentals of Organic Chemistry	Electronic effects in Organic molecules and their applications	2	Dr. P. K. Jena
		Bond scission and reactive intermediates	3	
		Aromaticity	1	
	Stereochemistry	Conformation in acyclic and cyclic systems	2	Dr. H. Nayak
		Optical isomers vs stereo isomers, their representations	3	
		Nomenclature of stereo isomers	3	
4	Aliphatic hydrocarbons	**Alkanes:** Preparation	2	Dr. H. Nayak
		Reaction	2	
		Alkenes: Preparation	2	Dr. P. K. Jena
		Reactions	3	
		Alkynes: Preparation	2	
		Reactions	2	

Course Breakup

Unit – 1 Chapter Name: Atomic Structure

Name of the Faculty: Dr. (Mrs) S. Jena

Lecture No.	Details of the topic to be covered
1.	Introduction to atomic structure,Thomsons, rutherfords model
2.	Review of Bohr's theory and its limitations,.
3.	Dual behavior of matter and radiation, de-Broglie's relation,problems
4.	Heisenberg Uncertainty principle. And its significance,spectrum and its types like line spectrum emission absorption ,spectrum
5.	Hydrogen atom spectra justification by Bohr model, Need of a new approach to Atomic structure.
6.	Basic concept on quantum mechanics? Derivation of Time independent Schrodinger equation
7.	Meaning of various terms inSchrodinger equation. Significance of ψ and ψ2,
8.	Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2 s,2p,3s,3p and 3d orbital (Only graphical representation).
9.	Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.
10.	Significance of quantum numbers, orbital angular momentum and quantum numbers ml ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms)
11.	Rules for filling electrons in various orbitals,. . Pauli's Exclusion Principle, Hund's rule of maximum multiplicity,Aufbau's principle and its limitations,electronic configuratoion of elements
12.	Electronic configurations of the atoms Stability of half-filled and completely filled orbitals, concept of exchange energy.
13.	Relative energies of atomic orbitals, Anomalous electronic configurations

Unit – 2 Chapter Name: chemical Bonding and molecular structure
Name of the Faculty: Dr. H. S. Sahoo

Lecture No.	Details of the topic to be covered
1.	Ionic Bonding: General characteristics of ionic bonding Energy considerations in ionic bonding,
2.	Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds.
3.	Statement of Born-Lande equation for calculation of lattice energy.
4.	Born-Haber cycle and its applications,
5.	Polarizing power and polarizability. Fajan's rules
6.	Ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
7.	Covalent Bonding: VB Approach
8.	Shapes of some inorganic molecules and ions on the basis of VSEPR theory
9.	Shape of covalent molecules and hybridization
10.	Concept of resonance
11.	LCAO method
12.	MO of H2, N2,O2, CO, NO

Unit – 3 Chapter Name: Fundamentals of Organic Chemistry
Name of the Faculty: Dr. P. K. Jena

Lecture No.	Details of the topic to be covered
1.	Inductive Effect, Electromeric Effect,
2.	Resonance and Hyperconjugation
3.	Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.
4.	Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles
5.	Carbocations, Carbanions and free radicals
6.	Aromaticity: Benzenoids and Huckel's rule

Unit – 3 Chapter Name: Stereochemistry
Name of the Faculty: Dr. H. Nayak

Lecture No.	Details of the topic to be covered
1.	Conformations with respect to ethane and butane
2.	Conformations with respect to Cyblohexane
3.	Concept of chirality (upto two carbon atoms).
4.	Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations
5.	Enantiomerism, Diastereomerism and Meso compounds) Threo and erythro representation
6.	D L and R S System of nomenclatures
7.	Geometrical isomerism
8.	E/ Z Nomenclature (for up to two C=C systems)

Unit – 4 Chapter Name: Aliphatic hydrocarbons
Name of the Faculty: Dr. H. Nayak

Lecture No.	Details of the topic to be covered
1.	**Alkanes:** Preparation: Catalytic hydrogenation, Wurtz reaction
2.	Kolbe's synthesis, from Grignard reagent.
3.	Reactions: Free radical Substitution
4.	Halogenation

Unit – 4 Chapter Name: Aliphatic hydrocarbons
Name of the Faculty: Dr. P. K. Jena

Lecture No.	Details of the topic to be covered
1.	**Alkenes:** Preparation**:** Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule).
2.	Cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction)
3.	Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine),
4.	Addition of HX (Markownikoff's and anti-Markownikoff's addition),
5.	Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.
6.	**Alkynes:** Preparation: Acetylene from CaC_2 and conversion into higher alkynes;
7.	By dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.
8.	Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,
9.	Ozonolysis and oxidation with hot alk.$KMnO_4$.