GOVERNMNET GENERAL DEGREE COLLEGE, KALNA-I

DEPARTMENT OF CHEMISTRY

LESSSON PLAN

CCFUP (NEP-2020)

DEPARTMENT OF CHEMISTRY
GOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN

for

Paper code: CHEM101-1
Paper title: Basic Chemistry-I

***Credits:* 3(Theory)+1(Practical)**
***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Theory (Marks-40)

Module-I ***Atomic structure***		
Bohr's theory- its limitations and atomic spectra of hydrogen atom, Sommerfeld's theory, wave mechanics-de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2, quantum numbers and their significance, Radial and angular wave functions for hydrogen atom, radial and angular distribution curves, shapes of s, p, d and f orbitals, Pauli's exclusion principle, Hund's rules and multiplicity, exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number up to 30.		
Module Objectives: 1. This unit aims to offer basic knowledge on structure of atom and fundamentals of atomic structure which provides the clear picture of the outermost electronic distribution of atom as well as the constituents of the nucleus. 2. From this portion students can get a clear idea about the structure of both Hydrogen like and polyelectronic atoms and ions with the use of various common existing principles guiding electronic configurations.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Bohr's theory, its limitations and atomic spectrum of hydrogen atom	
Lecture-2.	Sommerfeld's Theory	

Lecture-3.	Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance	
Lecture-4.	Schrödinger's wave equation, significance of ψ and ψ^2	
Lecture-5.	Quantum numbers and their significance	
Lecture-6.	Radial and angular wave functions for hydrogen atom	
Lecture-7.	Radial and angular wave functions for hydrogen atom	
Lecture-8.	Shapes of s, p, d and f orbitals	
Lecture-9.	Pauli's Exclusion Principle, Hund's rules and multiplicity, Exchange energy, Aufbau principle and its limitations	
Lecture-10.	Pauli's Exclusion Principle, Hund's rules and multiplicity, Exchange energy, Aufbau principle and its limitations	
Lecture-11.	Ground state Term symbols of atoms and ions for atomic number upto 30	
Lecture-12.		Discussion on simple problems.
Lecture-13.		Solutions of previous year questions
Lecture-14.		Tutorial assignment – 1
Lecture-15.		Tutorial assignment – 2

Module-II

Periodic properties

CONTENTS

Modern IUPAC Periodic table, Effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction. Ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. Secondary periodicity, Relativistic Effect, Inert pair effect.

Module Objectives:

1. From this portion students can acquire thorough background knowledge about the periodic trends of elements and their Compounds.
2. Periodic table and periodic properties, which helps the students to study the subject systematically. The chemistry of elements which make up the entire material world will be understood from the perspective of the periodic table.

Lecture Serial	Topics of Discussion	Remarks
Lecture-16.	Modern IUPAC Periodic table	

Lecture-17.	Effective nuclear charge, screening effects and penetration	
Lecture-18.	Slater's rules	
Lecture-19.	Atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction	
Lecture-20.	Atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction	
Lecture-21.	Ionization potential and electron affinity	
Lecture-22.	Electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities	
Lecture-23.	Electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities	
Lecture-24.	Group trends and periodic trends in these properties in respect of s-, p- and d-block elements	
Lecture-25.	Group trends and periodic trends in these properties in respect of s-, p- and d-block elements	
Lecture-26.	Secondary periodicity, Relativistic Effect, Inert pair effect	
Lecture-27.		Discussion on simple problems.
Lecture-28.		Solutions of previous year questions

Lecture-29.		Tutorial assignment
Lecture-30.		Tutorial assignment

Module-III ***Acids and bases***		
CONTENTS Acid-Base concept- Arrhenius concept, theory of solvent system (in H2O, NH3, SO2 and HF); Bronsted-Lowry's concept, relative strength of acids, Pauling's rules, Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects, thermodynamic acidity parameters, Drago-Wayland equation, super acids, gas phase acidity and proton affinity, HSAB principle, acid-base equilibria in aqueous solution (proton transfer equilibria in water), pH, buffer, acid-base neutralization curves, indicator, choice of indicators, concept of organic acids and bases, effect of structure, substituent and solvent on acidity and basicity, proton sponge, gas-phase acidity and basicity		
Module Objectives: Idea of acids and bases along with ionic equilibria helps students to identify various compounds in terms of acid and base and also to compare their relative strength. Concept of pH helps them quantify the acidity of a reaction medium, which is extremely important to understand various chemical phenomena.		
Lecture Serial	Topics of Discussion	Remarks
Lecture-31.	Acid-Base concept: Arrhenius concept theory of solvent system (in H_2O, NH_3, SO_2 and HF)	
Lecture-32.	Bronsted-Lowry's concept, relative strength of acids, Pauling's rules	
Lecture-33.	Bronsted-Lowry's concept, relative strength of acids, Pauling's rules	
Lecture-34.	Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects	
Lecture-35.	Thermodynamic acidity parameters, Drago-Wayland equation	
Lecture-36.	Superacids, Gas phase acidity and proton	

Lecture-37		Discussion on simple problems.
Lecture-38.		Tutorial assignment – 5

Module-IV

Chemical Bonding-I

CONTENTS

1. Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Solubility energetics of dissolution process.

2. Covalent bond: Polarizing power and polarizability, ionic potential, Fazan's rules. Lewis structures, formal charge. Valence Bond Theory. The hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, Dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach).

Module Objectives:

Chemical bonding in covalent compounds gives the most fundamental idea of why a compound is formed. Students will acquire the knowledge of ionic bond & covalent bond formation and its features.

Lecture Serial	Topics of Discussion	Remarks
Lecture-39.	General characteristics of Ionic bonds, types of ions, size effects etc	
Lecture-40.	Radius ratio rule and its application and limitations	
Lecture-41.	Packing of ions in crystals	
Lecture-42.	Born-Landé equation with derivation	
Lecture-43.	Importance of Kapustinskii expression for lattice energy	
Lecture-44.	Madelung constant	
Lecture-45.	Born-Haber cycle and its application	
Lecture-46.	Born-Haber cycle and its application & Solvation energy. Solubility energetics of dissolution process	

Lecture- 47.	Polarizing power and polarizability, ionic potential, Fazan's rules Bent's rule and Dipole moments & VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs and multiple bonding	
Lecture-48.	Polarizing power and polarizability, ionic potential, Fazan's rules	
Lecture-49.		Tutorial assignment

Module-V

Fundamentals in organic chemistry

CONTENTS

Electron displacement phenomena and physical properties: inductive effect, field effect, hyperconjugation, mesomeric effect, resonance energy, bond polarization and bond polarizability, electromeric effect, steric effect, steric inhibition of resonance, influence of hybridization on bond properties, bond dissociation energy (BDE) and bond energy, bond distances, bond angles, concept of bond angle strain (Baeyer's strain theory), melting point/boiling point and solubility of common organic compounds in terms of covalent & noncovalent intermolecular forces, polarity of molecules and dipole moments, relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation, calculation of formal charges and double bond equivalent (DBE)

Reactive intermediates: carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes, benzynes and nitrenes, generation and stability, structure using orbital picture and electrophilic/nucleophilic behaviour of the reactive intermediates (elementary idea)

Concept of aromaticity: Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring), concept of antiaromaticity and homoaromaticity, non-aromatic molecules, Frost diagram, elementary idea about α and β, measurement of delocalization energies in terms of β for buta-1,3-diene, cyclobutadiene, hexa-1,3,5-triene and benzene

Module Objectives:

This unit aims to offer basic knowledge on bonding in organic molecules and others physical parameters and stability factors. Students will also understate about aromaticity and delocalization.

Lecture Serial	Topics of Discussion	Remarks
Lecture-50.	Valence Bond Theory: Concept of hybridisation, shapes of molecules	
Lecture-51.	resonance (including hyperconjugation)	

Lecture-52.	Electronic displacements: inductive effect, field effect,	
Lecture-53.	mesomeric effect, resonance energy	
Lecture-54.	bond polarization and bond polarizability; electromeric effect	
Lecture-55.	steric effect, steric inhibition of resonance	
Lecture-56.	MO theory: qualitative idea about molecular orbitals, bonding and antibonding interactions, idea about σ, σ*, π, π *, n – MOs;	
Lecture-57.	basic idea about Frontier MOs (FMO); concept of HOMO, LUMO and SOMO;	
Lecture-58.	interpretation of chemical reactivity in terms of FMO interactions; sketch and energy levels of π MOs of i) acyclic p orbital system (C=C, conjugated diene, triene)	
Lecture-59.	sketch and energy levels of π MOs of allyl and pentadienyl systems	
Lecture-60.	ii) cyclic p orbital system (neutral systems: [4], [6]-annulenes; charged systems: 3-,4-,5-membered ring systems)	
Lecture-61.	Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring)	

Module-VI

Kinetic theory of gases

CONTENTS

Kinetic Theory of gases: Concept of pressure and temperature; collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), wall collision and rate of effusion Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions, kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case, calculation of number of molecules having energy $\geq \varepsilon$, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases. Real gas and virial equation: Deviation of gases from ideal behaviour, compressibility factor, Boyle temperature, Andrew's and Amagat's plots, van der Waals equation and its features, its derivation and application in explaining real gas behaviour, Dietrici equation of state, existence of critical state, critical constants in terms of van der Waals constants, law of corresponding states, virial equation of state, van der Waals equation expressed in virial form and significance of second virial

coefficient, intermolecular forces (Debye, Keesom and London interactions, Lennard-Jones potential - elementary idea)

Module Objectives:

1. This unit aims to offer basic knowledge on Kinetic Theory of gases and it gives the sound knowledge about the gases in molecular level.
2. From this chapter, students have the clear concept about the gases

Lecture Serial	Topics of Discussion	Remarks
Lecture-62.	Concept of pressure and Temperature	
Lecture-63.	Collision of gas molecules	
Lecture-64.	Collision diameter; Collision number and mean free path	
Lecture-65.	Frequency of binary collisions (similar and different molecules)	
Lecture-66	Wall collision and rate of effusion	
Lecture-67	Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions	
Lecture-68.	Kinetic energy distribution in one, two and three dimensions, calculations of average	
Lecture-69	root mean square and most probable values in each case; Calculation of number of molecules having energy $\geq \varepsilon$	
Lecture- 70	Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases.	

Lecture-71	Deviation of gases from ideal Behavior	
Lecture- 72	compressibility factor; Boyle temperature; Andrew's and Amagat's plots	
Lecture- 73	van der Waals equation and its features; its derivation and application in explaining real gas behaviour, other equations of state (Berthelot, Dietrici);	
Lecture- 74	Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states	
Lecture- 75	virial equation of state; van der Waals equation expressed in virial form and significance of second virial coefficient	
Lecture- 76	Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea)	
Lecture-77		Discussion on simple problems.

Module-VII

Thermodynamics-I

CONTENTS

Zeroth and 1st law of Thermodynamics: intensive and extensive variables, state and path functions, isolated, closed and open systems, zeroth law of thermodynamics, concept of heat q, work wand internal energy U, statement of first law, enthalpy H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions, Joule's experiment and its consequence

Thermochemistry: standard states, heats of reaction, enthalpy of formation of molecules and ions and enthalpy of combustion and its applications, laws of thermochemistry, bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions, adiabatic flame temperature, explosion temperature

Module Objectives:

1. From this portion students can acquire thorough background knowledge about preliminary thermodynamics.

2. It helps the students to develop the basic idea about the change of the heat and other important parameters along with the progress of the reaction.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-78	Zeroth and 1st law of Thermodynamics:Intensive and extensive variables; state and path functions; isolated,closed and open systems;zeroth law of thermodynamics	
Lecture-79.	Concept of heat, work, internal energy and statement of first law	
Lecture-80	enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions	
Lecture-81.	Joule's experiment and its consequence.	
Lecture-82.	Calculations of the change of enthalpy of the thermochemical reaction.	
Lecture-83.		Discussion on simple problems
Lecture-84.		Solutions of previous year questions
Lecture-85.		Solutions of previous year questions
Lecture-86.		Tutorial assignment
Lecture-87.		Tutorial assignment
Lecture-88.		Tutorial assignment

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.
7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).
9. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
10. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).
11. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.6
12. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
13. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
14. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.
15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
16. Morrison, R. T. Study guide to organic Chemistry, Pearson.
17. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.
18. Castellan, G. W., Physical Chemistry, Narosa Publishing House.

DEPARTMENT OF CHEMISTRY

GOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I

LESSON PLAN

for

Paper code: CHEM101-1
Paper title: Basic Chemistry-I

***Credits:* 3(Theory)+1(Practical)**

***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Practical (Marks-40)

Module-I Separation		
CONTENTS Based upon solubility, by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, etc., of components of a binary solid mixture; purification of any one of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/p-Toluidine; p- Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/p-Anisidine. **15 classes**		
Module Objectives: Students will experience hand on training regarding quantitative separation of organic compounds using several techniques. These classes may help students to develop their skills regarding laboratory experiments of various RNDs and research.		
Lecture Serial	**Title of the Experiment**	**Remarks**
Lab 1	Laboratory Instructions and guidance on Lab notebook preparation	
Lab 2	Theoretical discussion about the reactions involved in this course	
Lab 3	Skill development on weighing and glass instruments	
Lab 4	Training to Detect MP of some common organic compounds	
Lab 5	Separation of two component from the mixture of Benzoic acid/p-Toluidine	
Lab 6	Continuation	
Lab 7	Purification of benzoic acid through crystallization	
Lab 8	Detection of MP of benzoic acid	
Lab 9	Separation of two component from the mixture of p-Nitrobenzoic acid/p-Aminobenzoic acid	

Lab 10	Continuation	
Lab 11	Purification of p-Nitrobenzoic acid through crystallization	
Lab 12	Detection of MP of p-Nitrobenzoic acid	
Lab 13	Separation of two component from the mixture of p-Nitrotolune/p-Anisidine	
Lab 14	Purification of p-Nitrotolune acid through crystallization	
Lab 15	Detection of MP of p-Nitrotolune	

Module-II

Determination of boiling point

CONTENTS

Determination of boiling point of common organic liquid compounds e.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide. [Boiling point of the chosen organic compounds should preferably be less than 160 °C]. **3 classes**

Module Objectives:

Students will get training on determination of boiling point with some common organic solvents. It will help to detect proper solvent for a particular reaction in their future.

Lecture Serial	Title of the Experiment	Remarks
Lab 16	Apparatus set up and showing the process	
Lab 17	Determination of BP of ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone	
Lab 18	Determination of BP of acetylacetone, anisole, crotonaldehyde, mesityl oxide	

Module-III

Identification of a Pure Organic Compound by Chemical Test(s)

CONTENTS

Solid compounds: oxalic acid, succinic acid, resorcinol, urea, glucose and salicylic acid. Liquid Compounds: acetic acid, ethyl alcohol, acetone, aniline and nitrobenzene. **12 classes**

Module Objectives:

Students will experience hand on training regarding and skill development for identification of Organic Compounds by Chemical Tests which will help to detect the nature of compounds and their chemical behavior.

Lecture Serial	Title of the Experiment	Remarks
Lab 19	Identification of oxalic acid	
Lab 20	Identification of succinic acid	
Lab 21	Identification of resorcinol	
Lab 22	Identification of urea	
Lab 23	Identification of glucose	
Lab 24	Identification of salicylic acid	
Lab 25	Identification of acetic acid	
Lab 26	Identification of ethyl alcohol	
Lab 27	Identification of acetone	
Lab 28	Identification of aniline	
Lab 29	Identification of nitrobenzene	
Lab 30		Practice

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.
2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

Department of Chemistry

Government General Degree College, kalna-I

LESSON PLAN

for

SKILL ENHANCEMENT COURSE (SEC)

Paper code: CHEM105-1

Paper title: Drugs and pharmaceuticals

Credits-03

Course time hour:45

***Full Marks*:50 (Theory-40, Internal Assessment–10)**

Theory (Marks-40)

Module-I Drugs & Pharmaceuticals		
CONTENTS Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).		
Module Objectives: Medicinal/Pharmaceutical chemistry deals with the discovery, design, development and both pharmacological and analytical characterization of drug substances. The chapter describes stages of drug development followed by a summary of the phases of drug activity relating to a drug's formulation. Finally, classification systems for marketed drug substances are presented, with an emphasis on their structure, synthesis and use.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Drug discovery, design and development (part 1)	
Lecture-2.	Drug discovery, design and development (part 2)	
Lecture-3.	Drug discovery, design and development (part 3)	

Lecture-4.	Drug Targets, Mechanism of drug action (part 1)	
Lecture-5.	Drug Targets, Mechanism of drug action (part 2)	
Lecture-6.	Definition and classification of analgesics agents, antipyretic agents, anti-inflammatory agents	
Lecture-7.	Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, ibuprofen)	
Lecture-8.	Comparative discussion on activity and use of Aspirin, paracetamol, ibuprofen	

Lecture-9.	antibiotics (Chloramphenicol)	
Lecture-10.	antibacterial and antifungal agents: Sulphonamides; Sulphanethoxazol	
Lecture-11.	antibacterial and antifungal agents: Sulphacetamide, Trimethoprim	
Lecture-12.	antiviral agents (Acyclovir)	
Lecture-13.	Central Nervous System agents (Phenobarbital, Diazepam)	
Lecture-14.	Cardiovascular (Glyceryl trinitrate)	
Lecture-15.	antilaprosy (Dapsone)	
Lecture-16.	HIV-AIDS related drugs (AZT- Zidovudine)	
Lecture-17.		Discussion on Problems
Lecture-18.		Question-Answer

Reference Books:

1. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.

2. Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012. Waverly Pvt. Ltd. New Delhi.

4. El-Mansi, E.M.T., Bryce, C.F.A., Ddemain, A.L., Allman, A.R., Fermentatias Microbiology and Biotechnology, 2nd Ed. Taylor & Francis.

5. Prescott & Dunn's Industrial Microbiology, 2004, CBS Publisher.

DEPARTMENT OF CHEMISTRY
FOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN
FOR
Paper code: CHEM201-1
Paper title: Basic Chemistry-II

***Credits:* 3(Theory)+1(Practical)**
***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Theory (Marks-40)

Module-I ***Chemical bonding-I***		
Ionic bond: general characteristics, types of ions, size effects, radius ratio rule and its application and limitations, packing of ions in crystals Born-Landé equation with derivation and importance, Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its application, solvation energy, solubility energetics of dissolution process. Covalent bond: polarizing power and polarizability, ionic potential, Fazan's rules, Lewis structures, formal charge, Valence Bond Theory-hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach)		
Module Objectives: 1. This unit aims to offer basic knowledge on the various types chemical bonding shown in the molecular systems. 2. From this portion students will be able to elucidate the shape and geometry of any compound.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Ionic bond: general characteristics, types of ions, size effects, radius ratio rule and its application and limitations, packing of ions in crystals	
Lecture-2.	Born-Landé equation with derivation and importance, Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its application, solvation energy, solubility energetics of dissolution process.	

Lecture-3.	Covalent bond: polarizing power and polarizability, ionic potential, Fazan's rules, Lewis structures, formal charge, Valence Bond Theory- hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals	
Lecture-4.	Bent's rule, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach)	
Lecture-5.		Discussion on simple problems.
Lecture-6.		Solutions of previous year questions
Lecture-7.		Tutorial assignment – 1
Lecture-8.		Tutorial assignment – 2

Module-II

Redox Reactions and Precipitation Reactions

CONTENTS

Balancing of redox reactions: ion-electron method, elementary idea on standard redox potentials- Nernst equation (without derivation), influence of complexformation, precipitation and pH, formal potential Redox titrations: feasibility, redox potential at the equivalence point, redox indicators, redox potential diagram (Latimer and Frost diagrams) of common elements and their applications Disproportionation and comproportionation reactions (typical examples), solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides

Module Objectives:

1. From this portion students can acquire the knowledge about the electron transfer in chemical reaction.
2. Students will be able to tell whether the reactions will be occurred or not, through the overall cell potential value.

Lecture Serial	Topics of Discussion	Remarks
Lecture-9.	Balancing of redox reactions: ion-electron method, elementary idea on standard redox potentials- Nernst equation (without derivation)	

Lecture-10.	influence of complexformation, precipitation and pH, formal potential Redox titrations: feasibility, redox potential at the equivalence point, redox indicators, redox potential diagram (Latimer and Frost diagrams) of common elements and their applications Disproportionation and comproportionation reactions (typical examples)	
Lecture-11.	solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides	
Lecture-12.		Discussion on simple problems.
Lecture-13.		Solutions of previous year questions

Module-III

Stereochemistry-I

CONTENTS

Bonding geometries and representation of carbon compounds: tetrahedral nature of carbon and concept of asymmetry: Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations Chirality and symmetry: symmetry elements and point groups (Cv, Cnv, Cnh, Cn, Dh, Dnh, Dnd, Dn, Sn (Cs, Ci), molecular chirality and centre of chirality, asymmetric and dissymmetric molecules, enantiomers and diastereomers, epimers, stereogenicity, chirotopicity and pseudoasymmetry, chiral centres and number of stereoisomerism, systems involving 1/2/3-chiral centre(s)- AA, AB, ABA and ABC types Relative and absolute configuration: D/L and R/S descriptors, erythro/threo and meso nomenclature of compounds, syn/anti nomenclatures for aldols, E/Z descriptors- C=C, conjugated diene, triene, C=N and N=N systems, combination of R/S- and E/Z-isomerisms Optical activity compounds: optical rotation, specific rotation and molar rotation, racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates), resolution of acids,
bases and alcohols via diastereomeric salt formation, optical purity and enantiomeric excess.

Module Objectives:

i) This unit aims to offer basic knowledge on stereochemistry and fundamentals of Chiral axis, atropisomers, pseudoasymmetry, conformational isomers etc.

ii) From this portion students can get a clear idea about stereogenicity of simple as well as complex molecules having axial chirality, potential energy barriers of differentconformers, preferred conformation of functional molecules in their ground state.

Lecture Serial	Topics of Discussion	Remarks
Lecture-14	Bonding geometries and representation of carbon compounds: tetrahedral nature of carbon and concept of asymmetry: Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations Chirality and symmetry: symmetry elements and point groups (Cv, Cnv, Cnh, Cn, Dh, Dnh, Dnd, Dn, Sn (Cs, Ci), molecular chirality and centre of chirality,	

Lecture-15.	asymmetric and dissymmetric molecules, enantiomers and diastereomers, epimers, stereogenicity, chirotopicity and pseudoasymmetry, chiral centres and number of stereoisomerism, systems involving 1/2/3-chiral centre(s)- AA, AB, ABA and ABC types Relative and absolute configuration: D/L and R/S descriptors, erythro/threo and meso nomenclature of compounds, syn/anti nomenclatures for aldols, E/Z descriptors- C=C, conjugated diene, triene, C=N and N=N systems, combination of R/S- and E/Z-isomerisms	
Lecture-16.	Optical activity compounds: optical rotation, specific rotation and molar rotation, racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates), resolution of acids, bases and alcohols via diastereomeric salt formation, optical purity and enantiomeric excess.	
Lecture-17.		Discussion on simple problems.
Lecture-18.		Tutorial assignment
Lecture-19.		Solve the previous year problems.

Module-IV

General Treatment of Reaction Mechanism

CONTENTS

Free energy profiles: one-, two- and three-step reactions, catalyzed reactionselectrophilic and nucleophilic catalysis, kinetic control and thermodynamic control of reactions, isotope effect-primary and secondary kinetic isotopic effect (kH /kD), principle of microscopic reversibility
Tautomerism: prototropy (keto-enol, amido-imidol, nitroso-oximino, diazoamino and enamine-imine systems) and ring-chain tautomerism, composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3-dicarbonyl systems, phenols and related systems), factors affecting keto-enol tautomerism, application of thermodynamic principles in tautomeric equilibria

Module Objectives:

General Treatment of Reaction Mechanism gives the idea about the reaction mechanism, transition state and reaction intermediate. In addition to it, it will provide the salient features of tautomerism.

Lecture Serial	Topics of Discussion	Remarks
Lecture-20.	Free energy profiles: one-, two- and three-step reactions, catalyzed reactionselectrophilic and nucleophilic catalysis, kinetic control and thermodynamic control of reactions, isotope effect-primary and secondary kinetic isotopic effect (kH /kD), principle of microscopic reversibility	
Lecture-21.	Tautomerism: prototropy (keto-enol, amido-imidol, nitroso-oximino, diazoamino and enamine-imine systems) and ring-chain tautomerism, composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3-dicarbonyl systems, phenols and related systems)	
Lecture-22.	Factors affecting keto-enol tautomerism, application of thermodynamic principles in tautomeric equilibria	
Lecture-23.		Discussion on simple problems.
Lecture-24.		Tutorial assignment
Lecture-25.		Solve the previous year problems.

Module-V
Substitution and Elimination Reactions

CONTENTS

Nucleophilic substitution reactions: substitution at sp3 centre- mechanisms (with evidence), relative rates, stereochemical features, SN1, SN2, SN2', SN1' (allylic rearrangement) and SNi, effects of solvent, substrate structure, leaving group and nucleophiles (including ambident nucleophiles, cyanide & nitrite), electrofuges and nucleofuges, substitutions involving NGP, role of crown ethers and phase transfer catalysts [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides] Elimination reactions: E1, E2, E1cB and Ei (pyrolytic syn eliminations), formation of alkenes and alkynes, mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity, comparison between substitution and elimination

Module Objectives:

This unit aims to offer basic knowledge on different types of reaction mechanism and various factors controlling the rate of the reaction.

Lecture Serial	Topics of Discussion	Remarks
Lecture-26.	Nucleophilic substitution reactions: substitution at sp3 centre- mechanisms (with evidence), relative rates, stereochemical features, SN1, SN2, SN2', SN1' (allylic rearrangement) and SNi, effects of solvent, substrate structure, leaving group and nucleophiles (including ambident nucleophiles, cyanide & nitrite), electrofuges and nucleofuges	
Lecture-27.	, substitutions involving NGP, role of crown ethers and phase transfer catalysts [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides]	
Lecture-28.	Elimination reactions: E1, E2, E1cB and Ei (pyrolytic syn eliminations), formation of alkenes and alkynes, mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity, comparison between substitution and elimination	
Lecture-29.		Discussion on simple problems.
Lecture-30.		Tutorial assignment
Lecture-31.		Solve the previous year problems.

Module-VI

Kinetic theory of gases

CONTENTS

Concept of pressure and temperature; collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), wall collision and rate of effusion Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions, kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case, calculation of number of molecules having energy $\geq \varepsilon$, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases.

Module Objectives:

1. This unit aims to offer basic knowledge on Kinetic Theory of gases and it gives the sound knowledge about the gases in molecular level.
2. From this chapter, students have the clear concept about the gases

Lecture Serial	Topics of Discussion	Remarks
Lecture-32.	Concept of pressure and temperature; collision of gas molecules, collision diameter, collision number and mean free path,	
Lecture-33.	Frequency of binary collisions (similar and different molecules), wall collision and rate of effusion Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions	
Lecture-34.	Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case, calculation of number of molecules having energy $\geq \varepsilon$, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases.	
Lecture-35.		Discussion on simple problems.
Lecture-36		Tutorial assignment
Lecture-37		Solve the previous year problems.

Module-VII

Liquid state

CONTENTS

Viscosity: General features of fluid flow (streamline and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; temperature variation of viscosity of liquids and comparison with that of gases Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; work f cohesion and adhesion, spreading of liquid over other surfaces; vapour pressure over curved surface; temperature dependence of surface tension, principle of surface tension measurement

Module Objectives:

1. From this portion students can acquire thorough knowledge about the viscosity of liquid and its utilities

Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-38	Viscosity: General features of fluid flow (streamline and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; temperature variation of viscosity of liquids and comparison with that of gases	
Lecture-39	Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; work f cohesion and adhesion, spreading of liquid over other surfaces; vapour pressure over curved surface; temperature dependence of surface tension, principle of surface tension measurement	
Lecture-40		Discussion on simple problems.

Module-VIII

Thermodynamics-II

CONTENTS

Second Law: its need and statement, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine and refrigerator, Kelvin – Planck and Clausius statements and their equivalence in entropic formulation, Carnot's theorem,values of §dQ/T and Clausius inequality, entropy change of systems and surroundings for various processes and transformations, entropy and unavailable work, auxiliary state functions (G and A) and their variations (with T, P and V), criteria of spontaneity and equilibrium Thermodynamic relations: Maxwell's relations, Gibbs- Helmholtz equation, Joule-Thomson experiment and its consequences, inversion temperature, JouleThomson coefficient for a van der Waals gas, general heat capacity relations.

Module Objectives:

This unit provides knowledge about the Second Law of Thermodynamics and its applications.

Lecture Serial	Topics of Discussion	Remarks
Lecture41.	Second Law: its need and statement, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine and refrigerator, Kelvin – Planck and Clausius statements and their equivalence in entropic formulation	
Lecture-42.	Second Law: its need and statement, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine and refrigerator, Kelvin – Planck and Clausius statements and their equivalence in entropic formulation	
Lecture-43.	Thermodynamic relations: Maxwell's relations, Gibbs- Helmholtz equation, Joule-Thomson experiment and its consequences, inversion temperature, JouleThomson coefficient for a van der Waals gas, general heat capacity relations.	
Lecture-44.		Discussion on simple problems.
Lecture-45		Tutorial assignment
Lecture-46		Solve the previous year problems.

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.
4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).
5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.
6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.
7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).
9. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
10. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).
11. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.6
12. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
13. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
14. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.
15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
16. Morrison, R. T. Study guide to organic Chemistry, Pearson.
17. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.
18. Castellan, G. W., Physical Chemistry, Narosa Publishing House.

DEPARTMENT OF CHEMISTRY
FOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN
FOR
Paper code: CHEM201-1
Paper title: Basic Chemistry-I

Credits: ***3(Theory)+1(Practical)***
Full Marks-75 (Theory-40, Practical-20, Internal Assessment-15)

Practical (Marks-40)

Module-I
Experimental Techniques
CONTENTS
1. Study of kinetics of acid-catalyzed hydrolysis of methyl acetate 2. Study of kinetics of decomposition of H2O2 by KI 3. Determination of pH of unknown strong alkali and acid solution by colour matching method 4. Determination of pH of unknown buffer solution by colour matching method 5. Study of viscosity of unknown liquid (glycerol, sugar) with respect to water 6. Determination of surface tension of a liquid using Stalagmometer

Module Objectives:

Students will be able to know the different useful techniques for the determination of various physicochemical parameters.

Lecture Serial	Title of the Experiment	Remarks
Lab 1	Study of kinetics of acid-catalyzed hydrolysis of methyl acetate	
Lab 2	Study of kinetics of decomposition of H2O2 by KI	
Lab 3	Determination of pH of unknown strong alkali and acid solution by colour matching method	
Lab 4	Determination of pH of unknown buffer solution by colour matching method	
Lab 5	Study of viscosity of unknown liquid (glycerol, sugar) with respect to water	
Lab 6		Repeat Experiment
Lab 7		Repeat Experiment
Lab 8		Repeat Experiment
Lab 9		Repeat Experiment
Lab 10		Repeat Experiment
Lab 11		Repeat Experiment
Lab 12		Repeat Experiment
Lab 13		Repeat Experiment
Lab 14		Repeat Experiment
Lab 15		Repeat Experiment

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.
2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis,

CBS Publishers and Distributors.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

DEPARTMENT OF CHEMISTRY
FOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN
for

SKILL ENHANCEMENT COURSE (SEC)

Paper code: CHEM205-1
Paper title: Basic Analytical Chemistry

Credits-03
Course time hour:45

***Full Marks*:50 (Theory-40, Internal Assessment–10)**
Theory (Marks-40)

Module-I Analysis of soil		
CONTENTS Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators..		
Module Objectives: 1. This unit aims to offer basic knowledge on the determination of various types of parameters to test the soil for the cultivation, industrialization and etc.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Composition of soil	
Lecture-2.	Concept of pH and pH measurement	
Lecture-3.	Complexometric titrations	
Lecture-4.	Chelation	
Lecture-5.	Chelating agents	
Lecture-6.	use of indicators	
Lecture-7.		Repetition of previous class
Lecture-8.		Repetition of previous class
Lecture- 9.		Repetition of previous class
Lecture-10.		Repetition of

		previous class
Lecture- 11.		Repetition of previous class
Lecture- 12		Repetition of previous class
Lecture- 13		Repetition of previous class
Lecture- 14		Repetition of previous class
Lecture- 15		Repetition of previous class
Lecture-16		Discussion on
		simple problems.
Lecture-17		Solutions of previous year questions
Lecture-18		Tutorial assignment
Lecture-19		Tutorial assignment

Module-II		
Analysis of water		
CONTENTS		
Definition of pure water, contaminants (different type), water sampling methods, water purification methods		
Module Objectives:		
1. This unit aims to offer basic knowledge on the determination of various types of parameters to test the quality of water for the cultivation, industrialization and etc.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-20	Definition of pure water	
Lecture-21	contaminants (different type)	
Lecture-22	water sampling methods	
Lecture-23	Water purification methods	
Lecture-24		Repetition of previous class
Lecture-25		Repetition of previous class

Lecture-26		Repetition of previous class
Lecture-27		Repetition of previous class
Lecture- 28		Repetition of previous class
Lecture-29		Repetition of previous class
Lecture-30		Repetition of previous class
Lecture- 31		Repetition of previous class
Lecture- 32		Repetition of previous class
Lecture- 33		Repetition of previous class
Lecture- 34		Repetition of previous class
Lecture-35		Discussion on simple problems.
Lecture-36		Solutions of previous year questions
Lecture-37		Tutorial assignment
Lecture-38		Tutorial assignment

Module-III
Analysis of food products, Chromatography, Ion-exchange and Analysis of cosmetics

CONTENTS

1. Nutritional value of foods, idea about food processing and food preservations and adulteration.
2. Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.
3. Column, ion-exchange chromatography etc., determination of ion exchange capacity of anion & cation exchange resin.
4. Major and minor constituents and their function: Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate

Module Objectives:

From this total unit,we have the sound knowledge about the food and different types of estimation methods.

Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-39	Nutritional value of foods, idea about food processing	
Lecture-40	Food preservations and adulteration	
Lecture-41	Definition, general introduction on principles of chromatography	
Lecture-42	Paper chromatography, TLC etc	
Lecture-43	Column, ion-exchange chromatography etc., determination of ion exchange capacity of anion / cation exchange resin	
Lecture-44	Analysis of deodorants and	

	antiperspirants	
Lecture-45	Analysis of Al,Zn, boric acid, chloride, sulphate.	
Lecture-46		Repetition of previous class
Lecture- 47		Repetition of previous class
Lecture-48		Repetition of previous class

DEPARTMENT OF CHEMISTRY
FOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN
FOR
Paper code: CHEM3011
Paper title: Inorganic Chemistry (Theory)

***Credits:* 3(Theory)+1(Practical)**
***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Theory (Marks-40)

Module-I ***Chemical bonding-II***		
Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO) (elementary pictorial approach): sigma and pi-bonds and delta interaction, multiple bonding. Orbital designations: gerade, ungerade, HOMO, LUMO. Orbital mixing, MO diagrams of H2, Li2, Be2, B2, C2, N2, O2, F2, and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO+, CN-, HF, BeH2, CO2 and H2O. Bond properties: bond orders, bond lengths. Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids – stoichiometric and non-stoichiometric. Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Intermolecular forces: Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.		
Module Objectives: 1. This unit aims to offer advanced knowledge on the various types of chemical bonding shown in the molecular systems and concerned physicochemical parameters of different molecular assemblies. 2. From this portion students will be able to logically sketch the diagram of molecular orbital of various homonuclear and heteronuclear molecules.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO) (elementary pictorial approach): sigma and pi-bonds and delta	

	interaction, multiple bonding.	
Lecture-2.	Orbital designations: gerade, ungerade, HOMO, LUMO. Orbital mixing, MO diagrams of H_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO^+, CN^-, HF, BeH_2, CO_2 and H_2O.	

Lecture-3.	Bond properties: bond orders, bond lengths. Metallic Bond: Qualitative idea of valence bond and band theories.	
Lecture-4.	Semiconductors and insulators, defects in solids – stoichiometric and non-stoichiometric. Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Intermolecular forces: Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.	
Lecture-5.		Discussion on simple problems.
Lecture-6.		Solutions of previous year questions
Lecture-7.		Tutorial assignment – 1
Lecture-8.		Tutorial assignment – 2

Module-II

Coordination Chemistry-I

CONTENTS

Double and complex salts. Werner's theory of coordination complexes, Classification of ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereoisomerism, Geometrical and optical isomerism in square planar and octahedral complexes.

Module Objectives:

1. From this portion students can acquire knowledge about Double and complex salts.

2.Students will be able to describe the Classification of ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereoisomerism, Geometrical and optical isomerism in square planar and octahedral complexes.

Lecture Serial	Topics of Discussion	Remarks
Lecture-9.	Double and complex salts.	
Lecture-10.	Werner's theory of coordination complexes, Classification of ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers)	

Lecture-11.	Isomerism in coordination compounds, constitutional and stereoisomerism, Geometrical and optical isomerism in square planar and octahedral complexes.	
Lecture-12.		Discussion on simple problems.
Lecture-13.		Solutions of previous year questions

Module-III

Chemistry of s and p-block elements

CONTENTS

Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Beryllium hydrides and halides. Boric acid and borates, boron nitrides, borohydrides (diborane) and graphitic compounds, silanes. Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine. Peroxo acids of sulphur. Sulphur-nitrogen compounds, Basic properties of halides and polyhalides, interhalogen compounds, pseudohalides, fluorocarbons and chlorofluorocarbons

Module Objectives:

i) This unit aims to offer basic knowledge on Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Study of the many compounds with emphasis on structure, bonding, preparation, properties and uses.

ii) ii) From this portion students can get a clear idea about the uses and reactivity of different compounds of S/P block elemnts

Lecture Serial	Topics of Discussion	Remarks
Lecture-14	Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Study of the many compounds with emphasis on structure, bonding, preparation, properties and uses.	
Lecture-15.	Beryllium hydrides and halides. Boric acid and borates, boron nitrides, borohydrides (diborane) and graphitic compounds, silanes. Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine. Peroxo acids of sulphur. Sulphur-nitrogen compounds	
Lecture-16.	Basic properties of halides and polyhalides, interhalogen compounds, pseudohalides,	

	fluorocarbons and chlorofluorocarbons.	
Lecture-17.		Discussion on simple problems.
Lecture-18.		Tutorial assignment
Lecture-19.		Solve the previous year problems.

Module-IV

Noble Gases

CONTENTS

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation, structures (VSEPR theory) and properties of XeF2, XeF4 and XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2 and XeF4). Xenon-oxygen compounds.

Module Objectives:

This chapter provides sound knowledge on the reactivity and uses of different chemical compounds of Noble Gases.,

Lecture Serial	Topics of Discussion	Remarks
Lecture-20.	Occurrence and uses, rationalization of inertness of noble gases	
Lecture-21.	Clathrates; preparation	
Lecture-22.	Structures (VSEPR theory) and properties of xef2, xef4 and xef6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for xef2 and xef4). Xenon-oxygen compounds	
Lecture-23.		Discussion on simple problems.
Lecture-24.		Tutorial assignment
Lecture-25.		Solve the previous year problems.

Reference Books

1) Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006

2) Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, ButterworthHeinemann, 1997

3) Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., Advanced Inorganic Chemistry, 6th Ed. 1999., Wiley

4) Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010

5) Purecell, K.F. and Kotz, J.C., An Introduction to Inorganic Chemistry, Saunders: Philadelphia, 980

6) Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998)

DEPARTMENT OF CHEMISTRY
FOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN
FOR
Paper code: CHEM3012
Paper title: Inorganic Chemistry (Practical)

***Credits:* 3(Theory)+1(Practical)**
***Full Marks*-75 (Theory-40, Practical-20, Internal Assessment-15)**

Practical (Marks-40)

Module-I

Qualitative Analysis & Inorganic Prepartion

CONTENTS

1. *Qualitative analysis of Acid and Basic radicals from an inorganic sample* containing four radicals (oxide, hydroxide and carbonate may not be counted among four radicals). Emphasis should be given to the understanding of the chemistry of different reactions and to assign the most probable composition. Semi-micro analysis may also be followed. The use of centrifuge machine, thioacetamide instead of H2S and spot tests for specific radicals should be introduced

Basic radicals: Na+, K+, Ca2+, Sr2+, Ba2+, Al3+, Cr3+, Mn2+/Mn4+, Fe2+/Fe3+, Co2+/Co3+, Ni2+, Cu2+, Zn2+, Pb2+, Cd2+, Bi3+, Sn2+/Sn4+, As3+/As5+, Sb3+/Sb5+, NH4+, Mg2+.

Acid Radicals: F-, Cl-, Br-, I-, S2O32-, S2-, SO42-, SO32-, NO3-, NO2- , PO43-, AsO43-, BO33-, CrO42-.

Insoluble Materials: Al2O3 (ig), Fe2O3 (ig), Cr2O3 (ig), SnO2, SrSO4, BaSO4, CaF2, PbSO4.

2. *Inorganic preparations*

1) [Cu(CH3CN)4]PF6/ClO4
2) Potassium dioxalatodiaquachromate(III)
3) Tetraamminecarbonatocobalt(III) ion
4) Potassium tris(oxalato)ferrate(III)

Module Objectives:

Students will be able to know the different useful techniques for the determination of unknown inorganic samples and the methodologies for the preparation of inorganic compounds.

Lecture Serial	Title of the Experiment	Remarks
Lab 1	Basic radicals: Na+, K+, Ca2+, Sr2+, Ba2+, Al3+, Cr3+, Mn2+/Mn4+, Fe2+/Fe3+, Co2+/Co3+, Ni2+, Cu2+, Zn2+, Pb2+, Cd2+, Bi3+, Sn2+/Sn4+, As3+/As5+, Sb3+/Sb5+, NH4+, Mg2+.	
Lab 2	Acid Radicals: F-, Cl-, Br-, I-, S2O32-, S2-, SO42-, SO32-, NO3-, NO2- , PO43-, AsO43-, BO33-, CrO42-.	
Lab 3	Insoluble Materials: Al2O3 (ig), Fe2O3 (ig), Cr2O3 (ig), SnO2, SrSO4, BaSO4, CaF2, PbSO4.	
Lab 4	[Cu(CH3CN)4]PF6/ClO4	
Lab 5	Potassium dioxalatodiaquachromate(III)	
Lab 6	Tetraamminecarbonatocobalt(III) ion	
Lab 7	Potassium tris(oxalato)ferrate(III)	
Lab 8		Repeat Experiment
Lab 9		Repeat Experiment
Lab 10		Repeat Experiment
Lab 11		Repeat Experiment
Lab 12		Repeat Experiment
Lab 13		Repeat Experiment
Lab 14		Repeat Experiment
Lab 15		Repeat Experiment
Lab 16		

Lecture Serial (Lan no.)	Title of the Experiment	Remarks
17.		Repeat Experiment
18.		Repeat Experiment
19.		Repeat Experiment
20		Repeat Experiment
21		Repeat Experiment
22		Repeat Experiment
23		Repeat Experiment
24		Repeat Experiment
25		Repeat Experiment
26		Repeat Experiment
27		Repeat Experiment
28		Repeat Experiment
29		Repeat Experiment
30		Repeat Experiment
31		Repeat Experiment
32		Repeat Experiment
33		Repeat Experiment
34		Repeat Experiment
35		Repeat Experiment
36		Repeat Experiment
37		Repeat Experiment
38		Repeat Experiment
39		Repeat Experiment
40		Repeat Experiment
41		Repeat Experiment
42		Repeat Experiment
43		Repeat Experiment
44		Repeat Experiment
45		Repeat Experiment
46		Repeat Experiment
47		Repeat Experiment
48		Repeat Experiment
49		Repeat Experiment
50		Unknown Sample determination
51		Unknown Sample determination

52		Unknown Sample determination
53		Unknown Sample determination
54		Unknown Sample determination
55		Unknown Sample determination
56		Unknown Sample determination
57		Unknown Sample determination
58		Unknown Sample determination
59		Unknown Sample determination
60		Unknown Sample determination
61		Unknown Sample determination
62		Unknown Sample determination
63		Unknown Sample determination
64		Unknown Sample determination
65		Unknown Sample determination
66		Unknown Sample determination
67		Unknown Sample determination
68		Unknown Sample determination
69		Unknown Sample determination
70		Unknown Sample determination
71		Unknown Sample determination
72		Unknown Sample determination

73		Unknown Sample determination
74		Unknown Sample determination
75		Unknown Sample determination

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.
2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

DEPARTMENT OF CHEMISTRY
FOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I
LESSON PLAN
for

SKILL ENHANCEMENT COURSE (SEC)

Paper code: CHEM305-1
Paper title: IT skills in Chemistry

Credits-03
Course time hour:45

***Full Marks*:50 (Theory-40, Internal Assessment–10)**
Theory (Marks-40)

Module-I *Mathematical tools*
CONTENTS 1. Fundamentals: mathematical functions, polynomial expressions, logarithms, the exponential function, units of a measurement, interconversion of units, constants and variables, equation of a straight line, plotting graphs. 2. Uncertainty in measurement: Displaying uncertainties, types of uncertainties, combininguncertainties. Statistical treatment. Mean, standard deviation, relative error. Data reduction and the propagation of errors. Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression). 3. Algebraic operations on real scalar variables (e.g. manipulation of van der Waals equation in different forms). Roots of quadratic equations analytically and iteratively (e.g. pH of a weak acid). Numerical methods of finding roots (Newton-Raphson, binary-bisection, e.g. pH of a weak acid not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions). 4. Differential calculus: The tangent line and the derivative of a function, numerical differentiation (e.g., change in pressure for small change in volume of a van derWaals gas, potentiometric titrations). 5. Numerical integration (Trapezoidal and Simpson's rule, e.g. entropy/enthalpy change from heat capacity data).
Module Objectives: 1. This unit aims to offer basic knowledge on the various mathematical tools used in

chemistry nowadays.		
Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-1.	Fundamentals: mathematical functions, polynomial expressions, logarithms, the exponential function, units of a measurement, interconversion of units, constants and variables, equation of a straight line, plotting graphs.	
Lecture-2.	Uncertainty in measurement: Displaying uncertainties, types of uncertainties, combininguncertainties. Statistical treatment. Mean, standard deviation, relative error. Data reduction and the propagation of errors. Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).	
Lecture-3.	Algebraic operations on real scalar variables (e.g. manipulation of van der Waals equation in different forms). Roots of quadratic equations analytically and iteratively (e.g. pH of a weak acid). Numerical methods of finding roots (Newton-Raphson, binary-bisection, e.g. pH of a weak acid not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions).	
Lecture-4.	Differential calculus: The tangent line and the derivative of a function, numerical differentiation (e.g., change in pressure for small change in volume of a van derWaals gas, potentiometric titrations).	
Lecture-5.	Numerical integration (Trapezoidal and Simpson's rule, e.g.	

	entropy/enthalpy change from heat capacity data).	
Lecture-6.		Repetition of previous class
Lecture-7.		Repetition of previous class
Lecture-8.		Repetition of previous class
Lecture- 9.		Repetition of previous class
Lecture-10.		Repetition of previous class
Lecture- 11.		Repetition of previous class
Lecture- 12		Repetition of previous class
Lecture- 13		Repetition of previous class
Lecture- 14		Repetition of previous class
Lecture- 15		Repetition of previous class
Lecture-16		Discussion on
		simple problems.
Lecture-17		Solutions of previous year questions
Lecture-18		Tutorial assignment
Lecture-19		Tutorial assignment

Module-II

Computer Programming

CONTENTS

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.
Fortran or C programming for curve fitting, numerical differentiation and integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, NewtonRaphson method).

Module Objectives:

1. This unit aims to offer basic knowledge on the the utilities of computer programming.

Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-20	Constants, variables, bits, bytes, binary and ASCII formats	
Lecture-21	arithmetic expressions, hierarchy of operations, inbuilt functions. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.	
Lecture-22	Fortran or C programming for curve fitting	
Lecture-23	numerical differentiation and integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, NewtonRaphson method).	
Lecture-24		Repetition of previous class
Lecture-25		Repetition of previous class
Lecture-26		Repetition of previous class
Lecture-27		Repetition of previous class
Lecture- 28		Repetition of previous class
Lecture-29		Repetition of previous class
Lecture-30		Repetition of

		previous class
Lecture- 31		Repetition of previous class
Lecture- 32		Repetition of previous class
Lecture- 33		Repetition of previous class
Lecture- 34		Repetition of previous class
Lecture-35		Discussion on simple problems.
Lecture-36		Solutions of previous year questions
Lecture-37		Tutorial assignment
Lecture-38		Tutorial assignment

Module-III

Handling numeric data

CONTENTS

Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck's distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell Boltzmann distribution curves as function of temperature and molecular weight), spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations

Module Objectives:

From this total unit, students will gain the sound knowledge about the Handling numeric data

Lecture Serial	**Topics of Discussion**	**Remarks**
Lecture-39	Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and	

	formulae, creating charts, tables and graphs. Incorporating tables	
Lecture-40	graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck's distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell Boltzmann distribution curves as function of temperature and molecular weight)	
Lecture-41	spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations	
Lecture-42		Repetition of previous class
Lecture-43		Repetition of previous class
Lecture-44		Repetition of previous class

Lecture-45		
Lecture-46		Repetition of previous class
Lecture- 47		Repetition of previous class
Lecture-48		Repetition of previous class

Reference Books

1) McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008)

2) Mortimer, R. Mathematics for Physical Chemistry. 3rd Ed. Elsevier (2005).

3) Steiner, E. The Chemical Maths Book Oxford University Press (1996).

4) Yates, P. Chemical calculations. 2nd Ed. CRC Press (2007).

5) Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.

6) Levie, R. de. How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.

7) Noggle, J. H. Physical chemistry on a Microcomputer. Little Brown & Co. (1985).

8) Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).

Semester-IV